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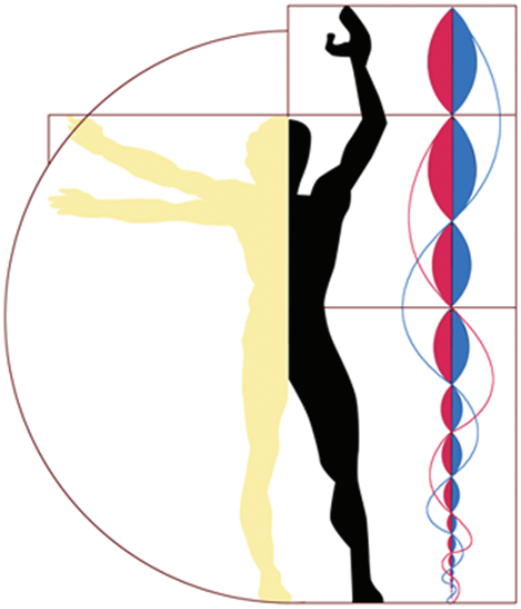
XIII Forum Internazionale di Studi

Le Vie dei Mercanti

Carmine Gambardella



HERITAGE and TECHNOLOGY

Mind Knowledge Experience

La Scuola di Pitagora editrice

Fabbrica della Conoscenza numero 56
Collana fondata e diretta da Carmine Gambardella

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Carmine Gambardella

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Mind Knowledge Experience
Le Vie dei Mercanti
XIII Forum Internazionale di Studi

Editing: Manuela Piscitelli

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Il Progetto "Ecoturismo urbano per la fruizione sostenibile dei Beni Culturali in Campania", in attuazione degli Obiettivi Operativi 2.1 e 2.2 del Programma Operativo FESR Campania 2007/2013 per la realizzazione e/o il potenziamento, nel territorio della regione, di forti concentrazioni di competenze scientifico tecnologiche, di alto potenziale innovativo, intende favorire la concentrazione di competenze scientifico-tecnologiche finalizzata a rafforzare la competitività dei sistemi locali e delle filiere produttive regionali non solo nei settori dei servizi associati al turismo e beni culturali ma anche in settori ad altissima tecnologia che possano rappresentare una svolta tecnologica e culturale all'approccio innovativo per lo Sviluppo sostenibile in aree ad altissima vocazione turistica.

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Heritage
Tangible and intangible dimensions
History
Culture
Collective Identity
Memory
Documentation
Management
Communication for Cultural Heritage
Architecture
Surveying
Representation
Modelling
Data Integration
Technology Platforms
Analysis
Diagnosis and Monitoring Techniques
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Restoration
Protection
Safety
Resilience
Transformation Projects
Technologies
Materials
Cultural landscapes
Territorial Surveying
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Government of the Territory
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Peer review

Scholars has been invited to submit researches on theoretical and methodological aspects related to Heritage and Technology, and show real applications and experiences carried out on this themes.
Based on blind peer review, abstracts has been accepted, conditionally accepted, or rejected.
Authors of accepted and conditionally accepted papers has been invited to submit full papers. These has been again peer-reviewed and selected for the oral session and publication, or only for the publication in the conference proceedings.

Conference report

357 abstracts received from:

Albania, Argentina, Australia, Benin, Brazil, Bulgaria, Canada, Croatia, Egypt, France, Greece, Iraq, Israel, Italy, Japan, Latvia, Malta, Mexico, Norway, Poland, Portugal, P.R. China, Russia, Slovakia, Spain, Turkey, United Kingdom, USA.

More than 500 authors involved.

291 papers published.

Table of contents

P. 35 Preface
Carmine GAMBARDELLA

P. 36 **ID 002**
Architectural Restoration projects in metropolitan areas: the case of the Su-pyo Bridge
Beniamino POLIMENI

P. 46 **ID 003**
Windows of memory: perspective panels to communicate archeological heritage
Alessandra PAGLIANO, Mariano MARMO, Roberta MONTELLA, Angelo TRIGGIANESE

P. 55 **ID 004**
Heritage enhancement and communication: “Palazzo Te allo Specchio” follow-up
Alessandro BIANCHI

P. 64 **ID 007**
Influences of building techniques on the annual primary energy requirement of buildings in Frignano (Italy)
Luigi MOLLO

P. 69 **ID 008**
The sentry of Castellino Tanaro: the structural recovery of an ancient medieval tower
Cesare Renzo ROMEO

P. 77 **ID 010**
Environmental monitoring of electromagnetic fields of urban territory of Samara Region of Russia
Andrey VASILYEV

P. 85 **ID 011**
Methods and results of environmental monitoring of soil pollution by oily waste
Andrey VASILYEV, Dmitry E. BYKOV, Andrey A. PIMENOV

P. 90 **ID 012**
Approaches to soil treatment from oily products and results of it approbation
Andrey VASILYEV, Vlada V. ZABOLOTSKIKH

P. 95 **ID 013**
Besides the design: the analysis and documentation of the ancient "Via Pretoria" in Potenza. The most significant transformations of a Roman road axis in the historic city
Enza TOLLA, Antonio BIXIO, Giuseppe DAMONE

P. 104 **ID 014**
Referential interpretation of vernacular heritage in recent architectural design
Emrah ASLAN, Dogan Sevinc ERTUR, Zafer ERTURK

P. 114 **ID 015**
Teaching and Practice of Architecture in Recife (Brazil) 1959 – 2009
Enio LAPROVITERA DA MOTTA

P. 124 **ID 016**
The Architect and the People of Recife (Brazil): 1959 – 2009
Enio LAPROVITERA DA MOTTA

P. 132 **ID 018**
Student-Centred Learning as an Approach to Design Primary Schools' Outdoors
Doaa HASSAN

P. 143 **ID 019**
Superkilen, Copenhagen
Mario PISANI

P. 151 **ID 020**
Revitalisation of historical landscape areas in UNESCO city of Banská Štiavnica
Ingrid BELĆÁKOVÁ

P. 158 **ID 022**
Retrofit and conservation of historical concrete buildings in Turin (Italy)
Alessandro P. FANTILLI, Barbara FRIGO, Bernardino CHIAIA

P. 166 **ID 024**
Turin in 1815
Nadia FABRIS

P. 174 **ID 026**
The new and the old in the perception of cultural heritage. The language of innovative materials between conservation, protection and enjoyment
Gigliola AUSIELLO

P. 181 **ID 027**
The traditional sacral wooden construction in Lithuania. An illustrated catalogue of building techniques for the safeguard and recovery of cultural heritage
Liucija BEREŽANSKYTĖ, Tiziana CAMPISI

P. 191 **ID 029**
Public buildings in the construction tradition of the 20th -century Italian suburbs
Alessandro CAMPOLONGO

P. 199 **ID 030**
Projectivity and the homological relationship as a verification of the computer mathematical representation: the representation of plane and skew curves in graphical models.
Antonio MOLLICONE

P. 210 **ID 031**
New urban models | San Pablo case /// 'Luis Buñuel'
José Javier GALLARDO ORTEGA

P. 218 **ID 032**
Designing by strata: notes from the underground. Hypogeous spaces and the archeological museum of Pompei
Corrado DI DOMENICO

P. 228 **ID 038**
Cover, overlapping and layering: protection and promotion of archaeological heritage in Paris
Alice PALMIERI

P. 238 **ID 039**
The other side of the Ring-Bruxelles
Rosalba DE FELICE

P. 248 **ID 040**
Metropolitan cities of Italy: law, environment and sustainable development
Michele RUSSO

P. 257 **ID 041**
Urban landscape and new venustas
Salvatore LOSCO

P. 266 **ID 043**
The Technology of an Early Reinforced Concrete Structure in Turkey: The Great Storehouse of the Kayseri Sümerbank Textile Factory (1932-1935)
Nilüfer BATURAYOĞLU YÖNEY, Burak ASİLİSKENDER

P. 275 **ID 044**
Fedele Fischetti and the Gallery of Real Casino Carditello
Antonella DIANA

P. 283 **ID 045**
Contemporary design drawings as cultural heritage: interpretation and communication. Towards a digital archive of Rosani's industrial projects
Roberta SPALLONE, Francesca PALUAN

P. 293 **ID 046**
Exploring and interpreting the landscape using technological innovative systems
Giacinto TAIBI, Rita VALENTI, Mariangela LIUZZO

P. 302 **ID 047**
Architecture and subtraction: Ostiense square in Rome
Assunta NATALE

P. 312 **ID 048**
Surveying for documentation and management the Renaissance building of Royal Hospital in Granada (Spain)
Juan Francisco REINOSO-GORDO, José Luis RAMÍREZ-MACÍAS, Francisco Javier ARIZALÓPEZ, Carlos LEÓN-ROBLES, Antonio GÓMEZ-BLANCO, Concepción RODRÍGUEZMORENO, Íñigo ARIZA-LÓPEZ

P. 318 **ID 049**
Data quality elements for BIM applied to heritage monuments
Íñigo ARIZA-LÓPEZ, Francisco Javier ARIZA-LÓPEZ, Juan Francisco REINOSO-GORDO, Antonio GÓMEZ-BLANCO, Concepción RODRÍGUEZ-MORENO, Carlos LEÓN-ROBLES

P. 326 **ID 050**
San Francisco Schools, 1839. Virtual reconstruction of The Franciscan convent of Betanzos and its transformations, in the XIX Century. (Galicia, Spain)
Marta COLÓN, Fernando FRAGA

P. 336 **ID 051**
Wandering Experience in Napoli
Idit GOLDFISHER, Shani ZIV, Talila YEHIEL

P. 343 **ID 052**
The representation of the memory: the analogic-digital survey of two funeral monuments in the Verano cemetery of Rome
Laura CARNEVALI, Fabio LANFRANCHI, Mariella LA MANTIA

P. 353 **ID 053**
Archaeology and architectural design. New studies and projects for the Acropolis of Athens
Luisa FERRO

P. 363 **ID 054**
Multilevel planning regional management. A GIS Platform Structure
Francesco ZULLO, Serena CIABO', Lorena FIORINI, Alessandro MARUCCI, Simona OLIVIERI, Stefano PERAZZITTI, Bernardino ROMANO

P. 372 **ID 055**
"col cerviello et non con le mani" New hypotheses on the Michelangelo plaster works of the Fine Arts Academy of Perugia
Paolo BELARDI, Luca MARTINI, Michele MARTORELLI

P. 382 **ID 056**
The lost imperial palace of Antioch on the Orontes (now Antakya, Turkey)
Stefano BORSI

P. 387 **ID 058**
New technologies for knowledge and the physical space of the museum
Gioconda CAFIERO

P. 396 **ID 059**
A pyramidal kitchen vault in a gothic-renaissance palace. Oliva, Valencia, Spain
Alba SOLER ESTRELA, Rafael SOLER VERDÚ, Manuel CABEZA GONZALEZ

P. 404 **ID 060**
LANDY. LANdscape DYnamics. Survey, representation, monitoring and communication of the dynamics of the landscape and risks related to them
Enrico CICALÒ1, Maurizio Minchilli, Loredana Tedeschi, Mara Balestrieri, Gianfranco Capra, Alessandra Casu, Arnaldo Cecchini, Tanja Congiu, Raffaella Lovreglio, Antonella Lugliè, Giuseppe Onni, Bachisio Mario Padedda, Paola Pittaluga, Clara Pusceddu, Paola Rizzi, Nicola Sechi, Silvia Serreli, Sergio Vacca

P. 409 **ID 061**
A strategic plan of investigation into the urban areas carried out together with public bodies
Giacinto TAIBI, Rita VALENTI, Michele LIISTRO, Sebastiano GIULIANO

P. 418 **ID 062**
Reticular valorization model for castles in Central-Eastern Europe. The Slovak experience
Mirko CAPUTO

P. 428 **ID 063**
Methods and Techniques "to work on the built"
Maria Antonia GIANNINO

P. 435 **ID 064**
Villa Cambi – the discovery of an unpublished posthumous building of G. Michelucci realized by B. Sacchi
Frida BAZZOCCHI, Vincenzo DI NASO, Andrea MASI, Charles Michael STARNINE

P. 445 **ID 065**
"Sensing to the past" like a new paradigm: knowledge and experience on fortified architectures
Alessandra QUENDOLO, Claudia BATTAINO, Maria Paola GATTI

P. 455 **ID 067**
Introduction to the study of the Apice territory.
Assunta CAMPI

P. 465 **ID 068**
Unveilings. Mnemonic project of the archaeo- logical invisible landscapes
Claudia BATTAINO, Luca ZECCHIN

P. 475 **ID 069**
UAV surveys for representing and document the cultural heritage
Mauro CAPRIOLI, Francesco MANCINI, Francesco MAZZONE, Mario SCARANO, Rosamaria TRIZZINO

P. 483 **ID 070**
The environmental engineering in Vesuvius National Park
Ferdinando ORABONA

P. 490 **ID 072**
Methodological study on the application of the stratigraphic analysis to the New Towns of the Middle Age
Barbara BONGIOVANNI

P. 498 **ID 074**
The immaterial city. An innovative look at the unrealized projects for 20th century Spoleto
Valeria MENCHETELLI, Laura NARDI, Giovanna RAMACCINI

P. 508 **ID 075**
Planning dimension of restoration
Antonluca DI PAOLA

P. 513 **ID 078**
A dialogue between architecture and technology. Methodological processes for the knowledge and preservation of buildings of value in the eastern part of Sicily
Giacinto TAIBI, Rita VALENTI, Sebastiano GIULIANO, Emanuela PATERNÒ

P. 521 **ID 079**
Morphological Investigations and Virtual Reconstructions of the Domus of the Northeast Quarter of Volubilis (Morocco)
Concepcion RODRIGUEZ-MORENO, Jose Antonio FERNANDEZ-RUIZ

P. 531 **ID 080**
A model of strategies used for traffic calming in an urban environment
Alma AFEZOLLI, Elfrida SHEHU

P. 541 **ID 081**
Cultural heritage confiscated from racketeering. A course toward adaptive reuse and effective management
Stefania DE MEDICI

P. 551 **ID 082**
Tighremt Aslim_ Aguddim Taliwin: cases study in the Draa Valley
Marinella ARENA

P. 560 **ID 083**
The management of private properties with heritage values
Elfrida SHEHU, Alma AFEZOLLI

P. 569 **ID 084**
Pompeii - World Heritage Site: the buffer zone urban structures and spaces of collective interest
Enrico DE CENZO, Giovanni BELLO

P. 579 **ID 085**
Building techniques in the Umbrian Middle Ages: from history to conservation
Eleonora SCOPINARO

P. 588 **ID 086**
Development of a GIS environment for archaeological multipurpose applications: the Fano historic centre
Roberto PIERDICCA, Eva Savina MALINVERNI, Paolo CLINI, Adriano MANCINI, Carlo Alberto BOZZI, Paolo CLINI, Romina NESPECA

P. 598 **ID 089**
HISTORY BUILDS, SURVEYING RE-BUILDS: conservation work of a medieval building through the representation of its (most likely) construction history.
Hilde Grazia Teresita ROMANAZZI

P. 607 **ID 091**
Design + Nursing: From laboratories to Users, The Transformation of Concussion Prevention
Steven DOEHLER, Roberta LEE, Jeanine GOODEN, Jean ANTHONY, Kimberly HASSELFELD

P. 615 **ID 092**
Oscar Niemeyer, the architect of the curve surfaces. The freehand relief as tool for investigation of modern Brazilian architecture
Domenico SPINELLI

P. 623 **ID 093**
Survey on the landscape and morphological singularities of the Cliff of Aci Castello
Mariangela LIUZZO, Sebastiano GIULIANO, Salvatore SAVARINO

P. 632 **ID 094**
The use of external claddings in the functional recovery of disused industrial buildings.
Giulia MATERAZZI, Nicola CAVALAGLI, Vittorio GUSELLA

P. 641 **ID 095**
Structure and stone cladding in building constructions in L'Aquila, Abruzzo, Italy, from the 12th to the 18th century: methods used for the analysis and indexing of masonry categories and related performances in response to seismic activities
Stefano CECAMONE

P. 650 **ID 096**
Structural calculations by horizontal and vertical interoperability for the redevelopment of existing buildings
Bernardino CHIAIA, Sanaz DAVARDOUST, Anna OSELLO

P. 659 **ID 097**
Cultural built heritage in cemeteries, between architecture and urban design. The Serramanna Cemetery Chapel
Vincenzo BAGNOLO

P. 666 **ID 098**
The single hall churches in the historic centre of Catania (Italy): a cognitive method behind the design of sustainable refurbishment.
Alessandro LO FARO, Attilio MONDELLO, Angelo SALEMI

P. 676 **ID 099**
Unveiling a heritage through digital enlightenment: the Lisbon Royal Opera House of Tagus
Pedro Miguel Gomes JANUÁRIO, Maria João Mendonça Pereira NETO, MárioSay Ming KONG

P. 686 **ID 100**
Heritage and technology: novel approaches to 3D documentation and communication of architectural heritage
Mariateresa GALIZIA, Laura INZERILLO, Cettina SANTAGATI

P. 696 **ID 101**
Aljezur, “between vision” of Place and Memory: The use of new technologies for the protection of a place and its heritage
Maria João Pereira NETO, Pedro Gomes JANUÁRIO, Mário Say Ming KONG, Raffaella MADDALUNO

P. 701 **ID 102**
Building Color Survey of Four Districts for Preserving a Group of Traditional Buildings in Japan
Kiwamu MAKI

P. 709 **ID 103**
Experience, Immersion and Perception: Communication Design for Urban and Natural Environments
Daniela CALABI, Elisa CHIODO, Sabrina SCURI

P. 718 **ID 104**
Pompeii - Nature and Architecture
Clelia CIRILLO, Luigi SCARPA, Giovanna ACAMPORA, Barbara BERTOLI, Raffaela ESPOSITO, Marina RUSSO

P. 729 **ID 105**
Galeazzo Alessi: narration, representation and contemporary theatricality fora XVI c. architectural heritage
Maria Linda FALCIDIENO, Massimo MALAGUGINI, Maria Elisabetta RUGGIERO

P. 739 **ID 106**
A Geographic Information System for the documentation of the medieval and modern fortifications. The district of "Castello" in Cagliari.
Andrea PIRINU

P. 747 **ID 107**
Building in / Building on. Composition strategies for re-conversion of productive buildings
Gaspare OLIVA

P. 757 **ID 108**
The intangible visuality of invisible cultural landscapes. The aerial view for the knowledge of the past.
Davide MASTROIANNI

P. 766 **ID 112**
The roles of industrial heritage areas on urban renewal: the case of “Ödemiş”
Julide KAZAS PEKCAN

P. 777 **ID 113**
St. Erasmus in Isernia: a medieval cave church
Piero BARLOZZINI

P. 784 **ID 115**
Implications of earthquake return periods on the building quality
Sandra TONNA, Claudio CHESI

P. 794 **ID 116**
Architectural History from a Performance Perspective. The Latent Potential of Knowledge embedded in the Built Environment
Michael HENSEL, Defne SUNGUROĞLU HENSEL

P. 803 **ID 117**
The underground city between design and survey: the greek hollow of Poggioreale
Maria Ines PASCARIELLO, Raffaele MARTINELLI

P. 813 **ID 120**
Strategies for the building stone and damage mapping applied to the historical center of Catania
Giulia SANFILIPPO, Angelo SALEMI, Erica AQUILIA, Germana BARONE, Paolo MAZZOLENI, Angelo SALEMI

P. 823 **ID 121**
The invisible roads of contemporary businesses
Agostino URSO

P. 833 **ID 122**
Fragments and memory of landscape: preservation of some fragile architectures
Emanuele ROMEO, Emanuele MOREZZI, Riccardo RUDIERO

P. 842 **ID 123**
Development of the urban-rural network in the metropolitan area of the Strait of Messina through the recovery of the historical and cultural obsolete heritage.
Alessandra MANIACI, Gianfranco SALEMI SCARCELLA

P. 851 **ID 125**
Revisiting residential architecture in the city of João Pessoa, Paraíba, Brazil
Maria Berthilde MOURA FILHA, Ivan CAVALCANTI FILHO

P. 860 **ID 127**
Development of a database using GIS technology: study and intervention in vulnerable neighbourhoods
AGUSTÍN HERNÁNDEZ, Miguel SANCHO MIR, Noelia CERVERO SANCHÉZ

P. 869 **ID 128**
Development of indicators to graphically and geometrically define state subsidised residential blocks in Zaragoza. Spain. Geometrical exposure to sun.
Aurelio VALLESPIN MUNIESA, Angélica FERNÁNDEZ MORALES, Zaira PEINADO CHECA

P. 878 **ID 130**
Integrated methodologies for documentation and restoration of Modern architecture: survey and representation of the “Casa das Canoas” by Niemeyer
Marcello BALZANI, Federica MAIETTI

P. 888 **ID 131**
Three-dimensional morphometric database for visualisation and critical analysis of the San Sebastiano in Mantua by Leon Battista Alberti
Marcello BALZANI, Federico FERRARI

P. 896 **ID 133**
Restoration works and valorization strategies of the architectural complex of S. Francesco in Amantea (CS)
Renato OLIVITO, Alessandro TEDESCO

P. 906 **ID 134**
Realistic 3D view as a form of interpretation and presentation of historic gardens
Ivan STANKOCI, Tamara REHÁČKOVÁ

P. 915 **ID 135**
Augmented reality for the understanding of cultural heritage. The case study of the monument of Giuseppe Sirtori in Milan
Carlo BATTINI

P. 920 **ID 136**
Adjustments. Repairing and reinventing damaged landscapes
Fabrizia IPPOLITO

P. 926 **ID 138**
The Recovery of Urban Post-War Landscape Middle-Class Housing in Naples
Chiara INGROSSO, Luca MOLINARI

P. 932 **ID 139**
Guidelines for the drafting of Maintenance plan dedicated to Archaeological Heritage: case-study Villa di Poppea, Oplonti
Maria Rita PINTO, Flavia LEONE

P. 941 **ID 141**
The Influence of Colouring on Style Expression of Industrial Architecture
Eva BELLÁKOVÁ, Eva ŠPERKA

P. 949 **ID 143**
The role of non invasive diagnosis for preventive archaeology in the frame of projects of industrial and energetic plants.
Pasquale MARINO

P. 953 **ID 144**
Sustainable development of hospital structures
Marsida TUXHARI, Denada VEIZAJ

P. 960 **ID 145**
World heritage and technology, the different understanding
Christina RAIDESTINOU APERGI

P. 968 **ID 151**
Utility and necessity in architecture: design, construction and transformation of alpine buildings
Maria Paola GATTI, Giorgio CACCIAGUERRA, Andrea DONELLI

P. 976 **ID 152**
Use of TLS technology for the fem-based structural analysis of the anatomy theatre
Alberto GUARNIERI, Andrea MASIERO, Livia PIERMATTEI, Francesco PIROTTI, Antonio VETTORE

P. 984 **ID 153**
A planning & design approach for the rehabilitation of historic centres in Iraq
Giuseppe CINÀ

P. 997 **ID 154**
Survey of Architecture. Complex models for analysis, valorisation, restoration
Aldo DE SANCTIS

P. 1004 **ID 155**
The Industrial Building Heritage: first steps for the Damages Evaluation of Innocenti-Maserati Strucutral Plants
Pietro CRESPI, Alberto FRANCHI, Paola RONCA, Antonio MIGLIACCI, Alessandro ZICHI

P. 1012 **ID 156**
In-situ tests, analytical and numerical studies for the assessment capacity of a historic building in l'Aquila
Alberto FRANCHI, Pietro CRESPI, Paola RONCA, Nicola GIORDANO, Giulia RANSENIGO

P. 1020 **ID 157**
The Trezzo sull'Adda's Castle: restoration consolidation and reuse of the Cultural Heritage for a sustainable future use.
Pietro CRESPI, Fausto NEGRI, Giovanni FRANCHI, Paola RONCA, Alessandro ZICHI

P. 1027 **ID 158**
A methodology able to investigate the phenomenon of Unauthorized building: the case of Giugliano in Campania
Claudia DE BIASE

P. 1037 **ID 159**
Landscapes of repentance and of compensation
Esther GIANI

P. 1043 **ID 160**
From the knowledge process to the representation of the built environment. The case of the "Istituto del Rifugio" in Naples
Lia Maria PAPA, Pierpaolo D'AGOSTINO, Giuseppe ANTUONO

P. 1051 **ID 162**
Which survey for which digital model: critical analysis and interconnections.
Andrea GIORDANO, Paolo BORIN, Maria Rosaria CUNDARI

P. 1059 **ID 163**
3D modelling in Architecture: from tangible to virtual model
Tatiana KIRILOVA KIROVA, Davide MEZZINO

P. 1074 **ID 165**
Innovation and Creativity of Architectural as a tool to Confrontation and Observation the Changes in the Mosque Architecture During Different Eras
Wafeek Mohamed Ibrahim MOHAMED

P. 1094 **ID 166**
An online multilingual dictionary as a technology platform for heritage studies and development
Monika BOGDANOWSKA

P. 1101 **ID 167**
Geophysics and Cultural Heritage
Pier Matteo BARONE, Carlotta FERRARA

P. 1111 **ID 168**
The architectonic perspectives in the villa of Oplonti: a space over the real
Barbara MESSINA, Maria Ines PASCARIELLO

P. 1121 **ID 170**
Investigations on building techniques of the defensive walls in Kınık Höyük excavation (Turkey)
Valentina CINIERI, Emanuele ZAMPERINI, Marco MORANDOTTI

P. 1131 **ID 171**
Surveying and Restoration of St. Basilio Monastery in L'Aquila
Mario CENTOFANTI, Stefano BRUSAPORCI, Francesca CERASOLI

P. 1140 **ID 172**
A system for dating changes in building fabric via nail spectra
Chris HOW

P. 1150 **ID 173**
The aesthetic vision of the landscape in nineteenth century Piedmontese painting
Anna CIOTTA

P. 1159 **ID 174**
Grotesque forms and representations in baroque balconies of eastern Sicily.
Caterina GULLO

P. 1166 **ID 176**
The water and its monuments in Provence
Laura BLOTTO

P. 1176 **ID 178**
Knowledge and innovation in the field of Cultural Heritage
Caterina GATTUSO

P. 1180 **ID 179**
Cultural Heritage 2.0. Toward innovative tools for the communication of cultural and historical asset.
Stefano ZAGGIA, Angelo BERTOLAZZI, Federico PANAROTTO

P. 1188 **ID 180**
Self Explaining City
Luigi STENDARDO, Raffaele SPERA, Angelo BERTOLAZZI

P. 1298 **ID 181**
Protection of Cultural Heritage on the Example of Krakow Tenement Houses from the End of the 19th and the Beginning of the 20th Century
Beata MAKOWSKA

P. 1203 **ID 182**
Urban presence: the fountain
Federica CAPRIOLO

P. 1210 **ID 183**
Structural analysis of finite element models of masonry balconies and overhangs obtained by B.I.M.
Ingrid TITOMANLIO Giuseppe FAELLA

P. 1218 **ID 184**
Building Information Modeling for the static and seismic safety of masonry balconies and overhangs
Ingrid TITOMANLIO

P. 1227 **ID 185**
Construction of the Museum of Fine Arts in Riga (1903-1905)
Arturs LAPINS

P. 1233 **ID 186**
The Impressionist Range Of Creativity And Technical Innovation Of The Heritage Cities Between Cosmic And Heritage Concept And Reformulation Of The Mental Image
Wafeek Mohammed Ibrahim MOHAMED

P. 1249 **ID 187**
A tower for Shangai
Anna MANDIA

P. 1252 **ID 188**
Protecting unpopular heritage. The difficulties of listing 1950s architecture and postwar planning in Plymouth, UK
Daniel BARRERA FERNÁNDEZ

P. 1261 **ID 189**
Sharing knowledge, grasping Cultural Heritage: a digital multidisciplinary approach to the historical process of architecture and urban changes
Rosa TAMBORRINO, Fulvio RINAUDO

P. 1271 **ID 190**
Algorithmic transformation between heritage and innovation in design
Michela ROSSI, Giorgio BURATTI

P. 1279 **ID 191**
Structure and geometry
Vito Maria Benito VOZZA

P. 1289 **ID 195**
The redraw of the architecture in the smart city
Vito Maria Benito VOZZA Luigi CORNIELLO

P. 1299 **ID 196**
Architecture as living sculpture.
Stefania DI DONATO

P. 1309 **ID 197**
Bathing facilities: memory and survey of a forgotten coastal heritage
Antonella SALUCCI

P. 1317 **ID 199**
Representing the time: the role of sequences representation in the design of visual information
Stefano CHIARENZA

P. 1326 **ID 200**
Hollow clay elements of typical Calabrian tradition: typologies and construction techniques
Renato Sante OLIVITO, Caterina GATTUSO, Carmelo SCURO

P. 1333 **ID 201**
Best practice or bad practice? Technological perspectives, Administrative proceedings and urban perceptions in the historic cities: the case of Royal Arsenals of Seville.
Daniela LALLONE, Fernando AMORES

P. 1343 **ID 202**
Analysis of ecological criteria for traditional housing and its adaptation to new housing design
Ebubekir GÜNDOĞDU, Emel BİRER

P. 1353 **ID 203**
Technologies to know and share the Cultural Heritage between East and West: geometric patterns in the decorations
Anna MAROTTA

P. 1363 **ID 205**
Identity+Innovation: how to give hope and opportunities to forgot suburbs. A comparative study between EU and China.
Tiziano CATTANEO, Yongjie SHA, Emanuele GIORGI, Giorgio Davide MANZONI

P. 1373 **ID 206**
Not restoration but plannet and preventive conservation
Barbara SCALA

P. 1383 **ID 208**
Construction site information modelling and operational planning
Manuele CASSANO, Marco Lorenzo TRANI, Stefano DELLA TORRE, Benedetta BOSSI

P. 1393 **ID 209**
Key Enabling Technologies for an accessible Cultural Heritage: methods of application of the EU 2014-20 Programme strategy for Culture
Valeria DI FRATTA, Valeria AMORETTI

P. 1403 **ID 210**
Environmental protection versus simplification and development policy: searching for a difficult (but achievable) balance
Marco CALABRO'

P. 1411 **ID 211**
Wayfinding Accessible Design
Roberto DE PAOLIS, Silvia GUERINI

P. 1421 **ID 213**
A style between two centuries: the Great Hall of the Faculty of Architecture of Rome
Laura CARNEVALI, Giovanni Maria BAGORDO

P. 1427 **ID 214**
The rehabilitation of the school building heritage in Potenza (Italy)
Ippolita MECCA, Tiziana CARDINALE

P. 1436 **ID 215**
Cultural Heritage communication between narrative and creativity. 3D Video Mapping Projection and new suggestions of Augmented Space
Iolanda DI NATALE, Alice PALMIERI

P. 1446 **ID 216**
Urban symbiotic architecture in Pavia. The origins of Giancarlo De Carlo's Building Development Plan for Pavia University
Simone LUCENTI, Emanuele ZAMPERINI

P. 1456 **ID 217**
Different futures in the labyrinth of the carto-iconographical heritage of Milan
Maria Pompeiana IAROSSI, Sara CONTE, Marco INTROINI

P. 1465 **ID 218**
Ancient villages: the Eco-museums to Eno-museums
Francesca MUZZILLO, Fosca TORTORELLI

P. 1471 **ID 219**
Pompei between Archaeology and "Agritecture"
Fosca TORTORELLI

P. 1476 **ID 222**
Conservation Practices in Turkey in Last Decade, Two Monuments from Two Eras: the 4th-Century Laodikeia Church and the 16th-Century Rabi Madrasa
Ege Uluca TUMER

P. 1485 **ID 224**
Intersecting lives: Giovanni Battista Naldini and Giovanni Antonio Dosio
Antonella MARCIANO

P. 1495 **ID 225**
The Augustan Bridge at Narni: Documentation and Analysis by Laser Survey and 3D Modeling
Alberto CUSTODI, Flora SCAIA

P. 1505 **ID 226**
Morpho-architectural analysis, constructive modalities and structural diagnostics for the restoration of the Church of SS Bartholomew and Stephen in Bergamo
Alessio CARDACI, Antonella VERSACI, Davide INDELICATO

P. 1515 **ID 227**
The twenty-seven buildings of the Littorio rural village in Candiana. Hypotheses of recomposition
Enrico PIETROGRANDE

P. 1525 **ID 228**
Survey and Representation of the complexity of ancient theaters and amphitheatres
Giuseppe DI GREGORIO, Angelo MONTELEONE

P. 1535 **ID 229**
The experience of the journey. Digital technologies and visual itineraries to enjoyment of the city's cultural heritage
Elena IPPOLITI, Alessandra MESCHINI

P. 1545 **ID 230**
Golden Cartelline from the Wall Mosaic of S. Giovanni in Fonte. Remarks and Scientific Analyses on the Constituent Materials
Ciro PICCIOLI, Caterina GATTUSO, Valentina ROVIELLO

P. 1554 **ID 231**
Strategies for the sustainable development of historical town centre and compatible conservation and reuse of the built heritage
Giuliana QUATTRONE, Elena GIGLIARELLI

P. 1562 **ID 232**
Structures for the museumification of underwater cultural heritage
Marco RUSSO

P. 1572 **ID 233**
Architectural and Environmental Compositional Aspect for Technological Innovation in the Built Environment
Mario GROSSO, Giacomo CHIESA, Marianna NIGRA

P. 1582 **ID 235**
UAV Remote Sensing for the Preservation and Restoration of Houses of Worship. Potential and Limitations
Margaret BICCO

P. 1589 **ID 236**
From ruin to hinge of urban renewal: the restoration of the church of St. Demetrius in Ceglie Messapica (BR)
Antonio BIXIO, Ippolita MECCA

P. 1599 **ID 237**
Architecture of Light Case study St. Cross Church in Nin, Croatia
Ivanka STIPANČIĆ-KLAIĆ, Davor ANDRIĆ, Anja KOSTANJŠAK

P. 1608 **ID 240**
Innovative working spaces: the case study of Novartis and the “InNova” project
Lorenzo CAPOBIANCO, Giuliana CHIERCHIELLO

P. 1616 **ID 241**
Sanfelice Palace, the house of a genius: some insights about the geometrical relations
Gerardo Maria CENNAMO

P. 1625 **ID 242**
Toward the “Smart Polis”: methods, tools and strategies of intervention for the sustainable regeneration of historic urban centres
Elena GIGLIARELLI, Lu BIN, Luciano CESSARI

P. 1632 **ID 244**
Remote sensing evaluation of fire hazard: towards operational tools for improving the security of citizens and protecting the environment
Carmine MAFFEI, Carmine GAMBARDELLA, Massimo MENENTI

P. 1640 **ID 246**
Marble sculptures FRP-based reinstating and consolidating practices
Ignazio CRIVELLI VISCONTI, Marina D’APRILE, Domenico BRIGANTE, Claudio CIGLIANO

P. 1650 **ID 247**
New fiber composite materials for Cultural Heritage conservation
Giuseppe CHIDICHIMO, Amerigo BENEDUCI, Caterina GATTUSO, Alessandro SENATORE, Francesco DALENA, Valentina ROVIELLO

P. 1654 **ID 248**
Sustainable reutilization of the Pombaline System essentially based on the properties of the so-called “Gaiola Pombalina”
António José MORAIS, Alexandra Al QUINTAS

P. 1661 **ID 249**
The Roman Theatre in Trieste. Digital Analysis and 3D Visualizazion
Alberto SDEGNO, Paolo CASARI, Piero MICEU, Marco JEZ, Lisa MINIUSSI

P. 1671 **ID 250**
Pressure of tourism on heritage and technologies for an inclusive society
Valeria MINUCCIANI, Gabriele GARNERO

P. 1675 **ID 251**
The spatial-temporal journeys and the urban filters
Vincenzo CIRILLO

P. 1685 **ID 254**
New heritage: Architecture and biological sciences
Rossella BICCO

P. 1691 **ID 256**
Ordinary maintenance in the Venice "minor". Problems in nontrivial resilience
Piero PEDROCCO

P. 1701 **ID 257**
HafenCity Hamburg
Agrippino GRANIERO

P. 1709 **ID 259**
Survive the Saracoglu District - Preservation of Architectural Heritage of Ankara
Duygu KOCA

P. 1716 **ID 262**
"School Project EXPO 2015" : LANDesign BREEDING-GROUND SALERNO
Maria Dolores MORELLI

P. 1723 **ID 263**
“Universities for EXPO 2015”: LANDesign in Mostra d'Oltremare
Sabina MARTUSCIELLO

P. 1735 **ID 265**
The influence of colors on the sound environment perception
Virginia PUYANA ROMERO, Giuseppe CIABURRO, Luigi MAFFEI

P. 1742 **ID 266**
Additive technology and design process: an innovative tool to drive and assist product development
Francesco TAMBURRINO, Valeria PERROTTA, Raffaella AVERSA, Antonio APICELLA

P. 1748 **ID 268**
Applying Geographical Information Systems for documenting and managing Iraqi archaeological heritage: the case study of the Akre Castle in Kurdistan
Angela LOMBARDI, Jambaly MOHAMMED, Abdulkareem SAMAN

P. 1758 **ID 269**
The recomposition of fragmented objects: the case study of St. Andrea statue at Stiffe, L’Aquila
Marco CANCIANI, Corrado FALCOLINI, Mauro SACCONE, Lorenza D'ALESSANDRO, Giorgio CAPRIOTTI

P. 1765 **ID 270**
Democratic evaluation of architectural heritage
Marta BERNI

P. 1775 **ID 271**
Cultural Landscape: Sintra, the Shock of the Past into the Future
Alexandra Al QUINTAS, António José MORAIS

P. 1783 **ID 272**
My concrete is damaged?
Andrea BASILE, Giorgio FRUNZIO, Giuseppe MATTIELLO

P. 1792 **ID 273**
Build on natural tendencies to strengthen resilience of cultural and environmental heritage
Serena BAIANI, Antonella VALITUTTI

P. 1798 **ID 274**
“Additional services” in the management of Cultural Heritage: the paradox of archeological site of Pompei
Fabiana FORTE, Roberta FORMISANO

P. 1805 **ID 275**
Sponsorship in the enhancement of Cultural Heritage and the role of Creative Industry: some evaluative aspects.
Fabiana FORTE Manuela RUPE

P. 1813 **ID 276**
Signs of popular religiousness in the Southern Piedmont territory. The drawing of votive pillars
Maria Paola MARABOTTO

P. 1820 **ID 277**
Geldo's Castle Palace, at Castellón Province, Spain.
Joaquín MARTINEZ MOYA, María Jesús MAÑEZ PITARCH, José Teodoro GARFELLA RUBIO

P. 1828 **ID 278**
The instructions of s. Carlo Borromeo in the Vistabella church. Castellón. España.
Joaquín MARTINEZ MOYA, María Jesús MAÑEZ PITARCH, José Teodoro GARFELLA RUBIO

P. 1836 **ID 279**
Evolution of techniques in osteoarcheology: a proposal for a new on-field schedule for preliminary study of ancient population
Valeria AMORETTI, Vittorio NAZIONALE

P. 1848 **ID 281**
Naples, the modern living sense. A comparison between residence and society after World War
Marco CARUSONE

P. 1855 **ID 282**
Figura praesentis urbis Nolae: geometric theorems and learned sources in Renaissance’s urbanism and in De Nola of Ambrogio Leone.
Maria Carolina CAMPONE

P. 1864 **ID 284**
The dams of Rio Grande's basin (Amelia TR)
Fabio BIANCONI, Marco FILIPPUCCI

P. 1875 **ID 285**
From the acquisition of cartography, the latest methods of representation
Vincenzo POLLINI

P. 1884 **ID 286**
Italian architects and transformations of Tirana, regulatory plans of the new capital in the years 1925-1943
Armand VOKSHI

P. 1894 **ID 287**
New qualities for the revitalization of the ancient villages
Mariarosaria ARENA, Antonio BOSCO, Sergio RINALDI

P. 1906 **ID 288**
Triumph Arch in the archaeological site in Tyre (Lebanon): a new approach to GIS analysis of vertical elements in 3D environment
Laura BARATIN, Sara BERTOZZI, Elvio MORETTI

P. 1915 **ID 289**
Theories and techniques to solve complex systems
Antonio APICELLA, Giuseppe D'ANGELO

P. 1922 **ID 290**
An application of optimization processes in the evaluation of a security basket
Maria Cristina MIGLIONICO, Giuseppe D'ANGELO

P. 1930 **ID 291**
BIOMATERIALS: the synthetic biology applied to architecture
Antonella VIOLANO, Ayşen CIRAVOĞLU, Semin ERKENEZ, Veronica MONTANIERO, Francesca VERDE

P. 1940 **ID 292**
BUILDING WITH WOOD: the summer energy performance according the UNITS 11300:2014-I
Antonella VIOLANO, Monica CANNAVIELLO, Antonella DELLA CIOPPA

P. 1948 **ID 293**
Innovative fence systems as best practice for the sustainable construction site
Lucia MELCHIORRE

P. 1956 **ID 294**
The Basilica of Santa Restituta in Naples. Towards an information and interactive model.
Giovanni Maria BAGORDO, Gian Carlo CUNDARI, Maria Rosaria CUNDARI

P. 1962 **ID 295**
A multisensorial visiting experience simulation in an immersive virtual reality environment.
Aniello PASCALE, Francesco SORRENTINO, Massimiliano MASULLO

P. 1967 **ID 297**
Consolidation with reinforced concrete for the ecclesiastical architecture in l'Aquila (Italy): observations after the earthquake
Claudia CENNAMO, Concetta CUSANO

P. 1977 **ID 298**
Daylighting measurements and evaluation of the energy saving in an historical building
Giovanni CIAMPI, Antonio ROSATO, Michelangelo SCORPIO, Sergio SIBILIO

P. 1985 **ID 299**
Primary energy calculation of italian residential applications via a national standard and a dynamic simulation software
Giovanni CIAMPI, Raffaele COLUCCI, Antonio ROSATO, Michelangelo SCORPIO, Sergio SIBILIO

P. 1995 **ID 302**
Analysis of historic urban fabric of sariyer in Istanbul. In terms of sustainability and proposals for its conservation
İpek Z. KAPTANOGLU, Elif MIHCIOGLU BILGI

P. 2004 **ID 304**
Art and Technology. The Guggenheim Museum Helsinki.
Efisio PITZALIS

P. 2012 **ID 305**
Structural modeling and conservation of single columns in archaeological areas
Giuliana CHIERCHIELLO, Antonio GESUALDO, Antonino IANNUZZO, Michela MONACO, Maria Teresa SAVINO

P. 2021 **ID 306**
Archaeological Environmental Park of Sennacherib's irrigation system (Iraqi Kurdistan)
Roberto ORAZI, Francesca COLOSI

P. 2031 **ID 307**
Project for the Archaeological Park of Chan Chan, Peru
Francesca COLOSI, Roberto ORAZI

P. 2041 **ID 309**
Empatic forms for relational spaces
Marco BORRELLI

P. 2051 **ID 310**
REMOTE SENSING: hightech tool for law enforcement in crimes perpetrated against environment
Flaviano TESSITORE

P. 2059 **ID 311**
Innovative Strategies for Urban Regeneration in Coastal Areas – the Case Study of the Metropolitan Coast of Naples
Massimo CLEMENTE, Eleonora GIOVENE DI GIRASOLE

P. 2069 **ID 312**
A Comparative Study of Ottoman and European Bridal Gowns During 18th and 19th Centuries
Sema YALÇIN

P. 2077 **ID 313**
A generative design algorithm for the architectural design
Carlo COPPOLA, Rosa BUONANNO, Vincenzo NIGRO, Andrea DI ROSA

P. 2085 **ID 314**
The signage and communication systems in the ancient city of Pompei
Sabrina MATALUNA

P. 2092 **ID 315**
The archaeological site of Pompeii: multimedia systems' analysis.
Maria Grazia GIULIANO

P. 2101 **ID 316**
Seismic joints: architectural integration and structural safety
Caterina FRETTOLOSO, Mariateresa GUADAGNUOLO

P. 2108 **ID 317**
Floor masonry beams reinforced by BFRG
Mariateresa GUADAGNUOLO, Giuseppe FAELLA

P. 2115 **ID 318**
The Pompeii Artifact Life History Project: Conceptual Basis, Methods and Results of First Three Seasons
J. Theodore PEÑA, Caroline CHEUNG

P. 2124 **ID 319**
The virtual representation of the past.
Paola D'AURIA

P. 2130 **ID 320**
The impermanent project. Animation and 'multiplicative persistence' in contemporary urban space
Silvana SEGAPELI

P. 2138 **ID 321**
Heritage - Religious buildings in the routes of restoration: the case of the church of St. Gennaro at the elm
Roberto CASTELLUCCIO, Veronica VITIELLO

P. 2147 **ID 322**
Relation between sustainable economic growth and Safety, security in Albania and the region
Artur BEU

P. 2153 **ID 323**
From Pompeii in Nola: the restoration of Mediterranean habitat. The De Nola of Ambrogio Leone.
Saverio CARILLO

P. 2163 **ID 324**
The non-finiteness heritage. A project strategy
Francesco COSTANZO, Gaspare OLIVA, Giuseppe DI CATERINO

P. 2173 **ID 325**
From Borbonic Royal Gunpowder to mouth of the river Sarno: a redevelopment project architectural and landscape
Andrea SANTACROCE

P. 2181 **ID 326**
The rebirth of the water in Rome. Aqueducts and fountains
Maria MARTONE

P. 2191 **ID 327**
Knowledge in Apollonia. The Medieval Monastery and the territory
Luigi CORNIELLO

P. 2201 **ID 328**
Mario Botta, the man's house in the New Stone Age
Lorenzo GIORDANO

P. 2209 **ID 329**
Museum Quarter as the "core of urban balance" in the post-industrial city
Elena SHLIENKOVA

P. 2222 **ID 330**
Roman period survivals in modern farms: the case of Masseria Tuoro in Vitulazio
Margherita DI NIOLA

P. 2232 **ID 331**
The Waterway from the Royal Palace of Caserta to the Royal Palace of Carditello.
Federica DEL PIANO, Valeria DI SALVATORE

P. 2241 **ID 332**
Among smart governance and smart communities. A survey in the city of Milan
Nunzia BORRELLI, Davide DIAMANTINI, Giulia MURA, Monica BERNARDI

P. 2249 **ID 333**
The design for the modification of the Marina and the Sentiero Terramare in Praiano
Paolo GIORDANO

P. 2261 **ID 334**
Istanbul World Heritage property. Representing and cataloguing the material and intangible assets for local sustainable development.
Alessandro CIAMBRONE

P. 2270 **ID 335**
Analysis and Landscape Planning. The Landscape Project of Taburno-Camposauro.
Concetta CUSANO

P. 2280 **ID 336**
The Caserta's Centre: cataloging as an instrument for knowledge
Luciana ABATE

P. 2290 **ID 337**
Virtual architecture: 3D representation in archeology - a new approach to the presentation of ancient architecture –
Ciro FERRANDES

P. 2295 **ID 338**
Design and communication for the Volturno rivers, between Capua and the Mediterranean sea
Ludovico MASCIA

P. 2203 **ID 339**
Knowledge, survey, technology for carbon neutral restoration: from an old hospital to a luxury hotel
Paolo GIANDEBIAGGI

P. 2311 **ID 340**
Italian military engineers in the court of the King of Spain in the 18th century
Giada LUISO

P. 2317 **ID 341**
Neo-gothic influences on the academic architecture of Giovanbattista Patturelli.
Concetta GIULIANO

P. 2322 **ID 342**
Reading the Territory, sign graphics and remote sensing images. The case study of Historic Center of Naples
Rosaria PARENTE

P. 2332 **ID 343**
Digital Invasion at the Royal Palace of Caserta. Telling a story/Telling your story
Alessandra CIRAFICI, Manuela PISCITELLI

P. 2341 **ID 344**
Charles and Georges Rohault de Fleury illustrators and historians of the medieval architecture.
Danila JACAZZI, Antonio MENALE

P. 2354 **ID 345**
Modern churches in the province of Caserta
Riccardo SERRAGLIO

P. 2364 **ID 347**
Images of possible futures. Rapresenting changing landscape
Alessandra CIRAFICI, Antonella VIOLANO, Antonio MAIO

P. 2371 **ID 348**
Urban farming as an eco-oriented tool for redevelopment of urban contexts
Raffaela DE MARTINO, Rossella FRANCHINO, Caterina FRETTOLOSO

P. 2379 **ID 350**
Nisida: integrated and transdisciplinary survey for interpretation of sources
Claudia CENNAMO, Ornella ZERLENGA, Salvatore PETRILLO, Domenico PIGNATA, Ciro SCOGNAMIGLIO

P. 2389 **ID 351**
Architecture and material culture: the construction of the working-class neighborhood of the new Pompei
Pasquale VAIANO

P. 2399 **ID 352**
Beyond the visible Remote sensing and Photointerpretation
Francesco MAIOLINO

P. 2409 **ID 353**
A methodical approach to knowledge the sacred heritage of Aversa
Luciana ABATE, Davide MASTROIANNI, Rosaria PARENTE

P. 2419 **ID 354**
Perception and fruition of open spaces in the historical centers
Manuela PISCITELLI, Milena KICHEKOVA

P. 2429 **ID 355**
Multisensor and multiscale surveying into Pompeii's archeological site. Three case studies.
Carmine GAMBARDELLA, Nicola PISACANE, Alessandra AVELLA, Pasquale ARGENZIANO

P. 2469 **ID 356**
Metropolitan Strategies. Urban planning scenarios for a territorial system
Giuseppe GUIDA

P. 2478 **ID 357**
Smart Planning
Ottavia GAMBARDELLA

P. 2489 **ID 358**
THE MUTABLE VISION: The study case of Montesanto Metro Station
Elena DI GRAZIA, Giuliana CHIERCHIELLO, Valerio PALMIERI

P. 2498 **ID 359**
"Environmental networks" as complex management tool of the urbanized territory
Raffaela DE MARTINO, Rossella FRANCHINO

P. 2505 **ID 360**
Urban Regeneration - Largo Ex-Gesuitico - Piazza A. Moro - Ortanova (FG)
Gianluca CIOFFI

P. 2512 **ID 361**
Evolution of design and application of a method
Gilda EMANUELE

Preface

The theme of the thirteenth Forum “Le Vie dei Mercanti” aims to investigate the complex relationship that develops between technological innovation, knowledge, enjoyment and protection of cultural heritage and the landscape. This leads to the need for an international multidisciplinary comparison in order to explore the questions and issues that are being debated not only in academia, but also among those who govern, manage and control Public Administrations, Institutions and businesses.

The subtitle specifies the macro areas: Mind, intended as both speculative thought as well as the preparation of a methodological process; the subject who investigates, establishes an inescapable destiny with the object analyzed at different scales of analysis, from the architectural structure and design, to the infrastructure and the landscape; Knowledge, as the historicizing of the state of the art reached by the disciplinary skills, integrated with those of material culture, humus generative of innovation for the formation of a human capital that continues to grow; Experience, the representation and sharing of results obtained with good practices, exemplary and paradigmatic, as patrimonial value for humanity to achieve a better quality of life and places created working with Art.

The conference is open to multidisciplinary experiences on one or more of the proposed themes. Scholars are invited to present research on either the theoretical and methodological aspects or concrete applications carried out on these issues.

Carmine Gambardella

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Architectural Restoration projects in metropolitan areas: the case of the Supyo Bridge

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Abstract
In the last ten years, Asian metropolises have invested large amounts of money in urban renewal projects by encouraging large-scale environmental interventions that re-introduced nature to the cities and promoted a specific identity for the downtown areas. Among these projects, the restoration of the *Cheonggyecheon* River in Seoul is the most well-known case.
The transformation of the river in twenty-nine months from an outdated highway into a multipurpose linear park deserves recognition as a pivotal project in modern urban design. The plan is an outstanding achievement that recovers the biological and social ecology of the city and demonstrates the keen ability of design at the urban scale to generate concrete transformation successfully over vast territories.
As an example of a process of urban identity, the creation of this large-scale intervention evokes the historical legacy of the city and has been considered a step towards redeveloping the city's cultural heritage.
The construction of a network of pedestrian pathways to connect the historic places and the restoration of the historic monuments are part of a cultural strategy characterized by a long debate of how to restore these areas. In particular, the restoration of two historic bridges *Gwangtonggyo* and *Supyogyo* was a highly controversial section of the plan as several interest groups voiced opinions on how to restore historical and cultural sites and their remnants and whether to replace the bridges or not.
This article will examine the different restoration strategies designed for the *Supyo* Bridge (*Supyogyo*) that has stood in the *Jangchungdan* Park since 1965 and, according to the main project, should be relocated in its original position.

Keywords: Cultural Heritage, Historical Preservation, Su-pyogyo, Cheonggye River, Urban Renewal

1. Introduction

The effects of demographic concentration and the consequent development of new urban areas in many cities of Far East are peculiar case studies to analyse problems and contradictions of the idea of "growth". The uncontrolled expansion of many metropolises of the early 1990s was the result of urban politics, focused on real estate development, which tried to respond to the new economic and political requests by building infrastructures and public facilities [1]. This process had a strong influence on the idea of public space and led to a loss of the distinctive and authentic facets of many areas.
Hong Kong, Kuala Lampur and Seoul represent the most emblematic cases of urban growth that generated transformations that did not consider the general quality of the city environment, the historical identity of the places and the urban mobility problems.
For a little while now, however, signs of a re-evaluation of this model of growth have been emerging, with a series of urban renewal initiatives that are trying to remedy some past planning mistakes. Among these, one of the most interesting examples is the transformation of *Cheonggyecheon* river from an outdated highway into a multipurpose linear park. This massive urban regeneration project, very uncommon for the facets of its planning, serves as a paradigm of this change in policy, of a move away from unconditional development to the creation of more pleasant city environments, in the awareness that economic and social growth cannot remain divorced from architectural and environmental quality [2].

Despite the results and the international awards obtained, some of the design solutions seem to be inconsistent with the initial goals of the plan, particularly those related to preservation of historic buildings and archaeological remains present in the area.
The next paragraphs will describe the history of the river and the strategies adopted to restore and protect the historical heritage, analysing as a case study the conservation issues of the *Supyo* Bridge.



Fig. 1: Digital model of the Cheonggyecheon seen from west.

2. The urban renewal project

2.1 The river and its history

The *Cheonggyecheon* used to be a naturally formed river before the *Joseon* Dynasty designated Seoul as its capital. This river caused a flood and inundated private houses in full spate. In ordinary times, it was unsanitary because of standing sewage therein. Hence, King *Taejong*, the third king of the *Joseon* Dynasty, firstly beginned river training work by starting construction work for an open channel. After that, King *Yeongjo*, the 21st king of the *Joseon* Dynasty, conducted the overhaul of the river in earnest by dredging the stream, building stone banks and changing a waterway. Due to this construction, the curved waterway of the river became straight one at last [3].
In the first part of the *Joseon* Dynasty, the river was called, in official documents, *Gaecheon*, which means “Dug River”. There are several different theories as to the origin of the actual name: the most reliable one is that the *Cheonnggheon ye*means “stream of pure water” [4].
The Annals of the *Joseon* Dynasty, called *Joseon Wangjo Sillok*, as well as the reports of the authority that managed the water resources, called *Gaecheondogam*, allow us to collect and coordinate all the historical information about the operations of dredging and of maintenance of the waterways.
The annuals also include information about the development of the scientific device invented for the measurement of flood levels, called *Su-pyo*. These inventions were part of the effort to control and understand nature’s influence on agricultural activities [5].
During this historical period, thirty-two stone bridges were built across the *Cheonnggyecheon*. Twenty-two of these still exist as archaeological remains, only two partially maintain their original structure: *Supyogyo* and *Gwangtonggyo*.
At the end of the 18th century a process of demographic concentration along the riverbanks as well as the proximity of the neighbourhoods inhabited by the lowest caste of commoners, called *Cheonmin*, transformed the river in an open sever. With the people across the nation flocking into Seoul and industrialization progressing, water contamination became a critical problem.



Fig. 2: Cheonggyecheon in the 1950s.

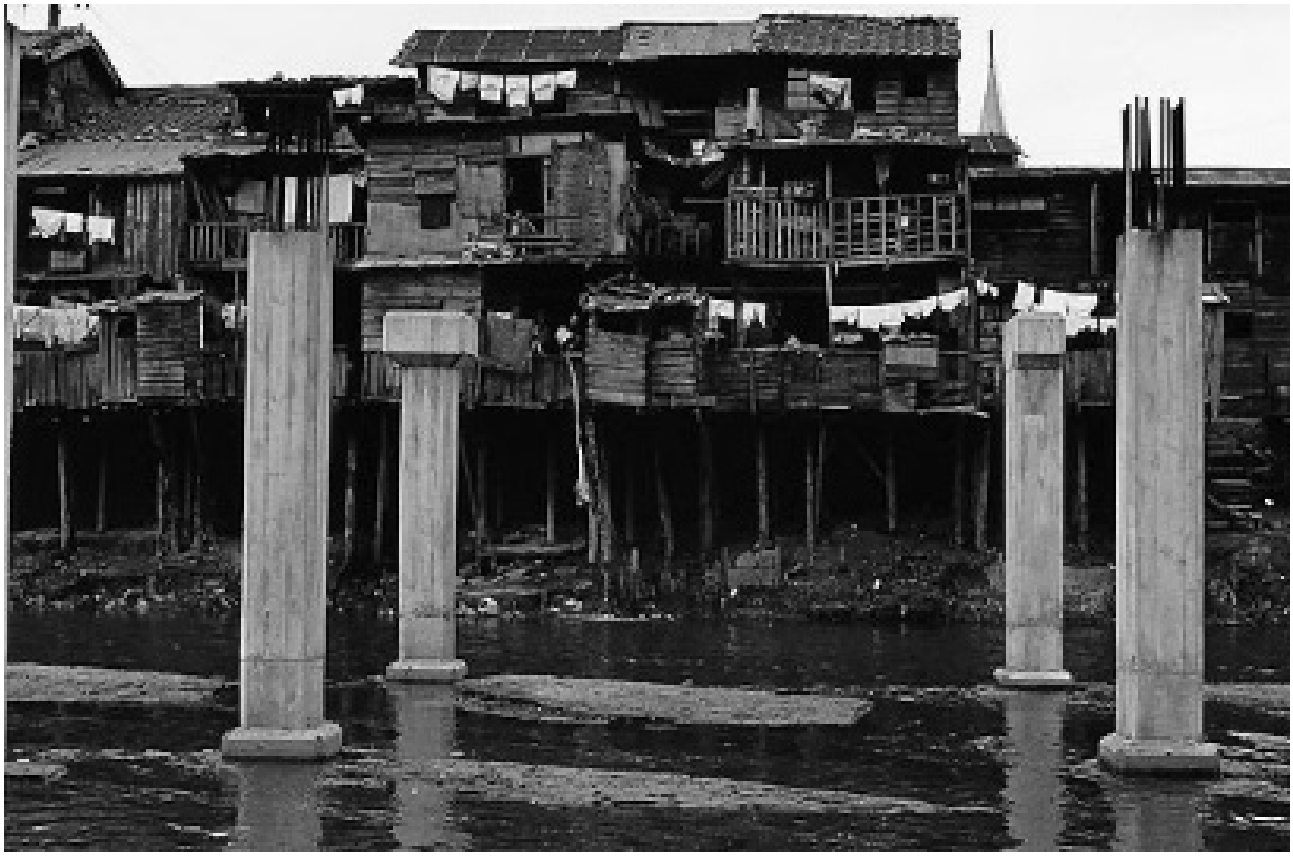

Fig. 3: Cheonggyecheon during the operation of covering.

In the 1930s under Japanese imperial period, a general rearrangement of the urban structure was planned and it was decided to cover the river over with concrete conduits.
This work was interrupted by a series of wars that progressively afflicted Korea, and the covering of the watercourse was only finished in the early 1960s, when a whole renovation of the city's sewer system also started. However, that same period saw the beginning of the development that was to make South Korea one of the emerging economies of Asia and expand Seoul to its present megalopolis status. Around the covered water course of the *Cheonggyecheon* an important business centre was built, and the ever-growing commercial zone around it brought in more and more traffic.
In order to meet ever-increasing transportation demand, an elevated road was constructed on the covered structure between 1967 and 1971, taking advantage of the open space along the path of the hidden stream.
Building this viaduct eliminated the last traces of bridges, which until then still bore witness to the subterranean watercourse.

2.2 The idea of a linear park

After the *Cheonggyecheon* elevated freeway was constructed and old shelters were removed, revitalization encouraged growth along the former river and new elevated freeway. Post-war Seoul was soon becoming a symbol of growth and prosperity in South Korea. This however was short-lived and by the mid-1980's, this part of the city was the busiest, noisiest and most polluted area in Seoul. Associated with deteriorating urban life, the automobile traffic ushered in large environmental and health issues for urbanites. Both citizens and politicians alike agreed upon it in that the urban area along the *Cheonggyecheon* freeway had "become an eyesore born out of Korea's drive in the 20th century to industrialize at all costs". Opposition to the elevated freeway grew through as talks began after Seoul hosted the 1988 summer Olympics to restore and uncover the *Cheonggyecheon* River after years of degradation [6].
It wasn't until 2003, when Seoul's then-Mayor Lee Myung-bak realized the economic, social, environmental, and likely political ramifications a major river restoration project could bring to the city of Seoul. He believed the removal of the freeway and roadway below to restore the river could only positively affect the city.
When the idea was first presented, public opinion was bewildered. However, the project gained support through a public information campaign that won over its opponents, especially from the merchants who worked in that portion of the city. The idea of restoring the river also aroused international attention: in 2004, the project was presented at the ninth International Architecture Exhibition in Venice, where it was awarded with the prize "Città d'Acqua".
The demolition work started in July 1 2003, and the *Cheonggyecheon* elevated highway was completely dismantled on October 5, 2003. The dismantling of structures covering the stream began on August 18, 2003 and was completed by December 30, 2004. In order to reduce noise and dust during the work, the city used diamond wire saws and wheel saws. A total 680,000 tons of waste was generated during the demolition work. Among these, 100% of the scrap iron and steel was recycled and 95% of the waste concrete and asphalt was reused [7].



Fig. 4: The construction site in 2005.



Fig. 5: View of the second section of the park.

2.3 Nature and scope of the work

As previously discussed, the project tried to integrate economic, cultural end environmental objectives, contributing to a larger process of transformation of the image of the urban center, by creating a green corridor where legacies from the past are blended together with the idea of modernity.

The landscape design concept took into account the creation of three different sectors, each with its own cultural theme: the upstream section represented history and tradition, the midstream represented culture modernity and the downstream section represented nature and future.

The different sectors were designed to provide a balance between improving urban ecology and public access. In the first part, conceived to evoke the history of the site, the designers symbolized the start of the river with a fountain and two-stage cascading waterfall positioned at the edge of a large square. The two large walkways, built along each side of the stream, are characterized by a simple scheme and seem to function as a continuation of the plaza above. These walkways end in curved platforms converging on the centre of the stream.

The second section of the park is a focus on culture. This area starts with an artwork that represents five modern artists interpretation of “nature and the environment”. In this part, the riverbanks become stairs moving downward and inviting walkers to come to the edge of the stream.

Vegetation and plants define the irregular geometry of the third part, which has become the habitat for several species of fish, birds, and insects.

One of the most controversial question was how to bring water back to the river, especially considering that all the natural water sources, which used to be the sources of *Cheonggyecheon* stream, were all almost dried.

The final choice was to supply 120,000 tons of water per day in order to maintain a depth of 40 cm and 0.25 m/sec current speed in average. 100,000 tons of *Han* River water, which is about 15 km away from the downstream of *Cheonggyecheon* and 20,000 tons of groundwater from taking from subway tunnels, were supplied daily. Among the total supply, almost 60% of the water was discharged at *Cheonggye* Plaza and the rest from four locations in the forms of fountains and waterfalls [8].



Fig. 6: An example of pedestrian crossing in the second section of the river.



Fig. 7: View of the first section at night.

2.4 Challenges and criticisms

Although the area around the river has become one of the most visited landmark in the city; the whole operation has received criticisms from different sections of the population. Some Korean environmental organizations have criticized the plan for its high costs and lacking ecological and historical authenticity. Other criticisms came from persons with disabilities who have criticized the plan for the irregular distribution of the ramps along the streets.

The strategies developed to preserve cultural heritage generated a long debate about philosophical and methodological aspects of the plan, which has been identified as a “restoration project”.

According to several scholars and some civil society organizations, the Seoul Metropolitan Government emphasized the importance of heritage restoration as a way to evoke the historical legacy of the city, rather than creating continuity between past and future. The aim of the project was thus not merely to preserve monuments in their intact shape but rather to use them for enhancing the appealingly of the stream as a recreational place.

The approach towards the conservation of ancient structures can be described studying the restoration strategies designed for two of the historical bridges of the area: the *Gwangtonggyo* and the *Supyogyo*.

Gwangtonggyo was built in 1410 using stones taken from the royal tomb of Queen *Sindeok* by King *Taejong* and enlarged in 1762 by King *Yeongjo*. The original structure, which remained buried under the old highway for more than 50 years, was completely disassembled and relocated 150 meters away from the original site. As the width of the reshaped river is longer than the length of the ancient structure the south part of the bridge was extended by a new stone structure.

Supyogyo is a stone bridge built in 1420 during the reign of King *Sejong*. The structure was positioned on the current site in 1965 when the covering up of the *Cheonggyecheon* was undertaken. The original decision of Seoul Metropolitan Government was to restore the bridge in its original location along the river, although this operation implies the redesign of the section because of the discrepancy between the length of the bridge and the width of the stream.

3. The Supyogyo bridge

3.1 Construction history

As mentioned in the previous paragraph, the *Supyogyo* is one of the stone bridges constructed over the *Cheonggyecheon* during the *Joseon* Dynasty. The bridge has stood in the *Jangchungdan* Park since 1965, after having been dismantled from its original position and temporarily relocated in the district of *Hongje*.

Construction of the original type began in 1420. At the time, there was a horse market at the site, so the bridge was called the *Majeongyo*, but after a watermark was established in 1441 to read the water level of the *Cheonggyecheon*, it was renamed the *Supyogyo* Bridge. The analyses of both the engravings presents on the stone structure and the official documents produced during the *Joseon* Dynasty allow us to identify the different construction phases.

In particular, the annual records of the *Joseon* royal secretariat called *Seungjeongwon* and the documents produced by the state office called *Bibyunsa* provide essential information about maintenance and repair interventions. The most important ones were made in 1768, when the bridge was enlarged and in 1887 when the stone balustrade was added for safety reason.

Supyogyo is characterized a multiple system of posts and lintels. The whole structure is supported by a series of pillars made of granite that hold up three layers of lintels. The first layer, called *Meonge*, is parallel to the short side of the bridge and consists of a series of beams with a rectangular section. The second one, called *Chungfan*, is parallel to the long side of the structure. The third layer consists of a series of small lintels with a trapezoidal section called *Sangfan MaRu*.

The balustrade consists of a series of balusters called *NanGanJuSeok* which support handrails with an octagonal section called *Nangan Dongja*. With the exception of some small part of the new foundations, the entire structure was made of granite: a rock that was widely used during the *Joseon* period because of the technical innovations introduced in stone extraction techniques during the first reigns of the Dynasty [9].

Many historical sources indicate *Iri* and *Yucheon* as the main quarrying sites during this period. The same sources also indicate that the stone carvers, called *Gongmul*, used to deliver a considerable amount of granite to the state administration as a form of taxation [10].

3.2 Preliminary studies and problems of conservation

The discovery of some remains during the course of works forced the administration to carry out an intensive archaeological study. During the excavations undertaken from September 2003 to June 2004, vestiges of the original stone embankments on both side of the river and structural remains of ancient bridges were found [11].



Fig. 8: Supyogyo in *Jangchungdan* Park.

In the same period, a geometric architectural survey and meticulous diagnostic campaign were carried out to understand the state of conservation of *Supyogyo*.
Further contributions came from international scholars who tried to collect and combine information and knowledge coming from environmental and geological analyses in order to propose a new alternative plan for the conservation of the historical structures in the area [12].
What emerged from all these studies was a clear indication about the state of the preservation of the bridge and its building components.
Although the structure is generally well preserved, some degradation mechanisms of the granite originate by high concentration of pollution, can be found.
In particular, one of the phenomenon that causes the alteration of the rock and its deterioration is the Kaolinization of feldspars. This alteration consists in the forming of kaolin by the weathering of aluminum silicate minerals or other clay minerals.
Besides chemical processes of stone decay, physical actions can generate irreversible degradations. In the case of the *Supyogyo* the main causes of granular disintegration and crumbling is thermal stresses weathering, which results from the expansion and contraction of rock. The change in micro-environmental conditions after the relocation from the *Cheonggyecheon* to the park could have accelerated this process.

4. The restoration project

4.1 The original working plan

As part of the restoration work planned for the whole area, it was initially proposed by the metropolitan government to relocate the *Supyogyo* in its original position, even at the cost of sacrificing part of the structure.
This decision was one of the most discussed issues of the project for both philosophical and technical reasons.
The philosophical reasons were related to the impossibility of maintaining the original shape of the structure because of the geometrical differences between the bridge proportions and the new stream section.
The technical reasons were instead related to the risk of damaging the structure during the relocation, as occurred to historical stone embankments discovered on both sides of the river in 2004 [13].
Although this solution was associate to the idea of evoking the ancient legacy of the city, the overall conservation strategy was primarily conceived as an attempt to reintroduce the appearance of the historical character of the area mainly represented by ancient bridges.
This approach remained also highly constrained by the idea that this restoration had to confirm the modern context of Seoul and thus it should not cause any type of inconvenience to traffic and economic activities occurring around the stream.
Under this point of view, authenticity of materials and risk of losing historical stratifications were secondary aspects compared to a global urban strategy designed for the entire centre [14].

4.2 Possible preservation options

The discussion around the restoration of *Cheonggyecheon* involved national and international academics that proposed some alternative strategies to protect the *Supyogyo* and the built heritage of the area. Most of them denied the possibility of moving the bridge in its original site and proposed a series of small conservative interventions. Implementations of programs of planned maintenance were also considered as basic tool for the safeguarding of the monument in the long run. All the proposals suggested a sequence of interventions to be conducted on two different phases. The goal of the first one was to preserve the granite and stop all future decay; this generally meant applying a coating to the surface of the stone, which both stabilises and protects it from the effects of the atmosphere around it [15].

The aim of the second one was to modify the microclimatic conditions of the area in order to reduce thermal stresses weathering and other causes of deterioration. Indeed, until the late 50s, the structure was partially immersed in a watercourse: this condition influenced seasonal and daily thermal excursions of the area, reducing the effect of decay induced by temperature changes.

The analysis of the seasonal and daily temperature excursions in the period following the bridge positioning in *Jangchungdan* Park suggested how minor changes in micro-environmental conditions could unintentionally trigger the rapid deterioration of the rock. One of the solutions proposed to mitigate these phenomena was to create an artificial watercourse in the area by using the existing water system.

5. Conclusions

Despite strong criticisms in the first place, the project was considered highly successful, strengthening the resilience of eco-system and providing a green space for the citizens.

Creating the environment with clean water and natural habitats was the most significant achievement of the plan. Species of fish, birds, and insects have increased significantly as a result of the stream excavation.

The recovery project, which removed almost six kilometres of elevated highway as well, also considerably cut air pollution from cars and reduced air temperatures. Small-particle air pollution along the corridor dropped to 48 micrograms per cubic meter from 74, and summer temperatures are now often five degrees cooler than those of nearby areas [16].

If the environmental achievements of the project can be considered outstanding, the aspects related to the safeguard of the built heritage represent an example of a strategy that did not take into account all the acquisitions of the international debate around historical preservation. In particular, the word “restoration”, often used to define the scope of the whole plan, seems to be inappropriate to describe a series of reconstructions and relocations of historical remains, according to the principles of internationally accepted heritage charters and protocols [17].

Bibliographical References

[1] PARK, Jungyoon. Il recupero del torrente "Cheonggy" a Seoul: rigenerare il cuore di una metropoli mondiale alla ricerca dell'attrattività. In INGALLINA, Patrizia. *Nuovi scenari per l’attrattività delle città e dei territori. Dibattiti, progetti e strategie in contesti metropolitani mondiali.* 3ª ed. Milano: Franco Angeli, 2010. p. 130-138.

[2] *Journal of Landscape Architecture.* RINALDI, Bianca. 2, 2007.London:Routledge. ISSN, 1862-6033. p.60-73.

[3] CHOI, Kwang Kyun, Interpretation of the Joseon Dynasty through historical exchange of Chungae River. 1ª ed. Seoul: Koryo Press, 2004. p.11.

[4] KIM, Hyun, A History of Jo Seon Dynasty in Korea: Culture and Lifestyle. 1ª ed. Seoul: Hakjisa,1986. p.117.

[5] CHOI, Kwang Kyun, Interpretation of the Joseon Dynasty through historical exchange of Chungae River. 1ª ed. Seoul: Koryo Press, 2004. p.67.

[6] MIKLINSKI, Nick, Cheonggyecheon River, Seoul, South Korea. River Restoration Case Study. 2010. p.2.

[7] HWANG, Kee-Yeon. Cheonggyecheon Restoration and Downtown Revitalization. In AA. VV. Proceedings of the Hong Kong Institute of Planners Conference, When Creative Industries Crossover with Cities, Hong Kong:HKIP&UPSC, 2007, p. 82-88.

[8] LEE, In Keun. Cheong Gye Cheon Restoration Project – a revolution in Seoul. In AA. VV.ICLEI World Congress 2006, 27 February- 3 March. Cape Town, South Africa.
Retrieved from: http://worldcongress2006.iclei.org/uploads /media/K_LEEInKeun_Seoul_River_Project.pdf

[9] KIM, Hyun, A History of Jo Seon Dynasty in Korea: Culture and Lifestyle. 1ª ed. Seoul: Hakjisa,1986. p.152.

[10] KIM, Hyun, A History of Jo Seon Dynasty in Korea: Culture and Lifestyle. 1ª ed. Seoul: Hakjisa,1986. p.153.

[11] JANG, Suh Noh. Suh Noh. Heritage authenticity and monumentalization for political power-a case study of Cheonggyecheon restoration project in Seoul, Korea. Master Thesis. Bangkok: Silpakorn University, 2009. p.41.

[12] POLIMENI, Beniamino, AN, Jin-Sung. Studi e Ricerche sul ponte Supyo a Seoul. Tesi di Specializzazione. Scuola di specializzazione in Restauro dei monumenti. Genova: Università degli Studi di Genova, 2006.

[13] HWANG, Kee-Yeon. Restoring Cheonggyecheon Stream in the Downtown Seoul, Seoul Development Institute, 2004. p.4
Retrieved from: http://www.globalrestorationnetwork.org/uploads/files/LiteratureAttachments/270_restoring-cheonggyecheon-stream-in-the-downtown-seoul.pdf

[14] JANG, Suh Noh. Suh Noh. Heritage authenticity and monumentalization for political power-a case study of Cheonggyecheon restoration project in Seoul, Korea. Master Thesis. Bangkok: Silpakorn University, 2009. p.51.

[15] TORSELLO, Paolo, Che cos'è il restauro? Nove studiosi a confronto. 1ª ed. Venezia: Marsilio, 2005. p. 54.

[16] LEE, In Keun. Cheong Gye Cheon Restoration Project – a revolution in Seoul. In AA. VV.ICLEI World Congress 2006, 27 February- 3 March. Cape Town, South Africa.
Retrieved from: http://worldcongress2006.iclei.org/uploads /media/K_LEEInKeun_Seoul_River_Project.pdf

[17] MUSSO, Stefano. Le carte del Restauro. In TORSELLO, Paolo, Che cos'è il restauro? Nove studiosi a confronto. 1ª ed. Venezia: Marsilio, 2005. p. 118.

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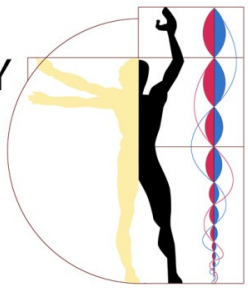

Windows of memory: perspective panels to communicate archeological heritage

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Abstract
Even though virtual archaeology has assumed an educational role, in no way it can be compared with the excitement of the visit to an archaeological site.
Our project proposes an innovative exhibition *in situ* of some archeological goods located in Campania. In order to suggestively enrich the emotional impact, we provide a Plexiglas display, based on a visual and perspective effect that overlaps the ruins still visible and reconstructs, "in the eyes of the observer", the original shape of the building.
It is a re-composition, in a perspective view, of both real and virtual signs. The transparent panels on which some appropriate perspective drawings are printed from a 3D virtual model, collaborate actively in the unveiling of what have been lost in architecture, in a cognitive process of strong impact, comparable only to the more expensive "augmented reality", that, however, interposes an electronic device between the object and the observer. We allow the visitor to enjoy the architectonic space just by direct vision. The project is a flexible solution to be adapted to several archeological sites. It will provide the observer with an emotional experience, so to communicate, through a multisensory effect, the inner value of the visited sites.

Keywords: Perspective, archeological heritage, memory, augmented reality, virtual reality

1. The *windows of memory*: new perspectives for a Low Cost Augmented Reality in archaeological sites[(1)]
The revised Code of Cultural Heritage and Landscape, of 2004, has included in the current legislation the innovative concept of "enhancement", in terms of promotion and dissemination, to an equal status level compared to the more traditional concept of safeguarding, which is no further to be conceived in terms of passive conservation, exclusively addressed to the physical preservation of the good, which nevertheless is the necessary condition of any action of revaluation. According to a fully correct perspective, the legislature sets the enhancement in close connection with the use of the cultural heritage, in order to transmit the knowledge, as a result of the "recognition of a value", which lays the basis for a subsequent transmission to the future generations. However, when we talk about communication, addressed to the wide public, is frequent the spectacularization of the information, with the aim of stimulating physical and emotional reactions, but not including a correct cognitive message: the task of a cultural institution, however, is to provide users, through appropriate and differentiated strategies and methodologies of communication, the codes to understand the monument. The temptation in which often falls the Virtual Reality is to create impossible perspective views, choosing the paths according to a spectacular contemporary sensibility, often disregarding the logic of the building and the physical and optical "rituals", which originally ruled the use of that particular architecture. But communicating the cultural heritage cannot mean, in the contemporary era, exclusively to provide correct information, but must necessarily invent new forms of data transmission, through which the visitor can assume an active role towards the exhibits, going over the simple contemplation of the beauty and the understanding of few basic data. It's fundamental today to give visitors the opportunity to consider, in a personal way, what stands in front of them, in order to develop their own

personal experience of learning. We therefore, emphasize the importance of using a cultural approach to the communication, which has to be based on the interpretive strategies in the construction of a meaning. Communication is therefore intended as a series of knowledge processes, through the continuous development of questions and answers. Our project proposes a knowledge, which is fulfilled from the identification of each possible relationship between the good and its context, no longer considered as an historical finding but as a living organism which needs to be transformed to survive over the centuries, to take on new meanings and to become a critical space, that could increase its educational potential and capacity. The only real experience of an architecture is the feeling of being inside; but when the building or the monument is reduced to a ruin, the loss of the greater volumes, lights, coatings and colors compromises decisively the possibility of appreciation of the good. In such cases, the interaction between the discontinuous real data with the 3D digital reconstruction, of what time has taken away, is perhaps the only way to make the observer understand the architectural values. In order to strongly enrich the emotional impact of the visitor, our project provides an exhibit installation in the archaeological areas of Paestum (SA), based on an original visual effect of perspectives that, overlapping the ruins still visible, reconstructs in the eyes of the observer, the original building shape. It is a composition of signs in a single perspective view, taken from the 3D model and transcripted on transparent display panels, located along some paths of the park. The Windows of the memory is a project that uses the most modern digital technologies in the fields of Virtual Archeology, with the aim to create immersive and interactive spaces, similar to those generated by the Augmented Reality, but without the need for any technological device between the data to transmit and the end user, in a communication process based on the wonder generated by the observer's perceptual phenomena, which is entrusted to an "epiphany of vision" to unveil the lost qualities of an archaeological good in an identification of a shape, whose main actor is the visitor, who becomes the active creator of the disclosure, rather than a passive recipient of information.

In this way, the designed semantic connection is activated by the observer, who becomes himself the creator of the meaning. The project, we propose, uses the latest generation digital technology to structure the contents of the cultural message, but creates a communication technique based on simple physical panels, usable by all people without any recourse to last generation tablets or Smartphone. This project aims to solve some theoretical and technical problems, highlighted by the large debate, of the last decades, in the variegated field of the Virtual Cultural Heritage, such as the criticized spectacularization of the archaeological data through unreliable reconstructions, not based on scientific methods.

«It is criticized the cases of arbitrary – or, at list, undocumented – reconstruction, which conveyed in the public the false impression that being ‘snapshots’ of the past, they had to be true. Virtual reconstruction in no way carried the uncertainty of interpretation and the possible existence of alternate solutions»[1]. In fact, the use of 3d models to reconstruct in detail the lost configuration of an archaeological ruin, generated some problems concerning the methods of representing the cultural heritage, primarily about the validity of the reconstructions hypothesis and then, it poses the question on how to make clear, in the digital model, the uncertainties and the possibility of choices that are the basis of any philological reconstruction. Excessive details, that make a 3D model appealing and realistic, give to the images the value of an absolute truth to what, for archaeologists, is only one of the alternatives hypothesis or, simply, the most likely.

To solve this problem we propose to evoke the architectural and technical drawing, with simple black lines even in presence of decorative details, in order to assign to the perspective image the value of ‘representation of reality’ and, thus, departing from the excessive hyperrealism of several photo-renderings, that instead ends up assuming the value of 'real data'. However this does not mean to reset all flourishing discipline of Virtual Archeology, because the drawing we propose is processed after a three-dimensional reconstruction of the building, which thus becomes a rich database available online for researchers, who want to investigate, by computer or laptop, the theoretical issues related to reconstructive hypotheses implemented. The computational load required by the free navigation in a complex 3D model is just sustainable by modern computers and, therefore, does not fit to the current mobile interactive terminals; on the contrary, is quite impossible to support the need for fixed terminals, possibily available in the archaeological site, that may even conflict with the emotional experience during the visit. Each *Window of memory*, thus, proposes to the visitor a single perspective view, appropriately taken from 3D model, that reproduces exactly the image generated by the physiological direct vision of the archaeological artifact, which an observer could experiment in a suitable position, along the exhibit path. This is a digital image, a perspective view from the 3D reconstruction of the architecture, but reworked according to a simpler

communication code, suitable to unveil the actual artifact and its relationship with the missing parts that we intend to integrate, in order to improve the emotional experience of the lost space [2].

In this way, our contribution to the digital communication aims to be properly integrated with the exhibition, looking for a balance between message, context and media. The declared overlapping between the direct vision of an archaeological fragment and its transparent digital reconstruction, highlights the fundamental role of the ruin and constructs a meaning in a cognitive process, which presupposes that each sign of the virtual rebuilt model has to be connected with the evidence of the witness's real and physical artifact.

We can also talk about 'low cost augmented reality' because, like this one, the project is characterized by the emotion of being immersed in a real space, increased by new signs that generate a deep interactivity and active involvement of the visitor. The affordability of such installation is also based on the non-perishable nature of the display physical panels, compared to the rather short life that characterizes all technological interfaces, whose inevitable fast progress would require, in few months, expensive upgrades of the software.

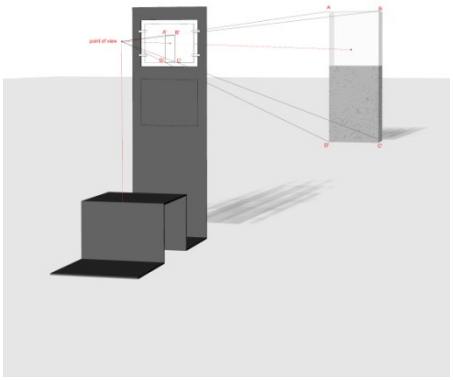

Fig. 1: Perspective scheme.



Fig. 2: The window overlaps the lost colors to the temple of Neptune.



Fig. 3: An ancient street in Paestum.



Fig. 4: The street in Virtual archeology.



Fig. 5: The window augments the reality.

2. A window in the Roman theater of Misenum

The theater of Misenum (Naples), datable to the second century AD, was built with an Hellenistic mould, digging the ridge of tuff and leaning the cavea; the structure, adapting to the Roman system, detaches from the tuff promontory of Capo Miseno thanks to architectural volumes to support, in the upper, portico and ambulatories. The theater, with a maximum diameter of 67 m, was originally constituted by three superimposed orders of arches; the upper floor needed to optimize the acoustics of the cavea. Today, however, only 19 of the 25 bays of the lower ambulatory and part of its vomitoria and corridors that led to the inner hemicycles as well as a tunnel 30m long and approximately 4.20m wide, dug directly in the rock of tuff coast, which now allows the direct access also from the sea, are visible and partially practicable. Built in conjunction with the construction of the theater, in the context of general urbanization wanted by the

emperor, to overcome the orographic obstacle of the cape for people coming from the north, the tunnel looks with almost parallel vertical walls, topped with an irregular barrel vault carved directly into the tuff hill setting a particular perceptual game of references between the inside and the outside. The site is the subject of the project P.O.R. Campania 2000-2006 of the Superintendence for Archaeological Heritage of the provinces of Naples and Caserta (expropriation, excavation, restoration and enhancement of the Roman Theatre with restoring of the access by sea), which has already led to the excavation of an access to the hemicycle of the theater and secured the structures from collapsing but which also has the overall objective of achieving an archaeological park that enhances the entire area by accepting the inseparable connection between the ancient and the modern city.

Despite this, however, the widespread illegal construction in the past years has led to the wild construction of private buildings on the area, that was supposed to be further excavated, so it makes impossible the interventions of recovery and definitively conceals a great part of an architecture that cannot be unearthed in any reasonable way. Therefore, this *status quo*, from which one cannot absolutely leave out of consideration, forces us to careful considerations about the most appropriate way of intervention to avoid that the errors of the past will lead to a definitive concealment due to a lack of interest caused by the insurmountable legislative-procedural problems that make impossible a "normal" process of restoration and enhancement. In contemporary practice on the protection and restoration, the importance of the concept of use of artistic and architectural heritage is unquestionable, since it is the essence of their existence.

Having, therefore, to think about the future of an archaeological site as that of the Theatre of Miseno we must reflect on appropriate actions to be implemented by targeting not only the communication or only its theoretical knowledge but, consistent with the reasons of protection, we have to ensure their direct use. So that the community is not a spectator stranger to reality but a dynamic actor able to establish a direct dialogue with the reality of the matter. We don’t want to alienate the people away from the architecture as often happens because of practices oriented exclusively towards the use of digital technologies.

Therefore, we prefer to suppose an intervention able not only to communicate but also mainly to generate a "concrete" augmented reality, thanks to the installation of a Window of memory. Thanks to its tangible presence in real spaces, we will be able to tell the forms of architecture but, at the same time, to live the experience of the visit to the theater in its original form. We want to insert simple totemic objects within the hypogeal space of the hemicycle that, in respect of the monumental place and in the absolute reversibility of installation, could stimulate an improved visual-sensory experience of the place, in a game of mutual reference between illusory perception of non-existent spatiality and direct use of concrete matter.

In the case of the Theater of Misenum, therefore, it is not possible to assume the full enjoyment of the complete architecture due to inability to perform the excavation over the entire area; so it is essential to focus exclusively on the part of the hemicycle currently practicable. We cannot, however, give up the communication to the visitor of the architectural complex so that he can at least perceive the original configuration of the site where he stay. It is important to emphasize that the current floor surface does not coincide with the original one, as it was at a lower level. The ambulatory, today dark and modest height, was a majestic place characterized by different proportions. But because we cannot bring back the floor to the real elevation, it becomes essential to think about the communication oh this important aspect so that visitors can at least imagine the real characteristics of the Roman architectural apparatus.

The blind and dark places do not help people to imagine that series of paths that lead to the upper levels or that accompanied to the large outside auditorium. Through the installation of a window of memory we want to highlight, with simple graphic signs, those forms that defined the spaces of the architecture so that the viewer can see beyond what exists, sensing his position with respect to the *status quo* and also imagining his position relative to the totality of the theater. In this way, the walls vanish in a conscious perceptual illusion and the floor, over the eyes, can return to the real elevation suggesting to the viewer the same dimensional relationships that belonged to the Theatre. The three-dimensional modeling is considered not only an instrument of abstract representation but also a means of dialogue and reading of space. The virtual reconstruction of the entire architectural apparatus, in its compositional complexity, has been associated with the environments currently viable to understand and communicate their relationships, in that dialogue between part and whole that tells a story now passed not more livable neither immediately understandable by the viewer.

Starting from the image that appears to the eye of the viewer, the projective operations, according to the rules of conic linear perspective, working in three-dimensional virtual environment, allow us to transcribe the

image that we want to be perceived on the transparent surface of the Window of the memory, which coincides with a fictitious vertical plane, already known as Alberti's veil. Therefore, in the direct use, all things properly recover themselves in the eye and in the mind of the observer. In order to practically implement a proper design it is, therefore, essential to work in three-dimensional virtual environment, starting with the full knowledge of the existing spatiality not only in its geometric abstraction but mainly in its present shape. For this purpose, first, in situ was conducted a survey through a laser scanner in order to obtain a cloud of points from which to draw all the necessary information for the virtual modeling of the ambulatory of Theatre: not only a theoretical knowledge of the status quo but a collection of data necessary to calibrate an object to a specific site. At the same time, it was essential to reconstruct, always in a virtual environment, the Theatre in its original configuration, starting from the available documentary sources, in order to superimpose the real forms with the original ones and understand the perceptual differences. Consequently, it was possible to proceed with the necessary geometric operations of central projection to determine the image to lay on reality. On the transparent surface of the glass, as with the simple stroke of the drawing, the contours of architectural forms are traced, as a perspective of the original configuration, so that, from the established point of view they can perfectly overlap the existing matter as if, within the window, everything was back to the second century AD. Abstraction and simulation of space to tell morphologies that go beyond the real view and people can discover new environments and new proportions currently hidden. Not just a totem, therefore, able only to exhibit images and textual descriptions but an object capable of interacting with the real space and above all capable of revealing shapes and proportions that no longer exist without departing from the site itself. Visitors can see, from the same position, the current state of the architecture, to live it in its three-dimensionality, but at the same time they will perceive, although in a fleeting and illusory way, what the time irrevocably deleted.

The concrete presence of an object, such as the Window of memory, located inside the path, ensures the use of the "augmented reality" and the use of the virtual reconstruction in a way more immediate than other practices of virtual archeology. It forces the visitor to stop attracting his attention and inviting him to watch something else that, if it was simply described on a display panel or on a web page, it would have been overlooked. The main aim is to give a new life to the existing matter trying to bring back into the darkness of the few viable bays inside the hemicycle the dynamism and energy of the ancient Roman pomp but mostly try to tell something that in any case cannot come back to light. Simple graphic signs that overlap, form a single point of view, on forms that actually exists without either cover them or deny them to narrate hidden aspects, extending the edges and relocating each element in the correct position.

An overlapping of images that belong to different periods, the past and the present that are compared in an instant and stimulate the mind of the viewer, telling him the spatiality of lost places. A perceptive dialogue that can make the effects of time on architecture manifest, allowing the viewer to compare the real image and that transcribed one on the glass in order to see the differences an to fully understand the changes that the Roman ambulatory suffered.

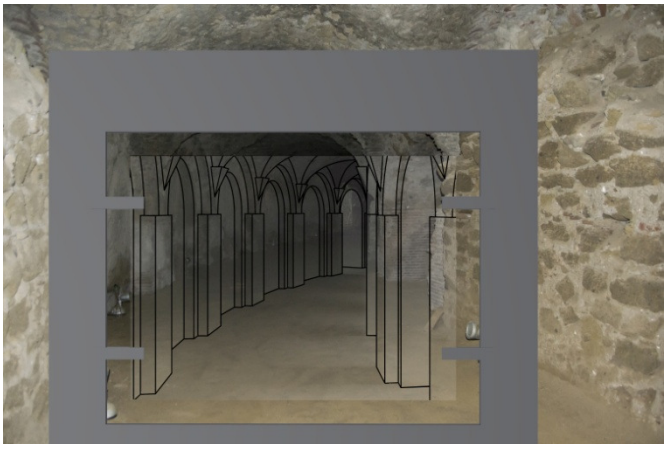

Fig. 6: Original proportion of the ambulatory



Fig. 7: A window in the Roman theater of Misenum

3. The memory of S. Nicola abbey in Padula (SA) – Italy

The S. Nicola abbey in Padula was probably founded between the 5th and the 6th century A.D. and it is a direct evidence of the Byzantine preachers' presence in the area, to spread the St. Basil's Greek ritual [3]. The abbey was annexed to the Cava abbey in 1089 [4] and subsequently to the S. Lorenzo Charterhouse in Padula probably because of its healthy position on the top of a hill, to serve as hospital for the sick monks in 1538 [5]. It is not given to know much more about the life of the abbey or about its archive.

The S. Nicola abbey is placed on a hill, not far from the urban center and it is the oldest building in proximity of Cosilinum, the early settlement from which Padula was founded. Padula is also well known for its stone, and two quarries are on the north and on the south side of the town. The southern one is right below the abbey, and what is left of the building is overhanging on a cliff.

Most of its structure was badly damaged by a earthquake in 1857 [6] but the building layout was still visible on the ground when Sacco measured it: his drawings are the most accurate statement of S.Nicola's appearance before the following collapse of the structures. Sacco describes the building as rectangular in plan, with its parts closing around a rectangular patio fenced by a wall. The access to the patio was granted by a fine stone portal, centered in the wall. The church and the bell tower were on the right side of the patio, while service rooms were on the other two sides. Sacco mentions the access door, the bell tower and the fountain on the left in the patio as museum pieces.

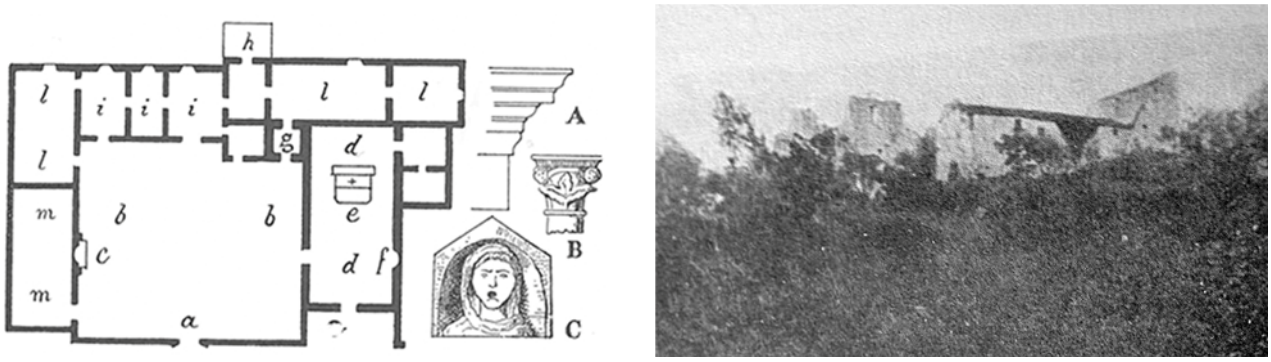

Fig. 8: Left: S. Nicola abbey plan. Right: photograph depicting S. Nicola abbey. Images from SACCO, Antonio. La Certosa di Padula disegnata, descritta e narrata su documenti inediti dal prof. sacerd. Antonio Sacco. Boccia Editore, Salerno, 1982.

At present time most of the structures are missing or are badly damaged and most of the building doesn't exist anymore. The quarry has worn out and eroded a great piece of the part of the hill where S.Nicola stood, but the walls still standing up are even now helpful to imagine the original dimension and size of the building, and can still provide a good reference point to place the outer wall that was once fencing the patio. The only documents that can help us to imagine the original appearance are the drawings and measurements by Sacco and some photographs that can be found in archives. After a research it was possible to get more informations about the elevation of the structures and about the roof pitches. To place the building in its original position it was necessary to refer to a GIS maps that contained the abbey's contour. Comparing the GIS map [7] with the drawings by Sacco and with the ones recovered from the interviews, it was possible to recreate and size a tridimensional model of the abbey.

The privileged point of view for the projection is in the old part of Padula, right in front of the valley separating the hills where Padula is and where S. Nicola abbey is. Placing the privileged point of view in this particular place allows to create an ideal and visual correlation between the town center, the abbey and the hill on its background, which is the one where Cosilinum (the ancient town) was, creating a historical connection through sight.

The project exposed in this paper can be easily extended to other parts of the abbey. The site where the ruins are is easily accessible, but it is impossible at the moment to see them clearly because they are covered with a thick vegetation coat. After further and more accurate measurements of what is left, and after clearing the ruins from the vegetation coat it will be surely possible to place analogue installations to allow the visitors to experience what the abbey would have appeared like when it was still a whole.



Fig. 9: Left: the installation from the point of view, where the observer will be able to see the original shape of the abbey. Right: the panel that holds the screen and an informative text is easy to install on the existing rail.

4. The windows of the invisible

The vesuvian territory is rich in wonderful architectonic proofs dated of Roman and Italic Era, crystallized after the eruption of 79 A.D. In this way they've joint to our era. Ruins of the ancient society, characterized not only by public and religious buildings but also and above all, private houses, which reflect the owner's social status, appear today as a scenographic set given by the vesuvian stones colors, above which are represented some frescos and mosaic floors which are very rich in elegance and symbolism.

In spite of all the reconstruction made, what is now visible lets the visitor of the archeological areas to perceive the original sight of a colorful scenario, based on scenographies where figurative places lived in symbiosis with the home and natural one. In this way, the ruins obtained during the excavations, some of the archeological, botanic and other hypothesis let us to set up the scenery before the eruption of 79 A.D, thanks to both the *Grand Tour* visitors' drawings and to architectonic, sculpture and painted restoration scales and to the sowing of vegetable species.

By integrating the bibliographic research with some reliefs based on geometry and perspective, it's been possible to highlight some important points of view belonging to the inner places of *domus* and *villae,* allowing to verify how the architectonic elements are put together showing all the environments, as people goes in the houses. At the same time it has been possible to understand and rebuild also the integration way of the figurative system with the architectonic one, defining some illusory spaces spaces which appear to be bigger than the real planimetric configuration. The perceiving of those spaces is based on some of exact points of view from which is possible to recreate as always a complete and a coherent image of a provided space.

Referring to the vesuvian archeological areas, known as a tangible proof of the heritage, where the most important thing to do is to propose some of invasive interventions (less intensive as they can be), the windows of memory are described as totems to locate in the exact point where it's possible to see "what is not possible to see anymore".

The ancient prospective imagine represented on the Plexiglas panel and which is juxtaposed on the actual one is filled not only by the cancelled architectonic elements but also thanks to the representation of the real paintings which, where absent, are not represented in their original colors. As regards the supporting structure is metallic, and it is possible to locate it easily both inside and outside of the houses. Particularly, outside of the *domus*, now permanently closed to the public, the windows of memory allow to rebuild the whole prospective view which was also visible for a spectator from the I century AD. It consist in a perfect integration of figurative, architectonic and vegetable levels which characterized both the illusionary and colorful vision of a bigger space beyond the *domus* level.

Maybe, inside, they're located in such a way to overlap the dark and naked walls of *viridaria, triclinia and cubicula*, dark and naked, because of the lack of the painting allowing people to see bigger spaces over them. In this way, the totem plays not only as a memory window of a past which is no more possible to see

and of the imaginary 'what is not possible to see no more' because the panel represents a reality which is not possible to produce once again both because some finds are now considered as ruins, and because of the morphology. For this reason, these kind of totem will be called 'the windows of the invisible'.
Both in the *domus* of the *Insula Occidentalis in Pompeii* and the summer *diaetae* in Arianna's Villa in Stabia, the windows of the invisible can show a sea sight once again, in which the coast was much closer to the archaeological areas than now. Those windows propose also the imaginary, propose a sort of illusion painted on a space against the closing where was possible to draw a symmetric configuration which is also bigger and axial.
The examples propose the application of the window to Sallustio's *domus* in *Pompeii*, currently closed for visitors and for which it is possible to conjecture an external installation.
In this way it is showed the prospective vision that it's also given by the juxtaposition of architectonic and figurative levels. So what is not possible to see no more is given by the lack of the paintings in First Style, whose different colors are characterized by the orthostatic (*atrium*) and to the lack of garden paintings on the wall of *viridarium*.
This illusory scenography is thought as a pictorial space more extended than the architectonic one that, with the representation of a wood beyond a painted colonnade, defines a symbolic opening in direction of the real wood that really existed.



Figg. 10-11-12: A window in Sallustio's *domus* in *Pompeii.*



Bibliographical references

[1] NICCOLUCCI, F., HERMON, F., *3D in archeology: 15 years of researches. The role of the EU project,* in Electronic images and the Visual Art, EVA 2013 Florence, Florence 2013, p. 50.

[2] cf. IPPOLITI, Elena, *Media digitali per il godimento del patrimonio culturale Digital Media and enjoyment of Cultural Heritage*, in Ippoliti, E., Meschini, A., *Tecnologie per la comunicazione del patrimonio culturale,* Disegnare con, Vol.4, n. 8 2011.

[3] SANSEVIERO, Michele. *L'opera degli scalpellini di Padula nelle dinamiche artistiche del Vallo di Diano*. Università degli Studi di Napoli, 2006.

[4] FABIANO, P. Paolo. *Il Vallo di Diano. Assetto territorial e sviluppo*. Boccia Editore, Salerno, 1981.

[5] SACCO, Antonio. *La Certosa di Padula disegnata, descritta e narrata su documenti inediti dal prof. sacerd. Antonio Sacco*. Boccia Editore, Salerno, 1982.

[6] SACCO, Antonio. La Certosa di Padula disegnata, descritta e narrata su documenti inediti dal prof. sacerd. Antonio Sacco. Boccia Editore, Salerno, 1982.

[7] GIS map:
http://95.110.188.151/webgis/map.phtml?resetsession=ALL&winsize=normal&language=it&config=padula

HERITAGE and TECHNOLOGY
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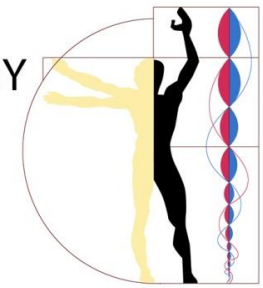

Heritage enhancement and communication "Palazzo Te allo Specchio" follow-up

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Abstract
Oscar Wilde in *The Picture of Dorian Gray* denounced the double face of the beauty: eternal youth at the price of corruption of the soul. Nowadays, the risk befalling architectural heritage is the same: preservation of the monument at the price of its marketing. Which perspectives may arise from such a remark? Problems connected to the 70's methodologies of preservation appear now as out-of-date due to the cogency of a much relevant problem: the unavailability of the finances needed to carry out even the most ordinary maintenance procedures.
The critical urgency is shifting from a cultural to an economical dimension and the present times are not favourable ones. It is necessary, therefore, to make the management of the monument a previous step to its preservation, also for the reason that we understand that nowadays the economic management stands to preservation as oxygen to human life.
As people in charge, as being cultural operators before being economic ones, we cannot afford to be deprived of the coordination of the process, in order to ensure preservation to be regarded as a primary issue for architecture. How to carry this out? The purpose of the present communication idea is to create a doorway towards the future for architectural design linked to photography, to the digital world and to the survey for architectural heritage. The processing of digital techniques for the design is based upon an attentive inquiry on Luigi Ghirri's photography and on his personal way of representing the Pianura Padana. For this edition of the Forum we will present the follow-up of "Palazzo Te allo Specchio" exhibition.

Keywords: heritage, exhibitions, museums, marketing

The architectural surveys of Palazzo Te, conducted in the "Laboratory of Survey and Project of Mantova City" of the Polytechnic of Milan, directed by the author, are the result of eight years of research based on the material survey of the architectural heritage of Gonzaga's territory. Expansions, restorations and maintenances of 500 years of history have produced the image of today's Palazzo Te, and the presented survey wants to be an open photo to the judgment of posterity, who tomorrow will judge our present actions. This exhibition aims to open a door on the future of the architectural design and preservation, where the event organization could be a driver for the marketing of the Italian historical architecture and of the world, becoming the main engine of fundraising for the enhancement and restoration of the heritage. We will end the debate on these issues at the end of this essay after to have demonstrated, with a detailed reflection, from the Renaissance to nowdays, the reasons that lead ourselves to the setting unscrupulous, between classicism and modernity, of the exhibition itself.
In 1519, a few years earlier than the construction of Palazzo Te, Raphael wrote to Pope Leone X: *"Quanti Pontefici, Padre Santissimo, li quali avevano il medesimo officio che ha Vostra Santità, ma non già il medesimo sapere, né il medesimo valore e grandezza d'animo, né quella clemenza che la fa simile a Dio: quanti, dico, Pontefici hanno atteso a ruinare templi antichi, statue, archi e altri edifici gloriosi! Quanti hanno comportato che solamente per pigliar terra pozzolana si sieno scavati dei fondamenti, onde in poco tempo poi gli edifici sono venuti a terra! Quanta calce si è fatta di statue e d'altri ornamenti antichi! che ardirei dire*

che tutta questa Roma nuova che ora si vede, quanto grande ch'ella si sia, quanto bella, quanto ornata di palagi, chiese e altri edifici che la scopriamo, tutta è fabricata di calce e marmi antichi"[1].
It is evident how, in the history of the modifications of the existing contexts, this kind of behaviour it was not a news, indeed it was an established practice responding to material needs and cultural background of those who put them into practice. The difference between a Renaissance architect in front of a conservative architect of ancient ruins was his autonomous operativity marked by an undoubted design action. Palladio surveyed with a designing conscience, surveying proportionately and not metrically, thinking to a new building to be constructed. The survey has begun to be just a scientific document regardless from a final task linked to design, in French schools of the '700, when the Grand Tour-leading best architecture students touring Europe to discover the ancient greek-roman architecture. From Monge to Letarouilly the drawing science is stated as a separate discipline that sometimes seems to forget the relationship to the project, as if the building had become a matter of rapresentation, no more as a drawing for the project. In fact this is the time when even the archeology structures its autonomy of action and of thought, considering the education of the designer architect indifferent to the issues of archaeology.
The link between the ancient and the classic unity was very much present in the classical architects of fourth to fifth centuries, and the theme of the discussion was not the exception to the rule but the harmony, the composition of architectural elements by the Roman cultural heritage that was reinterpreted and reassembled with new words. Raffaello always in the same letter says: *"Però al disegno dell'architetto s'appartengono le misure tirate sempre con linee parallele per ogni verso. E se le misure fatte talora sopra pianta di forma tonda scortano, ovvero diminuiscono, ovvero fatte pur sopra il dritto in triangolo o altre forme, subito si ritrovano nel disegno della pianta, e quello che scorta nella pianta, come volte, archi e triangoli, è poi perfetto nelli suoi dritti disegni. E per questo è sempre bisogno aver pronte le misure giuste de' palmi, piedi, dita, grani, fino alle sue parti minime"*[2].
Palladio demonstrates how the study of architecture through the direct survey could bring more "truth" to the construction of Renaissance architecture, truth to be understood as adherence to the principles of Roman architecture. The survey, however, was intended as practice of knowledge for the project and not as documentary material for the archives. In fact they surveyed ancient architecture through instruments that had a direct proportional relationship to the human body, as we have just heard the words of Raphael, and the modular system and its exception constituted the basis of language.
Rudolf Wittkower writes: *"The classical studies which he began under Trissino remained Palladio's life-long preoccupation, and his art cannot be dissociated from the humanist training in this circle […]. The first fruits of his journeys to Rome were two small guide-books, of greater importance than their size might indicate. Both appeared in Rome in 1554. One,* Le antichità di Roma*, consists of short descriptions of the classical ruins and their history, arranged in groups, for the information of travellers. The book replace the mediaeval* Mirabilia Urbis Romae *which, as Palladio put it, were 'full of strange lies'. Classical material was now presented in accordance with the new standards of Renaissance research"*[3].
This is the topic. The stringency of the method is subject to the historical moment, the particular feeling of an era compared to the universal values: in this there is neither progress nor Darwinian evolution, but a common spirituality that transcends the becoming of the events. Panofsky had well described the phenomenon in his best-known essay *Perspective as symbolic form*.
But things change, the reasons of justice prevail over rational reasons. Without advancing in politics issues we get up to Piranesi, who M. Tafuri dedicates an emblematic book of his lavish cultural production: "La sfera e il labirinto". After Piranesi, according to the Venetian historian, nothing will ever be the same. I will not attempt to paraphrase his complex thought, it would be simplistic and useless for purposes of this reflection.
Tafuri says: *"Il salto storico che proponiamo" è "una riflessione sulla continuità dei due grandi temi impostati da Piranesi: quello relativo ai limiti della forma e quello della violenza sulle forme stesse. Ma i «viaggi piranesiani» e le crudeli peripezie cui essi obbligano i viaggiatori annunciano anche il tema di un nuovo rapporto fra il soggetto e il pubblico. Le Carceri sono teatri in cui si mettono in scena le acrobazie compiute da un apostata desideroso di trascinare i propri spettatori nell'universo della «virtuosa scelleratezza»"*[4].
The architecture feels for the first time, even if only in theory and not in application, the possibility of subversion, irrationality, or more in concrete way of the deprivation of sense. The ancient precepts of Vitruvian utilitas-firmitas-venustas can indulge exceptions, the drawn image wins over the reasons of the construction. The floor no longer corresponds to the section, the facade becomes emblem of vanity and not more projection of an interior space. The sense is finished in the absence of meaning, in the celebration of the arbitrary as power finally returned to the single man after centuries of abuse from above. It is just the beginning - we are at the end of the eighteenth century - of a gap that still to nowdays has not been

[1] Cfr La Rocca G. (edited by), *Lettera di Raffaello d'Urbino a papa Leone X*, Baldassarre Castiglione, Le lettere, Mondadori, Milano 1978, pp. 531-542
[2] Ibidem
[3] cfr Wittkower R., *Architectural Principles in the Age of Humanism* , Alec Tiranti LTD, London 1952, p. 55-56.
[4] cfr Tafuri M., "La scena come «città virtuale»", in La sfera e il labirinto, Einaudi, Torino 1980, p. 113

recomposed, indeed has produced a more pronounced separation of the knowledges, a specialization that too often prevented dialogue.
From Piranesi to twentieth century the step is, and Tafuri well describes it in his erudite essay. The vanguards break every scheme, and at these movements of rupture are not required elements of justification.
But history shows us many variations to the main thought, and very often these variants are the most interesting of the single thought. And maybe the variants can afford us to make a synthesis, to compose classic and avant-garde in a sort of historical continuum, in which there is no short circuit rather a continue recapitulation for broaden the foundation of knowledge.
In this regard, we analyze the work of two interpreters of the cultural tradition of the Italian twentieth century that are not architects, but in many ways they have made a work very close to architecture. These two authors are Luigi Ghirri and Michelangelo Antonioni, a photographer and a director, both manufacturers of images from spatiality so deep that they would have could confront themselves with the work in perspective of Piero Della Francesca and Andrea Mantegna. Perhaps that synthesis that architects of the twentieth century failed, is instead studied by authors who - for inescapable reasons - have had to deal with the relationship with the new "technologies" (or techniques, as objects Emanuele Severino), a photographic camera and a filming machine. From their biography we see a classical education, a culture founded on the basis of history, but the new arts have forced them to learn new tools. Necessity becomes virtue and open to new possibilities that the medium offers us, not always in the wake of orthodoxy.
In his book *Lezioni di fotografia*, in a photographic work commissioned by the Triennale di Milano in 1988 on the Arsenale di Venezia, Ghirri writes: *"Quella che vediamo è l'immagine di un luogo importantissimo, perché qui Canaletto, utilizzando una camera oscura (una scatola contenente uno specchio che gli permetteva di tracciare i contorni delle architetture che doveva dipingere) fece una delle sue prime vedute. Si tratta di un'immagine famosissima, fondamentale non solo nell'ambito della storia della fotografia da nella storia della rappresentazione in generale. Vi ho portato questa serie di fotografie come esempio di applicazione di quanto dicevamo a proposito del fotografare, mio e di altri fotografi, seguendo uno schema che attribuisce grande rilievo alla visione progettuale e una certa importanza alla ripresa, mentre la stampa diventa secondaria"*[5].
And even further about the geometric-proportional construction of the pictorial space*:"Da questa idea di uno spazio che riproduceva lo spazio esterno, di un doppio della realtà che si poteva vedere praticando un forellino all'interno di una scatola, sono nati i sistemi di proiezione, di disegno, di rappresentazione del mondo utilizzati in seguito da molti grandi pittori, sistemi interni a una storia della rappresentazione della realtà che arriva fino ai nostri giorni. […] dovete tenere la macchina ortogonale. In un dipinto prospettico le linee vengono disegnate; la camera oscura, e così la macchina fotografica, ubbidiscono naturalmente a regole prospettiche precise, che sono quelle della prospettiva rinascimentale"*[6].
Through these assumptions Luigi Ghirri works without distinction on classic architecture and landscapes and the suburbs of his contemporaneity (mostly 70s and 80s of the last century), making the place as expedient of his own design vision. No matter if the place is not "beautiful" in a classic sense, the image construction must follow the principles of his own classical education. So the vanguard enters in the classicism, not in a antagonistic key - according to Tafuri's reading - but as a continuing principle of the historical-design research. The image is motivated in a new way, in a composition that remains in a Aristotelian logic.
Why then such refractoriness - especially in Italy - of the domestic contemporary culture towards to the contemporaneity? Every age has had its contemporaneity and from it, in dialectic way between tradition and news, were born the materials for the future.
Even Michelangelo Antonioni worked seemingly on indifferent themes and places, especially on the city's economic boom of the '60s, photographing with introspective eye and psychoanalytically disaggregating the obviousness of the daily observed.
Gian Piero Brunetta tells about Antonioni: *"L'uomo antonioniano non è più centro e misura dello spazio e della realtà. Si muove e agisce con un rapporto di inadeguatezza e di asintonia rispetto agli altri e all'ambiente. Non trova la misura più giusta per comunicare, e neppure quella per essere semplicemente sé stesso.*
In questo lavoro di ristrutturazione di rapporti la prima sfida del regista è quella di una «fuga banale» - come l'ha definita Tommaso Chiaretti – ottenuta attraverso un'immersione totale nel banale stesso per farne emergere, dal fondo, significati imprevisti e inquietanti"[7].
And just some words before he says: *"Le cose, poco a poco, occupano il centro della scena, acquistando un valore simbolico e divenendo attori dell'azione, mentre, da parte loro, i personaggi subiscono un processo di oggettivazione e reificazione che li porta a confondersi e annullarsi nelle cose stesse"*[8].

[5] cfr Ghirri, L., *Lezioni di fotografia*, Quodlibet, Macerata 2010, p. 58-59
[6] Ibidem, p. 105
[7] cfr Brunetta G. P., *"Orbite e parabole nel cinema dei maestri – 2. Michelangelo Antonioni"*, in *Storia del cinema italiano - volume quarto*, Editori Riuniti, Roma 1993, p. 34.

About this theme we remember the book by Jean Baudrillard “Le Système des objets” of 1968, published only a few years after La Notte by Antonioni of 1961 and Deserto Rosso of 1964, and in contemporaneity of the exit of Blow-up of 1966 and Zabrinskie Point of 1970. Ma il lavoro del grande maestro non si discosta mai, nel suo essere avanguardia, dalla necessità del racconto, del senso But the work of the great master never deviates, in its being avant-guard, from the need of the story, of the sense. *“[…] le mosse di Antonioni, Fellini e, dopo qualche tempo, anche di Rossellini appaiono ancora più irregolari e confermano la tendenza alla disomogeneità: in effetti, in tutti e tre questi autori, gli elementi innovativi prevalgono su quelli conservativi, senza peraltro che la nozione di narratività sia messa in discussione”*[9].

Besides, in 70’s happens the passage to the electronic tools: *“Il passaggio all’uso dell’elettronica, delle camere, di un tipo di lavoro completamente differente, avviene in questi anni; i pochi episodi registrabili (il più significativo è senz’atro Il mistero di Oberwald di Antonioni) preludono a un rapido spostamento tecnologico a favore di questi ultimi mezzi”*[10].

The questions hitherto borrowed from other disciplines - painting, photography, cinematography - are an expedient to cast a glance on the architecture that it was not too self-referential, in a time when the extreme specialization has made shortsighted the view of those who do research. When the crisis - before of language than of economy - has made impossible the dialogue among the parties operating on the architecture, broadly conceived as built heritage and as heritage project, other crafts have to become the mirror of our actions. We must have the courage to use as example - no ifs, ands or buts - the experience of researchers and practitioners who have been able to integrate their work in real contemporary.

The conference linked to the exhibition "Palazzo Te at the mirror" underlined many aspects of the problem with a multidisciplinary vision, from the project, to the history, restoration, techniques of representation. From Italy and abroad were called specialists who have shown their contribution theoretical and applied, trying to open a window on the possible scenarios that we face: Federico Bucci, Andrea Bruno, Sergio Crotti and the author of this paper of the Politecnico di Milano, Francesco Benelli and Mark Rakatansky of the Columbia University, Marco Gaiani of the Università degli Studi di Bologna, Mario Carpo of the Yale University. The event was deliberately open to external partnerships - Cultural District “Le Regge Gonzaga” and the International Center of Art and Culture of Palazzo Te - in the spirit of sharing our work with civil society and the now unavoidable need to return to the comparison among different economic and cultural operators of the heritage. The architectural survey of Palazzo Te becomes a pretext to rethink the enhancement of architectural heritage, a kind of spotlight on a sector severely plagued by problems in funds raising for the restoration and maintenance. It should, however, change perspective and start to see newly a monument first as a building, as architecture, and only later as precious relics to be preserved. In this sense, it is urgent to return to have a design vision.

E.N. Rogers writes: *“Conservare e costruire sono momenti di un medesimo atto di coscienza, poiché l’uno e l’altro sono sottoposti a un medesimo metodo: conservare non ha senso se non è inteso come attualizzazione del passato e costruire non ha senso se non è inteso come continuazione del processo storico: si tratta di chiarire in noi il senso della storia. Conservare e costruire sono atti creativi”*[11].

That is the reason why introducing the exhibition "Palazzo Te in the mirror" at the Fruttiere of Palazzo Te we used the metaphor of Oscar Wilde's “The Picture of Dorian Gray”. In the text, the Irish great writer denounced the double face of beauty: the eternal youth at the price of the corruption of the soul. And now the risk of the architectural heritage is the same: the preservation of the monument at the cost of its marketing. In the exhibition were presented some works of contemporary architects about buildings belonging to our memory, from many people considered inviolable. Some of them are excessive, more subdued, few are reasonable, and maybe it is not the author the best judge. But the significance of this open door is to believe that "now" is as important as "yesterday", in a continuity of preservation of the values, forms and symbols in transformation. Giulio Romano and Palazzo Te are our pretext, are the ancestor and the product of the work of genius, that yesterday as nowdays feed the consciousness of sensitive men, that in every age are looking for a reason and a justification for their existence. And these reasons live in a continual pursuit of the recovery of what we were in the novelty of contemporary life, in the vital contradiction of styles and theoretical models, in the hybrid synthesis of cohabitation, beyond the preconceptions that make dull our crystal ball.

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[8] Ibidem, p. 340
[9] Ibidem, p. 177
[10] Ibidem, p. 14
[11] E. Rogers, *IV Congresso INU*, Lucca 1957

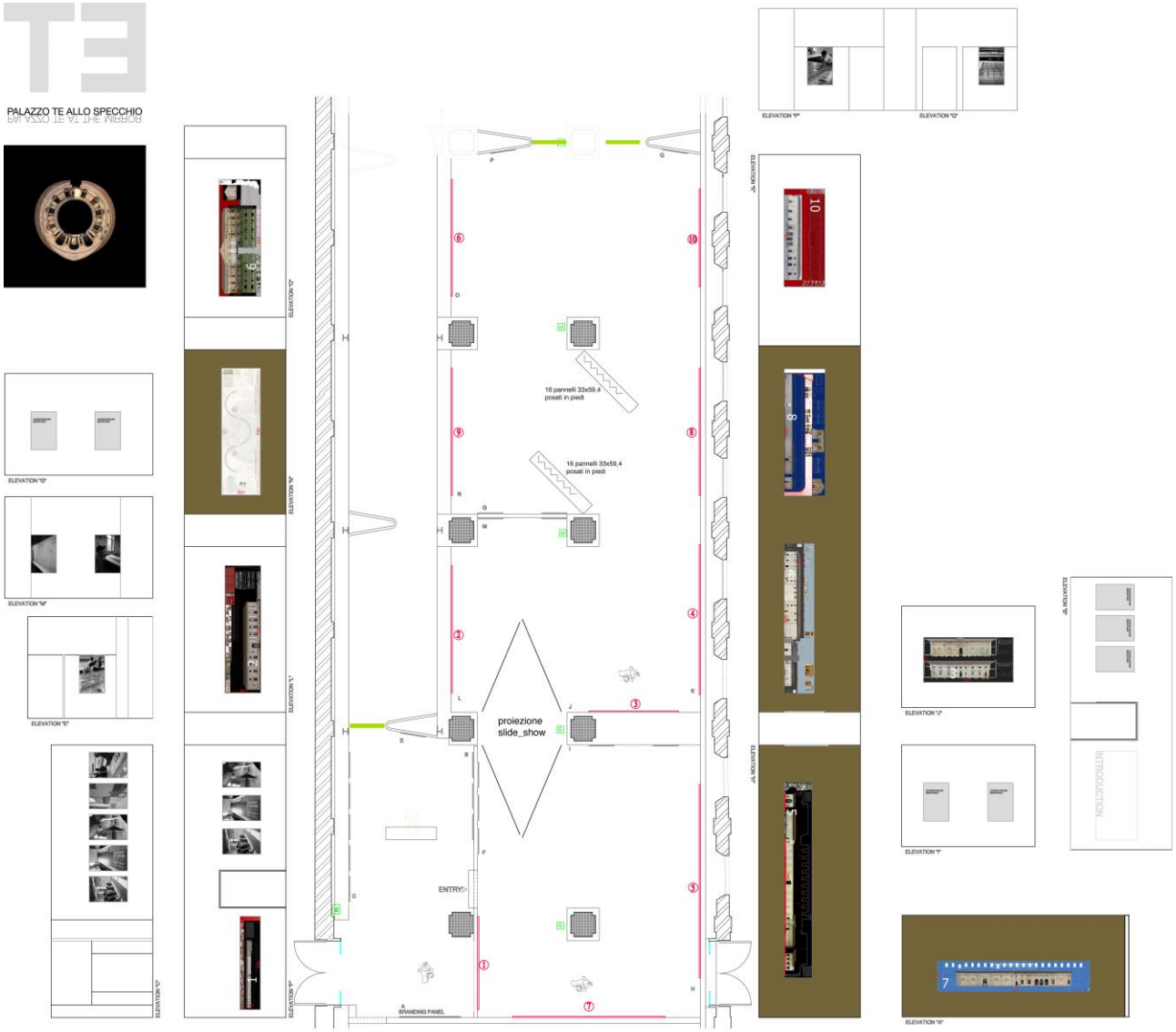

Fig. 1: Exhibition design by Abad Architetti from Milano

Politecnico di Milano
Polo Territoriale di Mantova

Pro-Rettore
Federico Bucci
Responsabile operativo
Francesca Ferrari

Scuola di Architettura e Società -
Dipartimento DAStU
Laboratorio di Rilievo e progetto città di Mantova / *Laboratory of Architectural survey and design Mantova city*
IN_OUT_ARCHITECTURE

Palazzo Te allo specchio /
Palazzo Te at the mirror
Quale futuro per i beni architettonici? /
What future for the architectural heritage?
Progettare tra fotografia_digitale_rilievo
per la valorizzazione del patrimonio /
Designing among photography_digital_survey for the enhancement of heritage

Mostra alle Fruttiere di Palazzo Te
dal 13 Gennaio al 10 Febbraio 2013

Inaugurazione presso la sala Polivalente di Palazzo Te il 12 Gennaio 2013 alle ore 17

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- Centro Internazionale d'Arte e di Cultura di Palazzo Te (www.palazzote.it)

Mostra a cura di
- Alessandro Bianchi - Politecnico di Milano Coordinamento
- Massimiliano Zigoi - Politecnico di Milano Progetto grafico
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Promotori /Promoter

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Fig. 2: Colophon of the exhibition with logos of the main sponsor



Fig. 3: Speakers at the opening of the exhibition. From left: Massimiliano Zigoi, Alessandro Bianchi, Angelo Crespi, Nicola Sodano e Elena Aiello.


Fig. 4: Alessandro Bianchi is presenting the exhibition during the opening ceremony (first hall)



Fig. 5: Visitors at the exhibition (second hall)



Fig. 6: Speakers and politicians at the conference. From left: Andrea Bruno, Sergio Crotti, Francesco Benelli, Mark Rakatansky, Irma Pagliari, Marco Tonelli.



Fig. 7: Palazzo Te at the mirror (third hall)

Bibliographical references

[1] BAUDRILLARD, JEAN 1978
Baudrillard, J., *Le Système des objets*, Gallimard, Paris 1978.
[2] BRUNETTA, GIAN PIERO 1993
Brunetta, G. P., *Storia del cinema italiano - volume quarto*, Editori Riuniti, Roma 1993.
[3] GHIRRI, LUIGI 1989
Ghirri, L., *Paesaggio italiano / Italian landscape, Quaderni di Lotus*, Electa, Milano 1989.
[4] GHIRRI, LUIGI 2010
Ghirri, L., *Lezioni di fotografia*, Quodlibet, Macerata 2010.
[5] LA ROCCA, GUIDO 1978
La Rocca, G. (a cura di), *Baldassarre Castiglione, Le lettere*, Mondadori, Milano 1978.
[6] LETAROUILLY, PAUL MARIE 1997
Letarouilly, P. M., *Edifices De Rome Moderne*, Princeton Architectural Press, Reprint, Princeton 1997.
[7] MONGE, GASPARD 1799
Monge, G., *Geometrie descriptive*, riproduzione facs. dell'edizione: Paris, Baudouin, A. VII 1799.
[8] PAÏNI, DOMINIQUE 2013
Païni, D., *Lo sguardo di Michelangelo. Antonioni e le arti*, Ferrara Arte, Ferrara 2013.
[9] ROGERS, ERNESTO NATHANS 1958
Rogers, N. R., *Esperienza dell'architettura*, Einaudi, Torino 1958.
[10] TAFURI, MANFREDO 1980
Tafuri, M., *La sfera e il labirinto*, Einaudi, Torino 1980.
[11] WITTKOWER, RUDOLF 1952
Wittkower, R., *Architectural Principles in the Age of Humanism*, Alec Tiranti LTD, London 1952.

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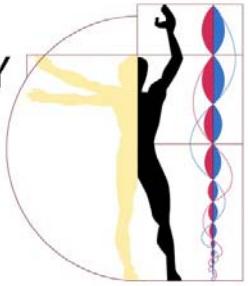

Influences of building techniques on the annual primary energy requirement of buildings in Frignano (Italy)

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Abstract
This work shows how the energy performance of buildings have changed with the change of technological design criteria over the century. In particular, in Frignano, a little city around Caserta, has been calculated the annual primary energy requirement of 10 buildings (one for each decade of the century). These buildings, with the same orientation and volume, differ only for building techniques and functional distribution. The comparison of the results obtained shows that the Annual Primary Energy Requirement at the beginning of the century - buildings designed with traditional design criteria - is smaller and grows between second and third decade to a value comparable to the Annual Primary Energy Requirement obtained at the end of the century - buildings designed with the first diffuse applications of modern technologies of thermal insulation.

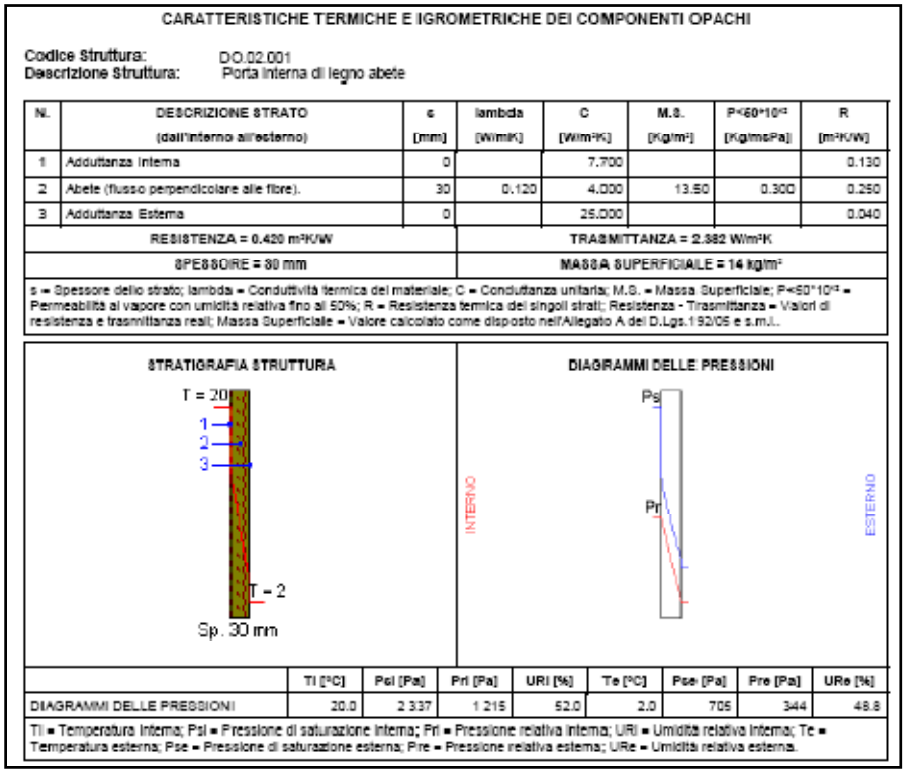
Keywords: energy conservation approaches, annual primary energy requirement, vernacular architecture, building technologies

Introduction
Vernacular buildings are the structures built by people using locally available material and affordable technology to meet the daily local needs [1, 2]. The design of vernacular buildings is the outcome of the traditional knowledge based on trial and error approach [2]. Normally people thinks that this type of architecture addresses the local climate constraints and shows maximum adaptability and flexibility, the uniqueness to these vernacular architectures is often used as a symbol to represent a particular community or cultural setup [3]. Bioclimatism integrates the micro-climate and architecture to human thermal comfort conditions [1,4]. Recent studies on vernacular buildings conclude that bioclimatism is an integral part of vernacular architecture and a deciding parameter towards achieving sustainability of modern architecture [3,5,6,7]. About 30–40% of total energy consumption in western countries is assigned to building [8,9]. It is need a climate-responsive building design to reduce this continuous increasing energy demand. In recent years number of studies have been carried out on climate oriented building design to enhance thermal comfort conditions in living space and at the same time to reduce both the embodied and operational energy consumption [3]. But the results reported in these studies often deviate from the actual scenario [10–12]. This discrepancy arises because most of the available thermal comfort standards are suited for air-conditioned buildings [13]. The situation leads ton great difficulty in estimating the thermal performance of vernacular buildings due to lack of adequate field experiments and long-term data collection[14]. It is evident that the thermal performance of vernacular buildings depends also from the materials and from the technologies used [15]. In fact new approaches to energy efficient design are not only moving in the direction of lower and lower U-values to achieve lower energy consumption, but also the development and use of natural and local building materials [16]. By using natural building materials in structures, human health can also be positively influenced [17]. Traditional natural building materials regulate internal air humidity well and their characteristic odor acts on the human psyche beneficially [18, 19]. This two different aspects of problem are often confused and so this induces to think that energy performance of traditional buildings has always been better than that of contemporary buildings. Really there are not many studies on this aspect of problem. In this work it are compared the winter Annual Primary Energy Requirement (Italian acronym FAEP) of ten buildings built during the Twentieth Century (one for decade) The buildings, with similar geometrical features and with the same indoor and outdoor environmental parameters, are chosen because they represent

building technologies of their decade. This work is hereinafter and deepening of previous works that studied the same issue in Marcianise and Frattaminore [20,21].

Materials and methods

The numerical simulation, as mentioned, is conducted on ten buildings built during the Twentieth Century (one for decade). The buildings, with similar geometrical features and with similar indoor and outdoor environmental parameters (orientation, volume/surface ratio - V/S, shading, exposure to wind, sunshine, etc.), are chosen because they represent building technologies of their decade. The simulation is developed in the hypothesis that all buildings have the same installation system. At first one it was need to single out the technological characteristic of different decades in Frignano. In this phase of work, the technological solution described in literature [22-38] was compared with the constructive solutions adopted in ten different buildings built in every decade in Frignano.



CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI

Codice Struttura: DO.02.001
Descrizione Struttura: Porta interna di legno abete

N.	DESCRIZIONE STRATO (dall'interno all'esterno)	s [mm]	lambda [W/m°K]	C [W/m²K]	M.S. [Kg/m²]	P<60*10^-12 [Kg/mPa]	R [m²K/W]
1	Adduttanza Interna	0		7.700			0.130
2	Abete (flusso perpendicolare alle fibre).	30	0.120	4.000	13.50	0.300	0.250
3	Adduttanza Esterna	0		25.000			0.040
RESISTENZA = 0.420 m²K/W				TRASMITTANZA = 2.382 W/m²K			
SPESSORE = 30 mm				MASSA SUPERFICIALE = 14 kg/m²			

s = Spessore dello strato; lambda = Conduttività termica del materiale; C = Conduttanza unitaria; M.S. = Massa Superficiale; P<60*10^-12 = Permeabilità al vapore con umidità relativa fino al 50%; R = Resistenza termica dei singoli strati; Resistenza - Trasmittanza = Valori di resistenza e trasmittanza reali; Massa Superficiale = Valore calcolato come disposto nell'Allegato A del D.Lgs.192/05 e s.m.i..

STRATIGRAFIA STRUTTURA

DIAGRAMMI DELLE PRESSIONI

	TI [°C]	Psi [Pa]	Pri [Pa]	URI [%]	Te [°C]	Pse [Pa]	Pre [Pa]	URe [%]
DIAGRAMMI DELLE PRESSIONI	20.0	2 337	1 215	52.0	2.0	705	344	48.8

TI = Temperatura interna; Psi = Pressione di saturazione interna; Pri = Pressione relativa interna; URI = Umidità relativa interna; Te = Temperatura esterna; Pse = Pressione di saturazione esterna; Pre = Pressione relativa esterna; URe = Umidità relativa esterna.

***Fig. 1**: File of calculated thermal characteristics of internal door used in Frignano in second half of XX Century*

This work is need to understand as the different locally available materials and affordable technology meet the daily local needs joins in the national workmanlike. At the end for every decade, is defined, for every technological unit of the building envelope, the local features and is defined, for everyone, the thermal features to use in the numerical simulation. . For example the internal doors in second half of Century were built with spruce wood that replaced the traditional chestnut more expensive and more difficult to work. S
The results, showed in fig 1, were used in the calculation of FAEP of buildings of these decades. The same procedure were replicated for everyone of technological units of envelope of every building of every decade. The degrees-day of town is 1101, determined in according to the Italian Law n. 412 of 26 August 1993, consequentiality the climate zone is "C". The V/S ratio is 0.92 and so, according to the Ministerial Order 11 March 2008, the value of FAEP limit, in Italy from 01 January 2010, is 50,60 kWh/m^{2}year. The value of FAEP is calculated with a commercial software developed in the respect of Italian technical standards (TerMus® by ACCA® software).

Results and discussion

The results of calculation of FAEP is showed in table 1 and in fig. 2. In the same table is showed the mean value of crude oil price in every decade of Century.
As first result, the value of FAEP is constantly bigger of value of FAEP limit during all the Century and it is also distant from FAEP limit value fixed by Italian standard. This is interesting because certainly explodes the common idea that an old building is automatically green building. It remembers that the values are calculated with reference to winter environmental conditions. A second observation is referred to one of the most

prominent traits of the world during the 20th century: the drastic growth of use of new technologies also in building sector.

Decade	1900-1909	1910-1919	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999
FAEP [kWh/m^{2}year]	106	109	148	168	175	190	187	175	165	155
FAEP limit (from 01.01.2010) [kWh/m^{2}year]	50.60	50.60	50.60	50.60	50.60	50.60	50.60	50.60	50.60	50.60
Crude oil mean price [$/barrel]	0.83	1.15	1.60	1.87	2.33	2.92	3.02	10.44	25.11	25.77

Table 1: *Calculated value of FAEP compared with calculated FAEP limit and crude oil mean price*

The use in architecture of new technologies and atopic typologies starts in the third decade of Twenty Century with the born of Modernism. Example guide of this attitude is Villa Savoye that was not designed for a particular environmental condition since the relationship with the site is only a factor of secondary importance; this because, as told Le Corbusier, the Villa can be transported everywhere, even in Argentine countryside, having twenty Villa Savoye with a simple system of streets, without diminishing the quality of buildings. The Villa is considered, therefore, the prototype of the dwelling unit standards composed of elements based on standard solutions acquired by experience and practice. Villa Savoye is "a machine for living", designed in an abstract space and placed in a real environment without real connection with it.

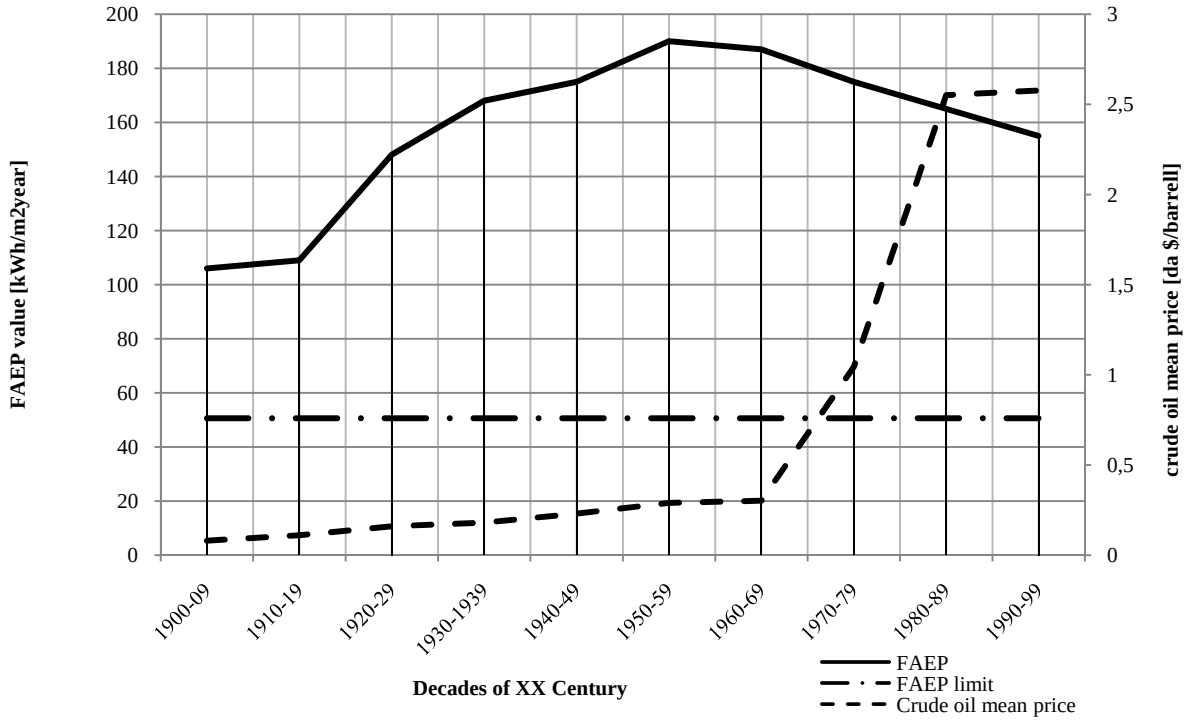


Fig 2: *Graphic representation of data in table1*

So the change of attitude, with the neglect of traditional knowledge and with enormous diffusion of installation for comfort, has diverted the attention from the thermal behavior of building and has caused an increase of FAEP as seen in fig. 2. This attitude has increased the consumption of carbon combustible, also

thanks an enormous availability of low cost energy and new materials. This until to Seventies Years, in fact this process have an abrupt stop after the 1973 oil crisis.
So the FAEP, during the last three decades of Twenty Century, is reduced in corresponding of great increase of crude oil mean price as seen in fig 2. The graphics in figure 2 show that the decrease of FAEP is not rapid as the increase of oil price because, on a hand, the original principles of Modernist culture, very widespread in the Schools of Architecture, prevents the architect from designing as traditional knowledge and, on other, the inertia of building industry and of building market slows down the understanding and the reception of phenomenon.

Conclusions

The comparison of the results obtained shows that the Annual Primary Energy Requirement at the beginning of the century - buildings designed with traditional design criteria - is smaller and grow between second and third decade to a value comparable to the Annual Primary Energy Requirement obtained at the end of the century - buildings designed with the first diffuse applications of modern technologies of thermal insulation. This results are in accordance with the results of previous research conducted in the municipalities of Marcianise and Frattaminore. So it is possible to affirm that the traditional technologies and the traditional design criteria, applied until the second decade of XX Century in architecture, guarantee a less value of FAEP compared to Modernist design criteria that neglect traditional knowledge and use enormous number of installation for comfort. Obviously only the use of modern insulations and of renewable energy combined with the traditional design criteria will get the value of the limit FAEP. The future aimed is to repeat the experiment in other towns in order to confirm the results presented in this work.

Bibliographical References

[1] Singh MK, Mahapatra S, Atreya SK. Bioclimatism and Vernacular Architecture of North-East India. Build Environ 2009;44(5):878–88.

[2] Singh MK, Mahapatra S, Atreya SK..Thermal performance study and evaluation of comfort temperatures in vernacular buildings of North-East India, Build Environ 2010;45(1):320–329

[3] Plemenka S. Vernacular architecture: a lesson of the past for the future. Energy Build 1982;5(1):43–54.

[4] Gaitani N, Mihalakakou G, Santamouris M. On the use of bioclimatic architecture principles in order to improve thermal comfort conditions in outdoor spaces. Build Environ 2007;42(1):317–24.

[5] Singh MK, Mahapatra S, Atreya SK. Development of bio-climatic zones in north east India. Energy Build 2007;39(12):1250–7.

[6] Cardinale, N, Rospi G, Stefanizzi P, Energy and microclimatic performance of Mediterranean vernacular buildings: The Sassi district of Matera and the Trulli district of Alberobello, Building and Environment, Vol 59, 2013, p. 590−598

[7] Hermawan J,PriantobE., Setyowati E, The Difference of Thermal Performance between Houses with Wooden Walls and Exposed Brick Walls in Tropical Coasts, Procedia Environmental Sciences, Vol 23, 2015, p. 168−174

[8] Synnefa A, Santamouris M, Akbari H. Estimating the effect of using cool coatings on energy loads and thermal comfort in residential buildings in various climatic conditions. Energy Build 2007;39(11):1167–74.

[9] Pulselli RM, Simoncini E, Marchettini N. Energy and emergy based cost–benefit evaluation of building envelopes relative to geographical location and climate. Building and Environment 44 (2009) 920–928

[10] Nicol JF, Humphreys MA. Adaptive thermal comfort and sustainable thermal standards for buildings. Energy Build 2002;34(6):563–72.

[11] Borong L, Gang T, Peng W, Ling S, Yingxin Z, Guangkui Z. Study on the thermal performance of the Chinese traditional vernacular dwellings in summer. Energy Build 2004;36(1):73–9.

[12] Nicol JF, Humphreys MA. Maximum temperature in European office buildings to avoid heat discomfort. Sol Energy 2007;81(3):295–304.

[13] Mahdavi A, Kumar S. Implications of indoor climate control for comfort, energy and environment. Energy Build 1996;24(3):167–77.

[14] Fountain M, Brager G, de Dear RJ. Expectations of indoor climate control. Energy Build 1996;24(3):179–82.328 M.K. Singh et al. / Building and Environment 45 (2010) 320–329

[15] Orehounig K, Mahdavi A, Energy performance of traditional bath buildings. Energy and Buildings 43 (2011) 2442–2448

[16] Korjenica A, Petránekb V, Zachb J, Hroudováb J, Development and performance evaluation of natural thermal-insulation materials composed of renewable resources Energy and Buildings 43 (2011) 2518–2523

[17] Torring T, in Proceedings for the International Symposium of Integrated Life-Cycle Design of Materials and Structures, May 22-24, Helsinki, Finland, 2000, pp. 522–526.

[18] Chybik J, Natural Building materials, Grada Publishing, 2009, ISBN 978-80-247-2532-1.

[19] D'Orazio M, Di Perna C, Di Giuseppe E, The effects of roof covering on the thermal performance of highly insulated roofs in Mediterranean climates, Energy and Buildings 42 (2010) 1619–1627

[20] Mollo L, Influences of Building Techniques on the Annual Primary Energy Requirement of Buildings in Marcianise (Italy). In: (a cura di): Oktay Ural Muhammed Şahin Derin Ural, Vision for a future of housing: MEGA CITIES. p. 927-931, Istanbul (Turkey), 2012, ISBN: 9789755614182

[21] Mollo L, Influences of building techniques on the A.P.E. requirement in Frattaminore. In: (a cura di): Ural O., Pizzi E. Croce S. , Changing needs adaptive buildings, smart cities. vol. 2, p. 129-134, Poliscript, Milano, 2013, ISBN: 9788864930206

[22] Ragucci R, Principi di Pratica di Architettura e Dizionario di Vocaboli Tecnici, Napoli 1834

[23] Formenti C, La pratica del fabbricare, Milano, 1893

[24] Misuraca G, Boldi MA, L'arte moderna del fabbricare, Milano, 1900

[25] Breymann G, Trattato generale di costruzioni civili, Milano, 1925.

[26] Guerra C., Architettura Tecnica , Napoli, 1938

[27] Di Stefano R, Edilizia, elementi costruttivi e norme tecniche, Napoli, 1967

[28] Mandolesi E., Edilizia, vol. I, II, III, IV, Torino, 1978 ÷ 1991

[29] Tagliaventi I, L'organismo architettonico, Bologna, 1988

[30] Aveta A, Materiali e tecniche tradizionali nel napoletano, Napoli, 1990

[31] Manuale del recupero delle antiche tecniche costruttive napoletane, Napoli, 1993

[32] Proceedings for the International Symposium on Ancient buildings restoration, handbooks and new technologies, Napoli, 1993

[33] Proceedings for the International Symposium on Building architecture: materials, components, technique, Napoli, 2001

[34] Bucci, A, MOLLO L., Regional Architecture in the Mediterranean Area, Alinea Editrice, ISBN: 978-88-6055-293-8, Firenze, 2010

[35] Proceedings of IX Forum Internazionale di Studi "Le Vie dei Mercanti: SAVE Heritage-Safeguard of Architectural, Visual, Environmental Heritage", Capri, 2011

[36] De Joanna P, Francese D, Passaro A (edited by) , Sustainable Mediterranean Construction. vol. unico, FrancoAngeli, Milano, 2012,

[37] Gambardella C. (editor), Heritage Architecture Landsign - Focus on Conservation Regeneretion Innovation - Le vie dei Mercanti - XI Forum Internazionale di Studi. vol. unico, La scuola di Pitagora editrice, Napoli, 2013

[38] Gambardella C.(editor), Best practices in heritage conservation and management. From the World to Pompeii., La Scuola di Pitagora, Napoli, 2014,

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The sentry of Castellino Tanaro (1): the structural recovery of an ancient medieval tower

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Abstract

They intend to introduces in this occasion the project of refunctionalization and the phases of yard that have characterized the structural recovery of the medieval tower of Castellino Tanaro in the Provinces of Cuneo. The good architectural object of study, datable to the XIII century, he has suffered notable damages above all caused by the abandonment and by the carelessness of the hand that they have made hit fall into is deprecabile of maintenance. The project, that has involved numerous disciplines from the statics to the applied chemistry, is founded on to careful project of knowledge that has allowed the suit restauration of the structure waiting for one further functional recovery of his.

Keywords: conservation, restoration

The historical context of the Marchesato of Ceva

On the base of a careful analysis you/he/she can be ascertained as in all the parts of the feudal Piedmont numerous traces of that that were the complex of the strategic defense of the principal dominions but you/he/she must be underlined as the Marchesato of Ceva withstands you represent a case to if. The capital, in fact, was situated in the center of the confluence of the river Tanaro with the Cevetta, sets to the center of a tangle of narrow, brief and steep valleys. Gives the unhappy geographical situation of the capital it is born the necessity of a system of rapid communications with the dependent earths that it realizes him through the building of towers of sighting finalized to the overcoming of the peculiar difficulties of the zone. Particularly you/they are also erected some real strong plazas with the presence of bodies of watch and attached structures to the towers of notable consistence with the purpose to be able to lodge garrisons that, in some cases, they were decidedly consistent.

And' this the case of the tower of Castellino Tanaro and his/her architectural complex currently almost entirely gone lost. In any part of the Piedmont, in fact, they find in so great number, neither so tall, isolated on the necks with the alone value of observatory for their vast visual ray, for the most deprived of every strengthened system. The fact that the multiplicity of the towers coincides with the confinements of the marchesato and that at each of them could be looked and to be looked at door to hypothesize that their whole responds to the purpose of rapidses descriptive communications, more than to functions of defense or toll.

The castles and the towers, also the fairest or interesting turisticamente, as works of art were not born therefore, but as realizations of military engineering and they became after sometime so much more important as more with their presence they made the control of a road sure, of a street, of a footstep, of a bridge or however the communications made among the different points of observation possible.

The necks set on the right of the Tanaro appear us similar to a great amphitheater whose countries generally gather him around churches, castles or towers; we notice so Cigliè, Roccacigliè, Castellino and Marsaglia, Murazzano and Mombarcaro and less visible Rooms and Montezemolo.

Exactly for the unhappy position of Ceva the Marquises had erected a strengthened complex, still existing, dominated from a tower from which it was possible to enjoy of an ample sight. We are able, therefore, easily to imagine the bright messages, of you smoke and other signals in zones characterized by crystalline air that allowed the maximum one some visibility. Also today from Ceva you/he/she could be communicated with the towers of Castelnuovo, Montezemolo, Salt, Murazzano,

Castellino, Marsaglia, Cigliè. Many of these countries still possess intact beautiful towers, among which for morphology, height, position they distinguish him those of Castellino, Murazzano, Castelnuovo, Scagnello and Battifollo. Of others as that of Mombarcaro, of Marsaglia, of St. Michael, they don't remain but stumps, others as those of Lesegno, of Viola, of Bastia is been turned to use bell tower, others finally turned into elements ampler fortifications as the tower of the castle of Bagnasco, of Malpotremo, of Priola and of Priero. The study of the ray of visual efficiency of the a lot of quoted places it induces to observe as the complex of the towers and the proper points for the signaling of the marchesato of Ceva it converged toward the point of great importance, that is same Ceva, while all the remainders points constituted a system of connection. These centers of connection were essentially formed from the towers of Castellino, of Scagnello, of Mombasiglio, with possibility of communication also with the places out of the marchesato what for instance the towers of Mondovì and Murazzano or with the Castle of Nucetto for the Valley Tanaro or with Montezemolo for the Valley Bormida.
Beginning from the XV century the smaller Dominions are absorbed from those great, from this it derives further an improvement of the system of the communications to a change of you support him strategic. From this moment the towers become therefore useless, you/they are left often in abandonment or as material are sometimes used for the formation of new constructions.
In this context it results of big interest the safeguard of the memory of this ancient system of communications inside our valleys, and in this optics the facing project the recovery of the Tower Medioevale of Castellino Tanaro is placed. The works of fortification and sighting Towers and castles, footsteps and roads: a territory for a long time of border between Piedmont and Liguria, between France and Italy, among lowland and Appennino as that of the tall Val Tanaro, Mongia and Cevetta it now finds in his/her intact fortifications, now redoubts to the state of ruin a strong element of identity, also if in the continuity with the adjoining areas similarly interested by the development of the defensive structures and sighting.
The vast area between Piedmont and Liguria, among lowland and Appennino that he/she understands big way the territory of the Langhes, of the tall Monferrato of the Cebano it is in fact one of the more densely castellate of Italy.
Still they remain over 220 among castles, casseforti and towers and of numerous other buildings of the kind sure news it is had by historical documents; the term has also entered bossily the toponomastica, with the various Castle of I err, Scaffold of it bereaves, Castellazzo Bormida, Castelnuovo of Ceva, Castelnuovo Bormida, Castelnuovo Belbo, Castelnuovo Calcea, Scaffold Molina, Castel Rocchero, Castelboglione, Castiglione Tinella, Fortress Mondovì, Roccavignale, Rocchetta Cairo, Rocchetta Cengio, Rocchetta of Spigno, Rocchetta Belbo, Roccaverano, Tower Mondovì, Castellino Tanaro, Scaffold Uzzone, Tower Uzzone, Violet Castle and as listing, without variedly forgetting all the farmhouses or the allusive estates in their name to owners castellani (Castellaro, of the Castle etc.). In the majority of the cases it deals with towers or castles built in a weary of inclusive time among the XI and the XIV century, with some trace of anterior fortifications and few examples of main villas castellate, among which you/they detach the Castle of Lesegno and that of Montezemolo, while entirely anomalous with structure to half between the cenobio and the residence of hunting, it is the castle of Shelter that deserves a contemplated analysis and it specifies.
Apart this exception however if there are Renaissance or Baroque structures that complete the native fortifications, these are almost always the result of the transformation of preceding castles, of the passage of the castle from the function merely defensive to a residential function, when not of vacation.
Every country of the community Montana Tall Val Tanaro, Mongia and Cevetta it possesses a tower or a rest of small fortress, so much to be been able to easily imagine the importance of runs today become entirely secondary in comparison to the ordinary roads. Nevertheless the structures are how much never different and introduces an interesting section of constructive typologies, of building techniques and also of aesthetical results, factor this of scarce importance during the construction, but how much never important today if read in an optics of tourist fruition of the territory.
Just this is one of the principal problems to resolve: unlike the big part of he/she asked her, of the sanctuaries, of the oratories and of some castles, the building fortifications and the towers generally pour in a state of semiabbandono when they are not precarious straight, inaccessible or invaded by the vegetation. Before speaking of a possible cultural and tourist fruition aldilà of the obvious function of important element of the natural landscape, it needs therefore to generally handle ample and expensive but necessary restaurations to avoid collapses or dangers. It needs then to think about the possibility of the towers to make also accessible in the inside spaces, at least for all those that introduce a discreet state of maintenance and to be able to cross for all of their height the inside perimeter. On the summit after a didactic and cultural run it would be interesting to have a series of indications that allows the visitor to frame the tower in the surrounding landscape, recognizing her other fortifications and the other inhabited centers and to understand so the defensive role taken place in the past centuries. The inside of some of them could be exploited on the occasion of shows of ancient utensils farmers, while to the outside annual demonstrations of great tourist call you/he/she

could be hypothesized, as for instance the nighttime lighting of the indicative fires on the summit to visually show the runs and the formalities of diffusion of the news and the information in age medioevale.
Unfortunately the situation is how much never criticism, for which a lot of times would be already an important footstep before the simple laying in work of the system of signs that the presence of the tower points out, with the date or the period of constructions and the signaling of possible architectural merits or historical news, on the example than you/he/she has been done, for instance, to Castelnuovo of Ceva, one of the smallest Communes in the zone, that however has known to show a particular attention in the safeguard and in the promotion of his/her own artistic and architectural patrimony, symbolized from the cemetery Romanesque Parish of St. Maurice, with a splendid cycle of frescos I delay fifteenth-century and, note, from the tower medioevale. The general picture of the territory of the Tall Community Val Tanaro, Mongia and Cevetta show therefore us a notable whole strengthened structures, at least one for country, that you/they not only testify the defensive wish of the Marquises of Ceva, but also one not common cultural vivacity, artistic, economic and a strong interest for the maintenance of the communications between coastal Liguria and the hinterland. Particularly an elevated presence of towers is noticed, at times inclusive in a more complex military system, at times isolated and slender to look-out and watch of the mountains and the valleys.
The towers were the symbol that showed the importance of a noble family besides developing the more functions above remembered. The form, the height and the sturdiness of the construction were thought for defensive (the visibility, the possibility to check etc the territory.) demands but also, in certain cases, because the tower assumes a symbolic meaning a sort of value and call. The tower as real religious signal as secular bell tower, that the gentleman raises for celebrating himself and his/her own family. In the Christian tradition that has refused the Jewish conception of the chaotic tower, negative, demoniac and you/he/she has been influenced instead by the feudal military constructions, rich note of towers and males, the tower is become in fact the symbol of vigilance and ascent.

The Tower of Castellino Tanaro
If the history of the evolution tipologica of the castles must keep in mind of the rehashes intervened in relationship to the defensive system for the more determined by the historical stories of the ladylike families, the typology of the towers and the towers, typical defensive structures, reflect the most ancient history of the countries cuneesi and the loris demands to exclusively organize poles of defense, in years when the footsteps and the passes mattered vital for the place and over, to vast ray. Exemplary urbanistic position that of the towers on the ridges of the Langhes and in the valleys climb on they had ends of it precise of sighting and signalings and they were structures eminently defensive.
Particularly in Val Tanaro it detaches the exceptional tower of Castellino Tanaro stung of remarkable importance inside the system of communications used inside the Marchesato of Ceva.
This datable manufactured jewel to the XIII century, it surely distinguishes him for his/her notable dimensions: height equal to around 40 meters and circumference equal to around 25 meters.
The very regular building weaving results constituted to the outside by blocks lapidei and to the inside probably from a mixture of pietrame and tiles. The tower introduces two only openings set to different levels, the first one still today well defined it appears as a hold and tall window while the greatest second strongly results unfortunately damaged in the profile of the masonry. To crowning of the structure him note what remains of three files of hanging bows realized in bricks on shelves in stone. The manufactured article still introduces today him under good conditions from a static point of view and of the building weaving and of the same equipment even if in some points this last rather results chaotic. The greatest problems are found in correspondence of the summit of the tower. The crowning results in fact lacunoso in the different zones, so much that the last line of hanging bows almost entirely appears destroyed. The intervention of consolidation has interested the existing masonry handling to integrate where necessary the material having care to differentiate the interventions from the existing one and equalizzare the summit of the tower. Proceeds then to the realization of a flush in mortar of hydraulic mortar opportunely tilted toward the extremities with the purpose to avoid an accumulation of meteoric waters. Through the preparation of a scaffolding perimetrale has been possible progress with a careful and contemplated job of pulitura generalized with the purpose to remove the superficial deposits of any nature accumulated during the years. The zones, where the masonry coesa introduced more adequately him you are been treated with scarificatura of the joints of mortar and following integration with mortar of natural hydraulic mortar consistent with that existing with the purpose to avoid useless static efforts to the various plans of support of the weaving in you tan of stone. The all, where necessary you/he/she has been accompanied by an operation of you unstitch-sew. As it regards the present native openings, after the intervention of consolidation of the structure, the laying is followed in work of special protections (metallic nets) and other types of dissuasori, actions to avoid the intrusion of the volatile ones inside the tower. You/he/she is finally provided to an operation of general pulitura at the base of the tower eliminating the infesting vegetation. From the finished visual examination on the whole external perimeter of the architectural

manufactured article necessity has also emerged to proceed to an intervention contemplated of static consolidation of the masonries (inside and external) through contemplated operations of injection of coherent mortars to base of natural hydraulic mortar. The project of restauration and mass in safety of the building hanging and above all of the crowning in tile, frieze this of interest for his/her oneness, has expectation the canonical operations of structural consolidation of the building curtain and the mortars of allurement that introduce notable areas of crumbling and loss of consistence materica.
In the specific one the phases of workmanship are been characterized by the following interventions:
- cleaning of the whole extension of the walling in order to take each remainder away and polluting others put down on the surfaces (vegetation, musk, lichens, particellato and so on) and to favour the following phases of structural consolidation either litotipi, stone of Langa and sandstone, or bricks seen face of the part sommitale of the tower (ornament);
- scarnificazione of the joints and the fugatures of mortar is incoherent, both that mostly degraded and inconsistent with the purpose to restore the structural unitarietà of the whole masonry;
- injections of mortars consolidating with the purpose to restore the consistence materica of the mortars of allurement and, of reflex, of the whole building equipment for the general his/her thickness;
- substitution of the tiles particularly degraded with operations of you unstitch / sew;
- consolidation of the stony surfaces and bricks. Of an operation of fundamental importance is treated with the purpose to preserve the present litotipis that would go toward to sudden I degrade some superficial layers and, in the long run you/he/she could bring a further, I also degrade to the deepest layers for the sudden deterioration of these particular types of stone;
- restoration of the building hangings in proximity of the openings;
- restoration and waterproofing of the surfaces of coverage to favor the leaving of the meteoric waters.

(1) Little Municipality in Province of Cuneo along the Valley of the river Tanaro, in the south of the Piemonte, on the ancient run of connection to the sea.



Fig. 1: the town of Castellino Tanaro.



Fig. 2: view of Valle Tanaro



Fig. 3: Overview



Fig. 4: Particular (Tombstones stone)



Fig. 5: the yard



Fig. 6: particular the degradation of the stone



Fig. 7: particular the degradation of the stone.

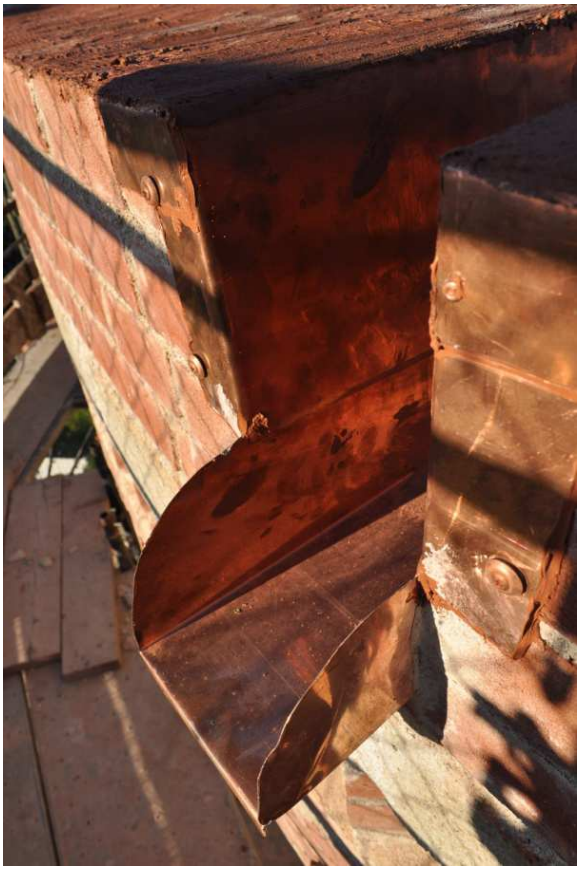
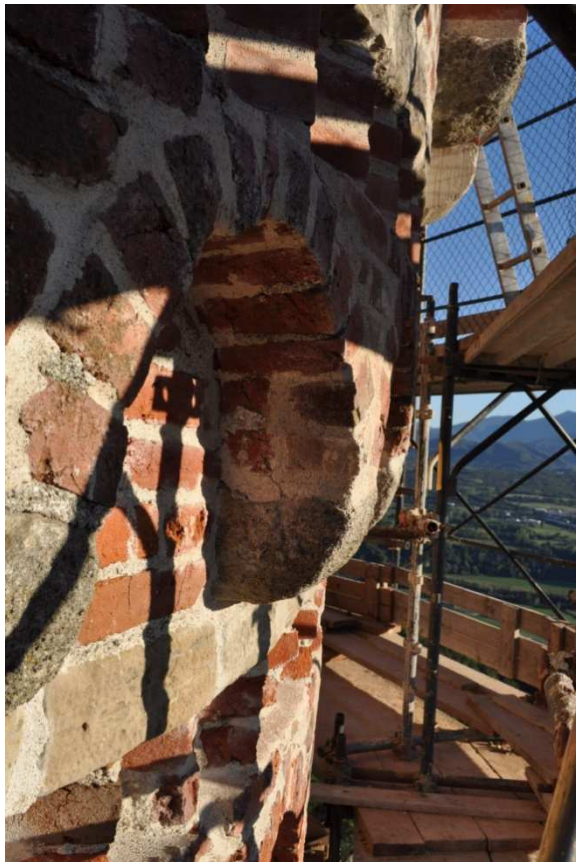


Fig. 8: details of the crowning





Figg. 9, 10: details of the crowning.





Figg. 11, 12, 13, 14: details of the crowning.









Figg. 15 e 16: internal object of future reuse.

Bibliographical References

Romeo, Cesare Renzo
Considerazioni finali sul tema della conservazione dei materiali nell'edilizia storica. Appunti di studio e riflessioni. In AA.VV, Un primo approccio all'arte e all'architettura liberty, 1ª ed. Savigliano (CN): L'Artistica Editrice, 2012, p. 225-271.

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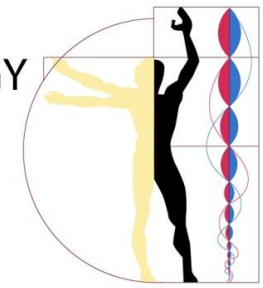

Environmental monitoring of electromagnetic fields of urban territory of Samara region of Russia

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Abstract
Electromagnetic fields of different frequency range may cause significant negative impact both to environment and the health of population. Problems of monitoring of electromagnetic fields of urban territories are discussed. Approaches and criteria of estimation of electromagnetic fields negative impact are considered.
Results of environmental monitoring of electromagnetic fields on living territory of Samara region are considered. Electromagnetic fields maps of territory of Samara region have been developed. It is shown that there are exists some zones of living territory with increased impact of electromagnetic fields.
Suggestions of reduction of electromagnetic fields negative impact in conditions of Samara region have been proposed.

Keywords: Electromagnetic fields, impact, monitoring, mapping

1. Introduction

There are many sources of electromagnetic fields in conditions of urban territories which may cause the negative impact to environment and to inhabitants [1-8]. The negative effect of impact of electromagnetic radiation to the humans depends upon the power and the frequency of the radiation. For low-frequency radiation (radio waves to visible light) the best-understood effects are those due to radiation power alone, acting through the effect of simple heating when the radiation is absorbed by the cell. For these thermal effects, the frequency of the radiation is important only as it affects radiation penetration into the organism (for example microwaves penetrate better than infrared). Initially, it was believed that low frequency fields that were too weak to cause significant heating could not possibly have any biological effect.
Electromagnetic fields of different frequencies may cause negative impact not only to the man's health, but also to animals and plants.
To be able to take the required measures for electromagnetic fields reduction it is necessary to carry out monitoring.
This paper is devoted to study and to development of environmental monitoring of electromagnetic fields on the example of living territory of Samara region of Russia.

2. Main sources, problems and approaches to ecological monitoring of electromagnetic fields of urban territories

Electromagnetic fields of ecological monitoring usually are natural, anthropogenic or natural-anthropogenic. It is important that ecological monitoring of electromagnetic fields should be not only passive statement of facts, but also modeling and forecasting.
Among of the main principles of ecological monitoring of electromagnetic fields it is possible to emphasize the following [2, 3]:
- Identification of sources of electromagnetic fields of urban territories and of degree of it potential ecological danger;

- The most dangerous zones of urban territories from the point of impact of electromagnetic fields;
- Measurements of electromagnetic fields in conditions of urban territories;
- Processing of experimental data, issue of conclusions;
- Mathematic and calculative modeling of propagation and estimation of electromagnetic fields in conditions of urban territories;
- Development of electromagnetic fields mapping in conditions of urban territories;
- Development of measures of reduction of electromagnetic fields in the most dangerous zones of urban territories.

In dependence of place and conditions of impact of electromagnetic fields four main kinds of electromagnetic fields radiation are classified: professional, non- professional, domestic radiation and radiation for medical purposes - general and local.

Main sources of electromagnetic fields of urban territories may be the following: electric power lines, domestic electrical nets and electrical devices, contact nets of electrical transport, surfaces with electrostatic charge, radio transmitting devices, means of personal radio transmission, microwaves etc.

In conditions of towns the most significant danger may be caused by impact of external sources of electromagnetic fields: high voltage power lines, radio- and TV stations, means of radio transmission, scanning antennas, open distribution devices, different energetic devises and units.

Analysis of the most intensive sources of electromagnetic fields in conditions of samara region is showing that the most significant danger is from electric power lines, radio transmission devices, antennas, devices of TV communication.

The most intensive electromagnetic radiation of industrial frequency is generated by electric power lines near Zhigulevskaya hydro power station and abutting territories of city district Zhigulevsk and of Komsomolsky district of Togliatti city. It should be noted that level of electromagnetic radiation is not stable in time and depends on the load of electrical nets which cause seasons and even day variations.

Problem of negative influence of electromagnetic radiation in conditions of Samara region is amplified by the fact that a number of zones of living territory are situated extremely close to the sources of electromagnetic fields.

3. Equipment, methods and approaches to monitoring of electromagnetic fields of urban territories (Russian experience)

In Russia for measurement of electromagnetic fields of industrial frequency electrical part E, kV/m and magnetic part H, A/m of electromagnetic field strength) generated near to the electrical mounts of high voltage (in particular, near to the power lines) meter of strength of field of industrial frequency PZ-50 is widely used. Frequency range of meter is from 48 up 52 Hz. Range of measurement of electrical field strength is from 0,01 up 100 kV/m, magnetic field - from 0,1 up 1800 A/m. Normal operation of meter is provided during correspondence of external climate conditions to operating conditions of exploitation.

Operation of meter is based on the generation in antenna-transformer by impact of measured field of variable voltage with the same frequency and proportional to the electromagnetic field strength. Variable voltage is preliminary amplified in antenna-transformer and than is coming to the input of the readout device where it filtration, further amplification, transforming to the constant voltage and indication are occurring.

In accordance with Russian sanitary rules and norms 2.1.2.000-2000 normative value of strength of variable magnetic field of industrial frequency is 50 mkT (1 A/m ≈1,25 mkT), normative value of electrical part of strength of variable electrical field of industrial frequency is 1 kV/m.

But the values of variable magnetic field are not stable in time and depending on the number of factors (firstly form the load of electrical power nets), what is casing season and even daily variations of electromagnetic fields. Due to it professors G.E. Klenov and E.A. Svyadoshch have suggested method of estimation of distribution of intensity of variable magnetic field of industrial frequency according to which values of module of vector of strength of variable magnetic field are subdivided to the 3 main ranges:

- first range: $|H| < 0,1$ А/м – is corresponding to the values of magnetic fields coinciding with level of electromagnetic background.
- second range: $|H| < 1,0$ А/м – levels of pollution of variable magnetic fields corresponding to normative values.
- third range: $|H| > 1,0$ А/м – levels of magnetic fields with increased ecological danger.

Therefore it is reasonable to estimate the values of strength of variable magnetic field of industrial frequency also in accordance with method of Klenov-Svyadoshch.

For measurement of strength of electrical and magnetic fields and also of density of flow of energy of radio frequency range meter of strength of field compact microprocessor IPM-101M (manufacturer is scientific-industrial enterprise "Dose") in set with antennas E01 and H01.

In a set with antenna-transformer E01 meter is providing measurement in free space during the distance from conducting bodies to the point of measurement of the field not less than 0,2 m of following parameters of electromagnetic fields:

- root-meat-square value of module of vector of strength of electrical field by the method of directional reception;
- density of flow of energy of plane electromagnetic wave by recalculation of measured value of strength of electrical field into the density of flow of energy.

Frequency range of measurement: from 30 kHz up 1,2 GHz and from 2,4 up 2,5 ГГц. Range of measurement of strength of electrical fields is depending on the frequency of measured field and lies in limits from E_{MIN} up E_{MAX}, where E_{MIN} and E_{MAX} in V/m are determined by the following equations:

$$E_{MIN} = K_F \cdot 1B/M, \quad E_{MAX} = K_F \cdot 100B/M, \qquad (1)$$

where K_F – frequency coefficient of antenna-transformer E01 (is selected according to the table).

The range of measurement of density of flow of energy is in limits from Π_{MIN} up Π_{MAX}, where Π_{MIN} and Π_{MAX} in mkW/sm^2 are determined by the following equations:

$$\Pi_{MIN} = 0{,}265(E_{MIN})^2, \quad \Pi_{MAX} = 0{,}265(E_{MAX})^2, \qquad (2)$$

In a set with antenna-transformer H01 meter is providing measurement in free space during the distance from conducting bodies to the point of measurement of the field not less than 0,2 m of root-meat-square value of module of vector of strength of magnetic field by the method of directional reception.

Frequency range of measurement: from 30 кГц up 3 МГц.

Range of measurement of strength of magnetic field is depending on the frequency of measured field and is in limits from H_{MIN} up H_{MAX}, where H_{MIN} and H_{MAX} in A/m are determined using the following equations:

$$H_{MIN} = K_F \cdot 0{,}5A/м, \quad H_{MAX} = K_F \cdot 50А/м, \qquad (3)$$

It should be noted that existing methods and approaches to monitoring of physical pollutions of urban territories are having some disadvantages [4, 7]:
- Dependence of results of measurements from conditions of environment: meteorological conditions (wind, temperature, humidity, pressure), dislocation of buildings and barriers, reflection from soil and from the other surfaces etc.;
- Dependence of the distance of source of physical pollutions;
- Dependence of the final result of measurements from qualification of staff;
- Error effects of the other sources of physical pollutions;
- Significant workload of final processing of measurements results.

It is evident that long-term automated environmental monitoring allows to significantly increase the precision of measurements and the quality of electromagnetic fields measurements results processing [2, 4, 7].

4. Results of monitoring of electromagnetic fields of urban territory of Samara region of Russia

As examples of monitoring of electromagnetic fields of urban territories in Russia let us describe some results of monitoring of electromagnetic fields and of noise of the living areas of the largest cities of Samara region of Russia.

Measurements of electromagnetic fields were carried out for industrial frequency range (electrical part E, kV/m and magnetic part H, A/m of electromagnetic field strength) and for radio frequency range (electrical part E, kV/m; magnetic part H, A/m of electromagnetic field strength and density of flow of energy, mkW/sm^2).

On the territory of city district Samara more than 100 measurements of strengths of electrical and magnetic fields of industrial frequency in more than 50 points were carries out. Analysis of results of measurements of strengths of electrical field of industrial frequency on the selected territory of city district Samara shows that there no exceeding of normative requirement for all points of measurements. Maximally registered level of strength of electrical fields of industrial frequency in point of measurements №11, Sovetsky district, Vysokovoltnaya str. №10 is 0,012 kV/m, in point of measurements №6, Industrial district, living territory of micro district Solnechy-4 is 0,006 kV/m, in points of measurements №7, Industrial district, living territory of

micro district Solnechy-2; №10, Sovetsky district, Sovetskoy Armii street, houses №143; №32, Krasnoglinsky district, Krasnaya Glinka settlement, Sochinskaya street, houses №7; №35, Krasnoglinsky district, Yuzhny settlement, Secondary Yuzhnaya street, house №7 is 0,005 kV/m, what is significantly lower of maximal admissible values according to the sanitary requirements.

Analysis of results of measurements of strengths of magnetic field of industrial frequency on the selected territory of city district Samara shows that there no exceeding of normative requirement for all points of measurements. Maximally registered level of strength of magnetic fields of industrial frequency in point of measurements №11, Sovetsky district, Vysokovoltnaya str. №10 is equal to 0,395 A/m; in point of measurements №2, Kirovsky district, settlement 16 km, Dalnaya str., house №12 is equal to 0,395 A/m, what is significantly lower of maximal admissible values according to the sanitary requirements.

Also measurements of strengths of electrical and magnetic fields of radio frequency and of density of flow of energy on the territory of city district Samara were carried out. In total more than 80 measurements were carried out in more than 40 points. Analysis of results of measurements shows that there no exceeding of normative requirement for all points of measurements. Measurement of density of flow of energy в frequency in point of measurements №3, Kirovsky district, Kirov street, house №223 shows that maximal value was measured for the frequency 50 MHz and was equal to 234 nW/sm^2, what is significantly lower than maximal admissible values.

On the basis of results of measurements it is possible to conclude: there is no exceeding of normative values of strengths of electrical and magnetic fields of industrial and radio frequency range and of density of flow of energy on the territory of city district in all points of measurements.

On the living territory of Togliatti city in total more than 250 measurements of electromagnetic fields were carried out.

Results of measurements of electromagnetic fields strength industrial frequency range in the territory of Komsomolsky district are showing that the most values of electromagnetic fields strength were near to electric power lines Exceeding of sanitary norms was determined for Esenin street situated near to the Zhigulevsky hydro power station. In point of measurements №3-K, Esenin street, house N16 the value of strength of electrical field E was 3,950 kV/m (maximal normative value according to Russian sanitary norms is 1 kV/m).

For Central and Avtozavodsky districts the main problem is impact of electromagnetic fields of radio frequency range near to the TV mast / towers. Exceeding of sanitary norms were fixed for Mira street (Central district) and Sverdlov street (Avtozavodsky district).

Also on the territory of city district Togliatti measurements of electromagnetic fields strength radio frequency range and of density of flow of energy. Exceeding of normative hygienic requirements of strength of radio frequency range was observed in Avtozavodsky district, Moscowsky avenue, house N 21, where transmitting antenna is situated. On the frequency 100 MHz the value of strength of electric part of radio frequency range E is 3,23 V/m, on the frequency 200 MHz - 3,01 V/m (normative value is 3 V/m). Near to transmitting antenna there is also significant exceeding of background values of electromagnetic fields of radio frequency range.

In other points of measurements of density of flow of energy there is no any exceeding of sanitary norms requirements.

On the territory of city district Zhigulevsk in total more than 100 measurements of electromagnetic fields were carried out in more than 25 points.

Analysis of results of measurements of electromagnetic fields strength of electric part of industrial frequency range on the territory of city district Zhigulevsk is showing that exceeding of normative values is observed for the point of measurements №10, zone of dam of Zhigulevsk hydro power station (E = 1,150 kV/m), point of measurements №11, zone of dam of Zhigulevsk hydro power station (E = 1,275 kV/m), point of measurements №12, zone of dam of Zhigulevsk hydro power station (E = 1,275 kV/m).

Analysis of results of measurements of strengths of magnetic field of industrial frequency on the selected territory of city district Zhigulevsk is showing that there is no any exceeding of sanitary norms requirements in all points of measurements.

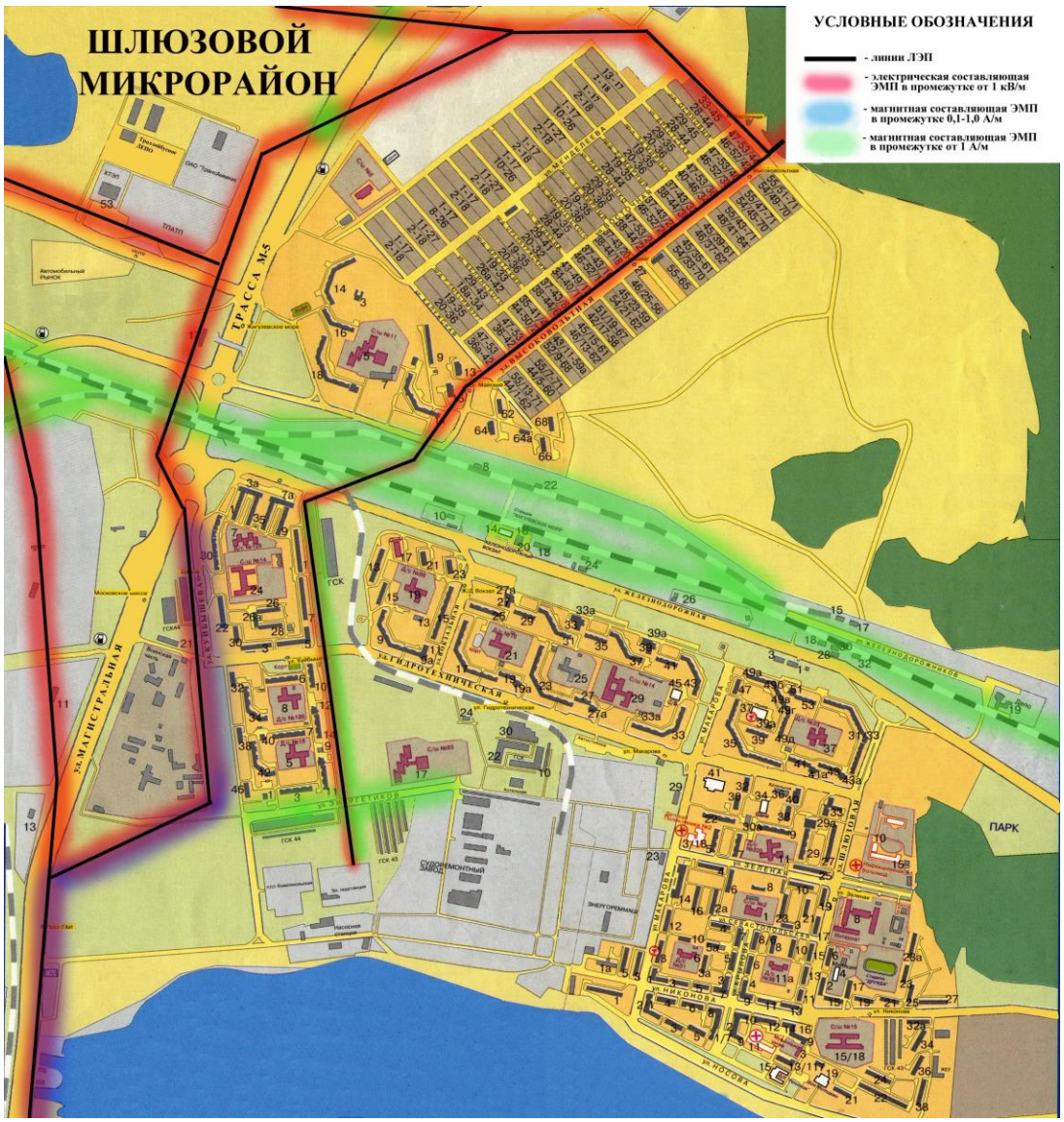
Also on the territory of city district Zhigulevsk measurements of strengths of electrical and magnetic field of radio frequency range and of density of flow of energy have been carried out. In total more than 80 measurements of electromagnetic fields were carried out in more than 20 points. Analysis of results of measurements is showing that there is no any exceeding of sanitary norms requirements in all points of measurements.

On the basis of results of measurements it is possible to conclude that there is no any exceeding of sanitary norms requirements for strengths of electrical and magnetic parts of radio frequency range and density of flow of energy on the investigated territory of city district Zhigulevsk. Exceeding of normative values of electrical part of electromagnetic fields strength industrial frequency range was observed in a number of points in zone of Zhigulevsk hydro power station.

5. Examples of mapping of electromagnetic fields of urban territories

By using of developed program provision [1] maps of electromagnetic fields of urban territory of Samara region were developed.

Map of electromagnetic fields of industrial frequency range of the territory of Shluzovoy micro district is shown in fig. 1. Map of electromagnetic fields density of flow of energy of Avtozavodsky district is shown in fig. 2. In green color values of electromagnetic fields are shown which are not exceeding of sanitary norms requirements, in red color - values of electromagnetic fields exceeding of sanitary norms requirements.



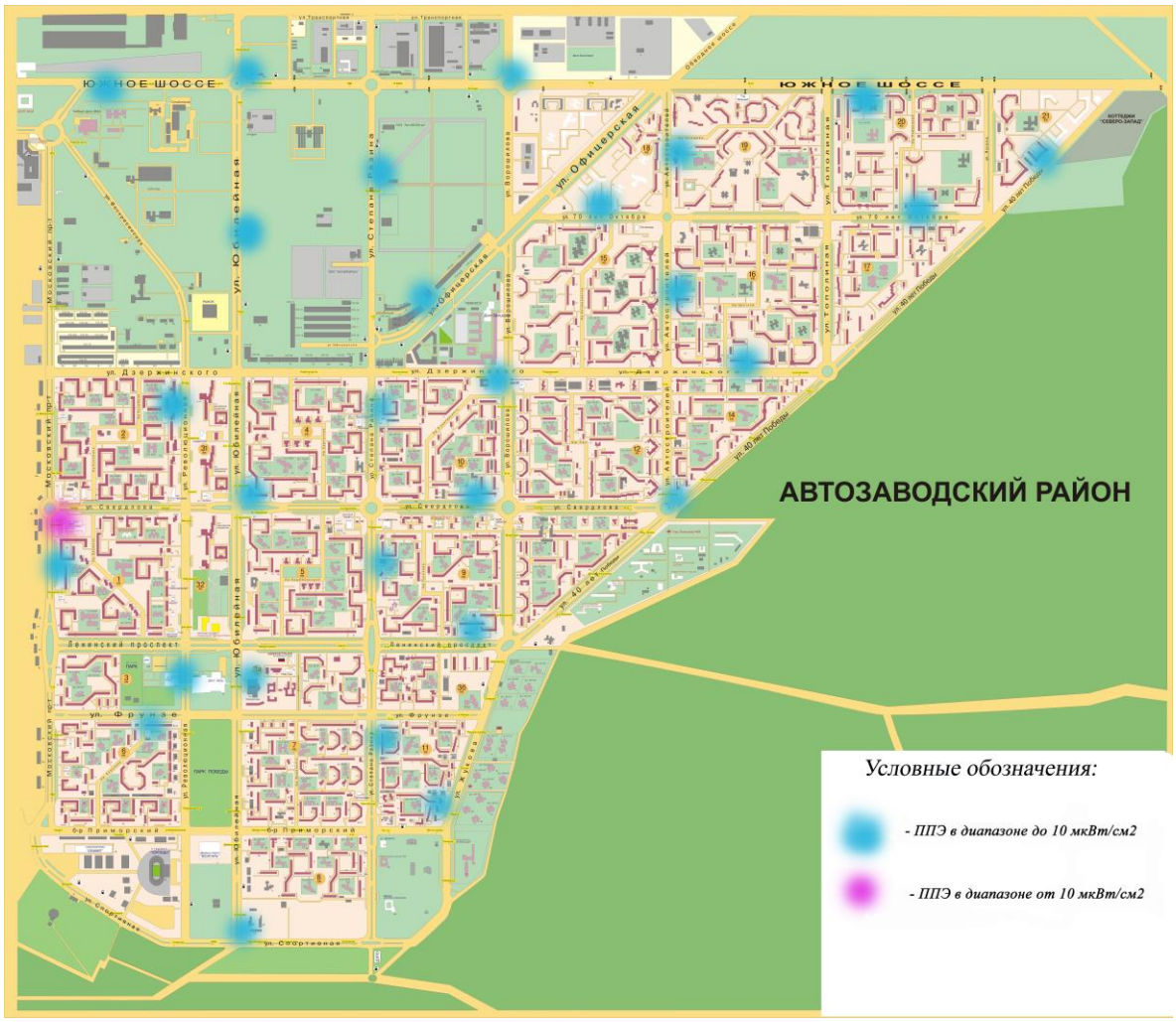


Figure 2. Map of electromagnetic fields of density of flow of energy range of the territory of Avtozavodsky district of Togliatti city

6. Suggestions of reduction of electromagnetic fields negative impact in conditions of Samara region of Russia

Suggestions of reduction of electromagnetic fields negative impact in conditions of Samara region of Russia have been proposed.

Presently classification of methods of reduction of electromagnetic fields negative impact is significantly complicated and diversified. Widely means of protection may be classified as collective and individual. In first turn it is necessary to use collective means and methods which are classified as following.

1. Architecture-planning methods:

- rational decisions of planning of living areas and of industrial zones;
- rational displacement of devices and of technological equipment creating electromagnetic radiation;
- rational displacement of working places;
- creation of sanitary-protective zones.

2. Technical means (e.g. installing of special barriers protecting from electromagnetic radiation).

3. Organizational-technical methods:

- using of power lines and technological processes with decreased level of electromagnetic radiation;
- variation of elements of constructions of intensive sources of electromagnetic fields;
- using of rational regimes of work and rest.

4. Legislative measures (state lows and local normative acts on restriction of influence of electromagnetic fields).

For reduction of negative impact of electromagnetic fields in the territory of Samara region with increased impact of electromagnetic fields it is suggested:

1. To restrict peoples access near to the electric power lines by installing of special enclosures (fig. 3).
2. Increasing of height of suspension of wires of electric power lines.
3. Installing of special barriers protecting from electromagnetic radiation etc.

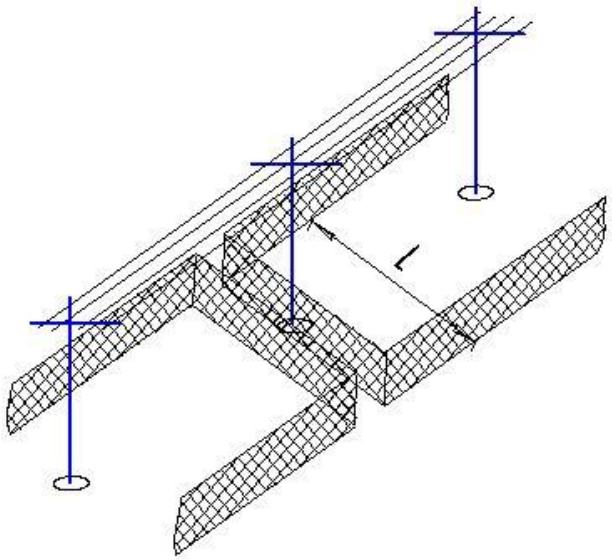


Figure 3. Installing of special enclosures near to electric power lines

7. Conclusions

Methods and approaches of estimation of electromagnetic fields negative impact to the health of population and to environment are described. It was shown that complex impact of electromagnetic fields may cause many negative effects for the health of population. Methods of monitoring of electromagnetic fields are described.

Some results of monitoring of electromagnetic fields of urban territories in Russia are described on the example of monitoring of electromagnetic fields of the living area of Samara region of Russia. Analysis of measurement results are showing that there are dangerous zones of dwelling territory on electromagnetic fields negative impact.

Results of research allows to conclude that in number of points of living territory of Samara region there is exceeding of existing sanitary-hygienic requirements on the impact of electromagnetic fields. It is necessary to carry out further monitoring of electromagnetic fields, to develop and implements measures on reduction of impact of electromagnetic fields in zones of living territory and industrial enterprises with increased levels of electromagnetic fields.

Acknowledgement

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Bibliographical References

[1] SHEVCHENKO, D.P., VASILYEV, A.V. Program Provision for Automated System of Environmental Monitoring of Physical Fields // *The Special Issue "ELPIT-2005" of the scientific edition "Proceedings of Samara Scientific Center of Russian Academy of Sciences",* Samara, 2005, volume 2, pp. 292-295.

[2] VASILYEV, A.V. Ecological Monitoring of Physical Pollutions on the Territory of Samara Region. Reduction of Impact of Sources of Physical Pollutions // Book. – *Edition of Samara Scientific Center of Russian Academy of Science*, Samara, Russia, 2009. 140 p., 36 ill. ISBN 978-5-93424-467-6.

[3] VASILYEV, A.V. Methods and Approaches of Estimation of Negative Impact of Physical Factors in Conditions of Urban Territories. Proc. of the International Scientific Conference (XII International Forum) Heritage. Architecture. Best Practice in Heritage Conservation and Management, "Le vie dei Mercanti", June 12th – 14th 2014, Aversa-Capri, Italy, Edition of La scuola di Pitagora, Naples, Italy. - pp.80-86. ISBN 978-88-6542-347-9.

[4] VASILYEV, A.V., BUKHONOV, V.O., VASILYEV, V.A. Approaches to Environmental Impact Assessment of Physical Pollutions of Territories During Design and Construction of Industrial Objects and it Realization in Samara Region of Russia. Proc. of the International Scientific Conference (XI International Forum) Heritage. Architecture. Landesign Focus on Conservation, Regeneration, Innovation "Le vie dei Mercanti", June 13th – 15th 2013, Aversa-Capri, Italy, Edition of La scuola di Pitagora, Naples, Italy. - pp.1183-1190. ISBN 978-88-6542-290-8
[5] VASILYEV, A.V., ZABOLOTSKIKH, V.V., BYNINA, O.V., TERESHCHENKO, J.P. Experience And Prospects Of Environmental Planning Of Towns Of Russia Taking To Account Noise Factor. Proc. of the international scientific conference (X International forum) Architecture. Design. Landscape "Le vie dei Mercanti", 30 May – 4 June 2012, Aversa-Capri, Italy, pp.1253-1260.
[6] VASILYEV, A.V., BUKHONOV, V.O., VASILYEV, V.A. Peculiarities and results of monitoring of electromagnetic fields in conditions of territory of Samara region. *Scientific edition "Proceedings of Samara Scientific Center of Russian Academy of Sciences",* Samara, 2013. Volume 15. № 3-1. pp. 585-590.
[7] VASILYEV, A.V., BUKHONOV, V.O., VASILYEV, V.A., TERESHCHENKO, J.P. Provision of ecological safety during the impact of physical factors on industrial sited of chemical enterprises. *Bashkirsky chemical journal*. 2012. Vol. 19. № 5. pp. 52-59.
[8] VASILYEV, A.V., VASILYEVA, L.A. To the question of system provision of ecological safety in conditions of modern city. *Scientific edition "Proceedings of Samara Scientific Center of Russian Academy of Sciences",* Samara, 2003. Volume 5. № 2. pp. 363-368.

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Methods and results of environmental monitoring of soil pollution by oily waste

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Abstract
Pollution of soil by waste is presently may be considered as one of the most important ecological problems. Oily waste may cause especially negative influence due to the high toxicity. Examples of oily waste negative impact are considered. Main features and methods of environmental monitoring of toxicity pollution of soils by oil products are analyzed. Results of experimental research by definition of degree of toxicity of the soils of territory of Samara region of Russia polluted by oil products by using of different biological test-objects are considered. Results of environmental monitoring are proving high danger of toxicity pollution of soils by oily waste.

Keywords: Oily waste, soil, pollution, monitoring

1. Introduction
Waste negative impact in urban conditions is constantly growing [1-10]. Presently the problem of waste reduction is coming one of the most important problems in all industrial countries. Waste may cause complex negative impact to the landscapes of territories, to biosphere and to the human health. Especially dangerous are toxic waste. Waste may cause negative influence to the human's health both in industry and in domestic conditions. Especially dangerous is impact of waste with high toxicity [1, 4, 6, 9]. For example, toxic waste of chemical nature may cause different negative impact to the humans leading to the damage of cardiovascular and respiratory systems, skin damage, toxicity poisoning and other negative sequences. Oily waste may cause especially negative influence due to the high toxicity.
Thus, it is necessary do develop and to implement into practice efficient system of waste monitoring.
This paper is devoted to the experience of monitoring of soil pollution by oily waste of urban territories and to it approbation in conditions of Samara Region of Russia.

2. Analysis of sources of soil pollution by oil and oily products and of methods of environmental monitoring of soil
Due to wide application of oil and of oily products in different branches of industry, in transport and in domestic conditions oily products are causing significant negative impact to the wide sites of soil.
The filed of propagation of negative influence of oil and of oily products is no restricted only by such sited in which is direct oil and oily products using is carried out. Even in zones which are free from the business activity of man (natural reserves, national parks etc.), hydrocarbons may be delivered with air and water flows and to pollute the territories.
Sources of soil pollution by oil and oily products it is possible to divide to local (impact) and complex. Impact pollutions may cause significant single impact to the soil and water and to make a significant damage to the man's health and to environment. Complex sources may be considered as combination of local sources and differ by more high continuation and scale of impact.
Main potential sources of soil pollution by oil and oily products are road vehicles, oil storages, oil fields, oil-pipelines, oil treatment enterprises, and also transport carrying oil products.
Local (impact) sources of soil pollution by oil and oily products are road vehicles, oil treatment enterprises, plants and oil storages. Single oil emissions to the soil may be low, but it constant impact may cause significant oil pollution.

Oil-pipelines may be considered as the most often and significant sources of oil pollution. The most significant sequences of soil pollution are occurring during oil-pipes accidents.
On the territory of oil fields main sources of pollution are operational and exploration drill holes from which accidental emissions may occur. In some oil fields a number of such drill holes may achieve several hundreds. On oil fields there are also the other sources of pollution: pipelines, collecting points, storages, points of oil preparation. In dependence from oil fields displacement oil and oil water lows may also penetrate to abutting territories.
Selection of method of environmental monitoring of soil during the impact of oil containing waste and of oily products it is necessary to carry out with taking to account existing sources of soil pollution and kinds of soil pollution: chemical, biochemical, microbiological etc. It is necessary to take into consideration that for estimation of soil state in changing environmental conditions not only quantity characteristics of pollutions are important, but also it sequences.
During determination of agrochemical soil characteristic methods of estimation of carbon, mobile phosphorus, nitrate nitrogen, ammonia nitrogen, sulfates in soil are using. For estimation of sequences of pollution characteristic of soil of polluted sited are generally compared with the same characteristic of soil in not-polluted sites.
During monitoring of soil pollution it is necessary to pay special attention not only to determination of current values of pollutions according to the different parameters, but also to forecasting of sequences of pollutions. Analysis shows that during monitoring of soil the most significant is estimation of influence of toxic pollutions on the most important physical-chemical soil characteristic. Therefore it is necessary to determine characteristics of these characteristic and trends of it variation in time.
Analysis of existing methods of environmental monitoring of soil is showing that due to high cost and technological complexity application of a number of it is restricted. Therefore using of methods of biological indication and of biological testing is efficient approach for determination of degree of toxicity of soil polluted by oil treatment products.
Biological monitoring is assuming using of organisms-indicators or of total communities for estimation of ecological conditions (often pollution of environment by man) is one of kinds of monitoring of state of biosphere and of it separate components.
Presently there is a number of modern approaches to biological testing of soils toxicity (e.g. молекулярно-biological tests of medium quality), but due high technological complexity and cost it application is restricted. Efficient and significantly low cost approach for estimation of oily polluted soil toxicity is using of methods of biological testing.
Biological testing may be efficiently used for estimation of toxicity of different components bring in into the atmosphere. Toxicity of habitat is determined with using of biological objects (test-organisms) for estimation of degree of toxicity of different components or of it summary impact.
On the basis of environmental monitoring of soil toxicity pollution with using of biological testing methods is representation that soil as living environment is unified system with populations of different organisms. Pollution of soil is caused by different pollutants influencing to soil, soil biota, general state of soil ecosystem.

3. Analysis of peculiarities of environmental monitoring of oily waste

Oil-slimes are 3-phase systems, composition and properties of which are varying in wide ranges in dependence of place and of method of it generation. Variation of composition of such complex multi-component dispersion systems in time is significantly difficulty for development of universal methods of it utilization [4].
Analysis of peculiarities of environmental monitoring of oily waste allows to determine main principles of monitoring emphasizing the following steps and practical recommendations [9]:
1. It is necessary to create normative-technical base of monitoring of oil containing waste, в том числе по проведению of special surveys and observations, determination of negative factors, estimation and forecasting, avoiding and liquidation of negative processes during impact of oil-containing waste to the man and biosphere.
2. It is necessary to develop in more details the list of necessary parameters and criteria during estimation of negative impact of oil containing waste.
3. It is recommended to carry out estimation territory of Russian Federation and of the other countries with the purpose of determination of external peculiarities, scale and levels of soil pollution by oil containing waste. It is reasonable more widely use modern methods and technical means of monitoring (including satellite geodesic systems, methods of remote sensing data, ground express-methods, methods of biological indication and of biological testing etc.).
4. During the provision of environmental monitoring of oily waste in is necessary to carry out estimation of separate and joint ecological pollutions because during joint impact of a number pollutions the character of it impact may significantly differ from the impact of single pollutions.

5. It is suggested to create automated system of monitoring of oil containing waste, including informational database about the state of soil zones polluted by waste, to arrange multi-level base of monitoring of oil-containing waste, to create system of forecasting, prevention and liquidation of consequences of negative impact of oil containing waste to the man and biosphere.
6. Taking to account results of environmental monitoring it is necessary to carry out ecological ranging of territory of Russian Federation and of the other countries in dependence of presence and degree of negative impact of oil containing waste, in particular to determine the zones of the most significant propagation of oily containing waste and the main negative processes in dependence of kind and degree of it impact to the man and to state of environment.
7. Taking to account results of environmental monitoring it is suggested to develop atlas of pollutions of territory of Russian Federation and of the other countries by oil containing waste with thematic maps of soil state, and also forecasting maps.
8. It is necessary to develop and provide realization of special programs of prevention and liquidation of consequences of negative impact of oil containing waste.

4. Methods and results of environmental monitoring of toxicity of oily waste on the Example of Samara Region of Russia

As it was described above, biological testing may be efficiently used for estimation of toxicity of different components. Toxicity is determined with using of biological objects (test-organisms) for estimation of degree of toxicity of different components or of it summary impact. Thus, for environmental monitoring of soil toxicity pollution it is reasonable to use biological testing.
Let us describe results of experimental research by definition of degree of toxicity of the soils of territory of Samara region of Russia polluted by oil products.
Biological monitoring is the kind of environmental monitoring allowing to estimate efficiently the degree of the toxicity of different sources. Presently many scientists have carried out research devoted to using biological indicators as test-objects. For example, it is well known that for estimation of quality of water it is using Woodiviss index. For estimation of degree of the toxicity of water medium green protococcus algae Chlorella (*Chlorella vulgaris* Beijer) and craw fishes *Daphnia magna* Straus are often used as test-objects.
Peculiarity of developed method in comparison with existing methods is complex consideration of the main toxicological values of toxicants on the basis of it point-rating ranging [5].
The following toxicological characteristics have been taken into consideration:
- irritating impact to eyes;
- skin-resorptive impact;
- sensitizing impact;
- toxic particles assignable under exploitation of lubricating cooling liquids (number of singled out toxicants and it class of danger);
- toxicity during inside-stomach injection.

Experimental research were carried out according to the requirements of Russian accredited methods of determination of acute toxicity of probes of surface fresh, ground, drinkable, sewage waters, water extractions from soil, sewage sediments and wastes in laboratory conditions by variation of optic density of test-culture green protococcus algae Chlorella (*Chlorella vulgaris* Beijer) according to methodic ПНД Ф 14.1:2:3:4:10-04 16:1:2:3:3.7-04 and by determination of mortality of craw fishes Daphnia (*Daphnia magna* Straus) according to methodic ПНД Ф Т 14.1:2:4.12-06, 16.1:2:3:3.9-06.
As experimental samples 1 dm^3 probes of wastes of the most widely used marks of lubricating cooling liquids used in "AVTOVAZ" Enterprise were investigated: ВЕЛС-1, Автокат Ф-78, Автокат Ф-40 etc. Such lubricating cooling liquids are also containing some oil components.
For achieving of water extraction the mixture of water and of lubricating cooling liquids in proportions (1:27 and 1:243) was agitated during 1 hour and stored during 24 hours. Than resulting suspension have been mixed during 10 minutes under rotation number 5 000 rotations per minute and supernatant liquid have been used for biological testing.
Results of biological testing are presented in fig. 1 and 2. Toxicity of different marks of waste lubricating cooling liquids have been determined. It is shown that a number of the most widely used marks of lubricating cooling liquids have hyper toxicity and strong toxicity.

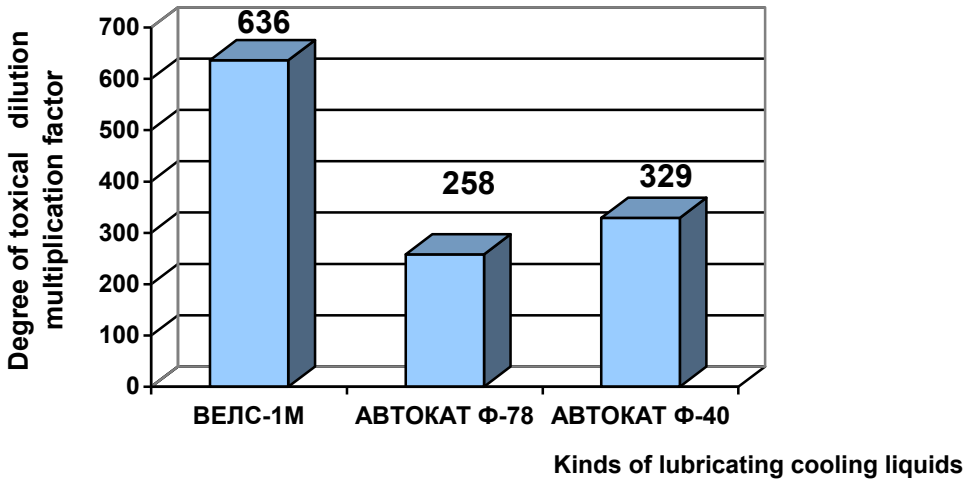

Figure 1. Degree of impact of different kinds of lubricating cooling liquids to test-object *Daphnia magna* Straus

Results of biological testing of degree of toxicity of soil polluted by oily products are also showing that degree of soil toxicity is strongly changes in depend of depth of probes sampling.
It should be noted that monitoring of the state of environment is also efficient way of estimation and of forecasting of changes of the state and of pollution of biosphere or of it separate components under the impact of oily products.

6. Conclusions

It was shown that oily waste may cause especially negative influence due to the high toxicity. Examples of oily waste negative impact were described. Main sources, features and methods of environmental monitoring of toxicity pollution of soils by oil products are analyzed. Analysis shows that oil-pipelines may be considered as the most often and significant sources of oil pollution. The most significant sequences of soil pollution are occurring during oil-pipes accidents. On oil fields there are also the other sources of pollution: pipelines, collecting points, storages, points of oil preparation. In dependence from oil fields displacement oil and oil water lows may also penetrate to abutting territories.
Analysis of literature sources shows that during the estimation of toxicity of oil products biological testing methods are widely studied. It is reasonable to use as a test-objects of green algae Chlorella (*Chlorella vulgaris* Beijer), and of crawfishes Daphnia magna Straus. Above mentioned methods are accredited in Russia. It allows to obtain rather high precision of results during it using for researches.
Results of biological testing of degree of toxicity of soil polluted by oily products are proving high danger of toxicity pollution of soils by oily waste. Results are also showing that degree of soil toxicity is strongly changes in depend of depth of probes sampling.
Generally, only using of complex of methods may give efficient results of significant reduction of negative influence of oily products.

Acknowledgement

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Bibliographical References

[1] BYKOV, D.E. Complex multilevel system of industrial waste investigation and treatment. Book. Samara: *edition of Samara State Technical University*, 2003. – 102 p.

[2] VASILYEV, A.V. Provision of ecological safety in conditions of city district Togliatti:: Educational textbook. Samara, Russia, Edition of Samara scientific centre of Russian academy of science, 2012. - 201 p., ill.
[3] VASILYEV, A.V. "Green politics: problems and structure. *"Pro et Contra" Journal*. 2002. Vol. 7. № 1. pp. 84-93.
[4] VASILYEV, A.V., BYKOV, D.E., PIMENOV, A.A. Analysis of Features and Practical Results of Ecological Monitoring of Pollution of the Soils By Oily Products. *The Bulleting of Samara Scientific Center of Russian Academy of Sciences*, Samara, 2014, Volume 16, No 1(6), pp. 1705-1708.
[5] VASILYEV, A.V., GUSAROVA, D.V. Analysis of lubricating cooling liquids negative influence to the human's health and the ways of it reduction. *Safety of Technogenic Environment*. 2013. № 4. pp. 37-41.
[6] VASILYEV, A.V., KHAMIDULLOVA, L.R., HYUKHTINA, L.V. Environmental Control Of Toxicity Of Urban Territories Using Biological Monitoring Methods. *Proc. of the international scientific conference (X International forum) Less More Architecture. Design. Landscape "Le vie dei Mercanti"*, 30 May – 4 June 2012, Aversa-Capri, Italy, pp. 1245-1252.
[7] VASILYEV, A.V., MELNIKOV, P.A., ZABOLOTSKIKH, V.V. Approaches to Classification and to Reduction of Negative Impact of Lubricating Cooling Liquids. Proc. of the International Scientific Conference (XI International Forum) Heritage. Architecture. Landesign focus on Conservation, Regeneration, Innovation "Le vie dei Mercanti", June 13th – 15th 2013, Aversa-Capri, Italy, Edition of La scuola di Pitagora, Naples, Italy. - pp.1191-1195.
[8] VASILYEV, A.V., MELNIKOVA, D.A, DEGTEREVA, M.S. Peculiarities of Organization of Waste Management System in Conditions Territory of Samara Region. Reduction of Impact of Sources of Physical Pollutions. – *Edition The Bulleting of Samara Scientific Center of Russian Academy of Science*, Samara, Russia, 2014, Vol .16, N 1 (1), pp. 313-316.
[9] VASILYEV, A.V., PIMENOV, A.A.. Peculiarities of Ecological Monitoring of Oily Containing Waste. *Academic Journal of West Siberia*, Tyumen, 2014, Volume 10, No 4, p. 15.
[10] VASILYEV, A.V., VASILYEVA, L.A. To the question of system provision of ecological safety in conditions of modern city. *Scientific edition "Proceedings of Samara Scientific Center of Russian Academy of Sciences",* Samara, 2003. Volume 5. № 2. pp. 363-368.

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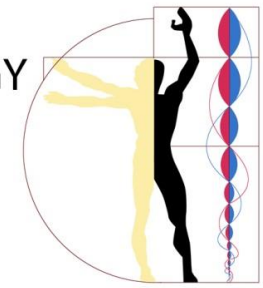

Approaches to soil treatment from oily products and results of it approbation

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Abstract
Oily products are usually having the high toxicity and are causing complex negative influence to the soil. One of the most serious problems is negative impact of oil containing waste to the soil which may cause irreversible variation of chemical compound, physical, biochemical and microbiological characteristics of soil. Main approaches to soil treatment from oily products are analyzed. As an example «Bioactivator» mixture for biological treatment and rehabilitation of soils polluted by oil and oil products suggested by authors is considered. The "Bioactivator" provides complex biological impact on oil pollution due to creation of necessary conditions for restoration and active self-cleaning of the soil. Results of experiments are showing that the «Bioactivator» mixture allowing to significantly decrease in toxicity of the soil, to stimulate the natural process of biological destruction of oily products to remove from the soil the oily and other toxic polluting substances.

Keywords: Oily products, soil, treatment, waste

1. Introduction

The negative effect of waste in conditions of urban territories is growing every year [1-12]. Waste may cause complex negative impact to the landscapes of territories, to biosphere and to the human health. Especially dangerous are toxic waste. Waste may cause negative influence to the human's health both in industry and in domestic conditions. Especially dangerous is impact of waste with high toxicity [1, 2, 6, 8]. For example, toxic waste of chemical nature may cause different negative impact to the humans leading to the damage of cardiovascular and respiratory systems, skin damage, toxicity poisoning and other negative sequences.
Oily products are one of the most dangerous kind of waste causing negative impact not only to the man's health, but also to animals and plants, especially due to it toxicity. One of the most serious problems is negative impact of oil containing waste to the soil which may cause irreversible variation of chemical compound, physical, biochemical and microbiological characteristics of soil.
Treatment of soil territories polluted by oily products is very difficult task requiring high expenses. Existing technologies of soil treatment are not sufficiently efficient and do not allow to reach full soil remediation [6, 10]. Therefore it is necessary to search new approaches and efficient measures to soil remediation and treatment form oily products. Analysis of problem allows to conclude that complex approach is the most efficient for the problem decision. Biological methods may be considered as very efficient for soil remediation.
This paper is devoted to development and experimental research of «Bioactivator» mixture for biological treatment and rehabilitation of soils polluted by oil and oil products.

2. Main approaches to soil treatment from oily products

Generally it is possible to subdivide mail approaches and steps to soil treatment from oily products used in Russia:
- collection, transportation, utilization of soil especially polluted by oily products;

- displacement of soil especially polluted by oily products in special sites;
- monitoring of degree of pollution of soil by oily products;
- using of technical solutions and technologies for soil treatment from oily products;
- ecological education, organization of efficient system of teaching of specialists in the field of waste management;
- enlightenment and upbringing of population in the field of waste management;
- improvement of legal and normative documentation in the field of waste management;
- informational provision degree of pollution of soil etc.
- Initiation of fundamental research of different stages of soil treatment from oily products;
- Development of logistics of soil treatment from oily products;
- Optimization of regional normative-legal base for reaching of strategic purpose «zero of waste».

It is necessary to point out that also monitoring of soil pollution is very important for efficient soil treatment. In Russia there is a system of waste monitoring including observation, control and collection of information at different levels:
- monitoring of impact to environment;
- monitoring of waste displacement etc.

Monitoring of environmental impact assessment provides for control of the following parameters: object of control, methods of research, frequency of measurements, methods and equipment of control, periodicity of measurements data processing and analysis, methods of estimation of environmental impact assessment, methods of estimation of environmental damage. In result it is necessary to implement the measures allowing to reduce the exceeding values of oily waste negative impact and to arrange control measurements.

3. Development and experimental research of «Bioactivator» mixture

«Bioactivator» mixture for biological treatment and rehabilitation of soils polluted by oil and oil products is developed and experimentally approbated by authors.

«Bioactivator» mixture is suggested by authors is consists of biological remedy, sorbent, mineral additions and mixture of legumes seeds.

Technology of complex biological impact to oil pollutions on the basis of application of multi-component mixture «Bioactivator» is developed and experimentally approbated. «Bioactivator» mixture firstly is directed to the activation of aboriginal oil oxidizing bacteria of soil.

The main idea of development and application of «Bioactivator» mixture is to create necessary conditions to soil micro community for soil remediation and active self-treatment. Multi-component mixture is carrying in to the place of soil pollution by oil and oil products and increases the stimulation of bio-destruction process of oil and to rapid and efficient soil treatment from toxic pollutants.

The "Bioactivator" provides complex biological impact on oil pollution due to creation of necessary conditions for restoration and active self-cleaning of the soil.

Experimental research have been carried out for study of efficiency of soil treatment from oil products on the basis of «Bioactivator» mixture.

As comparative experimental models different components and compositions of mixtures for soil treatment from oil and oil products comparing with efficiency of developed «Bioactivator» complex were investigated.

6 samples of grey forest soil were taken, 5 of which were polluted by oil products (petrol Ai-92) in the same volume (50 ml). Then in every probe separate components of mixture or it partial combination were added. Comparative efficiency of soil treatment during adding to soil probes dolomite powder, vermiculite, peat, pine sawdust, biological remedy "Vostok EM-1" were investigated.

Irrigation by equal parts of settled tap water was produced periodically.

During the experiment observations of variation of phytotoxicity of soil by the following indicators of test-object watercress:
- time of rising and it number for every day period;
- general germination (to the end of experiment);
- measurement of length of ground part (plants height);
- measurement of length of root part of sprouts of test-object watercress.

Results of observations are presented in table 1.

Table 1

Results of observations germination of seeds of watercress in different probes

Sample	Time					Percent of germination %
	13.04.13 Foundation	16.04.13	19.04.13	22.04.13	26.04.13	

	of experiment					
Probe 1	0	14	16	16	16	100
Probe 2	0	7	11	12	13	81
Probe 3	0	12	15	16	16	100
Probe 4	0	14	14	16	16	100
Probe 5	0	13	15	16	16	100
Probe 6	0	10	13	15	15	94

After 14 days plants were extracted from the soil and measurements of ground and underground parts were carried out. At the end of experiment measurements of length of ground part (plants height), length of plant roots and of general length were done. It was shown that in probe with application of «Bioactivator» complex destruction of oil products was mere efficient. In this probe the minimal toxicity of soil was observed. Length of sprouts of watercress and seeds germination were the highest and practically were equal to the values of length of sprouts and of seeds germination in background probe not polluted by oily products (in accordance with figures 1 and 2).

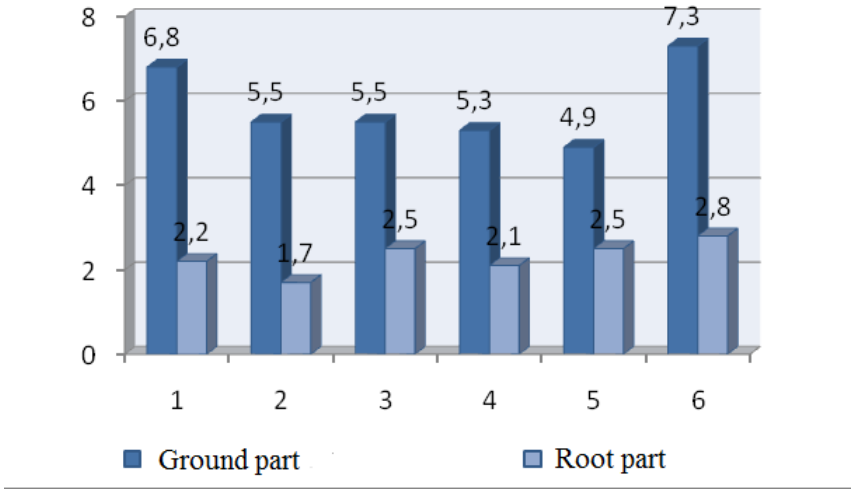

Figure 1. The length of ground and root parts of sprouts of watercress in probes № 1- 6

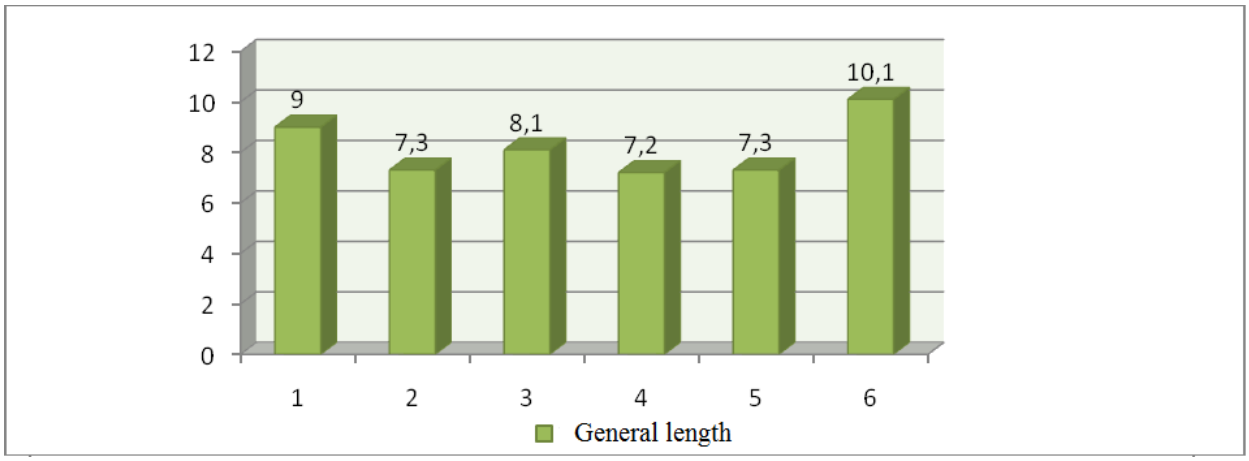

Figure 2. General length of sprouts of watercress in probes 1- 6

In second experiment efficiency of «Bioactivator» complex was investigated comparing with probe without the complex. Variations of soil toxicity were investigated in two variants: without adding of «Bioactivator» complex (probe 1) and with adding of «Bioactivator» complex (probe 2). Results of observations are presented in the figure 3.

Experimental researches with using of watercress test-object are allowing to determine different variations of soil toxicity in probe with adding of «Bioactivator» complex (probe 2.2.). Comparative investigations are showing that in result of application of developed bio-complex «Bioactivator» destruction of oil products was more efficient. Researched complex «Bioactivator» was the most efficient for decreasing of soil toxicity and it treatment from oily products. In probes with added «Bioactivator» complex (probe 1 in experiment 1 and probe 2.2. in experiment 2) was observed the minimal soil toxicity comparing with other probes. In these probes with adding of «Bioactivator» complex also the highest values of length of sprouts of watercress and of seeds germination were observed.

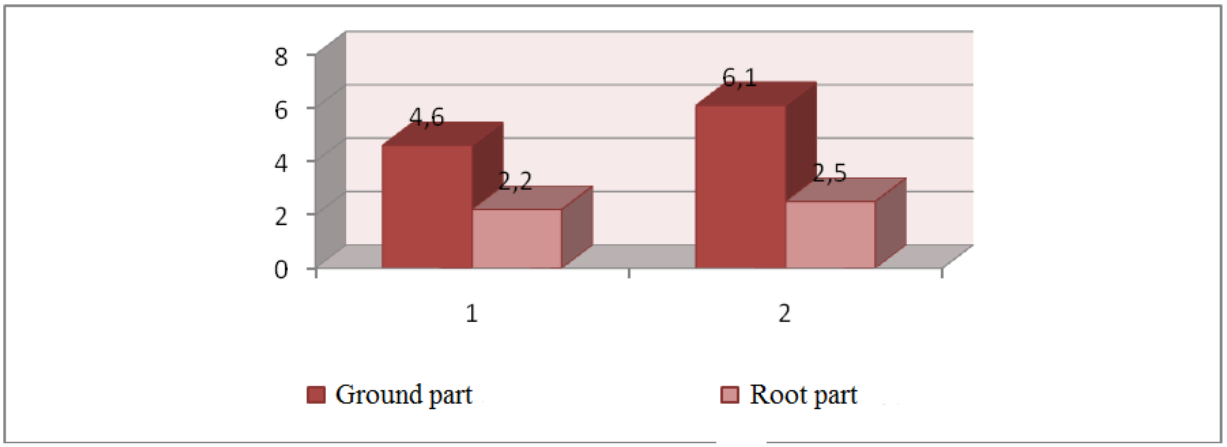

Figure 3. Results of biological testing of soil on toxicity according to the length of ground and root parts of sprouts of watercress: № 1- without application of «Bioactivator» complex; № 2 – with application of «Bioactivator» complex

Results of experiments are showing that the best result was achieved for probe with «Bioactivator» complex, and also in probes with adding of sawdust and of biological remedy with bio-complex. Seeds germination of test-plant in it was correspondently 100%, 100%, 100%, и 94%. In probe 2.1 without application of bio-complex seeds germination was 88 %, sprouts are depressed and it length is the least.

4. Conclusions

It is shown that oily products are usually having the high toxicity and are causing complex negative influence to the soil. Main approaches to soil treatment from oily products were analyzed. As an example «Bioactivator» mixture for biological treatment and rehabilitation of soils polluted by oil and oil products suggested by authors was considered. Results of research allows to conclude that developed and

experimentally approbated complex mixture «Bioactivator» for recultivation of oily polluted soils was found the most efficient comparing with used components for soil treatment in other probes. It allows to recommend adding of mixture on the stage of biological recultivation of soil during liquidation of oil accidental spill. In total application of «Bioactivator» complex is allowing to reduce soil toxicity, to accelerate oily pollutants biological degradation process, to activate soil self-purification processes. Mixture is consists of the low cost and easily obtainable natural materials, ecologically safe.

Acknowledgement
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Bibliographical References

[1] KARABASOV, U.S., CHIZHIKOVA, V.M. Ecology and management: *Book for universities*. – Moscow: MISIS, 2006. – P:712.

[2] VASILYEV, A.V. Provision of ecological safety in conditions of city district Togliatti:: Educational textbook. Samara, Russia, Edition of Samara scientific centre of Russian academy of science, 2012. - 201 p., ill.

[3] VASILYEV, A.V. "Green politics: problems and structure. *"Pro et Contra" Journal*. 2002. Vol. 7. № 1. pp. 84-93.

[4] VASILYEV, A.V. Methods and Approaches of Estimation of Negative Impact of Physical Factors in Conditions of Urban Territories. Proc. of the International Scientific Conference (XII International Forum) Heritage. Architecture. Best Practice in Heritage Conservation and Management, "Le vie dei Mercanti", June 12th – 14th 2014, Aversa-Capri, Italy, Edition of La scuola di Pitagora, Naples, Italy. - pp.80-86.

[5] VASILYEV, A.V., BUKHONOV, V.O., VASILYEV, V.A. Approaches to Environmental Impact Assessment of Physical Pollutions of Territories During Design and Construction of Industrial Objects and it Realization in Samara Region of Russia. Proc. of the International Scientific Conference (XI International Forum) Heritage. Architecture. Landesign Focus on Conservation, Regeneration, Innovation "Le vie dei Mercanti", June 13th – 15th 2013, Aversa-Capri, Italy, Edition of La scuola di Pitagora, Naples, Italy. - pp.1183-1190.

[6] VASILYEV, A.V., BYKOV, D.E., PIMENOV, A.A. Analysis of Features and Practical Results of Ecological Monitoring of Pollution of the Soils By Oily Products. *The Bulleting of Samara Scientific Center of Russian Academy of Sciences*, Samara, 2014, Volume 16, No 1(6), pp. 1705-1708.

[7] VASILYEV, A.V., GUSAROVA, D.V. Analysis of lubricating cooling liquids negative influence to the human's health and the ways of it reduction. *Safety of Technogenic Environment*. 2013. № 4. pp. 37-41.

[8] VASILYEV, A.V., KHAMIDULLOVA, L.R., HYUKHTINA, L.V. Environmental Control Of Toxicity Of Urban Territories Using Biological Monitoring Methods. *Proc. of the international scientific conference (X International forum) Less More Architecture. Design. Landscape "Le vie dei Mercanti"*, 30 May – 4 June 2012, Aversa-Capri, Italy, pp. 1245-1252.

[9] VASILYEV, A.V., MELNIKOV, P.A., ZABOLOTSKIKH, V.V. Approaches to Classification and to Reduction of Negative Impact of Lubricating Cooling Liquids. Proc. of the International Scientific Conference (XI International Forum) Heritage. Architecture. Landesign focus on Conservation, Regeneration, Innovation "Le vie dei Mercanti", June 13th – 15th 2013, Aversa-Capri, Italy, Edition of La scuola di Pitagora, Naples, Italy. - pp.1191-1195.

[10] VASILYEV, A.V., MELNIKOVA, D.A, DEGTEREVA, M.S. Peculiarities of Organization of Waste Management System in Conditions Territory of Samara Region. Reduction of Impact of Sources of Physical Pollutions. – *Edition The Bulleting of Samara Scientific Center of Russian Academy of Science*, Samara, Russia, 2014, Vol .16, N 1 (1), pp. 313-316.

[11] VASILYEV, A.V., VASILYEVA, L.A. To the question of system provision of ecological safety in conditions of modern city. *Scientific edition "Proceedings of Samara Scientific Center of Russian Academy of Sciences",* Samara, 2003. Volume 5. № 2. pp. 363-368.

[12] VASILYEV, A.V., ZABOLOTSKIKH, V.V., VASILYEV, V.A. Development of methods for the estimation of impact of physical factors on the health of population. *Safety of Technogenic Environment*. 2013. № 4. C. 42-45.

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Besides the design: the analysis and documentation of the ancient "via Pretoria" in Potenza. The most significant transformations of a Roman road axis in the historic city

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Abstract
The city of Potenza, in Basilicata, offers many points of reading of a complex urban fabric with an ancient history, and that, although it is an internal reality geographically and for centuries not many connected to the rest of the country, was the scene of important changes related to cultural ferment of the most wide-ranging.
The design of the same becomes an opportunity for the understanding of these complex transformations, besides its documentation, leading to consider the city a small laboratory for the development of a methodology of investigation directed not to the large monumental urban areas, but to peripheral realities that, however, are particularly important in relation to specific historical and little investigated aspects.
Particular attention was paid to the ancient "via Pretoria", made from the third century B.C., and object of a radical restructuring in the early nineteenth century when the city became the chief town. It is at this stage that are destroyed medieval buildings, built on previous ones of the Roman period, which are remembered from some blocks of bare. More substantial changes will be made in the aftermath of the devastating earthquakes of 1857 and 1980. The analysis of archival sources and field analysis allow to grasp the peculiarities of urban planning and architectural not always easy to read, given the complex urban stratification, in order to reconstruct an iconographic memory of the historic city.
The architectures of value and all the minor architecture are investigated with a multidisciplinary approach, with the aim also to fill documentary gaps especially of the earliest phase of the city.

Keywords: documentation, survey, heritages

1. Potenza: birth and transformations of a city

1.1 The Intendents city: an interrupted image
Potenza, already Roman town, located at the intersection of the Herculean and Popilia streets, episcopal place from the fifth century, in the Middle Ages is "the illustrious prestige city, very wide and populated, rich in vineyards and farmland," [1]. Its morfology is typical of medieval towns: with walls and perched on the ridge overlooking a long stretch of flat of Basento. Having rebelled against the Angevins in 1268, the city is sacked and its walls are torn down.
A few years later - in 1273 - an earthquake further contributes to its destruction and its rapid decline. Isolated, with a poor economy to the edge of pure survival, Potenza maintains its appearance until the beginning of the nineteenth century.
The main entrance is the “Porta Salza”, the only vehicular access to the city, provided of a drawbridge; hence «a narrow, winding road, badly paved, the road Praetorian» [2] through the whole town up to the “Piazza del Sedile”, which takes its name from an old Aragonese building, center and place of the city's public life ; very few are the palaces. «Almost all the other houses, huddled each other are low, squat and

deformed»; only some have a mezzanine and almost all have external stairs on the way. The poorest people live the "sottani", confined spaces under the top soil, with the ceiling at street level, which, as only opening, have the gateway leading into the compartment for a steep staircase. The urban morphology is rather homogeneous apart from the few public buildings, civil or religious, the residential fabric of the city is not socially discriminated: the "gentlemen" in fact live in the first floors of buildings, or in the palaces richer but live together with shopkeepers, artisans, the people and its parts can be recognized and organized in a coherent system; for its residents it is a biotope, which is a place where the most diverse forms of life achieve a balance and in it persist.
In 1806 Potenza is raised to the rank of main city of the province of Basilicata. So the city is worthy to play the new role, were required substantial changes in the urban structure. From that moment, will take the start a whole series of works designed to transform the "medieval town" into a "capital city".
The lack of housing, of places suitable to house the civil and military offices, of adequate infrastructures, services, roads, will push the stewards that are taking place to try to reorganize the city with the intention of giving a precise answer to these problems, but leaving time to time throughout a number of unresolved situations, in their morphological and functional configuration.
The city remained until then closed in on itself, is forced to open up to the territory which has to administer, the existing routes are widen, were create new squares and new roads cut among the old ones, they look along the main streets of redesign the architecture of the facades, chasing, however, a project that will not ever be realized at all.
These changes reflect a fairly widespread phenomenon in the nineteenth-century culture. In many Italian cities you can read such interventions that insert themselves, often violently, in the urban fabric earlier, helping to give, however, a new identity in entire neighborhoods, if not in the entire city. This happened only in part to Potenza: the transformations have had the only result of deleting a part of the medieval city, without having had power and organic nature such as to give a new identity [3].
The first works performed affected the main street: “via Pretoria”, were demolished stairs protruding on the road, was demolished “Porta Salza”, was redone flooring, and in 1839 began the construction of «piazza Prefettura”, the current “piazza Mario Pagano”, commissioned by steward Edoardo Winspeare, in front of the Palace of the Intendence of Basilicata and built by demolishing the blocks in front of the palace, "were demolished so low and miserable hovels, crossed by three lanes that finished perpendicular on “Pretoria”, one of whom was in the middle and the other two sides of the present square.... » [4].
More than the fulfillment of a coherent plan, we see, therefore, the implementation of partial measures, uncoordinated, destined to leave the "gaps" in the urban fabric, in the ongoing attempt to overlay the existing city to another city, perhaps more functional, at least in his utterances, but indefinite and uncertain in its realization.



Fig. 1: The historical city of Potenza from Portasalza (lettera C) to Porta San Luca (lettera M) in the engraving of Giovan Battista Pacichelli (particular) (from PACICHELLI Giovan Battista,1703).

From the examination of the available design's drawings, affecting mostly parts of the city, it can not be traced to an overall project, it can be possible, however, grope to trace authorizing elements scrolling the program of works to be carried out, coordinated by the Building Council .
In his speech at the Provincial Council of Basilicata in 1847 by the intendent duke of "Verdura" are dashed the guidelines of the program of the works for the city; the report stresses the need to eliminate unhealthy housing and to overcome the lack of the same building a new village, also aims to provide for the construction of housing for the farmers in the country in order to avoid that they are forced to live in the city, remember, finally, the need to provide for a rapid adaptation to new requirements of the city streets.
An important tool for the implementation of the program of the works was the «Regulations for the improvement and urban extension of the city of Potenza, capital of Basilicata», approved by the Building Council in 1844, this regulation allows «modifications of the old streets, elevations of homes up to second floor, creation of networks of underground, urban extension of the building through the construction of new houses and new roads» [5]. The earthquake of 1857 greatly amplified the existing problems: the city reported remarkable damages to the entire housing stock. The palace of the Intendence, the Royal College, the palace of the Courts, the churches, the Hospital and all other public buildings were greatly damaged.
The reconstruction once more takes provisional way, losing once again the opportunity to tie the wire between architecture and urban design, to close the meshes of a path never concluded in an organic design.
With the unification of Italy, the interventions in the historical center thin out and take the start a whole series of works (roads, railways, etc.) designed to remove the Province from isolation, largely interested in the phenomenon of banditry, making it easier to control the territory.
In 1883, it was approved the Master Plan of the city prepared by engineer Rosi which provides accommodation of the main streets of the old center, the creation of an extramural street, running along the northern side of the hill, it should join the village "Porta Salza" with the Addone part. The proposals contained in the Plan are made only in part, and the realization of some works is completed partially. One example may be the realization of the "extramurale" that cropped into small pieces between the existing building, produces spaces formally unresolved as in the case of the "Larghetto Plebiscito", obtained limited only to the demolition of a plug of buildings without any redesign of the project area. Much of interventions designed and implemented from 1806 onwards are destined to remain unfinished, nevertheless the image of the nineteenth century city is strongly connoting the current historical center.
The processes of expansion and transformation, the restructuring of the existing historical fabric, the construction of new roads as the "via del Popolo" or the extramural street, of new square as "piazza Prefettura" and "piazzetta duca della Verdura", of important public buildings such as the "Teatro Stabile", have certainly oriented the design and the development of the city.

1.2 The transformations: "via Pretoria" and district "Addone"

The work of historical investigation conducted starting with the examination of the poor mapping available is served precisely to stimulate a rethinking of the city and in particular on some areas of the ancient city. The historical centre is the place where, more than anywhere else you can grasp the complexity of urban relationships, where the multitude of functions and diverse sequence of spaces imply overlapping of forms and meanings offering a natural resistance to the schemes more mundane of the planning. A historical reinterpretation of the built need, therefore, to clarify roles and meanings, to correctly identify the traces of the past but also highlighting attendance survivors strangeness and anomalies in an attempt to provide all the elements needed for the reconstruction of urban identity.
Via Pretoria, the main street, named in the documents prior to the nineteenth century only as public street, through the historical center from west to east, perched on the crest of the hill, cut by a series of narrow streets, is lined with contiguous buildings, whose facades, while retaining their formal autonomy, often tend to zero in the return of a single curtain wall [6]. Here, more than anywhere else, has materialized that desire for a different city which, in different ways and in different historical moments, has contribute the alteration and modification of the original architecture.
To break the continuity that characterized have contribute the transformations of the nineteenth century, but also the building substitutions of the thirties of the twentieth century. This is the case, for example, of the block in the south of the "piazza Mario Pagano" entirely demolished, although it had one of the four city gates, to allow the construction of a building that, in the formal and typological plant, is absolutely stranger from the surrounding urban fabric. The height, the presence of a row of arcades on the ground floor, the materials used, create a sort of visual discontinuity, and contribute to alter the identity of the road. It is also the case of the building of the Bank of Italy in the same year that replaced the eighteenth-century "Palazzo Navarra", and that in a general widening of the street, is backlog built, thus interrupting also the alignment of street front.

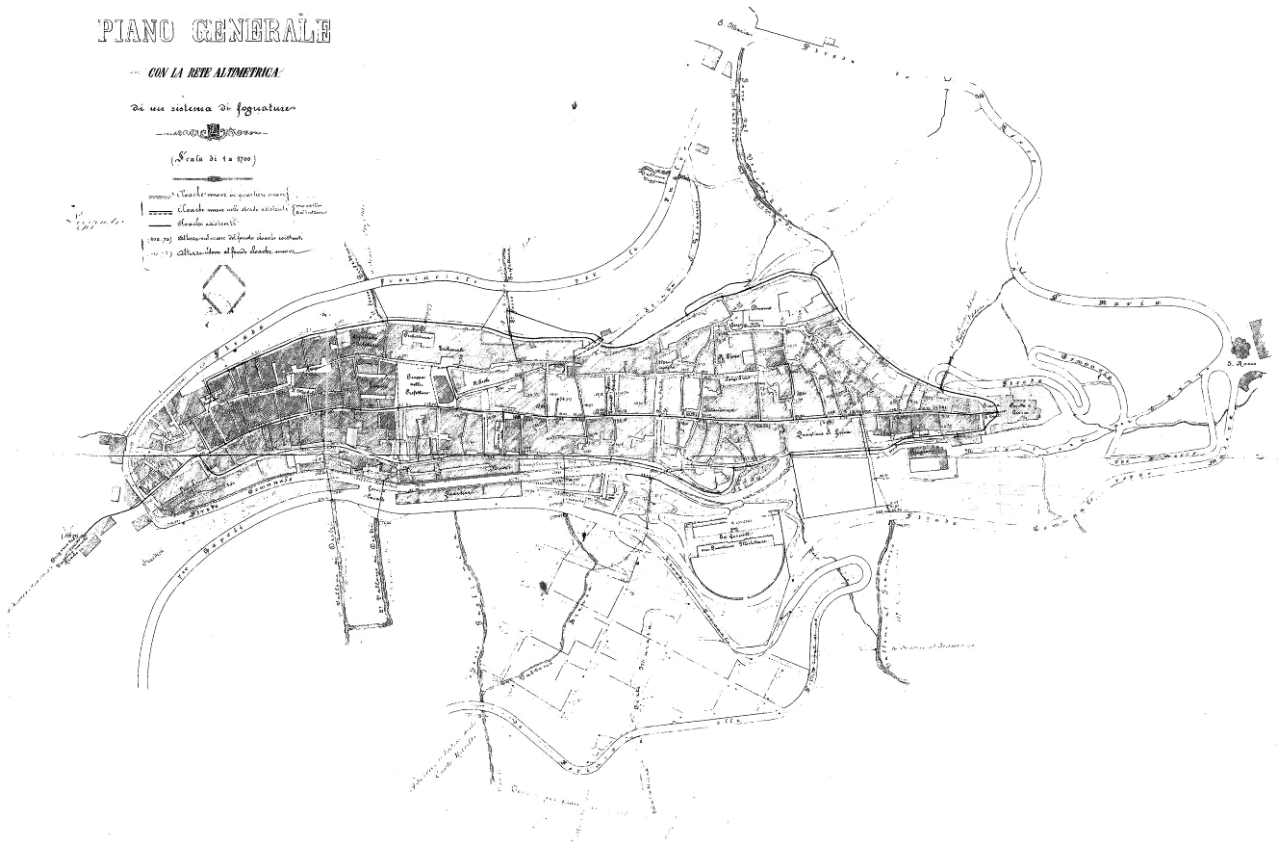

Fig. 2: General map for the altimetry web 1883 (from DE NUCCI Alberto, TOLLA Enza, 1988).

But elements of discontinuity are also the "gaps" caused by summaries expansions, as in the case of the Larghetto in front of the church of SS. Trinity, where the demolition of a built created only one space left over, cut just between two old houses and the entrance to an alley.
It is interesting to examine the signs of the Building Council regarding the refurbishment of the buildings performed especially after the earthquake of 1857. An examination of the projects submitted to the Commission and the notations written in the margin by the officials responsible for monitoring, can be found attention rather than on technical and constructive data on the formal aspects. The notations given concerns often need to observe certain symmetries in the openings of the buildings but also in relation to adjacent buildings, there are many notations on the type of balcony railings to be taken, on the cornices, on alignments. in the search for a "picture meaning" take sometimes borrowed from the stylistic repertoire of monumental decorative architectural elements such as pilasters, bases and rusticated to coat facades with precise will to connote the road on the basis of a renewed aesthetic canon.
Of course, the transformation process is continued in the next century, and there is no stretch of the road, where it is not possible to read heavy rehashes, since the elevations made from the mid-nineteenth century to the present, to the replacement building, the degradation of materials original building, hidden by improper interventions finishing, to the dismantlement of masonry arches that closed the opening of the shops operated from the 50s of the twentieth century to enlarge the shop windows. It is altered then, little by little the identity of a road entrusted mostly to small decorative episodes, to a few architectural elements: stone arches, portals, balcony railings. All this has tried to remedy with the interventions of recovery that followed the 1980 earthquake through a greater attention to the recovery and, in many cases to the redesign of the typological and architectural identity of the existing buildings on the street. This turnaround is perhaps in part also due to a new focus that citizens and scholars have had for the history and architecture of the historical center of Potenza city [7].
Different is the case of the district “Addone”. Here the transformation of a part of the city is realized through the complete replacement of the district building, causing the loss of an important part of the historical centre, replaced by a type of building totally in contrast to the neighboring type, materials, construction characteristics and dimensional relationships. This intervention has profoundly altered the design of the entire district, even for those parts remained intact, weakening the overall morphological structure and dismembering a system of relationships difficult to restore.
The district “Addone”, situated between the cathedral, the Via Pretoria and the castle, was characterized by a medieval road. The area, overlooked by the nineth-century interventions, in the early twentieth century had

precarious housing conditions; with the General Plan of 1928 and then with that of 1935 it was estimated the remediation. In 1956 the report of March 10, sent from City Hall to the Ministry of Power LL. PP., reports that "for the reconstruction of the district “Addone” not done anything concrete. The District, the city's oldest, is located at one end of the hill on which stands Potenza, between the Castle and the Cathedral. It consists mostly of rural houses of very little importance both for the amount (almost all to a plane or two) and for lack of maintenance. These huts are intensely inhabited mainly in the compartments located below street level (basements) almost all devoid of the most basic sanitation. All of the various plans, remained on paper without ever obtaining the approval, have always contemplated the complete demolition of the district for urban reasons but mainly for hygienical reasons. "
When the work of "restoration" is completed, the old district “Addone” disappears altogether, replaced by new buildings and a new road network, resulting in that part of the old town a break in the morphological and architectural continuity.
Even in the parts not directly affected by the demolitions will have a profound alteration space. In particular with the demolitions carried out in “Largo Isabelli” we have lost the spatial configuration and the original meaning of the entire urban area. The “Larghetto”, with the fifth of homes demolished, closed “Largo Pignatari” and served as a hub along the route that linked two major urban centers, namely the “Piazza del Sedile” and the Cathedral [8].

2. A method of cognitive investigation for the city’s reading and survey

The study of the existing architectural heritage - single architecture or whole town - can not be without a careful examination of documentary sources, which are a valuable tool for understanding the complex dynamics that have affected a man-made artifact.
Analyzing iconographic or descriptive documents means to grasp the genesis of architecture, in order also to develop a methodology with which to approach the object for subsequent direct surveys.
What was said is fundamental if the object of the study is a historic town, inhabited seamless for millennia - as in the case of Potenza - and where the building fabric has transformed adapting to the changing needs of those who have inhabited.


~ PIANTA DELLA CITTA' DI POTENZA ~
SCALA 1:2.000
RILEVATA NEL GIUGNO 1875 DALL'UFFICIO TECNICO DI FINANZA
Piazza Prefettura
Piazza 11 Agosto
Strada Provinciale
Strada Nazionale
Strada Comunale
Strada Ferrovia
Strada Garibaldi
Strada Meridionale
Strada Circonvallazione
Strada Appulo
Strada Lucana
Strada Vittorio
Largo Isabelli
Largo Duomo
Largo Cavour
Largo Sedile
Largo Pignatari
Largo Fontana
Largo Cairoli
Largo Mercato
Largo Fiera
Largo Fontana Vecchia
Largo Fontana Nuova
Largo Fontana Grande
Largo Fontana Piccola
Largo Fontana Piccola
Largo Fontana Grande
Largo Fontana Nuova
Largo Fontana Vecchia

Studing a portion of the urban fabric of the city involves a detailed knowledge of all the elements that compose it - buildings, urban spaces, road layouts, etc. - read individually and collectively, all aimed also to the understanding of the relationships that exist between the parties. It is therefore necessary to work step by step, subordinated and coordinated among them.
Knowing architecture means not stopping to read only the macroscopic aspects - which may be the geometry - but we need to be able to break down the man-made object, able to understand the relationships between the individual parts, and be able to reconstruct what were the dynamics that have led to the creation and any transformations of the same, or parts of this.
The phase of the operation pad is then the basis for analysis of a building or portion of a settlement that is so described in its simplicity or complexity.
With the historical-critical survey, you can determine the value of an architectural work, which is not easy when to be investigated is the building where minor must recognize the value of formal structures in which the form is not born as a product of intentionality artistic designer as happens in the monumental buildings, but is the consequence of the specific needs of the daily life of those who live there.
Initial anchor of a careful study is the research of archival material: written documents, drawings (plans, sketches, etc.) or old photos allow you to be able to approach the study of the historical artifact. Even the collection of documents not directly related to the building under study, but that affect the entire urban fabric where the same is located, or part of this, allows us to understand the dynamics of historical construction of the site in which it is realized.
The foregoing plays an important function when you can not locate a specific documentation on a single monument or building and, therefore, the understanding of the dynamics and evolution of the urban construction in which this site is the only key is access to the study historical documentary.
This is what happens to the child construction of which is difficult to find archival documents to it directly attributable.
With a critical approach have also read the sedimentary informations in the stone of the structures in high, which are counted by campaigns targeted relief, and conducted with direct methods. An outline methodology for data collection and analyzed the same, you will have a summary return of the sedimented informations.
From an initial review of archival and bibliographic material switches to a technical-scientific reading of the matter masonry and, therefore, to understand the dynamics and historical building that affected buildings. The archive shortcomings are so filled by a careful study of archeology architecture [9].
Studying and understanding the evolutionary and construction dynamics of a city or a monument involves having to rebuild their lives using the instruments of historiography.
In this study it is necessary to complement more traditional, as we have seen, a direct study of the artifact that will have an overview of the building and the context where it is hosted.

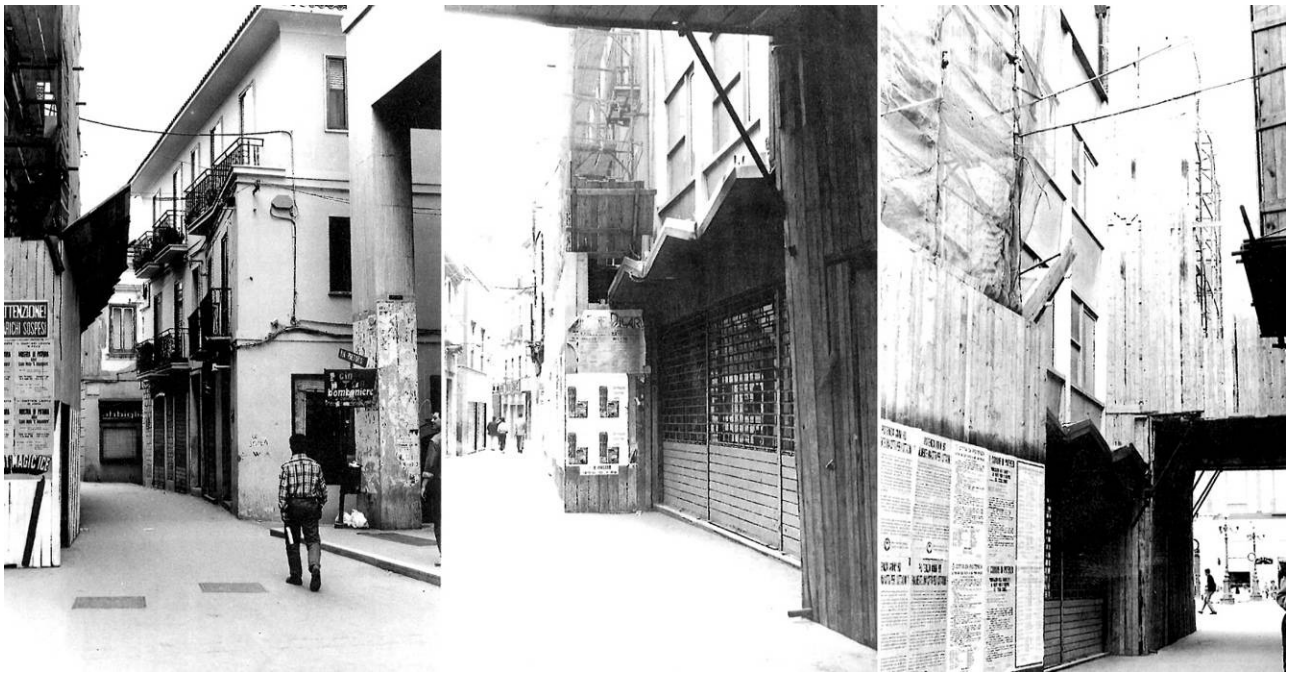

Fig. 4: Some particulars of via Pretoria after the earthquake 1980. (From DE NUCCI Alberto, TOLLA Enza,1988).

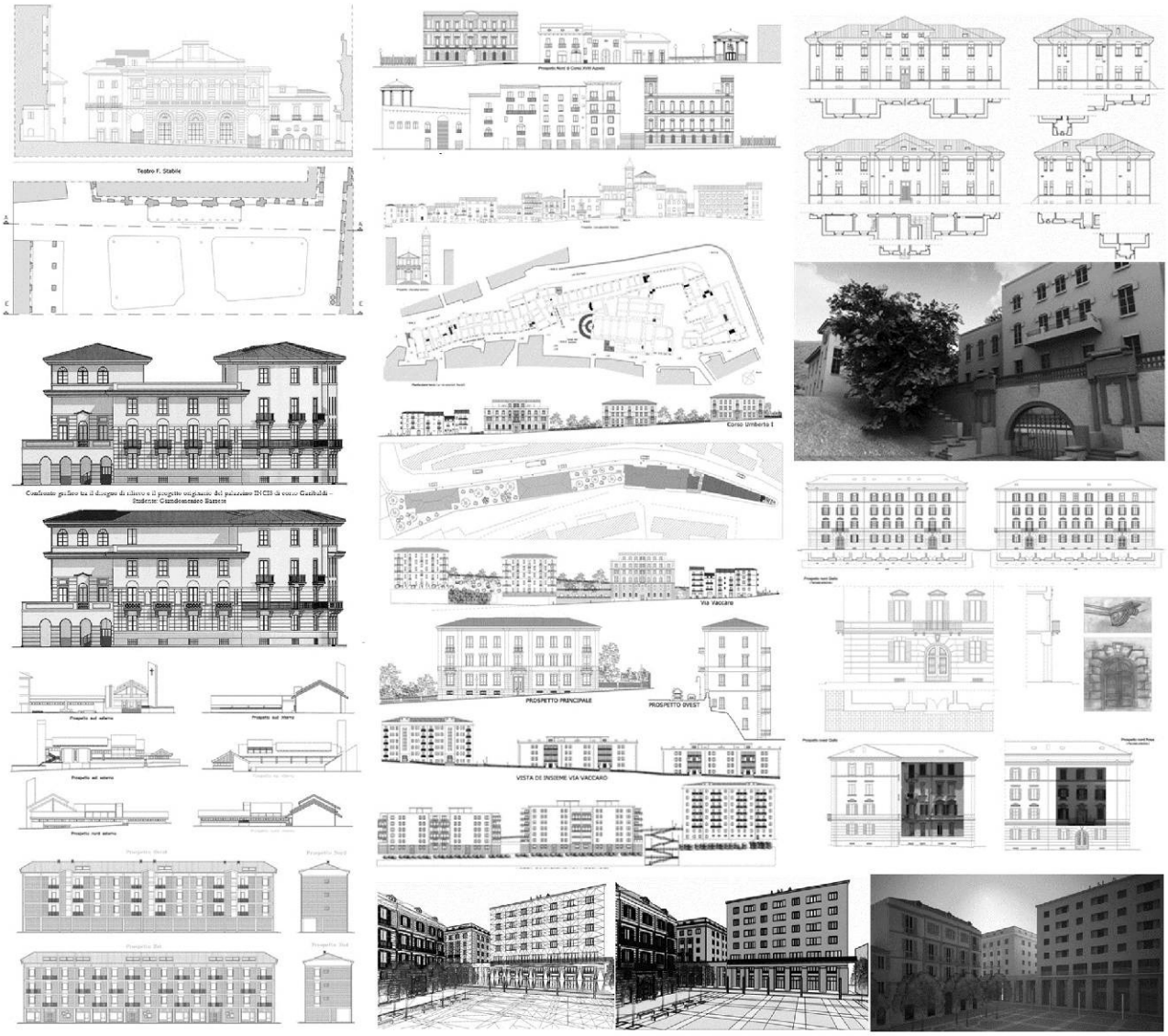

Fig. 5: Survey's drawings of some of the buildings (from TOLLA Enza, BIXIO Antonio, 2012).

In reference to the city of Potenza, and especially to "via Pretoria", it is evident that the study of the relevant documents the nineteenth century is fundamental to the understanding of the dynamics that have affected the city's historic centre.

"Via Pretoria", in fact, being the generator axis around the historic core, is several times over the past centuries to be the subject of major transformations that in many cases have permanently deleted the historical traces of the city.

The first important graphic production belongs to the nineteenth century when it is made, as mentioned in the previous paragraphs, a restructuring of the city became the capital. They are, however, mainly project papers - now collected in archival Council building of Potenza [10] - for renovations of existing buildings of which however is not documented the state of affairs. This does not therefore be able to trace the design of the city that had remained virtually unchanged since the Middle Ages, and of which we have received only some iconography very exemplified.

It is the aftermath of the devastating earthquake in December 1857 that the renovation of the city become systematic, leading to the definition of a new image of the historic city that is still possible to trace. Important changes - alterations or replacements buildings - will also operate throughout the twentieth century, and the city will change until the earthquake of November 1980.

The survey drawings executed in the aftermath of the last devastating earthquake become the new key to analyze the image of the historic city, and to understand how this - mutilated in parts - has modified over the centuries.



Fig. 6: Survey's drawing of a building on via Pretoria. The survey becomes an important document of the damages on the manufact after the earthquake of 1980 (from DE NUCCI Alberto, TOLLA Enza, 1988).

In conclusion we can say that the analysis conducted on the ancient "via Pretoria" in Potenza is an important example of how the design becomes an essential tool for the reconstruction of historical-philological historical realities, and as the direct analysis of the molded lead to understanding transformations that have affected the city by placing them in a precise timeframe. The architecture design thus becomes an important tool for the story.

Bibliographical References

[1] VIGGIANO Emmanuele. *Memorie della città di Potenza*. Napoli: Vincenzo Orsini, 1805.

[2] PEDIO Tommaso. *Potenza, dalla fondazione al XX secolo*, in *Storia Urbana* n. 14, 1981.

[3] TOLLA Enza. *Analisi e lettura delle trasformazioni ottocentesche nel centro storico della città di Potenza*, in *Disegno e immagine della città nell'Ottocento*, atti del seminario di studio giugno 1990. Trieste: Pre-print, 1990.

[4] RIVIELLO Raffaele. *Cronaca Potentina dal 1789 al 1882*. Potenza: Tip. A. Santanello, 1885.

[5] MOTTA Antonio. *Memorandum per il Centro Storico di Potenza*. Potenza: Archivio Lucano Studi Territoriali, 1981.

[6] MOTTA Antonio, PERRETTI Vincenzo. *Potenza, toponomastica ottocentesca.* Potenza: Edizioni Ermes, 1994.

[7] DE NUCCI Alberto, TOLLA Enza. *Via Pretoria. Didattica della rappresentazione per la rilettura della città.* Potenza: Zafarone & Di Bello, 1988.

[8] SOLETTI Adriana, CEROTTO Paolo, CONTE Antonio, TOLLA Enza. *Disegni di Potenza minore.* Perugia: Galeno, 1992.

[9] MUSSO Stefano F. *Recupero e restauro degli edifici storici. Guida pratica al rilievo e alla diagnostica* Roma: EPC Libri, 2004.

[10] ANGELINI Gregorio (a cura di). *Il Consiglio Edilizio di Potenza (1844-1861)*. Potenza: Edizioni Ermes, 1995.

[11] TOLLA Enza, BIXIO Antonio. *Un laboratorio per il rilievo*. Salerno: Edizioni Cues, 2012.

[12] BOFFITO Maura. *Il rilievo del tempo. Percorso di un lavoro rigoroso tra archivi e biblioteche*. Genova: Sagep, 1990.

[13] PACICHELLI Giovan Battista. *Il Regno di Napoli in Prospettiva*. Napoli: Stamp. M. L. Mutio, 1703.

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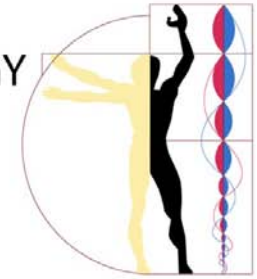

REFERENTIAL INTERPRETATION OF VERNACULAR HERITAGE IN RECENT ARCHITECTURAL DESIGN

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Abstract

This research is designed to look for the influences of vernacular heritage in contemporary architecture, using different design actions**; imitation, bricolage**, **analogies, interpretation and mimesis**. In order to search for the possible effect of vernacular heritage on contemporary architectural practice, seventeen cases have been analyzed with interviewing architects. The data collection method has been chosen carefully and applied in several different ways: literature review, digital documents, observations, sketches and scaled drawings; semi-structured interviews with the designer in order to catch their intentions in case studies. The result of the research showed that the Anatolian vernacular archetypes are being used by the architects in their practices via different level of referential interpretations, design actions. The research goes beyond simple subjective observations of using archetypes; this has been achieved through the development of framework for the systematic classification and analysis of a range of reference types and used both in the interpretation of visual material and in the analysis of documentary sources and interviews with architects. The intentions of each architect have been identified in case studies.
Keywords: Imitation, Bricolage, Analogy, Interpretation, Mimesis

1. Introduction

How do architects generate architectural form? How do we explain the origin of styles or the persistence of tradition and the role of genius [11]. This presentation, which is based on a research that has been done at Salford University that have been tried to explain the role and influence of vernacular architecture in contemporary architectural design. The concept of "**primary form generator**" is not a new one [6]. Darke used it in 1970's. Rapoport (2006) has taken vernacular design process as a model and also the vernacular buildings are taken as a base for new solutions in architectural design.

In this research, the aim is to look for how to use Anatolian **vernacular archetypes** [25] and their possible reflections in contemporary design. Anatolia has a rich heritage of buildings from its many past civilizations. Contemporary architects often draw upon this heritage in their work in a variety of ways. Whilst at a superficial visual level the influence of traditional building may be obvious, its influence at a deeper level, on the thinking and design practice of architects is less well understood. It is this deeper level of influence that this presentation attempts to explore [6]. One of the most interesting areas to be considered in terms of vernacular architecture in the world is that **Anatolia,** perhaps it is the source of many civilizations and cultures. Anatolia (as known as Asia Minor) is a cultural melting pot and therefore its vernacular architecture reflects its mixed cultural heritage. "With its varied geography, the natural wealth of its soil and its favorable climatic conditions, Anatolia has been a region marked by nature for the

birth, growth, and development of the earliest forms of human civilizations" [8]. Vernacular architecture, which is evolved as a response to the natural and cultural context for ages, has certain potential to be applied in the recent architectural developments [17]. In this respect, there are several ways and styles utilizing vernacular heritage from different point of views [2].

2. Vernacular Archetypes as form Generator; From Imitation to Mimesis

In the twentieth century, especially from the period of the end of the consensus view of modernism, architects have once again begun to use historical references but in a different way from that employed by their eighteenth and nineteenth century predecessors. In this period, architects have been more reflective in their interpretation of the past. "Architecture goes through dynamic progression and development. Modernism, in turn, provoked a reaction from Post-Modernists from the 1970s that argued against its blandness and once again began to refer to historical and vernacular cultures in order to express themselves with a new image and identity" [1]. "Graves' ability to transform sources springs from his ability to draw. His notebooks are filled with many quick sketches, referential drawings of historic and vernacular buildings, which are abstracted and then combined in new ways. In a sense, he creates by elaborating pre- existing motifs until they look fresh, and fitting to the new context, but they always carry over some memories of the past" [13]. The new interest in historical reference stems, at least in part, from the failure of Modernism to cope with the "complexities and contradictions" of the contemporary living [26]. Modernism's lack of "meaning" was conducive to the spread of design criteria that gave priority to communicative values. The plurality of community life threatens to overthrow the homogeneous identity of traditional spatial conceptions.

In architectural design, there are several approaches for referring to the historical environment. These are **imitation, bricolage, analogy, interpretation and mimesis.** Cavdar (1990) suggests that, time and space transcend the boundaries of the present and reach out to the complexity of history, culture and mythology. Cluster of history, culture and mythology disorderly forms "images". The images generated from collective memories of society, as well as architectural languages formed from these images in relation to the social realities, are richer than the minimalist approach of "Modern Architecture". Here, the task of the architect is to bring new and original combinations to the language with generally meaningful forms.

There are five different types of concepts and approaches to the interpretation of vernacular architecture available. Theorists, like Broadbent (1973), Rowe (1987) and also Lawson (2006) are the pioneers in the use of these types of concept in the literature of the theory of architectural design. Not much research involving the observation of architectural design process has taken place due to the difficulties of the satisfactorily observing and recording design activity. This presentation tries to bring together different concepts under the general headline of '**design actions'**. These design actions are classified as it can be seen below; [2], [8].

Imitation	Total imitation Partial imitations
Bricolage	Total Bricolage Partial Bricolage
Analogy	Iconic Canonic
Interpretation	Formalist Interpretation Typological Interpretation
Mimesis	Historical figures Mythological events Cultural and social events

2.1. Imitation

Architecture is one of the most repetitive genres in the art. "Repetition of a model is always a key issue in architectural activity" [27]. In this respect, imitation can be accepted as one of the basic concepts of this repetition. Imitation is that which is made as a copy that direct or partial resembles an archetype, which had been previously experienced, there is no inspiration; it is a direct copy and paste action. Stern has explained this issue using the phrase: ''Copying is what a Xerox machine does; imitation is what an artist

does” [23]. Imitation can be applied direct i.e. whole part of the original of main source or partial i.e. some part of the source; it is the most primitive way of referencing to vernacular architecture. As it can be understood from the name, imitation is a direct copy without any interpretation, neither from history nor from vernacular architecture. One of the extreme examples for the imitation in terms of copy and paste could be the imitated Ronchamp in Zhengzhou, China [8] (Figure 1).



Fig. 1: Sample for Imitation, Ronchamp Chapel which is designed by Le Corbusier and the imitation copy of Chapel in Zhengzhou, China. Photo: The Guardian.

2.2. Bricolage

The use of the term “Bricolage” in a cultural context came through the French anthropologist Lévi-Strauss (1972) who used the word “bricolage” to describe any spontaneous action, further extending this to include the characteristic patterns of mythological thought. In this study’s context, bricolage recombines, reuses, and reconstructs similarities such as proportional systems, shape and figure, the setting of facade in size and shape as window framing, opening systems, overhanging balcony (cumba) and roofing systems, etc. which are the vernacular components of built forms. Generally, buildings designed through this interpretation express a sense of theatre since the façade is the focal point. Familiar vernacular images are merged to obtain the desired meanings and ambience. Bricolage can occur by the way of using different and unrelated materials, which are taken from vernacular architecture and used on the façade. So, bricolage means to set one façade or one news partial organization with various vernacular figures and patterns. Here, it is a necessity to explain that it is possible to observe other design actions with in bricolage. This shows that, most of the time it may not be possible to have a sharp border between these design actions and the definitions may overlap. Each pieces of bricolage can also be an imitation, because, in the nature of bricolage, different “ready-made” pieces come together to create the whole, so each of these pieces may have other design actions as well, according to the designer’s intention [8].

Mega Saray Holiday Village can be given as an example for bricolage which is built in 1996, in Antalya by Cavdar (Figure 2), where designer has used different types of vernacular archetypes from different architectural identities, such as classic Roman arches, Ottoman archetypes [2], [8].



Fig. 2: Sample for Bricolage, Mega Saray (Palace) Holiday Village designed by T. Cavdar. Photo: Zafer Erturk

2.3. Analogy

Chilvers et al. (2001) defines analogy as; “a comparison between two things, typically on the basis of their structure and for the purpose of explanation or clarification: an analogy between the workings of nature and those of human societies”. Architects and designers have looked to biology for inspiration since the early 19th century. There are some cases where analogy is drawn from vernacular archetypes. In these cases, the analogy seems to get close to the meaning of “imitation”, but analogy has to be distinguished from it. “Comparing analogy with imitation, the former is more operative and sophisticated, while the latter

is more direct, straight forward and obedient" [14]. Analogical interpretation can use a particular vernacular archetypes and it is the association by reviewing and detecting of relations between what had been done before and the newly experienced. In Architecture, there are different types of analogies. Authorities such as Collins (1965), Rowe (1987) and Steadman (2008) have classified analogy in many ways; these are biological analogy, analogy from nature, organic, anatomic, symbolic, etc. Broadbent (1973) has taken a slightly different perspective on analogy classifying it into two main groups; canonic and iconic.

2.3.1. Canonic Analogy

Canonic analogies have as their basis "ideal" proportional systems or formal geometric properties. They are usually manifested as somewhat abstract geometrical patterns and shapes. Broadbent (1973) defines canonic analogical design as follows: "it is either repetitive, which also supposes exact analogy, or it depends on the use of drawings –the canonic grid, and other design analogues for the buildings". In the vernacular context, canonic analogy is based on the principle of geometry. **Taşlık Kahvesi** "Coffee House", which is designed by Eldem in 1947, is an example for canonic analogy. In this example, architect has been inspired by one of the oldest timber buildings in Istanbul, Amcazade Hüseyin Paşa Yalısı that is built in 1699. Geometrically, both building has similarities, such as window proportion and solid/void proportion (Figure 3).



Fig. 3: Example for canonic analogy, Amcazade Yalısı on the left, built in 1699 and Taşlık Kahvesi on the right, built in 1947 by Sedad Hakkı Eldem. photos: Chamber of Architects, Istanbul

2.3.2. Iconic Analogy

Broadbent (1973) suggested, "Iconic design, clearly, is a type of analogy". In vernacular architecture, there are lots of archetypes that have been accepted as icons and these can be in the nature as well. In our nature, there are lots of objects that can be used as a source of inspiration. "In his work, Le Corbusier showed the instinctive prescience of genius by turning up wherever new things were being done, or wherever a stimulating relationship to a bygone era could be established. Le Corbusier always looked for the experiences of former times in his travels and he was equally interested in crystalline Greek forms and in the forms of Roman vaults or Islamic and Gothic Architecture. His search for inner similarities had nothing to do with art history: it embraced the experiences of the entire architectural development. It is no accident that the tower of Ronchamps has been compared with a primitive cult (Figure 4) structure" [12].

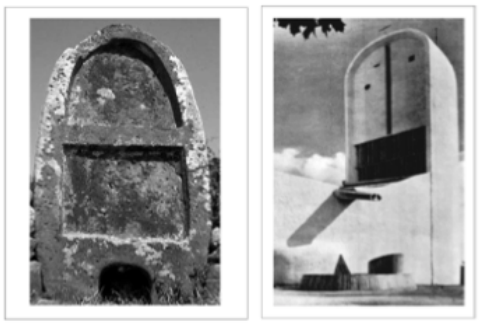

Fig. 4: Tomb of Giants, Sardinia and Tower of Ronchamps designed by Le Corbusier. Photo: Wandererseye and Giedion (2008).

2.4. Interpretation

Interpretation is everywhere in architecture. It is the basis of architectural creation [21]. In this study the interpretation will be divided into two main types: **formalist** and **typological** interpretation [2], [8].

2.4.1. Formalist Interpretation

This is primarily concerned with the formal composition of a building. In this interpretation, the design's formal resemblance to vernacular architecture is essentially with the visual appearance of the façade rather than original function of the building. The entrance portal of the Kempinski Hotel can be given as an example for this type of interpretation; the archetype or interpreted source is from Seljukian Architecture, Mosque of Sultan Han in Kayseri, 12th Century (Figure 5).



Fig. 5: *Entrance Portal of Kempinski Hotel in Antalya (left) and Mosque of Sultan Han built in 12th century in Kayseri, Turkey. photos: Eren & Branning*

2.4.2. Typological Interpretation

The essential principles of spatial configuration and its reflections on both plan organization and façade composition is traced in designed buildings. Atac Residence (Figure 6), which was designed in 1985 by Cansever, is an example of typological interpretation. Classical Ottoman timber houses type are the influence of this design, with the adapted classic overhang or "cumba" which is wooden latticework projection extending from the outside of a house window, on the elevations of the Atac summer residence. The result of interpretation as a design action could be concrete or abstract. Also subjectivity in judgment, whether it is an interpretation or not, can be low or high. On current example, which is Atac Residence, is a concrete interpretation; it is acceptable as an easy to investigate and low subjectivity in judgment.

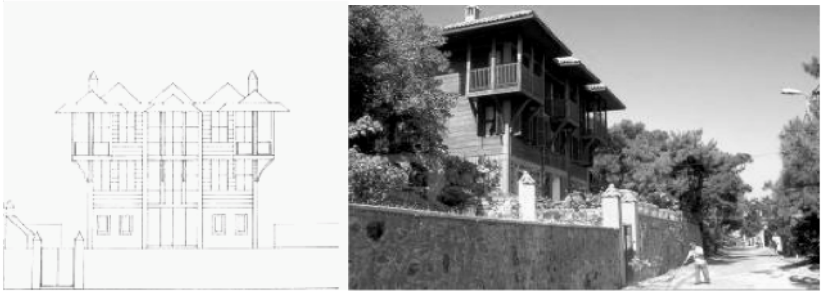

Fig. 6: Example of Typological Interpretation, Atac Residence. Photo&drawing: Archnet.

2.5. Mimesis: As a Cultural Practice

"The term mimesis has long been used to refer to the relationship between an image and its 'real' original. However, recent theorists have problematized and extended the concept, allowing new perspectives on such key concerns as the nature of identity." [18]. The concept of mimesis is more familiar in arts such as painting and sculpture, than in architecture; according to Puetz (2002) the concept appears first in the Greek world. Mimesis is the name of the action itself and in this study it is taken as a design action. Architecture, along with the other visual arts can be viewed as a potential reservoir for the operation of mimesis. Gebauer's and Wulf 's (1995) concept of mimesis does not define itself as imitation. However, it nonetheless recognizes the insidious ambiguity in the word mimesis, which at once advances the concept

of a “thing-like copy,” and which “might also refer to the activity of a subject which models itself according to a given prototype” [22]. In architecture, mimesis is the use of mythological or historical phenomenon as a base or starting point in architectural design. In every action, there is a degree of interpretation in conceptualizing of an archetype or an event or phenomenon. Cavdar (1990) states that, “It is about inspiration from something else, such as a miniature, a painting, a concept or mythology”. In fact, it is not the imitation of the solid or conceptual basis of an existing form in the vernacular heritage. It is possible to find a lot of research on ‘mimesis’ in performing arts and painting, but in architecture it is not easy. An example of mimesis in architecture can be given from Eren, who has designed the Phaselis Holiday Village. Eren stated that the Sphinx inspired him while he was designing the entrance of administration building (Figure 7). In this example, as it can be observed, there are not strong similarities between the mythological figure and the entrance of administration unit. The intention of the designer was beyond that; according to the designer, his aim was “to accept and hug the guests with two arms of Sphinx” [7].

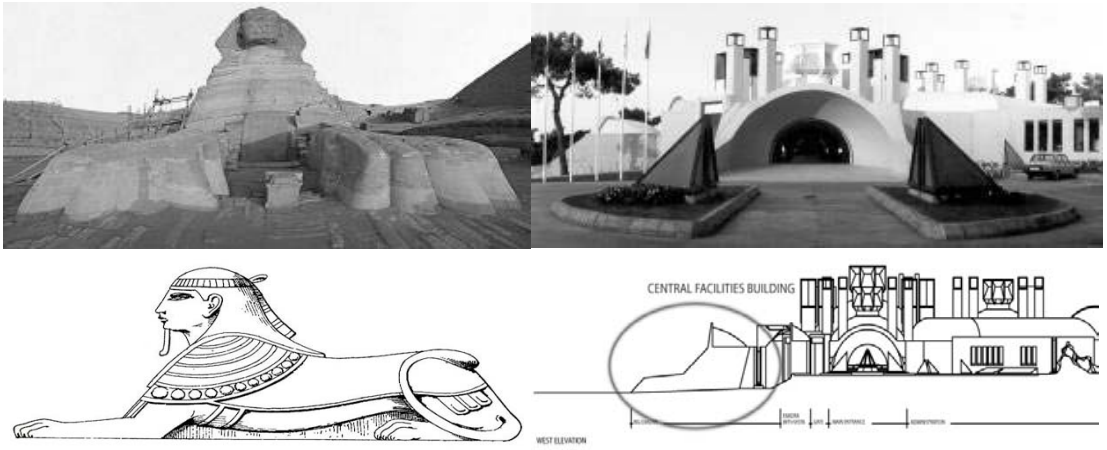

Fig. 7: Sphinx and Administration unit of Phaselis Holiday Village with Section of the Administration unit and the Profil view of the Sphinx, designed by Cengiz Eren, in Kemer, Antalya, Turkey

Definitions of all these actions and the given examples in the previous sections showed that researching the way in which vernacular elements or archetypes used could be easy or difficult. Moreover, subjectivity in judgment could be low or even absent or it could be very high. For example, detection of imitation is easy, because it is the copy of existing archetypes involving almost no subjectivity, so some of the extreme examples of imitation may be concrete. On the other hand, in the detection of mimesis, there is high level of subjectivity; even the designer him/herself may not easily make a judgment as to whether it is a mimesis or not, so some extreme mimesis samples may be abstract. So, in between the imitation and mimesis, the result of design actions such as bricolage, analogy and interpretation could be abstract and concrete that is overlapped as illustrated in Figure 8 [8]. This is very usual natural consequence of the design activity in which there is no border in these mental and also intellectual activities.

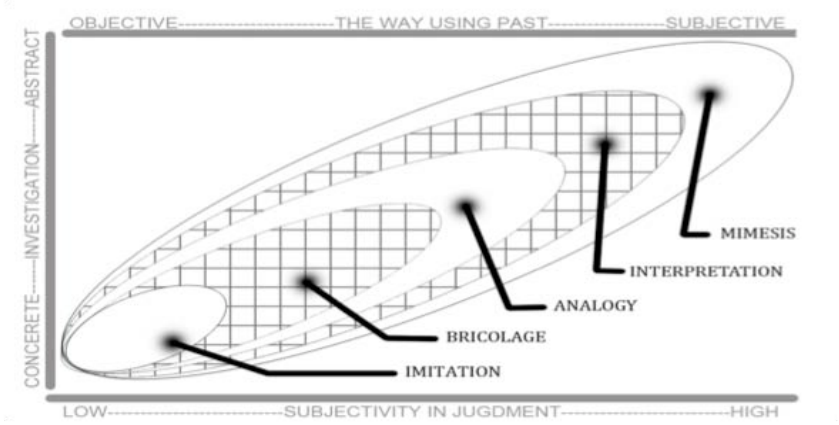

Fig. 8: Design actions, in terms of level of investigation and subjectivity in judgment.

3. Research Design

The main aim is to establish the existence of the different design actions and possible use of the vernacular archetypes and for these observational types of research tools are designed. These observational types of research techniques include interviews and site inspections and literature review. The method adopted is a qualitative research one based on a number of case studies. Case study is " used to research and experimental theory or topic using set procedures, often comprising several different combinations of data collection such as interviews, documentary evidence and observations where the emphasis is towards investigating a phenomenon within a context" [9]. Case study type of research is commonly based on "the use of triangulation in using three sources of evidence methods" [27]. Yin (2003) explains the history of case study as follows: "during the latter decades of the 20th century, case studies of specific programs, projects, initiatives, or sites also became an integral part of evaluation research". There are some considerations that have to be given by researchers. These considerations have been stated by Proverbs and Gameson (2008) as; time availability to carry out the investigation, availability of documentary information which can be such as drawings, images, published documents, literature, etc., access to persons involved (e.g., interviewing purposes), aim or trust of the investigation will determine the focus of the data collection techniques and their significance to the study and number of cases which can be changed according to the each unique study. The research design of the current research has been divided into two studies, which are desk studies and empirical studies. Desk studies include a literature review on vernacular architecture in general and with a particular focus on Anatolian vernacular environment, development of contemporary Turkish architecture and tourism architecture, interpretation in architectural design, possible design approaches and actions. Literature review on research methodology and possible data collections method will also be included in the desk studies. The empirical studies will include the case studies. The data collection methods and the analyzing of these collected data will be the main part of empirical study. There are three data collection methods that have been used, these are, site visit (observation), interviews, and data that can be found on literature. During the empirical study, there will be always a connection with the desk studies to have a wide range of literature review, because the findings from interview may require more literature review in order to analyze the data. All collected data will be analyzed in order to determination of the possible effects of vernacular archetypes and intended design actions. After all these processes have taken place, discussion of possible effects of the vernacular archetypes will be done. Finally, in the conclusion part, in addition to the suggestions for future work, overall evaluation will be done.

4. Case study and Framework

Initial selection of case studies has been made using the following criteria: Projects based on a national or international design competition and projects introduced in any national or international journals of architecture or design. Projects designed by the most popular or forward-looking architects of the country. Initial selection resulted in more than two hundred projects. Fifteen architects and fifty projects have been selected. This selection has been done on several criteria. In fact there are lots of projects due to the recent popularity of the region, the number of new tourism settlement are increasing every day. But the architectural quality, in term of design is sometimes not high, although new construction technology and new materials have been used. In the selection process the criteria have been the quality / the initial design ideas and to be subject of the any critics and/or publication. On the other hand, of course availability of data and access to the project played important role in selection process. Club Phaselis Holiday Village which is designed by Cengiz Eren, has been selected as a case pilot case study,

One of the most discussable points is how case study framework is going to be used to analyze the selected case study project. This point will be realized in four levels:

- Site visit of the selected building in order to point out possible use of the different archetypes.
- Discuss the result of the site visit with the designer during the semi-structured interview.
- Discuss those points with designers on projects, films slides and all other visual materials during the interview.
- Make the conclusion and consensus on the possible use of archetypes and actions.



Fig. 9: Case Study, Club Phaselis Holiday Village, 1984-1988, Kemer, Antalya, Turkey.

5. Conclusion

As stated in this report, Anatolia has one of the richest architectural heritages of the human race. Therefore, she gives us an extraordinary opportunity to have an extensive vocabulary to use in creating new and original images towards new combination of forms. Furthermore, the case of Anatolia gives a meaningful message to human beings that different civilizations and cultures could exist on the same land respecting and affecting each other without destroying other's monuments. The design vocabulary, which is delivered by the hybrid structure of Anatolian heritages, is the unique design language that combines and integrates the vocabulary of various civilizations and also religions in one. In this present research, a new methodology has been introduced for the analysis and interpretation of Contemporary Turkish Architecture and the data for this case study come from Anatolia, a crossroads of numerous civilizations, and from literature.

The pilot application of the method has showed that the techniques are quite adequate for the purpose the study intended to achieve. All connections between historical motives and referential interpretations are subjective. Therefore, for more objective interpretations, more detailed research studies are needed for the Anatolian heritage.

Post-Modernism is an individual interpretation in order to reach a new identity in architecture; therefore, to put forward the rules and principles of the style is almost impossible as a contrasting attitude to Modernist. Accepting this reality as a starting point, we should admit that each case is a unique situation and there will be no generalizations.

It is important to emphasize that the result of this study with its suggested method is open to discussion. To be able to evaluate the result more clearly in such an architectural study, further study can be done by architectural researchers. There are lots of academicians who deal with the idea of "interpretation of the past", but it is not enough. It is a necessity to have more studies on this subject, especially in with the context of the modern hegemony of globalization in our life.

Finally, It should be stated that, the past has not been a chain of continuous successes. History has given us successful and unsuccessful examples of buildings and settlements. But the successes and failures can both provide lessons for what should be done in the future to be able to conserve our traditions within the contemporary styles. Today one of the most important duties of designers, in terms of the future, should be to protect, and benefit from, the past without freezing the human life, time and flow of history. Not only keeping the traditions in architecture as they are, but also improving and integrating them with today's developments in architecture.

References:

[1] Anderson, S., 2005: The Vernacular, Memory and Architecture, in M. Umbach and B. Huppauf (eds), Vernacular Modernism: Heimat, Globalization, and the Built Environment, California: Stanford University Press.

[2] Aslan, E., Erturk, Z., Hudson, J., 2012: Historical References in Architectural Design with Special Emphasis on Anatolian Vernacular Architecture: A Study in Turkish Tourism Architecture, LAP Lambert Academic Publishing, Salford, UK.

[3] Broadbent, G., 1973: Design in Architecture: Architecture and the HumanSciences. London: John Wiley & Sons.

[4] Chilvers, I., et al., 2001: The Oxford Dictionary of Art. 2nd ed. Oxford ; NewYork: Oxford University Press.

[5] Collins, P., 1965 Changing Ideals in Modern Architecture, 1750-1950. Faber.

[6] Darke, J., 1978: The Primary Generator and the Design Process, in W.E Rogers and W. H Ittelson (eds), New Directions in Environmental Design Research: Proceedings of EDRA 9, 325-337.

[7] Eren, C., 2009: Interview with Cengiz Eren. In: Istanbul.

[8] Erturk, Z., Aslan, E., Hudson, J. and Erturk, S., 2011: Proposal A Design Methodology: Learning From Past, Architectural Design Between Teaching and Research, Rete Vitruvio, Bari, 645-654.

[9] Fellows, R. and Liu, A. (2008) Research methods for construction. 3rd ed. Oxford: Wiley-Blackwell.

[10] Gebauer, G. and Wulf, C., 1995: Mimesis : Culture Art Society. Berkeley: University of California Press.

[11] Gelernter, M., 1995: Sources of Architectural form A Critical History of Western Design Theory. Oxford: Manchester University Press.

[12] Giedion, S., 2008: Space, Time and Architecture : The Growth of a New Tradition.[5th] ed. Cambridge, MA ; London: Harvard University Press.

[13] Jencks, C., 2002: The New Paradigm in Architecture: The Language of Post-Modernism. London: Yale University Press.

[14] Kawamichi, R., 1988: Analogical Design: A Study of Analogy in Architecture,Part 1. Journal of Architecture, Planning and Environmental Engineering.,(385): 95-102.

[15] Lawson, B., 2006: How Designers Think : The Design Process Demystified. Oxford: Architectural Press.

[16] Mellaart, J. (1965) Earliest civilizations of the Near East. Thames & Hudson: London.

[17] Oliver, P., 1997: Encyclopedia of the Vernacular Architecture of the World.Cambridge: Cambridge University Press.

[18] Potolsky, M., 2006: Mimesis: The New Critical Idiom. New York: Routledge.

[19] Rapoport, A. 2006: Vernacular Design as a Model System, in L. Asquith and M. Vellinga(eds), Vernacular Architecture in the Twenty-First Century: Theory, Education and Practice, New York: Taylor&Francis.

[20] Rowe, P. G., 1987: Design Thinking. Cambridge, Mass. ; London: MIT Press.

[21] Snodgrass, A. and Coyne, R., 2006: Interpretation in Architecture Design as a way of Thinking. New York: Rou8tledge, the Taylor & Francis Group.

[22] Spariosu, M., 1984: Mimesis in Contemporary Theory : an Interdisciplinary Approach. Philadelphia: J. Benjamins Pub. Co.

[23] Spivack, G. J., 1985: Architecture and Imitation. New York: The NY Times.

[24] Steadman, P., 2008: The Evolution of Design : Biological Analogy in Architecture and the Applied Arts. London: Routledge.

[25] Thiis-Evensen, T., 1987: Archetypes in Architecture. Oxford: Norwegian University Press.

[26] Venturi, R., 1988: Complexity and Contradiction in Architecture. [2nd] ed.London: Butterworth Architecture.

[27] Yin, R. K. (2003) Applications of case study research. 2nd ed. Thousand Oaks ; London: Sage Publications.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Teaching and Practice of Architecture in Recife (Brazil)1959 – 2009.

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Abstract
The thinking of architects from the city of Recife in the past 50 years has gone from a building-centered debate to a city-centered approach.
In this period we watched a rearrangement amid the professional practice and the academia where the spotlight was to the gap between the fields of urbanism and architecture. Next, in this century, we watched a sort of merger between these two courses, and its name can be condensed into the idea of the urban design.
The background of these changes is a fast growth in the amount of professionals in Recife, as well as the depletion of job opportunities in the building design sector and also the rapid scarcity of available areas for new projects in the city. This scenario has led to an increase in new projects in historical areas of the city, and with that - in a kind of counter movement - to the creation of an awareness in favor of the historical heritage of the city.
In this 50-year period, we will show how the curricular structure of the Architecture Program of UFPE starts to abolish the courses of *urbanism* and *architecture design* and places them together now, in a common axis called *integrated workshop* - with an *interdisciplinary* approach focusing the *city* and no longer the *building*.
Such conceptual change takes place at the same time that architects - previously divided into *urbanists* and *building architects* - start occupying the same areas of professional representation.

Keywords: Architects, city, building, architecture teaching, urban project

1. Architecture teaching and practice in the 20th century.

In the 1930's, Recife launches the first official program for education in architecture: the architecture program of Escola de Belas Artes de Pernambuco (Fine Arts School of Pernambuco) - EBAP and the engineering program, that was part of the Escola de Engenharia de Pernambuco(School of Engineering of Pernambuco) and where the architecture courses would be taught. Notwithstanding the education in architecture was divided between the areas of Fine Arts and Engineering, in the case of Recife, engineering would not have the same weight it had in the state of São Paulo, where, for instance, besides the Escola de Belas Artes (Fine Arts School), the Escola Politécnica (Polytechnic School) and the Escola de Engenharia Mackenzie (Mackenzie School of Engineering) would qualify "Engineers-Architects".
The reference for the under graduation of architects in Recife would be, then, the Escola de Belas Artes de Pernambuco, where architects would study along with painters and sculptors. That would provide them with a more artistic type of qualification.
The architects remained at Escola de Belas Artes until 1959 when they finally founded the Faculdade de Arquitetura do Recife (School of Architecture of Recife) - FAUR, subordinated to the former Universidade de Recife (University of Recife)[1]. Shortly before that, in 1951, the group of pioneers in architecture had founded the first professional association of the category: the Department of Pernambuco from the Instituto de Arquitetos do Brasil(Institute of Architects of Brazil) - IAB/PE.

The time when the IAB-PE and the new program were founded coincided with a golden decade for Brazilian economics and the architecture, once they happened along with the consolidation of architectural modernism in Brazil and with the construction of the city of Brasília, the greatest expression of our architecture and of the work of Oscar Niemeyer.

This is to show the optimistic climate in the beginning of the profession and also the absolute agreement on the modern language of architecture - in a moment when the USA and Europe were starting to criticize modern architecture and urbanism. This situation also explains the strength and endurance of the modern language in Recife's architecture metier, something ordinary in Brazilian architecture, in our opinion.

What we see in the begining of the profession in Recife is a cohesive strength that bonds this professional group, either in terms of aesthetic language as in the same sociological background of the professionals. They were from the middle class, and belonged to the same age group, including professors and students, once it was common for a student to engage in teaching right after their graduation. It is worth noticing that back then there were no distinctions between academic and practical professionals. They would all work on both activities[2]. All these sociological circumstances push even further away any possibility of introducing new ideas that would scape the hegemonic mindset: modernism.

Moreover, the characteristics of a vast city, with traits of a metropolis, even in the 50's, and that back then starts abandoning its historical core of origin - the neighborhoods of Santo Antônio, São José and Recife - towards vast territories with few constructions and little historical reference, are seen as factors that may have inflated the natural trend of rupture and abstraction that inhabited the aesthetical mindset of the modern movement.

So, just like the professional practice - where constructions were raised in vast free areas with few historical references built there - the themes studied by professors and students showed a trend towards designing on empty lots without neighbors as a reference. That is why we can state that, in professional practice as well as in teaching, architecture (buildings) appeared isolated on the lot, and thus we can say it was apart from the city (neighbor houses, consolidated urban life, etc).

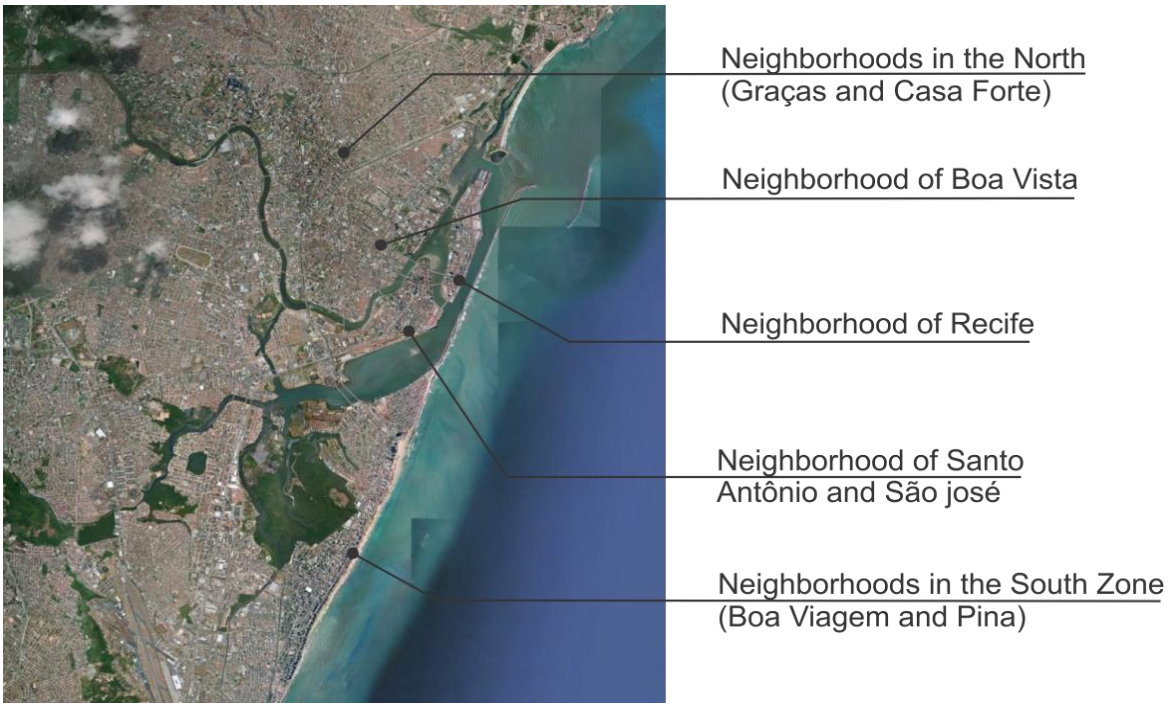

Fig.1: Recife territory. Source: web: http://www.googlemaps.com (Captions by the author)

In fact, from 1959 on, with the foundation of the first architecture school of Recife and until the 1990's, we see a progressive separation of the field of teaching *architecture* (buildings) from the *urbanism* as they became two courses that barely communicate with each other. In the field of professional practice, from the 70's on, the fast growth of available professionals [3] and the diversification of job opportunities would cause a strong split in the professional metier. On one side were the building architects and on the other, the urban planners. This occurred especially after the creation of major urban planning agencies [4] and of the Master Program in Urban Development, by UFPE in 1972.
Urbanism - that at Escola de Belas Artes dealt with the aesthetic treatment of squares, parks and streets - would then represent the *urban space* through index and activity zones (zoning) and would drift apart from the debate on the *buildings.* In the field of design (architecture), the *buildings* were into the spotlight whereas the *urban space* seemed to have been totally forgotten. The architecure of the buildings seemed to use itself as a reference to the point that in architects' sketchs everything that was*non-building* fully disappeared and when they did not disappear they were simplified and above all, *naturalized.Nature* (green areas, the beach and the rivers) did exist, but humanized *urban space* did not.

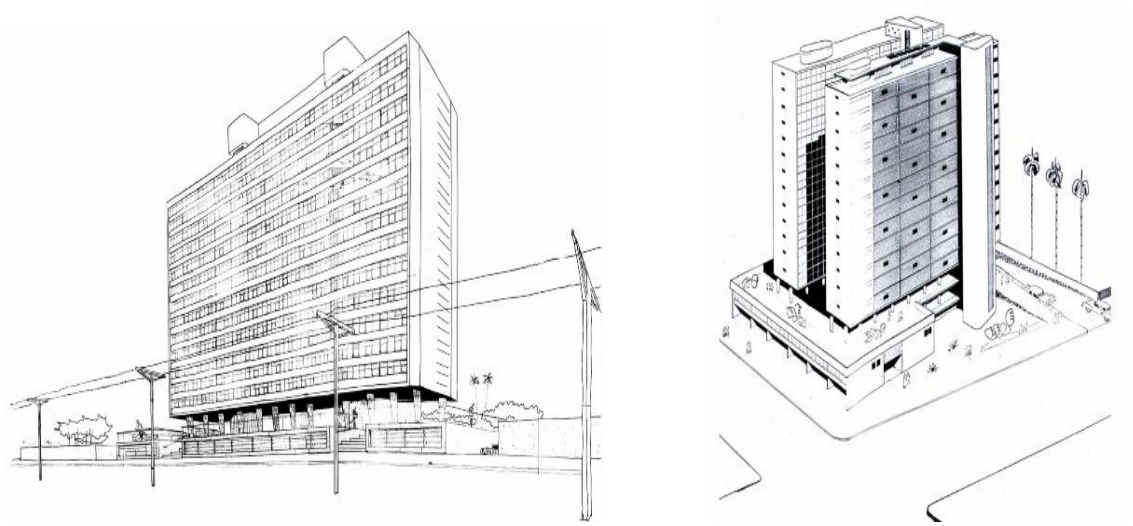

Fig. 2: Designs from architectures of Recife: to the left (1957) and to the right (1956). Source: NASLAVSKY(2012)

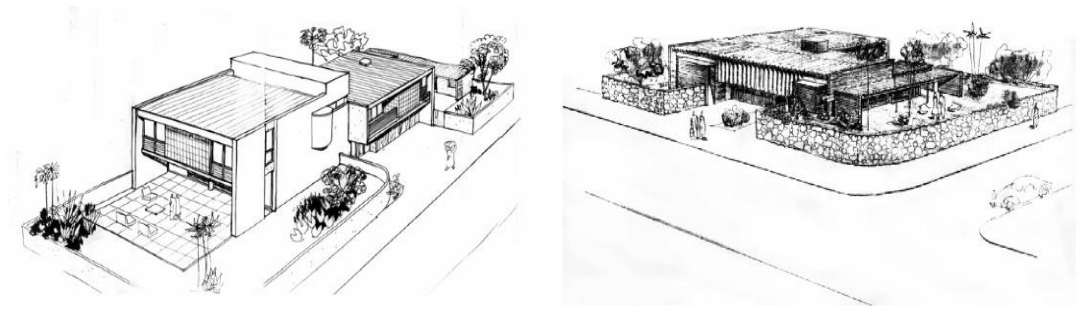

Fig. 3: Designs from architectures of Recife: to the left (1967) and to the right (1966). Source: NASLAVSKY(2012)

That is why the angle of view in the perspectives illustrating the architects' designs and pictures is so closed that it ended up hiding urban life and it only widened when a garden, the beach or another *natural* element, so to speak, was incorporated.

The simplification of urban space seemed to indicate that outside the *building* everything else was*nature.* In other words, undoubtedly, in this model, the *architecture* presented *had no historical precedents* and *prescinde of* urban life. We are in fact, before an *inaugural act* that left preexisting (historical) urban space out and, with it, all urban life, consolidating the modernist mindset in Recife's architectural representation.

Such dichotomy opposing *building* to the *city*in the debates among architects, in the themes of classroom exercises and in architect's designs, expresses in fact the dichotomy existing between *architects* and *urbanists* from the 1970's on, undoing then, the professional cohesion typical of the beginning of the profession.

And so it is that the education in the Architecture Program of the Federal University of Pernambuco started using two main axis: Architectural Planning and Urban Planning. The program began with the studies of building designs (Architectural Planning) and only in the middle of it, the courses on Urban Planning would start - and the focus here would be on the city and its zones and index (zoning), abstracting its aesthetical materiality.[5]

The other courses in the program also seemed to reinforce such dichotomy between *architecture* and *urbanism*. The courses on theory and history of architecture, for example, treasured the isolated building related to great architectural styles, among which, and above all, modern architecture, leaving a gap concerning the hystory of the city - that will only come into the scene in the program adopted in this century. The area of technology chose as its official technique the reinforced concrete - the icon material of our modernism - and, the area of artistic sketching focused on exercises related to the interior and exterior design of the *buildings,* not contemplating *urban life* and the *city.*

In sync with this professional representation, architects were split between *building* professionals - gathered into private offices - and *urban* professionals, mostly employed by the public sector. The spaces of professional representation would also express such separation once, during that period, the list disputes for the IAB-PE[6] began. Heated debates on urban legislation also took place, because building architects were farther and farther away from the main legislative commissions, now mainly made up of urban planners.

Actually, in the end of last century, a huge diversification on the way architects entered the professional field took place. It was expressed through the many professional associations, such as the urban planning, landscaping and interior architecure ones, among others. This situation emptied the traditional Instituto de Arquitetos de Pernambuco - IAB-PE, essentially made up of building architects back then.

Such diversity in the way architects entered the professional field caused an increase in the debates over the architecture and the urban shape of the city of Recife.

2. Architecture teaching and practice in the 21st century.

The 21st century would be marked by the debates over the city and would be based on the fast occupancy of the city's territory. Such fact is particularly expressed by an increase in the constructive density and by the phenomenon of vertical buildings.

Though since 1950 the city of Recife was considered a metropolis, because back then it already had a vast inhabited territory, the existing real estate occupancy was characterized by single-family horizontal houses and a few vertical buildings. From 1970's on we see a strong process of verticalization and single family houses are replaced by, back then, 10-floor buildings, increasing to 40-floor ones nowadays - thus characterizing a fast process of constructive and populational densification [7].

Add to these quantitative data the fact that the city's territory - 230 km² total - is outlined by a narrow coastal stretch set out by the Atlantic Ocean to the east and to a territory crossed by mangroves and several rivers to the west [8]. The scarcity of this territory is due, on one side, to objective criteria - such as the strong presence of slums, mangroves, rivers and a type of land with a restrictive subsoil in terms of vertical constructions - but also to subjective criteria expressed on the extensive areas with a strong social stigma related to the idea of poverty and marginality.[9]



Fig.4: A neighborhood in the South Zone (Boa Viagem). SOURCE: web:http://www.skyscrapercity.com (picture taken by Filipe)

The urban scenario would be then characterized by the densification and verticalization of constructions settled into a “narrow” territory and would be the background of heated debates and social mobilizations related to the current urban shape of Recife.

In the professional field of architecture, this debate would also be boosted by a considerable increase in the number of architects.

In fact, as to the amount of architecture programs, until the end of last century, there were only two schools of architecture and nowadays there are seven - six of them in Recife. The amount of undergraduate students getting a degree in architecture in the state of Pernambuco is about 600 per year. In the entire state of Pernambuco - Recife is the capital city - there are 4000 professionals registered with theConselho Federal de Arquitetura e Urbanismo (Federal Council of Architecture and Urbanism) - CAU/PE.

This increase in the amount of professionals takes place along with the fast growth of architects in the field of building design. At least two reasons explain why: a) the natural process of specialization where professionals start working in parallel fields such as landscaping, interior architecture, higher education and the traditional urban planning; and b) the monopolization of the design market by fewer and fewer big offices. Just to illustrate this phenomenon, out of the total registries of new projects, around 90% of them comes from 10% of the registered architects.

This new reality in the city and in the professional field seems to consolidate a fruitful critical environment to the model of urbanism then implemented and with that, to a critical reassesment of the educational model of architecture adopted back then.

There is, in fact, an increase in the critical awareness of the Recife society over the need to harmonize new constructions with urban landscape, especially, when these are close to historical sites [10]. The current debate extrapolates a lot the academic and specialized media, once it encompasses more and more of other sectors of the society. This phenomenon may be seen by the introduction of the densification and verticalization themes in various other types of local artistic expression, such as the movies, music and even carnival groups. It is also worthwhile to notice the increasing number of architects that seek graduation programs, and they are no longer only urban planners but also architects working in private offices. [11]

The first reaction of an academic institution in terms of critically reformulating its educational curriculum came from an initiative of the Department of Architecture faculty at UFPE. The debates started right in the beginning of this century, and the new educational project became official only in 2010.

In general, the new academic curriculum of the UFPE Program in Architecture and Urbanism brings at once, three new objects of study that were little emphasized until then: 1) architecture with vernacular inspiration; 2) urban landscape; and, summing it all up in one single word; 3) the city.

The new educational program in place, tries to undo the old dichotomy between the study of the *buildings* (architecture) isolated in a lot on one side, and, on the other side, the *urban context* (urbanism). In order to do so, it extinguishes the old courses of Architectural Planning and Urban Planning by putting them together in *one single structuring axis* of the curriculum: the Integrated Workshops of Architecture, Urbanism and Landscaping.

These *integrated workshops* of projects now count on professors with different specialities, in order to contemplate the areas of building, urbanism and landscape design - differently from the former project workshops where professors emphasized only the *buildings.* Furthermore, the dynamics of classroom works includes the presence of history and architecture theory, technology, design and social studies professors so as to move towards a true*interdisciplinary* approach.

The type of urbanism present at the integrated workshops is not limited to the old approach of Urban Planning based on the delimitation of urban index and activity zones. The urbanism present in the integrated workshops mixes a *zoning* approach with the *aesthetic treatment of the urban shape*approach: in one word, the urban planning comes closer now to what was called *urban design* (or *urban project*).

The *buildings* (architecture) are now definitely anchored on their urban context and are seen under the light of *urban landscape* that characterizes the history of the *place* they belong to. Conceptual references are not limited anymore to the masters of international and national modernism because they redeem critical currents, such as culturalist theories, critical regionalism and the vernacular-based approaches.

Consequently, the debates and the way of representing the architectural object, either by students in a classroom or by graduated professionals will express this shift in the paradigm, as the spotlight is no longer on the *building* but on the *city*. There is then a broadening in the scale of intervention that goes beyond the narrow limits of an urban lot. Therefore, the *public space* and the built *historical environment* start to take the center of the debate, becoming then, the main players (project, design and photographs).

In Image 5, below, we see an example of it. It is the work of first-year students from the program - a team called “Hematose Social” (Social Arterialization) [12] - where the floor plan of ground floors of the buildings are side by side, displaying a methodology of work that connects buildings among themselves and these with the *site* (neighbor buildings, streets, patios, green areas and voids). This way of thinking and representing the ground floors of buildings may seem ordinary to the eyes of an European observer, but it is absolutely unique to our urban tradition where buildings are represented isolatedly according to each urban allotment (urban lots).



Fig.5: Teamwork from “Social Arterialization”. First-year students of UFPE program (2nd semester, 2014). Author’s picture.

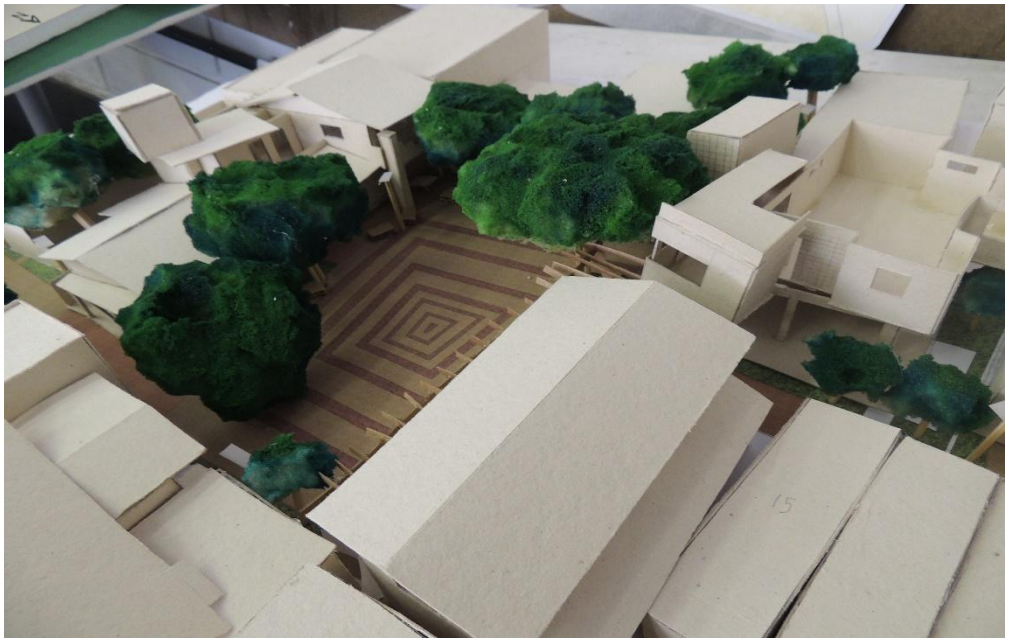

Fig.6: Maquette from team “Social Arterialization”. First-year students of UFPE program (2nd semester, 2014). Author’s picture.

The courses on artistic sketching now grouped under the denomination of observational sketching, guide the students' eyes to the *urban everyday life*, and then, their outlook once focused on the *buildings* moves towards the *city* as a whole.

All this conceptual change in teaching architecture and urbanism seems to take place at the same time that architects- formerly split into *urbanists* and *building architects* - appear to instill a rapprochement. This is noticeable when we perceive that the professionals start occupying the same areas of professional representation and when the professional practice chooses the so called *urban-project* as its main field of work.

In the field of professional association, the most important reference relates to the creation, in 2010, of the Federal Council of Architecture and Urbanism - CAU/PE [13]. That is so for three main reasons. Firstly because the list of the first administration of CAU-PE counted on architects with different profiles: urban planners, professors and architects from private offices, showing then a potential to put together again the expertise that belonged to different associations. Secondly because of the growing prestige of this space of representation that, besides taking an important role in the city debates, has a seat in the main management advisory boards, including the Urban Development Council of the City of Recife - CDU. Thirdly, because this board is in tune with the critical debates related to the current standard of urbanisation of Recife - based on vertical buildings - and to the clear defense of an urbanism closer to the urban design.

Even though we are referringto very recent phenomena, and so, subject to a temporary analysis, we can state that this movement putting different kinds of architectural expertise together again, results in two main factors: on one hand, the identification of a *common enemy* - the *vertical building* isolated in the lot and that abandoned the mixed use of ground floors - and, on the other hand, the identification of a *common intervention strategy*: the *urban project.*

It is also noticeable the first indications of what may be a possible abandonment of the liberal practice, based on private offices of architecure, when we observe professors-architects developing projects from the academia as it seems to be the case of Projeto Capibaribe (Capibaribe Project). [14] This movement seemed quite feasible from the different experiences in *project workshops* on areas of the city that are so typical of the academic debate in the beginning of this century.



Fig.7: Linear Park Project for the Capibaribe River. Authors: architecture professors from UFPE. SOURCE: Web: http://www.henriquebarbosa.com

If that is so, we can state that the path of debates along the last 50 years indicate that the vertical building - an object of glory from our modern architecture - goes from hero to villain, as the transformations in the types of professional exercises of architects point to a true exhaustion of the modernist mindset in Recife.

Notes

[1] Currently Federal University of Pernambuco - UFPE.

[2] For a detailed analysis of architecture teaching at the former University of Recife - currently Federal University of Pernambuco/UFPE - please see LAPROVITERA da MOTTA (2009).

[3] Initially with small classes of 15 students per year, from the 1970's on, the Faculdade de Arquitetura do Recife (Recife School of Architecture) now graduates two classes of 100 architects per year. In 1986, a second school of architecture was created. Currently there are eight programs in the State of Pernambuco: six in Recife and one in the city of Caruaru.

[4] In the 60's, a large planning agency for the Northeast region of Brazil was created: the Superintendence of Development of the Northeast - SUDENE. From 1970 on, the Foundation for the Development of the Metropolitan Region of Recife – FIDEM and the Foundation of the Development of Municipalities in the Countryside of the State of Pernambuco – FIAM were created.

[5] It is all about Urban Planning and not what the Urban Design (or Urban Project) will be like in the begining of the 21st century.

[6] On the history of IAB-PE, please see: LAPROVITERA da MOTTA (2003).

[7] Population of Recife: 524.000 inhabitants (1950); 1.060.000 inhabitants (1970); 1.298.000 inhabitants (1990); 1.422.000 inhabitant (2000); 1.537.700 inhabitants (2007); and, 1.797.400 inhabitants (2014). The entire Metropolitan Region of Recife - currently made up of 14 municipalities - has an overall population of 3.8 million inhabitants. Nowadays Recife is the 3rdmost dense city in Brazil, with a density of 1403.11 inhabitants per km². Only São Paulo and Rio de Janeiro are denser than Recife. SOURCE: Brazilian Institute of Geography and Statistics – IBGE.

[8] The main rivers that cross the city are Capibaribe and Beberibe. See Fig.1.

[9] The most desired areas by the real estate market and middle and high class buyers are 1.5km wide on average and in some situations, just in the neighborhood of Boa Viagem, this width reaches 300m. Outside this range, the offer and demand of real state is significantly low, causing a price drop per m² and a very slow sales speed.

[10] The main legislation on preservation of Recife's historical heritage dates back to 1982.

[11] In this century, the Department of Architecture of UFPE, also created a Doctorate program - beyond the traditional MDU Master's Program and the Architecture program of ColégioDamas, a post-graduation (specialization level) in interior architecture

[12] Team Called "Hematose Social" made up of the following students: Thatiane Rodrigues, Jônatas S. Medeiros, Jéssyca Lima, Sunamita Ma. da Silva and Adeilton Feitosa. Presentation made on the course of Project of Architecture, Urbanism and Landscaping 1 from UFPE, on the 2nd semester of 2014.

[13] Since the 1930's Brazilian architects shared with the engineers of different specialities the Federal Council on Engineering, Agronomy and Architecture - CREA. In December 2010 (Law 12.378) and because of the struggle of architects since the 60's, the Federal Council on Architecture and Urbanism – CAU was created, with representatives in every Brazilian state.

[14] *Parque Capibaribe* Project - *O Caminho das Capivaras* consists of a technical cooperation between the Municipality of Recife and UFPE. It is a research developed by different department of UFPE, among which are, professors from the Department of Architecure, that, besides research also coordenates and drafts executive project. (web:http//www.parquecapibaribe.org). After this project was accepted by the Municipality of Recife, other groups related to other schools of architecture in the city were mobilized into proposing projects to the city.

Bibliography

LAPROVITERA da MOTTA, Enio, (2003). *Por uma história do IAB-PE*. Recife: Revista do IAB-PE, nº 51.

LAPROVITERA da MOTTA, Enio, (2009). *L'Architecte et le Peuple.* Paris: École des Hautes Études em Sciences Sociales – EHESS, Doctoral's Thesis. 540p.

NASLAVSKY, Guilah, (2012). *Arquitetura moderna no Recife.1942-1972*. Recife: E. da Rocha, 2012.

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The Architect and the People of Recife (Brazil):1959 – 2009.

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Abstract
Though the debate on low-income housing has recently crept into the field of architecture *teaching*, the debate on low income seems to have been restricted, for almost half a century, to the field of *research* and the professional *practice* of architects from Recife.
The delimitation of the debate on thelow-income concept into the field of professional *practice* showed how much a certain professional group was able to filter the debate in the classroom in order to privilege noble themes related to the idea of a monumental architecture where low-income architecture would not find any resonance within.
The endurance of that representation in the field of architecture was fed by a professional mindset that privileged the idea of an architect-artist who worked in a private office as a profession.
The debate on low-income only comes into the field of architecture after the consolidation of a broad social enterprise related to the economic and political transformations fromthe last century. Such social enterprise places the local elites, among which are the architects, in the middle of the debate on huts, traditional construction techniques, self-building of dwellings and people's participation. In the case of architects, the entrance into this debate seems to have taken place in the field of *practice* of urban and regional planning in the 60's and 70's. It only came to be official in the *academic* field of architecture during this century.

Keywords: Architects, low-income housing, architecture, teaching

1.The Emergency of the low-income issue

1.1 The teaching of architecture
The hegemony of savant architecture has pushed away the debate on low-income housing mostly in the field of teaching. That has happened since the creation of the first School of Architecture of the University of Recife - FAUR, in 1959 until the first half of this century.[1]
The first curious fact to notice is that, from the 30's to the end of the 50's, the architects shared the academic space with painters and sculptors at the Fine Arts School (*Escola de Belas Artes*) and these latter used to prioritize the themes related to ordinary people. The architects from the academia only started to study this theme half a century later, i.e., in the 70's. Such an observation is even more emphatic when we recall that in all artistic expressions of modernism - music, literature, painting and sculpture - treasuring the *popular tradition* was a mandatory source of inspiration.
In that case, we understand why the fields of "project" and "history" teaching in architecture - a prioriatry field of work for architects - were immune to such a reflection. The first expression towards it curiously took place in the field of technology teaching.
It occurred with the creation of the "Housing Center" (Centro de Habitação) at FAUR, in 1964. That entity was related to the course "Construction Material and Soil Study", taught by engineer and full professor Ângelo José da Costa, who was also Director of the Institute of Technology of the State of Pernambuco - ITEP [2]. This experience is focused in the study of *technological* aspects of housing issues that, in their turn, were shaped as *material* studies, specially soil cement. ITEP opened its

facilities to the “Housing Center”, including access to a machine acquired for the production of soil-cement panels, suggesting the mass production of dwellings according to a new concept more suitable for the Northeast region of Brazil. Architect and professor Zildo Sena Caldas, assistant to Prof. Ângelo Costa, made his contribution by expanding the debate on the *technicalperformance* of the *material* to a more *architectural* and *aesthetic* approach in home building with soil. As he was a professor at a school of architecture, Prof. Caldas started to highlight aesthetic aspects - colors, textures - as well as functionalones - climate adaptation - of this building material: soil-cement and mud.
Though not specifically focused on housing issues themselves, it is important to highlight the thinking of Prof. Antônio Bezerra Baltar who, since the 50’s, studied the phenomenon of metropolization ofthe greater Recife area and then described and explained the creation of numerous informal settlements with a large percentage of houses made of soil, wood and other typical low-income housing materials from that time.

1.2 Professional practice

From the 60’s and 70’s on, the matter of low-income or social housing becomes part of the professional *practice* agenda of architects. Such a debate is guided by two main expressions: “low-cost housing” and “low-income housing”. *Low-cost* or *minimum* housing, more usual among architects, is characterized by a search for rationalizing the projects, specially due to compact architectonic programs that emerged for the expansion of housing divisions in big cities - such as Recife, even in the 50’s. On the other hand, it is in the debate of *low-income* housing that the theme of housing made of soil makes headway, and that is where the *cultural* dimension of housing will be debated.
In fact, such expressions are part of the social-political climate from the 60’s, overall in the Brazilian Northeast and, a little later, in another political environment, with the financial incentives from the National Housing Bank - BNH.
That means that, in origin, social housing, among which, low-income and made of soil, are associated to political requests and their social-geographical specificities. As we know, the Brazilian Northeast gathered a large set of political and social forces in favor of the populist demands and this allowed for the consolidation of a favorable field of low-income housing experiments and for heated debates on the living habits of the Brazilian Northeastern man.

1.2.1 The experience at Cajueiro Seco community

A pioneer and emblematic experience took place at *Cajueiro Seco* community between 1960 and 1964, during Miguel Arraes state administration. Architect Acácio Gil Borsoi tried to rationalize the use of mud in house building and his experience was presented at the VII International Union of Architects Congress - IUA held in Havana (Cuba), in 1963 [3].
The aforementioned project brought two novelties along with it. First, the rationalized translation ofa largely used popular technique in the Northeast: the mud house. The project consisted of designing prefabricated mud panels, showing the possibility of improvement and the mass fabrication of houses made of soil. Another novelty was the use of local labor, from the community, announcing then something to be known, at the end of the 70’s, as housing self-help orhousing self-construction policy. It’s also noticeable that even though the architect represented the modern architecture in Recife, the aesthetic language of the dwellings built reproduced the vernacular solution of a house with a door, a window and a gabled roof.



Fig.1: Prefabricated process of the traditional mud house. Source:SOUZA, Diego Beja Inglês, (2008).

Though architect Acácio Borsoi was also a professor at FAUR, this experience did not change the routine and the topics of study from the project courses in the architecture program. Such experience was restricted to the field of professional practice.

1.3 The field of research and the public request

Even though the military coup of 1964 had interrupted many experiences in low-income housing in the Brazilian Northeast, the formatting and implementation of big institutions and public agencies related to planning, such as the Federal Service of Housing and Urbanism - SERFHAU, the National Housing Bank - BNH and also, the continuity of the works at the Superintendence for the Development of the Northeast - SUDENE, allowed other practical and research experiences in social housing to continue.
Here I would like to quote two emblematic experiences. They are less famous than the one in Cajueiro Seco, but they show the growing interest of the architects of Recife in the topics related to social housing, and further, the growing permeability of the field of academic research related to these topics.

a)The research on traditional construction methods from the Northeast of Brazil

Architect Neide Mota, who was part of the Housing Center of the, now, Department of Architecture of the Federal University of Pernambuco - UFPE (former FAUR), along with architect Liana de Barros Mesquita from SUDENE and with the support of the National Council for Research - CNPQ, developed, in the beginning of the 70's, a broad research called *Traditional construction methods from the Northeast (Métodos construtivos tradicionais do Nordeste)*[4]. Their work puts togethera broad iconographic set of documentation from dwellings in the Northeast, with examples in *soil*, *stone* and other *mixed techniques* from the states of Pernambuco, Paraíba and Alagoas - all of them from the Northeast of Brazil.

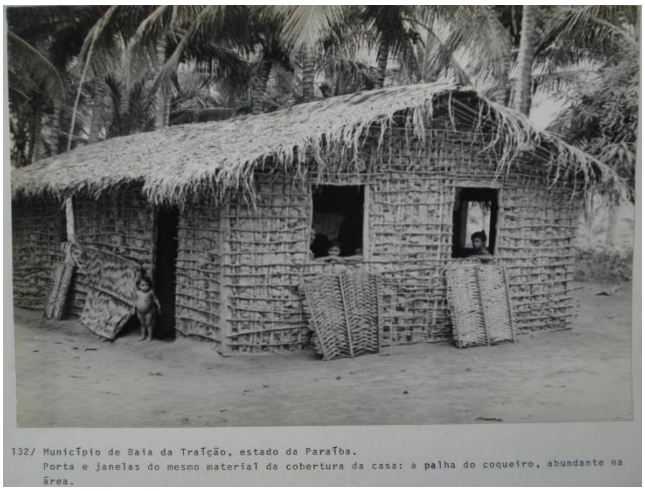

Fig.2: House with Mud walls and roof; doors and windows were made from coconut palm straw. SOURCE: Neide Mota in SUDENE/UFPE/CNPQ (1978)

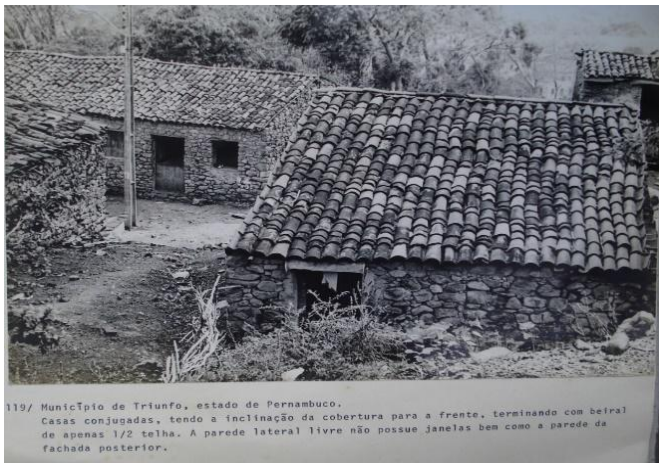

Fig. 3: House made of stone. SOURCE:Neide Mota in SUDENE/UFPE/CNPQ (1978)



Fig. 4: House made of bricks. SOURCE: Neide Mota in SUDENE/UFPE/CNPQ (1978)

The study aims to get to know the *culture* of the man of the Northeast in order to *perfect* the methods and techniques used in their homes. It is, then, a study that aims to *improve* housing conditions through the knowledge of the Northeast *tradition* in constructions. This research gathered togethera Higher Education Institution (UFPE) and a Planning Agency (SUDENE) that worked on practical application of existing solutions - in a rationalized fashion. They looked for an empiric and theoretical basis for a new housing policy for the Northeast based on the way the man of the Northeast used to live and build.

b)Experimental Project at São Bento community

Another emblematic experience, now more towards the proposition of new housing projects, was the *São Bento experimental project*, 1968-1972, from architect Liana de Barros Mesquita [5]. The project document brings a broad diagnosis of the uses and of the way the man of the Northeast lived, pointing, just like the previous study mentioned here, to the *cultural* dimension of housing.


Fig. 5: São Bento project. SOURCE:Liana de Barros Mesquita (1972).



Fig.6: São Bento project. SOURCE: Liana de Barros Mesquita (1972).

The houses adopted manual bricks and were built by the dwellers themselves. The project had bedrooms with hammocks instead of beds, a broad kitchen area with a clay oven, one single bathroom turned to the backyard where, according to the diagnosis, most of thedomestic life took place. The project still contemplated a specific place for animal raising and used several techniques for rainwater storage and for hanging vegetable gardens. These techniques and artifacts were well known in the countryside of the Northeast.

1.4 Brief Conclusion

Analyzed together, these experiences consolidate important displacements. All of the projects have a close relationship with the northeast *tradition* of living and building. Northeast popular habitat seems to have been discovered as a large field of *invention* and *aesthetic quality.* What was once seen through the prism of *poverty* is, from this *new way of looking*, an environment of sheer *creativity.*These architects are, therefore, responsible for the construction of a *sensitive outlook* - an aesthetically rich one - over traditional housing, redeeming then an old debt from the architecture to the Brazilian *tradition.* Now, just like the other arts that did it, the core source of inspiration for architecture is the *tradition* in building and living from the low-income groups of the Northeast.

The criticism from these authors is also clear in relation to the standardized and boring solutions of most of the housing production stimulated by the National Housing Bank - BNH, starting in 1964. Actually, that is where the architects from the Northeast built references that distinguished them from other architects who had no awareness of the northeastern reality. The cultural and housing features of the people from the northeast were, then, elements of differentiation and dispute in the professional field.

At the institutional format level, all these examples result in the convergence of political will, big public planning agencies, funding and research institutions and, of course, professionals willing to follow an alternative practice that, back then, was not commonplace for private offices, that were, at the time, attached to the emergent and modern language of architecture.

In fact, we can speak of a network of players and institutions that together wouldanticipate the next field of public research. Architect Neide Mota, for example, even before the existence of post-graduation programs in Urban Planning in Northeast, attended several Latin American courses on self-construction of dwellings, such as, in 1972, the “Regular Course on Urban and Regional Planning” [6] in Bogota and also, the course from the “Planning Institute of Lima -IPL”, from the National University of Engineering in Peru.

Moreover, this intellectual climate and the need to supply the growing professional demand from planning agencies are the triggers for the creation, in 1975, of the first Master program on Urban Development from the Department of Architecture of UFPE (former FAUR) and it is also the result of the new strategies of qualification from the Federal Housing and Urbanism Service.

2.The current debate on the popular issue

2.1 Period: 1979 – 2001.

In 1979 the redemocratization of the country started to happen and it gave room to a broad mobilization in favor of new practices of urban planning. This is the landscape where the participatory planning got consolidated and with it the self-management practices of the communities, the self-building of dwellings and the legalization and urbanization of slums.
Teimosinho, a project created in 1979 that aimed to consolidate and urbanize the Brasília Teimosa slum - a community next to Boa Viagem, an elitist neighborhood in the southern area of Recife - is considered the first experience where the professionals who worked in Recife, intermediated by Non-Governmental Organizations (NGOs), were hired directly by the community in order to elaborate an alternative (actually low-income) project of urbanization. Part of these professionals had just finished their doctorate studies in Europe, where especially those who studied in France, were able to observe similar experiences such as the Municipal Action Group - GAM from France. *Teimosinho* was the gathering of professionals and technicians who tried to collectively self-manage the problems from the community, including the preservation of the typology of the settlement: organic plan of the streets, aesthetics and construction techniques for low-income dwellings in Recife.
From themid-80's on, this movement counted on the massive support of politicians related to populist causes, and also, with a growing amount of technical-professional entities funded by the international cooperation: the NGOs. In that period the ZEIS were founded. ZEIS are Special Zones of Social Interest at a municipal level. They are a pioneer experience at a national level and are the result of the joint work of NGOs, independent militant technicians and professionals from the CJP - the Peace and Justice Commission from the archdiocese of Olinda and Recife with archbishop Dom Helder Câmara. This is the group of professionals that, in 1990, would work, along with the organized popular movement, in the development of Recife's Master Plan and the municipal organic laws.
Actually, the NGOs phenomenon, in the end of the 80's, allowed many architects to study slum urbanization, defending an urbanism and an architecture inspired on the "aesthetics of the slums" - as was the case of ARRUAR NGO. [7]

2.2 Period: 2001 – 2009.

In 2001, a leftist coalition, led by the Labor Party, took the municipal office of Recife and remained there until 2012. So, for over a decade, the political power proceeded with the main social and urbanizing policies led by the Labor Party (that from 2002 on also took the Federal Office), though it is important to reflect upon some issues.
In our opinion, because the Left has remained in power for so long, there seems to have been a transfer of part of the mobilizing and pledging energy from the civil society to the countryside of the State. So, notwithstanding the importance of major programs such as the participatory budgeting and the *territorialized* social policies as ZEIS, this style of intervention focused on "marginaland low-income territories" seems to lose space to a reflection more and more focusedon the notion of "city". The former notion of "poor communities" associate to "utopia territories" as the case of slum communities and the ZEIS, undergo, let's say, a process of *disenchantment* [8]. The managerial focus - a natural fact, actually, for a strategy of power reproduction - seems to zero in on, from this period on, in every territory of the *city* and in all *citizens* (individuals), and not anymore, at least not as it used to be, in *portions* of the territory and the mythical *poor communities.*
On the other hand, a series of experiences organized by professional entities, such as the academia itself, and the strong presence of the private initiative in the production of social housing, consolidate a promising scenario for this field of thinking and working.
In 2002, for instance, the IAB/PE - Pernambuco's Department of the Institute of Architects of Brazil - along with the CREA - PE [9], conceived the *Build it Right Project* (Projeto Construa Certo) aiming to qualify architects specialized in low-income housing. It was the first attempt to set up a permanent program for professionals to work, through the labor market, at the ZEIS, meaning that they would create their designs according to alternative parameters and techniques presented at the urbanization and housing standards of poor communities. In order to make it happen, IAB-PE consolidated a non-refundable credit line with the Inter-American Development Bank and set up a partnership with the municipality of Recife and the Department of Architecture of UFPE - Federal University of Pernambuco, to create a permanent educational program on social housing.
At the same time, at the Architecture Program of UFPE, for the first time we see a project course on "Low-Income Housing", thanks to the initiative of Professor and Sociologist Luís De La Mora. The field of practical experimentation, consolidated through an agreement with the Municipality of Recife, would be poor communities in the city.
Following the same trend, the curricular reform in the Program of Architecture, debated between 2002 and 2005 [10], emphatically contemplated courses in the area of Low-Income Housing, including the speculation of credit lines, legal approaches and alternative construction methods. Back then, during the debate of the new curriculum, history courses in architecture would treasure the study of vernacular architecture and some professors from the program were already developing practical studies on the manual production of adobe bricks.

It seems that there was a dispersion of initiatives towards low-income and social housing, includingthe previously impermeable environments of the academia (at least at the under graduation level), professional entities (IAB-PE) and companies from the market, boosted by plenty of public funding.
Congresses to articulate these experiences, agreements among universities, public planning agencies, other professionals and, of course, the attempt to bond the utopic energies together again, seem to be an essential step!

2.3 As for conclusion or current scenario.

Looking at the set of related experiences in the long run, we see that the debate on low-income becomes more solid among architects in Recife in the middle of the 1960's, focusing back then on the *housing* itself. In the 80's and 90's, the debate was concentrated on the *urbanization* of poor areas, especially the so called Special Zones of Social Interest - ZEIS, and from there we see the emergence of an architectural and urbanistic language inspired by the slum aesthetics and by other popular settlements.
In this century, the architects no longer debate only the poor areas but they encompass the entire city at the same time that the private and state production of housing moves farther from any focus based on the popular and vernacular language of housing. We do see a growth in dwellings now called economic housing - not low-income anymore - overall through the Federal Administration program called My House My Life (Minha Casa Minha Vida).
We can then say that at first, it was the field of professional practice from the architects that opened the reflection upon the vernacular language of architecture and that today, such a debate has moved towards the then impermeable field of education in architecture. The cornerstone of this new attitude in undergraduate education comes from the debate on the new academic curriculum for the Architecture and Urbanism Program of the Federal University of Pernambuco - UFPE. The debates started at the beginning of this century and a new academic curriculum was officially translated, a curriculum where the student starts studying the requalification of existing buildings and then has the opportunity to study popular architecture and urbanism.

Notes

[1] For an analysis of the work of architects in the low-income field, please check LAPROVITERA DA MOTTA (2009).

[2] ITEP was founded in 1942, a time where the transition of the Brazilian economics from an exporting-agrarian model was moving to a more industrial one. The Decree creating ITEP was signed by the Federal Intervenor Engineer Agamenon Magalhães, in the period when the entity "Social League against Refuges"(Liga Social contra o Mocambo) consolidated a national debate on the construction of low-income housings.

[3] For a detailed analysis of this experience, please see: Souza (2008).

[4] Architect Neide Mota was the coordinator of the research. She got her Architect degree in 1957 from the Escola de Belas Artes, in Pernambuco. Pleasesee: SUDENE/UFPE/CNPQ(1978). *Métodos construtivos tradicionais no Nordeste. Levantamento nos Estados de Pernambuco, Paraíba e Alagoas*. Recife: mimeo. 247p.

[5] Architect Liana de Barros Mesquisa was the author of the project. She got her Architecture degree in 1959 from the Escola de Belas Artes, in Pernambuco. Pleasesee: MESQUITA(1972), Liana de Barros. *Projeto Experimental São Bento, 1968-1972*. Recife: mimeo SUDENE/Prefeitura de São Bento-PB.

[6] Course related to the Inter-American Program of General Planning from the Organization of American States - OAS. The circulation of professionals is truly intensive and it includes CEPAL, there now ned Institute of Planning of Paris, International Institute of Research and Education for a Harmonized Development - IRFED from the Economics and Humanism group founded by Father Lebret, and also urban planning programs in England.

[7] As for the NGOs and the municipal administration of Recife, please see: LAPROVITERA DA MOTTA (1991). The People's Urbanization Consultancy - ARRUAR put together the following architects: Geraldo Marinho – an UFPE professor as well – Milton Botler, Rubéns Pecchio and Maria Leonor Maia.

[8] Such a fact was reinforced by some catastrophes in poor areas, such as landslides or explosions due to the accumulation of gases in old dumpsites illegally occupied and they seem to put in check the notion of *fixation* of communities, once *removing* them - though these are extreme cases - becomes part of the current political language.

[9] IAB-PE was chaired by architect Bruno Ferraz and the vice-chairperson was architect Enio Laprovitera da Motta. The Regional Council on Engineering and Architecture (CREA - PE) was chaired by Engineer Telga Araújo Filho.

[10] Between 2002 and 2005, the Architecture Program was coordinated by architect and professor Enio Laprovitera da Motta.

Bibliography

LAPROVITERA DA MOTTA, Enio (1991). *Um novo saber militante. Estado, movimento popular e práticaprofissionalalternativa: do autoritarismo à consolidação da participação popular à Recife (1964 – 1991)*. Recife: MDU/UFPE, Master Dissertation. 260p.

LAPROVITERA DA MOTTA, Enio (2009). *L'Architecte et Le Peuple.*Paris: École dês Hautes Études en Sciences Sociales – EHESS, Doctoral's Thesis. 540p.

MESQUITA, Liana de Barros, (1972). *Projeto Experimental São Bento, 1968-1977*. Recife: mimeo, SUDENE/Prefeitura de São Bento-PB.

SOUZA, Diego Beja Inglês, (2008). *Reconstruindo Cajueiro Seco: arquitetura, política social e cultura popular em Pernambuco (1960-64)*. São Paulo: FAU-USP, Master Dissertation.

SUDENE/UFPE/CNPQ (1978). Métodos construtivos tradicionais do Nordeste. Mimeo. Research Document.

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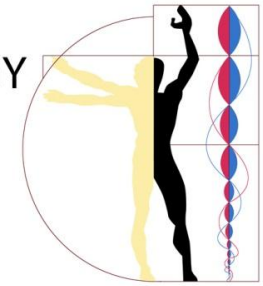

Student-Centred Learning as an Approach to Design Primary Schools' Outdoors

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Abstract
Student-centered philosophies of education emerged as a response to the limitations of traditional, authoritarian models of education, where learners construct knowledge for themselves and learn from their experiences. Recent researches look at ways of involving students more successfully in schools, as learners and participants. In this respect, it is crucial to recall the significance of learning taxonomies, which are utilized as a way of describing different kinds of learning behaviors and as a practical approach for deeper learning – active learning – which emphasizes the learning outcomes.
Student-centered learning (SCL) model shows that the learning environment is one of the crucial aspects of the quality education process. Previous studies revealed that schools' outdoors are potential educational spaces where concepts taught within the school building can come alive. Students' everyday places and activities affect developing self: mind, body, and spirit. Therefore, this research aims at adopting SCL as an approach to design primary schools' outdoors.
The study methodology depended on pursuing an analysis of the deep meaning of SCL and its relation to schools' outdoors. Then, a content analysis of primary schools curricula that was terminated by classifying them according to the learning domains – learning taxonomies – was carried out. After that, a content analysis of designing schools' outdoors and their functions, based on the targeted learning outcomes of the SCL model, was accomplished. Finally, the research resulted in a preliminary design schema that listed specific functions of schools' outdoors and their needed spaces and features in relation to the learning domain-based curricula.

Keywords: Student-Centered Learning (SCL), Learning Taxonomies, Primary School Curricula, Designing School Outdoors

1. Introduction
> "Education is a fundamental human right: every child in every country is entitled to it. Quality education is critical to development both of societies and of individuals, and it helps pave the way to a successful and productive future [1]."

Therefore the context in which the education process takes place is of great importance. Professor Ian Diamond – the Principal and Vice-Chancellor of the University of Aberdeen. He was knighted in the 2013 New Year Honours for services to social science and higher education – said: "Schools are the most vital social institution in any advanced society. How well they work is a concern for teachers, parents, managers, politicians, employers and most of all, pupils [2]."
Promoting learning is the main aim of school education. It ultimately makes a difference in the mind of the learner, and thus affects knowledge, skills, attitudes and the capacity of young people to contribute to contemporary societies [2]. Recent researches look at ways of involving students more successfully in schools, as learners and as participants during this most formative period of their lives [2].
In this field it is essential to declare that the built environment is of a great impact on involving students in their learning process, especially in their early years and primary education. Previous studies accentuate that physical features of the school environment can contribute to the implementation of inclusive education. Accordingly, this research focuses on the role of the primary schools' context or,

more precisely, their outdoors in promoting SCL; in other words, designing schools outdoors adopting the SCL approach.
Therefore, it is important to go first through the deep meaning of student-centered learning approach, discovering the essentiality of incorporating schools' outdoors in that process. Then, formulating a framework of criteria upon which schools' outdoors can be designed.

2. Research Methodology

To achieve the research aim, an analysis of the deep meaning of SCL and its relation to schools' outdoors was pursued based on a relevant literature review. Then, a content analysis of primary schools curricula that was terminated by classifying them following the learning domains had been carried out. After that, a content analysis of designing schools' outdoors and their functions based on the learning outcomes of the SCL model was accomplished. Finally, the research resulted in a preliminary design schema that listed specific functions of schools' outdoors and their needed spaces and features in relation to the learning domain-based curricula.

3. Student-Centered Learning and Schools' Outdoors

All children have the right to an education that helps them grow and develop to their *fullest*; this basic premise is at the heart of the understanding of SCL. SCL was ascribed to Hayward as early as 1905 and to Dewey's work in 1956. Carl Rogers was then associated with expanding this approach into a theory of education in the 1980s and this learning approach has also been linked with the work of Piaget (developmental learning) and Malcolm Knowles (self-directed learning) [3].
SCL is broadly based on constructivism as a theory of learning, which is built on the idea that learners must construct and reconstruct knowledge in order to learn effectively through their experiences as participants of an activity [3]. Therefore, it is significant to teach and support all children in their growth and development across all domains — social, emotional, physical, linguistic and intellectual—based on the fact that every child is a unique individual, who should be an active participant to reach their *fullest* [4].
In this respect, it is crucial to recall the significance of learning taxonomies or classifications, which are commonly utilized as a way of describing different kinds of learning behaviors and characteristics that we wish our students to develop. The most common and earliest of these is Bloom's Taxonomy (1956) [5]. Bloom and other educators worked on a way to classify educational goals and objectives, which resulted in three learning categories or domains. Each of the three categories requires learners to use different sets of mental processing to achieve stated outcomes within a learning situation. These domains are: *cognitive* domain (knowledge): verbal or visual intellectual capabilities; *affective* domain (attitudes): feelings, values, beliefs; and *psychomotor* domain (skills): physical skill capabilities [6]. Bloom believed this taxonomy could serve as a common language for learning goals to facilitate communication across persons, subject matter and grade levels; and means for determining the congruence of educational objectives, activities and assessments in a unit, course, or curriculum [7]. Bloom's taxonomy can be considered a practical approach for deeper learning –active learning. Deeper learning engages the learner who actively explores, reflects and produces knowledge rather than recalls and regurgitates. Each level of the taxonomy is reflected in at least one deeper learning principle [8]. Although there are debates around Bloom's taxonomy of cognitive domain and its layers of revised models, it is still the most widely used model.
Consequently, educational programs at schools moved to a learning outcomes-based approach to ensure that curriculum design evolves inverting roles as follows: learner-centered classroom, process-centered learning, teacher as an organizer of knowledge and enabler versus teacher-centered class room, product-centered learning and teacher as a transmitter of knowledge [9].
Based on Bloom's learning taxonomy, a study of the World Bank and other specific studies about the importance of SCL approach, policies and practices on quality education that aim at decreasing the gap between what is taught and what is learnt have been adopted. Namely, quality education refers to a quality process which involves quality teachers, quality content and quality environment to guarantee children engagement and result in the intended outcomes (Fig. 1) [10].
The model in (Fig. 1) shows that quality environment, whether indoors or outdoors, is one of the requisites in the SCL model. Dewey demanded making curriculum meaningful through the child's environment and experiences [11]. The concept of experience is central in Dewey's philosophy of education. Previous studies concerning learning process emphasized that the journey through education for any child must include opportunities for a series of planned, quality outdoor learning experiences. Schools' outdoors need to be reconceived and designed as interactive places for learning. Learning is most meaningful when it fully engages our senses, when it is grounded in daily life and when play is part of the process. Students' everyday places and activities affect not only their intellectual understandings, but also their development in other ways – physical, emotional, social and spiritual; that is, *developing self: mind, body, and spirit***.** The design of school outdoors holds boundless opportunities to foster these experiences [12].

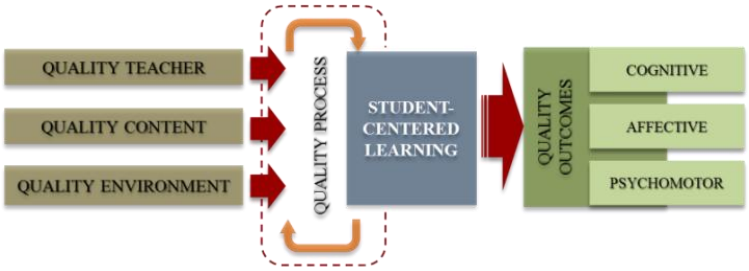

Fig. 1: Student-centered learning model.

Great Britain's Learning Through Landscapes (LTL) organization has undertaken the research and development of enriching school landscapes since 1990. LTL study of 400 schools indicated numerous benefits of well-designed grounds, including the development of physical skills, the building of confidence through exploration of the environment and the acquisition of social and behavioral skills through learning to participate and share with others [12].

Therefore, schools' outdoors represent a part of school environment that can play an effective role in experiential learning or, in other words, enhances the opportunities for students to be active participants to reach their fullest. Accordingly, planning and designing schools' outdoors is a core factor to support the learning process. Hence, it is worthy to mention that schools' outdoors guidelines vary in their proposed design criteria. Some guidelines set a number of goals and explain them in terms of illustrated examples. These goals can be designing and building for learning and teaching, healthy life style, positive behavior, community use and development, sustainable outcomes and different sectors and needs. Others ensure the relation between school buildings and grounds emphasizing the importance of light and views, the balance between soft and hard landscaping, circulation network and continuous fencing to define school property and security. On the other hand, there are guidelines that adopt technical facilities criteria which may include site selection, site analysis, children safety requirements, accessibility, play area components, manufactured play equipment, play area surfacing and plant materials. However, this research focuses on proposing a design schema or a framework of criteria that pursues the student-centered learning approach; accordingly, the quality learning outcomes should be targeted.

4. Primary School Curriculum

Curriculum is defined broadly to include four basic components: *goals,* which are measures or expectations for teaching and learning, often made explicit in the form of a scope and sequence of skills to be addressed; *methods*, i.e., the general principles, pedagogy and management strategies used for teaching and learning instructions; *materials,* which is the media and tools that are used for teaching and learning; and finally *assessment*, which is the reasons for, and methods of, measuring student progress [13].

Based on reviewing various primary education curricula, it could be concluded that there are two main categories of curricula. First, curricula that are concerned with core subjects and that include the mother language, math and science. Second, the non-core subjects, which include geography, foreign languages, history, social studies, religion, and practical/creative subjects that comprise visual arts, music, drama and physical education [14, 15, 16, 17]. However, another classification could be drawn according to the educational domain-based approach; i.e., there are subjects that are mainly *knowledge-based*, such as language, math and science, and others that are *practice-based*, like music, physical education and art.

In addition to the *knowledge-based* and *practice-based* curricula, there is social, personal and health education (SPHE) that provides particular opportunities to foster the personal development, health and well-being of the individual child, to become an active and responsible citizen in society. SPHE is a generic approach [18]. An effective SPHE program provides learning opportunities in a combination of three ways: in the context of a positive school climate and atmosphere, through discrete time (a specific time on the timetable) and through an integrated approach across a range of subject areas [19]. The curriculum is presented in three strands: *Myself, Myself and others* and *Myself and the wider world*. *Myself* strand is concerned with the personal development of the individual child and their health and well-being. *Myself and others* strand focuses on developing a sense of care and respect for other people in the surroundings, school community and family. *Myself and the wider world* strand enables children to explore and appreciate diversity among individuals and groups within communities in which they live. They can learn how to be involved competently in society and to understand the values of belonging and sharing [19].

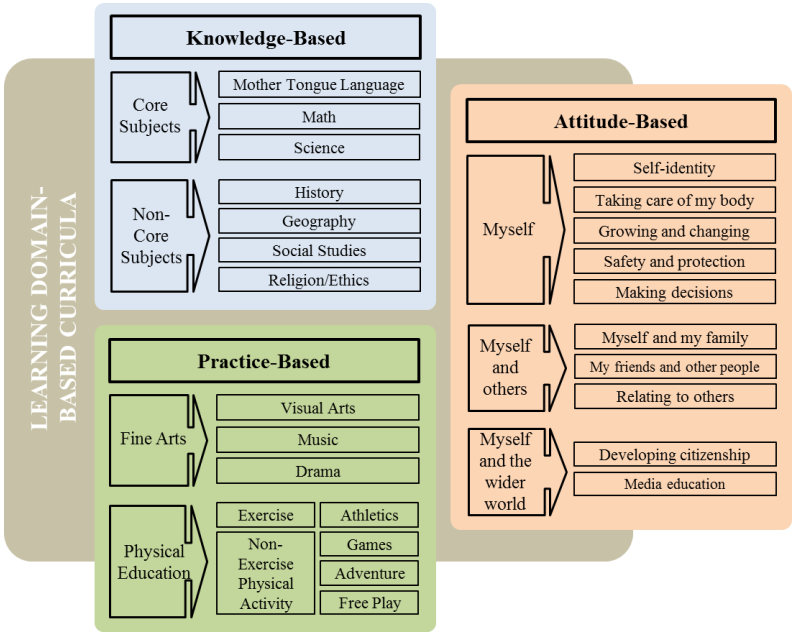

Fig. 2: Learning domain-based curricula in primary schools.

In brief, the classification of curricula based on the educational domain-based approach does not mean that the knowledge-based does not include psychomotor or affective aspects, but they are mainly associated with knowledge; and so are the other two domains. Therefore, methods differentiation and curricula integration are essential to realize the core of student-centered based learning (Fig. 2).
Based on the previously mentioned analysis and synthesis, it can be deduced that schools' outdoors could play an essential role to enhance learning outcomes in terms of supportive methods and materials (media and tools). Accordingly, a clear framework of criteria which follows learning domain-based curricula should be settled.

5. Supportive Outdoor Methods, Media and Tools

Primary schools' outdoors support various methods, media and tools for learning domain-based curricula. Therefore, a content analysis of designing schools' outdoors and their functions based on the learning outcomes of the SCL model was carried out as follows:

5.1 Knowledge-Based Curricula

Knowledge-based curricula as mentioned before (Fig. 2) include subjects that are mainly conducted indoors, even at classrooms or laboratories. However, out-of-classroom learning makes a unique contribution to a student's education in this domain. By taking part in outdoor experiences throughout their time at school, students learn lessons that complement those taught within the classroom.
Learning outdoors serves knowledge-based curricula in terms of creating *practical outdoor teaching spaces*. Some schools develop outdoor spaces where a whole class can join. Teachers value this type of space for whole-class presentation or discussion. Spaces for smaller groups can be equally valuable (Fig. 3) [20].
Inspiration spots or, in other words, using the grounds to inspire [20], is another facility. It is known that active learning process may depend on *trigger* to introduce a topic in a non-traditional fashion (Fig. 4) [24]. Some curricula may need specific features, such as the math maze and the wind turbine for science; i.e., *specific curricula-related features* (Fig. 5) [20].



Outdoor class [21] Storytelling place [22] Amphitheatre [23]

Fig. 3: Practical outdoor teaching spaces.



Fig. 4: Inspiring classrooms and learning environments: Tree house [25].



Fig. 5: Specific curricula-related features [26].



Fig. 6: Imagination and learning through play: sorting natural material (math theme: sets) available in the playground and creating different shapes [30].



Fig. 7: Practical tasks: learning life lessons through agriculture enhances science curriculum [31].

There is also a need for *experiential learning areas* that are designed to facilitate imagination, role play and real projects scenario or even practical tasks. Imagination and learning through play is central to developing creative thinking. The outside world provides settings and experiences that could feed the imagination. In this context it is worthy to accentuate the concept of versatility and combination among different materials to support imagination and develop creativity [27]. Making connections in the learning environment, such as sorting materials and shape search in math curriculum, is an example of imagination and learning through play (Fig. 6) [28]. Role play in science curriculum, such as the role of archeologist, suggests working in pairs to find artifacts and identify materials [29]. Real project scenario, or the real-life design process, can develop skills in devising solutions, thinking creatively, solving problems and working as a team [20]. Practical tasks, such as counting, calculating and shape, space and measures in math curricula, should be supported in a broad range of contexts in which students can explore, enjoy, learn and practice. Practitioners must offer opportunities for these skills to be practiced in order to give children confidence and competence in their use (Fig. 7) [28].

5.2 Practice-Based Curricula

Practice-based curricula depend on students' doing and engagement, since it could not be achieved without students' practice. Therefore, these curricula that include fine arts and physical education need specific physical features to be done. Along with games and athletics, outdoor, adventurous activities and free play are topics most likely to be taken outside. Physical activity refers to any bodily movement produced by skeletal muscles that increases energy expenditure above a basal level. It can be divided into two main categories: one is exercise that involves structured and repetitive bodily movements; the other is non-exercise physical activity, such as standing, commuting to and from school or participating in any chores or occupational work. Both exercise and non-exercise physical activity can further be classified by the level of intensity: light, moderate and vigorous. Also, the fine arts curricula that comprise visual arts, drama and music can be enhanced through definite related features.

Therefore, practice-based curricula can benefit from learning outdoor in terms of creating *experiential learning areas* that can serve in physical activity and active play (games, adventure and free play) (Fig. 8) [20]. In addition, real project scenarios, such as making musical instruments and artwork can be accomplished; built elements, like walls and grounds, can be allocated for graffiti. Role play in drama needs a performance area for experiential learning and shows.

There is also a need for *specific curricula-related features or areas*, such as areas for visual artwork that is associated with clay, construction and fabric and fiber. Furthermore, structured-musical instruments can be applied in outdoors [35]. *Outdoor playing fields* are crucial for athletics.



Fig. 8: Physical activity and active play (games, free play and adventure) [32, 33, 34].

5.3 Attitude-Based Curricula

The Social Personal and Health Education Curriculum (SPHE) should be a mandatory curricular subject in all primary schools. It aims at developing the child's personality, talents and mental and physical abilities to their fullest potential. Namely, SPHE curriculum is concerned with the preparation of the child for responsible life in a free society, in the spirit of understanding, peace, tolerance, equality of sexes and friendship to all peoples, ethnic, national and religious groups and persons of indigenous origin [36].

As declared before, SPHE curriculum emphasizes three strands: *myself*, *myself and others* and *myself and the wider world*. These strands include many units; nevertheless, the discussion will be restricted to the topics that can be enhanced via outdoor facilities.

First, the strand of *myself* focuses on the concepts of self-identity, taking care of my body, growing and changing, and safety and protection:

- **Self-identity** is concerned with "self-awareness" and "self-confidence" issues. This could be enhanced by experience involving senses in the immediate world [19]; definitely the outdoor environment supports a rich media for that; i.e., providing *experiential learning areas* that may include a garden which manipulates greenery, water, built elements and topography that, in turn, may attract wildlife. Also, self-awareness and self-confidence can be developed via physical activity and active play (games, adventure and free play) [20].
- **Taking care of my body** emphasizes the concept of "food and nutrition". Through growing and nurturing plants and animals, children learn practical and social skills and improve their physical well-being. They begin to understand where their food comes from, the interdependence of people, plants and animals, and the concept of eating healthy food. Growing food links to a range of curriculum areas and can lead to the achievement of vocational qualifications (Fig. 9) [20]. This theme can be included in *experiential learning areas* or *specific curricula-related features or areas*.
- **Growing and changing** is concerned with some issues of changing and new life [20]. "As I grow I change", namely, increasing responsibility, such as making own food or taking care of younger children. The latter can be done by supporting *environments conducive to social interaction* among different age groups (Figs. 10 & 11) [20]. This theme also introduces the concept of "new life", which means providing care for new born babies (Fig. 9). This can be achieved, as previously mentioned, by providing areas for growing and nurturing plants and animals, i.e. *experiential learning areas* [19].
- **Safety and protection** is associated with concepts of "challenge and risk". Health and safety (H&S) in school grounds is a major consideration for all sites. Appropriate risk and challenge are necessary and should be managed in a way that minimizes danger. Learning to manage risk is a vital aspect of children's development – and a degree of challenge allows them to recognize and take acceptable risks. Therefore, experiential learning areas of free play, games and adventure can support opportunities for challenge and risk.

Secondly, the strand of *myself and others* includes issues of "relating to friends and other people". It is important to identify and explore qualities and skills associated with friendship, to treat people with dignity and respect, and to recognize bullying behavior and what should be done if one is being bullied or sees it happening to others [19]. This could be achieved through outdoor space by providing a range of opportunities for different types of behavior such as: developing *environments conducive to social interaction (passive recreation)*, i.e., places to sit in quietly with friends, to read, chat or simply watch the world go by, and places for enjoying break-time snack. *Experiential learning areas*, which provide active play (games, adventure and free play), and *Outdoor playing fields* also enhance the relation with friends and other people. Such areas provide opportunities for everyday-life communication with friend and others (elder students, teachers and supervisors) [20].



Fig. 9: Food and nutrition, and new life [37].



Fig. 10: Environments conducive to social interaction: outside eating area [38].



Fig. 11: Environments conducive to social interaction: outside seating area [25].



Fig. 12: Older children worked with the younger ones to help develop plans for their playground. Creating a new climbing structure via created images and models before the final structure was built [20].



Fig. 13: Positive contributions and sense of belonging [39].

Thirdly, the strand of *myself and the wider world* emphasizes “developing citizenship”, i.e., school community and local community [19]. Regarding school community and achieving the sense of belonging, positive contributions, whether individually or in groups, can make the class or school a better place for everyone (Figs. 12 & 13). For example, involving students in achieving tasks concerning school environment, such as maintenance, can help deliver the curriculum and encourage a sense of ownership. Living in the local community means appreciating interdependence among people in many aspects of life, developing sense of belonging to the local community, and appreciating diversity, since differences enrich experiences. This can be realized by involving the local community in the school community through celebrating local events, community sports and arts. Thus, providing *multipurpose areas*, or an amphitheater*, outdoor playing fields, and experiential learning areas*, can facilitate community involvement.

6. Design Schema and Learning Domain-Based Curricula

Based on the analytical study of the supportive outdoor methods, media and tools following the learning domain-based curricula, a design schema for the primary schools' outdoors emphasizing the development of all the learning aspects involving students’ engagement, has been deduced as follows (Table 1):

7. Conclusion

Promoting learning and achievement of students is the main aim of school education, especially in the primary phase. Thus, student-centered learning (SCL), which is based on deeper learning, i.e., achieving the fullest development of every child’s mind, body and spirit through their active participation, should be the core of the education process.

The SCL model shows that the educational environment is an essential aspect of the quality education process in terms of methods and materials (media and tools). Previous studies on learning processes emphasized that the journey through education for any child must include opportunities for a series of planned, quality outdoor learning experiences. Therefore, the principles that should guide the design of schools’ outdoors are of a great importance and should be derived from the concept of deeper learning.

Thus, a content analysis of the relevant studies about supportive outdoor methods, media and tools to enhance students’ deeper learning was carried out. Accordingly, a design schema based upon learning domain-based curricula was deduced as a preliminary proposal for methods, media and tools of schools’ outdoors. These suggested functions, spaces and features are not set in stone and can be further researched, adjusted or expanded according to the changing needs and contexts. However, the core concept of learning domain-based curricula that accentuates developing knowledge, skills and emotions via students’ real engagement and active participation should be the cornerstone in designing and planning schools' environments.

Table 1: Primary School's Outdoor Schema

Outdoor Methods, Media and Tools	Learning Domain-Based Curricula		
	Knowledge-Based Curricula	**Practice-Based Curricula**	**Attitude-Based Curricula**
	Core subjects: language, math, science Non-core subjects: history, geography, social studies and religion/ethics	Fine arts: visual arts, music, drama Physical education: exercise (athletics), non-exercise (games, adventure, free play)	Myself Myself and others Myself and the wider world
Practical outdoor teaching spaces	Versatile space accommodates large audiences for performances and smaller groups (ex. an amphitheater).	An amphitheater for drama displays.	An amphitheater for local events.
	Story-telling area.		
	Shaded and accessible space outside classrooms.		
Curriculum-related features	Features such as math maze and wind turbine for science. Some of these features can be removed and recreated based on the needed theme.	Clay work related features and outdoor structured musical instruments.	Allocated areas or features for growing and nurturing plants and animals to enhance the concepts of "food and nutrition" and "new life".
Experiential learning areas	**Imagination and learning through play:** versatile spaces that provide opportunities, such as sorting leaves by colors or species; using leaves to work out rhymes; and making patterns.	**Physical activity and active play:** playgrounds for games and free play, with an allocated area for equipment and adventure activities, such as climbing walls.	**Physical activity and active play:** opportunities for games, adventure and free play support "self-awareness", "self-confidence", "challenge and risk", and "friendship, dignity and respect".
	Role play: some of role play activities need to be accomplished outdoors like the archeologist or the gardener in science curriculum.	**Role play:** drama needs a performance area for experiential learning and shows (an amphitheater: review practical outdoor learning).	
	Real project scenarios: outdoor workshop for real life design process.	**Real project scenarios:** outdoor workshop for fine arts and music. built elements like walls, and grounds could be allocated for graffiti.	**Real project scenarios:** designated areas or features for individual and group work toward school community enhance the sense of "belonging and ownership".
	Practical tasks: such as counting, calculating and shape, space and measures in math curricula.		
			Sensory gardens
			Appropriate risk and challenge opportunities while exploring values of friendship, dignity and respect via games and free play, with an allocated area for equipment and adventure activities, such as climbing walls.
Inspiration spots	Spaces and features for inspiration, such as nest seating, colored plants, wildlife and playing sculpture like boats.		
Outdoor playing fields		Athletic fields for PE classes.	Athletics fields for organized games and matches support "relating to friends and other people".
			Athletic fields for community sports.
			Playing fields for community events and arts.
Environments conductive to social interaction		A range of seating opportunities for rest.	Spaces for different age groups to enhance responsibility towards younger children: "As I grow I change".
			A range of seating places that provides opportunities to interact and behave in a variety of ways.
			Outdoor snack area.

Bibliographical References

[1] *Primary School*. Unicef, Official Website. 15 April 2014. <http://www.unicef.org/search/search.php?q_en=Primary+school>.

[2] *Improving Teaching and Learning in Schools*. Teaching and Learning Research Programme (TLRP). Economic and Social Research Council, London, 2006. P. 2, 4. 5 June 2014. <http://www.tlrp.org/pub/documents/TLRP_Schools_Commentary_FINAL.pdf >.

[3] Attard, Angele, Emma Di Iorio, Koen Geven, Robert Santa. *Student-Centered Learning: Toolkit for students, staff and higher education institutions*. Lifelong Learning Program. Berlin: Laserline, 2010. p. 2. 3 May 2014. <http://www.aic.lv/bolona/2010/Reports/SCL_toolkit_ESU_EI.pdf>.

[4] Morrison, George S. *Early Childhood Education Today*. Pearson Education, 2009. p. 109.

[5] O'Neill, Geraldine and Feargal Murphy. *Guide to Taxonomies of Learning*. UCD TEACHING AND LEARNING, Dublin, 2010. p. 2. 20 August 2014. <http://www.ucd.ie/t4cms/ucdtla0034.pdf>.

[6] *Bloom's Taxonomy*. Northern Illinois University, Faculty Development and Instructional Design Center. facdev@niu.edu, www.niu.edu/facdev, 815.753.0595. p. 1. 8 Sep. 2014. <http://www.niu.edu/facdev/resources/guide/learning/blooms_taxonomy.pdf>.

[7] Karthwohl, David R. "A Revision of Bloom's Taxonomy: An Overview." *Theory Into Practice.* Volume 41, Number 4, College of Education, The Ohio State University, Autumn 2002: 212-260. p. 212. 9 Sep. 2014. <http://www.unco.edu/cetl/sir/stating_outcome/documents/Krathwohl.pdf>.

[8] McGee, Patricia. "Learning Objects: Bloom's Taxonomy and Deeper Learning Principles." The University of Texas, San Antonio, USA. pp. 1, 5.

[9] *Active Learning and Teaching Methods for Key Stages 1&2*. Northern Ireland Curriculum, Council for the Curriculum, Examinations and Assessment (CCEA) , PMB publication, 2007. p. 4. 8 July 2014. <http://www.nicurriculum.org.uk/docs/key_stages_1_and_2/altm-ks12.pdf>.

[10] *Quality Primary Education: The Potential to Transform a Society in a Single Generation*. UNICEF. p. 1, 2. 25 June 2014. <http://www.unicef.org/dprk/qpe.pdf>.

[11] Berding, Joop W. A. "Towards a Flexible Curriculum: John Dewey's Theory of Experience and Learning." *Education and Culture*, Vol. XIV No. 1, Spring, 1997. p. 25. 29 May 2014. <http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1423&context=eandc>.

[12] Johnson, Julie M. "Designing for Learning: Values, Qualities and Processes of Enriching School Landscapes." *Landscape Architecture Technical Information Series*, LATIS, ASLA, 2000. p. ii. 18 May 2014. <http://www.asla.org/uploadedFiles/CMS/Store/LATIS/Design_for_Learning.pdf>.

[13] Meo, Grace. *Curriculum planning for all learners: Applying universal design for learning (UDL) to a high school reading comprehension program*. National Center on Universal Design for Learning, 2008. p. 2. 27 June 2014. <http://www.udlcenter.org/sites/udlcenter.org/files/CurriculumPlanningforAllLearners_0.pdf>.

[14] National Council for Curriculum and Assessment (NCCA). Dublin. Official Website. 16 July 2014 <http://www.ncca.ie/en/>.

[15] *Get into Teaching: Teaching Primary*. Department of Education, UK Government, Crown Copyright, 2007. 11 Aug. 2014. <http://www.education.gov.uk/get-into-teaching/subjects-age-groups/age-groups/teaching-primary>.

[16] Subjects and Curriculum. Danish Ministry of Education. 19 July 2014. <http://www.eng.uvm.dk/Education/Primary-and-Lower-Secondary-Education/The-Folkeskole/Subjects-and-Curriculum>.

[17] Classification of Physical Activity and Level of Intensity. Department of Health, the Government of the Hong Kong Special Administrative Region, 2013. 25 Aug. 2014. <http://www.change4health.gov.hk/en/physical_activity/facts/classification/index.html>.

[18] *Social, Personal and Health Education: Teacher Guidelines*. Government of Ireland, Dublin: Stationery Office, 1999. p. 5. 17 May 2014. <http://ncca.ie/uploadedfiles/Curriculum/SPHE_Gline.pdf>.

[19] *Social, Personal & Health Education Curriculum*. National Council for Curriculum and Assessment, Dublin: the Stationary Office , 1999. p. 2. 18 May 2014. http://www.ncca.ie/uploadedfiles/Curriculum/SPHE_Curr.pdf.

[20] Foster, Anita, Sonia Percival, Barbara Chillman, Mary Jackson, Julie Mountain, Gary Burn, Penny Martin, Guy Walters, Felicity Robinson. *Designing School Grounds*. Department for Education and Skills, London: The Stationer Office TSO, 2006. p. 54. 13 Jan. 2014. <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/276691/schools_for_the_future_-_designing_school_grounds.pdf>.

[21] Aranui Primary School in Christchurch, New Zealand. 14 Dec. 2014. <http://aranuiroom7.blogspot.com/2013/08/outdoor-learning.html>.

[22] Playground Ideas. 14 Dec. 2014. <https://www.pinterest.com/kisto/playground-ideas/>.

[23] Nan Hua Secondary School. Design Share. 15 Dec. 2014. <http://www.designshare.com/index.php/projects/nan-hua-secondary/images@181>.

[24] Hazzan, Orit, Tami Lapidot, Noa Ragonis. *Guide to Teaching Computer Science: An Activity-Based Approach*. Springer, 2011. pp. 16-18.

[25] Inspiring classrooms and learning environments – in pictures. Teacher Network, the Guardian. 15 Dec. 2014. <http://www.theguardian.com/teacher-network/teacher-blog/gallery/2013/may/14/inspiring-school-architecture-environments>.

[26] Educational Play Environments. England, 2015. 8 Jan. 2015. <http://educationalplayenvironments.com/latest-case-studies/reedings-junior-school>.

[27] *Outdoor Learning: Practical guidance, ideas and support for teachers and practitioners in Scotland*. Education Scotland, Foghlam Alba. p. 32. 16 Dec. 2014**.** <http://www.educationscotland.gov.uk/Images/OutdoorLearningSupport_tcm4-675958.pdf>.

[28] Richardson, Gail Ryder. *Open Up to Outdoor Mathematics*. Learning through Landscapes, UK. p. 15, 16. 17 Dec. 2014. <https://www.hope.ac.uk/media/liverpoolhope/contentassets/documents/education/media,25538,en.pdf>.

[29] Yunker, Molly, Nir Orion, Hila Lernau. “Merging Playfulness with the Formal Science Curriculum in an Outdoor Learning Environment.” *Children, Youth and Environments*, 21(2), 2011. p. 275. 18 Dec. 2014. <http://www.researchgate.net/publication/259751133_Merging_Playfulness_with_the_Formal_Science_Curriculum_in_an_Outdoor_Learning_Environment>.

[30] PlayGroundology. WordPress. 20 Dec. 2014. <http://playgroundology.wordpress.com/category/pop-up-adventure-play/>.

[31] Junior Landcare Team Award. Landcare, Australia Government. 21 Dec. 2014. <http://www.landcareonline.com.au/?page_id=13362>.

[32] Oakridge International School, Bongaluru. 23 Dec. 2014. <http://oisbengaluru.blogspot.com/2013/01/pre-primary-outdoor-activity.html>.

[33] New Playground Equipment (Example Project). Teachersengage.com. 24 Dec. 2014. <http://teachersengage.com/sample-project/>.

[34] Cornwall Outdoors, Carew House, Bodmin, Cornwall, PL31 2QN, UK, 2013. 27 Dec. 2014. <http://cornwalloutdoors.org/news>.

[35] Bratton, Carol, Una Crossey, Dawn Crosby, Wendy McKeown. *Learning Outdoors*. Northern Ireland Curriculum, 2005. pp. 19-21. <http://www.nicurriculum.org.uk/docs/foundation_stage/learning_outdoors.pdf>.

[36] *Social, Personal and Health Education (SPHE)*. Discussion Document and Proceedings of the Consultative Conference on Education, Irish National Teachers' Organization, 2005. p. 9. 12 Dec. 2014.
<http://www.into.ie/ROI/Publications/SPHEinthePrimarySchool.pdf>.

[37] Kingsmead Primary School. London. 27 Dec. 2014.
<http://www.kingsmead.hackney.sch.uk/news/?pid=3&nid=2&storyid=21>.

[38] Kelvedon St Mary's Primary Academy. Speaker Schools Council, London, 2014. 27 Dec. 2014.
<https://www.speakersschoolcouncil.org/034kelvedon-st-marys-primary-alfresco-dining-cookie-cave>.

[39] Ixworth Primary School. 20 Dec. 2014.
<http://nppixworthprimary.blogspot.com/>.

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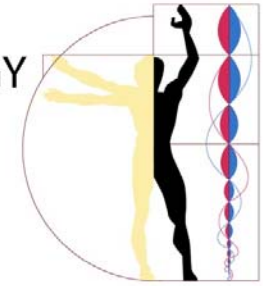

Superkilen, Copenhagen

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Abstract
In Europe, one of the problems that we begin to address is that of coexistence among people from different countries of the world. A recent experience made in Copenhagen indicates a possible path to develop a peaceful coexistence between people from about 60 different countries.
The design and construction of an urban track formed by a square, a street and a park in a suburb with deep social problems has been the catalyst for the development of knowledge and meetings and hold together histories, cultures, collective identities with the heritage material and the intangible of memories and experiences.
The project, the result of a competition, was opened in June 2012 and comes from the collaboration of a team of designers as Bjarke Ingels, the Danish architect who formed in 2006 the Bjarke Ingels Group - among the most interesting experiences of that country where he created works of great beauty that blend humor and practicality. To it are added Topotek1, an architectural firm specializing in landscape design and construction of urban open spaces. So Superflex, an artist collective founded by Jakob Fenger, Rasmus Nielsen and Bjørnstjerne Reuter Christiansen and active since 1993 in Copenhagen and Brazil with the will to develop tools to subvert the economic and social rules. Finally, the Lemming & Eriksson, a consulting engineering firm that operates on new construction or modification and renovation of existing ones.

Keywords: Coexistence, square**,** street, park , Copenhagen



Big Flags originals

1. **Section**

Designers: Bjarke Ingels, Topotek1, Superflex, Help PR & Communication, Lemming & Eriksson
Tangible patrimony and intangible dimensions, History, Culture, collective Identity, Documentation, memory.

One of the problems in Europe that we must begin to deal with and that increasingly affects our future is that of the coexistence of people from different countries.
A recent experience, realized in Copenhagen, indicates a path to developing the ability to live together among people from sixty different countries and subsequently with different cultures and customs.
The design and construction of an urban track, formed by a square, a street and a green space in a degraded suburban area with profound social problems, was the catalyst for the development of meetings and knowledge among the residents. This experience was able to bring together stories, cultures, collective identities with the material and immaterial heritage of memories and experiences.
The project, the result of a competition, was opened in June 2012 and is called Superkilen. It represents something more than the traditional idea of the square and the street because it is an urban space formed simultaneously by a road, a garden and a square that form a whole. It covers half a mile, wedged in one of the most ethnically diverse and socially difficult areas in Copenhagen. It was realised from the partnership between the local council and Realdania, a private association of owners of housing in Denmark that supports philanthropic projects in architecture and urban planning. In this case, they wanted to transform the Nørrebro district, located in the north of the city and the scene of periodical violent episodes, into an innovative urban center of occasions, with

international standards, with it possibly becoming a source of inspiration and encouragement for other cities in Europe.



Suk image by Iwan Baan

The project stems from the collaboration of a team of designers, including Bjarke Ingels, the Danish architect who formed the Bjarke Ingels Group in 2006. The team is one of the most interesting experiences in Denmark, where it has realised works of great beauty that blend humor and practicality. Currently, they have projects are under construction in Europe, North America and Asia. Topotek1 is also a part. An architectural firm specializing in landscape design and the construction of urban open spaces. This team was founded in Berlin in 1996 by Martin Rein-Cano. Superflex, a collective of artists founded by Jakob Fenger, Rasmus Nielsen and Bjørnstjerne Reuter Christiansen, active since 1993 in Copenhagen and Brazil with the aim of developing tools to subvert economic and social rules. Finally, Lemming & Eriksson, a consulting engineering firm that builds new constructions as well as modifies and renovates existing ones.
The basic idea is to take note of the diversity of the residents through a sort of large permanent exhibition that shows the best urban practices along with a sample of items from the 60 different countries where the people living in the area originally come from. The inhabitants have intervened actively in the project with their own ideas and proposed various artifacts. Contacted through newspapers, radio and the Internet, they have suggested items of street furniture for the future of the park and all the different ethnic communities are represented in the park by at least one object. It is therefore a collection of surrealist global urban diversity that reflects the true nature of the neighbourhood, rather than perpetuating a petrified and homogeneous image, that does not exist in Denmark.
The conceptual starting point is a division of Superkilen into three different coloured zones – green, black and red. The different surfaces and colours blend to form new, dynamic environments for

everyday items, while the desire for a greater presence of nature has been met with the planting of vegetation and plants throughout the area, organized into small islands with various types of tree, and flowers that enclose the different daily objects.



Suk image by Iwan Baan



Superkilen big 5581

A mosaic of pink rubber covers the ground and sides of the buildings in the first zone. The designers have planted maple trees with red leaves. The market is held here, while in the vicinity there are benches from Brazil, baskets made of cast iron from the United Kingdom and a Thai boxing ring. The designers Zigmunt Bauman once said that “sport is one of the few institutions of society, where people can still agree on the rules”. No matter where you come from, what you believe in and what language you speak, you can always play football together. This is why there are a number of sports facilities in the Green Park, including a hockey field and a basketball court, thus creating a natural meeting place for local youth from Mjolnerpark and the nearby school.
In this area, there is also a playground for children that contains an image of Chernobyl, a climbing frame from India and a number of swings from Iraq.



Suk image by Torben Eskerod

The second area is conceived as a kind of “urban living room” where residents can play with board games under the shelter of Japanese cherry trees and cedars from Lebanon. There are white lines on the ground, running from north to south and a curve around the external part of the street furniture which consists of Belgian benches and Brazilian bar chairs, Norwegian bicyclesparking and a Moroccan fountain.
The third area has a lawn as well as hills and contains areas for sports, sunbathing and picnicking. There is a Texan pavilion for dancing and a sports hall for football and basketball. There is also a wavy square that evokes Mexico as well as another that recalls the squares in Austria.
In addition to the objects mentioned above, there is also sports equipment from Muscle Beach in Los Angeles, wastewater piping from Israel, palm trees from China and neon signs from Qatar and Russia. Every item is accompanied by a small steel plate inlaid in the ground that describes the object, stating what it is and where it comes from in Danish as well as the language of its origin.

Client Copenhagen Municipality, Realdania
Site Nørrebro, Copenhagen
Site area 30.000 sqm
750 metres long public space
Building area No buildings
Budget 7 million euro
Architecture BIG Partner in Charge Bjarke Ingels
Project Leader Nanna Gyldholm Møller, Mikkel Marcker Stubgaard
Landscape Topotek1 Partners in charge Martin Rein-Cano + Lorenz Dexler
Project Leader Ole Hartmann + Anna Lundquist
Art consultancy Superflex

Partner-in-Charge Superflex
Team Jakob Fenger, Rasmus Nielsen, Bjørnstjerne Christiansen



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HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
Aversa, Capri 11-12-13 June 2015

Revitalisation of historical landscape areas in UNESCO city of Banská Štiavnica

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Abstract
The life of historical landscapes in the modern era is always under pressure from different factors, most of them socio-economical. However these same factors have already created the cultural landscape which is considered historical today.
In the case of Banská Štiavnica, the unique Calvary complex with its surrounding cultural landscape should be considered as an entity. It is a unique synthesis of art, architecture and landscape, so the preservation of its landscape scenic values should be set as a priority in landscape planning of future development.
This paper is focused on future Calvary vision that has been adopted by designers, owners, stakeholders and decision makers.
The Calvary of Banská Štiavnica is a unique landscape landmark which suffers the problems of rejection and problems of preserving scenic beauty. Several other calvaries in Slovakia suffer similar problems of ownership, rejection and use, and also problems of integration into the modern landscape. Based on dialogue between human art and nature, they need preservation policies not only as single objects, but also in the quality of their landscape setting.
Objectives of preserving the scenic values, the broader vistas and views connected with everyday decision making in the field of landscape planning at local and regional institutional level are difficult to achieve.

Keywords: Calvary of Banská Štiavnica, UNESCO, cultural heritage, revitalisation and management

1. Introduction

Cultural, historical and natural uniqueness of Banská Štiavnica and it's surrounding area is already a tempting point of interest for various groups of vistors. Thousands of tourists visit these places every year and use the cycling and educational tracks focused on local sightseeings. Despite great conditions for tourist, cultural and historical potential of this area, some valuable landmarks are being overlooked and get much less focus than they deserve. We have in mind famous sacral designed landscape areas represented mostly by calvaries – Calcary of Banská Štiavnica (Fig. 1a and 1b) and Calvary of Horná Roveň. From the list of several unique and valuable locations from the landscape point of view one should not forget national natural reserve Sitno, or the highest peak of Hodrušská hornatina, peak Paradajs [1].
Baroque landscape concept in this city put emphasis on dominants. In 18th century, in the beginning of baroque era in Slovakia, landscape dominants as churches and calvaries were being built [2]. Calvary (Kalvária) of Banská Štiavnica is the best example of the interrelation of late baroque architecture and cultural landscape. It is situated on the Scharffenberg hill near the town centre of Banská Štiavnica being considered as the most important late baroque Calvary complex in Slovakia. Kalvária is part of the volcanic mountain range Štiavnica Mountains around the city of Banská Štiavnica, which gives the name to the mountain range, and are located in central Slovakia.
In July 2007 the World Monuments Fund decided that Kalvária is among the 100 most endangered sites of cultural heritage in the world and triggered new discussions about the future of the complex and, later, a revitalisation project was initiated.



Fig. 1: View of the Calvary in Banská Štiavnica and its suuroundings

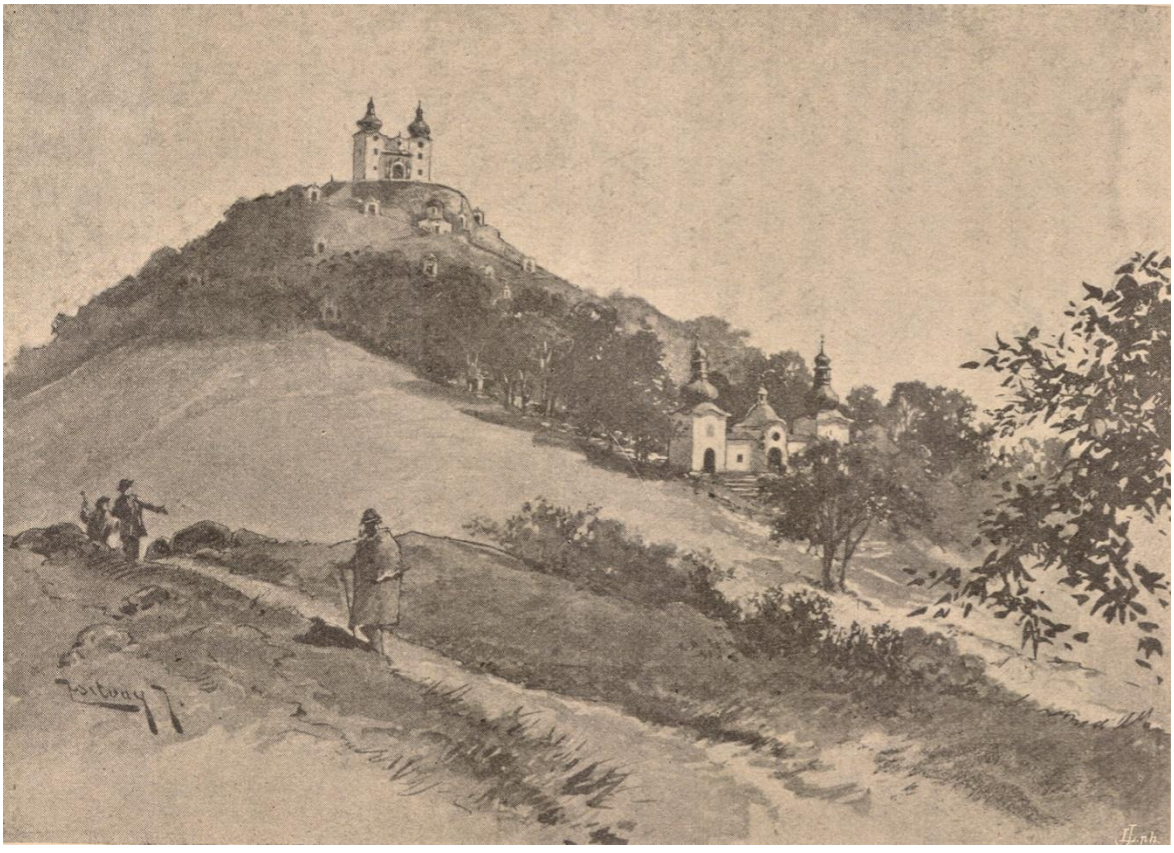

Fig. 2: Calvary in Banská Štiavnica in 1900

2. Functional design and organization

The composition of the architectural features follows its religious meaning. From the bottom of the hill to its summit, the main buildings are arranged symmetrically. The axis of the complex comprises an alley of old lime trees at the base of the hill, the Lower Church (Dolný kostol) featuring a chapel with the theme of the Last Supper, a group of stone sculptures depicting the Seven Sorrows of the Virgin Mary, the Holy Stairs (Sväté schody) and the Ecce Homo Chapel in the centre of the hill as well as the Upper Church (Horný kostol) and a representation of the Holy Sepulcher (Boží hrob) adjacent to it on the top of the hill. Even though it is smaller then the Lower Church, the Upper Church creates the perfect illusion of a monumental culmination of the Kalvária complex and stands out as the most dominant landmark of Banská Štiavnica and its vicinity [7].These main buildings are surrounded by two series of chapels that are connected by a serpentine path. The seven chapels on the left side, which are depicting the stations of Christ's Way to the Cross, correspond to the seven chapels representing the Seven Sorrows of the Virgin Mary located on the right side

The lower slopes of the hill are characterized by grassland. Some areas feature a number of woody solitaires, which gradually transforms into insular and connected groves. The forested part of Kalvária is considered protection forest with predominant function of soil protection (slopes which are endangered by erosion). Due to the protection status there are no impacts and changes to be expected. Maintenance of the forest has been disregarded in the past decades. The trees were partially in bad condition, breaking down and dying, which in many cases also bore a considerable safety hazard for visitors. The density of the tree stock has been significantly increased by shrubbery and young trees originating from airborne seed.

A special element of the woody vegetation is the two sides lime alley (Fig.3). It is located on the western slope of the hill, starting from the first chapel and leading uphill towards the Lower Church. Most of the existing trees are still the original ones, now around 250 years old. New lime trees, which were planted in 1990s, are not in alignment with the existing ones, but in a line parallel to the existing rows of trees on their outside. The alley is incomplete now and therefore the original strong spatial impression is partially diminished, partially lost.



Fig. 3: Historical lime alley

One of the main elements of Kalvária is the path system. Not only for historical reasons – as it was the Way of the Cross, which was the original idea for the whole complex – but also nowadays. The layout of the path together with the surroundings mainly determines the spatial experience of the complex.
Another important spatial element is the lime tree alley. It is suggested to prune the existing trees very strongly in order to activate regenerative mechamisms of the trees. Together with this proposal also lighting conditions within lime tree alley become more suitable for replanting the voids which should be done with young lime trees of good quality.
The view from the distance or from „outside in" is especially important.To this aim, important viewpoints desired vistas have been defined. The forest has to be dealt in order to emphasize the outside view of Kalvária complex. Within the area, the vegetation shall not be higher than 15 meters and less dense. The average radius of these areas is about 40 metres but required dimension must be verified on site.
Within a distance of approximately 15 metres the sector should be free of trees, the vegetation should not exceed 1 meter in height (the eception for specimen apllies here).
The above mentioned valuable visual relationship within Kalvária complex derive from its symetrical structure and are to be maintained. The measures for thinning out a forest will also work towards a visualisation and emphasis of the complete central axis.
Further elements such as pathways, staircases and rails should be restored or rebuild according to historical conditions.

3. Research and proposed measures

The future vision (project) taken up how can this place of unique character be revitalized, what can be done in order to give consideration again to the original spirit both in use and visually.The ownership of Kalvária cadastral parcels is split among three different institutions. The land in the lower part of the hill is property of the municipality of Banská Štiavnica, land in the upper part of the hill is owned by the State enterprise Forests of the Slovak Republic. Owner of the parcels of the chapels and the chapels themselves is the Roman-Catholic Church [5, 6]..
The current town master plan passed in November 2006 replacing the previous one from 1977. The information on the town plan underpins the importance of Kalvária as a valuable green space in close proximity of the city.
Interesting in the context of studies for the future of Kalvária is especially information on areas for development. At the foot of the hill a new development zone has been designated. It proposes the development of new housing within the time horizon until 2020.

In the case of Banská Štiavnica, the unique calvary complex with its surrounding cultural landscape should be considered as an entity. It is a unique synthesis of art, architecture and landscape, so the preservation of its landscape scenic values should be set as a priority in landscape planning of future development. This vision has been adopted by owners, stakeholders and decision makers.
The historic landscape has importance as a whole – the sum of all its parts as well as being able to show how individual sites fit into their surroundings and the wider landscape.
The Calvary of Banská Štiavnica is a unique landscape landmark which suffers the problems of rejection and problems of preserving scenic beauty. Several other calvaries in Slovakia suffer similar problems of ownership, rejection and use, and also problems of integration into the modern landscape. Based on dialogue between human art and nature, they need preservation policies not only as single objects, but also in the quality of their landscape setting.
Objectives of preserving the scenic values, the broader vistas and views connected with everyday decision making in the field of landscape planning at local and regional institutional level are difficult to achieve.
A detailed multidisciplinary analysis on site formed the basis for further considerations. Not only the hill itself with its architecture, open space and surrounding landscape have been evaluated, but also the conditions, the framework, the opinions, concerns and the interest of the public in Banská Štiavnica have been investigated .
Central project idea is to achieve a sustainable and feasible vision for the Kalvária of Banská Štiavnica. considering important factors and elements of the open space. This is especially important, as several studies on the complex of Kalvária have been conducted, but none of them is considering the open spaces.
One of main revitalisation factors is a landscape scenery which is a big potential of the complex. It is the most important factor for the impression of Kalvária from a distance. Several proposals have been made to maintain or change land use in some areas (Table 1).

Natural conditions:
The meadows at the foot and the lower slopes of the hill shall be preserved and maintained.
Beginning secondary succession shall be prevented.
The forest shall be preserved and maintained.
Erosion must be prevented.

Landscape scenery:
Negative impacts on landscape scenery must be avoided.
Important and most effective vistas shall be opened up again; unpleasant views shall be revealed.
The alley shall be restored professionally
Historical development of landscape scenery shall be taken into consideration and where possible be used as a link to the future concept.
The visual connection between Kalvária and the city center shall be strengthened.

Land use:
Building activity shall be restricted; building in inappropriate locations is inadmissible.
Land use shall be extensified, where it is currently intensive. It shall be maintained, where it is extensive.

Architectural features:
The churches, chapels and other architectural features shall be restored.
Original artefacts shall be restored and accommodated in a secure place. In their original setting in the chapels they shall be replaced by copies

Infrastructure:
The infrastructure (pathways, forecourts, staircases) and other built features in the surrounding shall be reconstructed in such a manner that it is suitable for public use in larger scale. Historical references are to be taken into account.
A security system shall be installed to protect churches, chapels, artefacts, and surrounding against vandalism and theft.

Table 1: Set of objectives for future development of Kalvária

Historical town of Banská Štiavnica and its vicinity together with its technical monuments has been inscribed in the UNESCO List of Cultural World Heritage. All protection measures have to be examined critically for the possibility to add or change certain aspects which would contribute to a higher protection status of the site with all its characteristics.
Therefore the formation of *Calvary fund* was neccesary in order to be able to act as legal capacity in the administration of the complex, its maintenance as well as endeavors towards its restoration. Another important issue is the coordination of several activities around Kalvária, such as voluntary work, studies, conferences, public relation and the representation of Kalvária's concerns and interests in planning processes and projects of Banská Štiavnica. To some extent the Institute for Monuments represents interests of Kalvária but this is limited to architectural and conservation issues for the buildings and the lime alley. The *Calvary fund* should also be capable of conducting profitable business which can bring in financial means for further investment. Moreover, it can represent the interests of Kalvária in negotiations with administrational and governmental bodies as well as in the public.
Calvary revitalisation project has been a common initiative led by the *Calvary fund* which involved local stakeholders, decisionmakers, interested individuals, a multidisciplinary team of professionals and others. The continuous communication and exchange of information between the parties were crucial; they formed the basis for decisions and for development of strategies towards the desired state (Fig.4 and 5).
The project started in 2008 and followed the previous initiatives in this direction (for example project "Banská Štiavnica Kalvária – Conservation, Training and Public Participation" in 1996, project of basic reconstruction in 2005, project for the revitalisation of the lime alley of the Protected Site "Kalvária Banská Štiavnica" – 1st phase in 2005, Revitalization of the Banská Štiavnica Calvary – Diploma Thesis in 2007, International Interdisciplinary workshop and international expert colloquium „The Calvary in Banská Štiavnica and the Prospects of its Revitalisation" in 2007, Memorandum on cooperation for the restoration of the Banská Štiavnica Kalvária in 2007 „Kalvária – a vision for a cultural heritage site" – PhD thesis in 2007, Project of World Monuments Fund in 2008. The renovation is not finished yet as it is a very long process.
Another important management and implementation point is the availability of financial sources and/or funding schemes.

Following the previous initiatives of the involved parties and based on the fact that Calvary is on the list of 100 Most Endangered Sites, World Monuments Fund was one of the first sponsors that assisted financially in the revitalisation process. Further funding schemes included VUB financial institution, World Monuments Fund, Ministry of Culture of Slovakia, SSE (Slovak Energy Enterprise), Combin Company, The Headley Trust and a many individual physical persons.

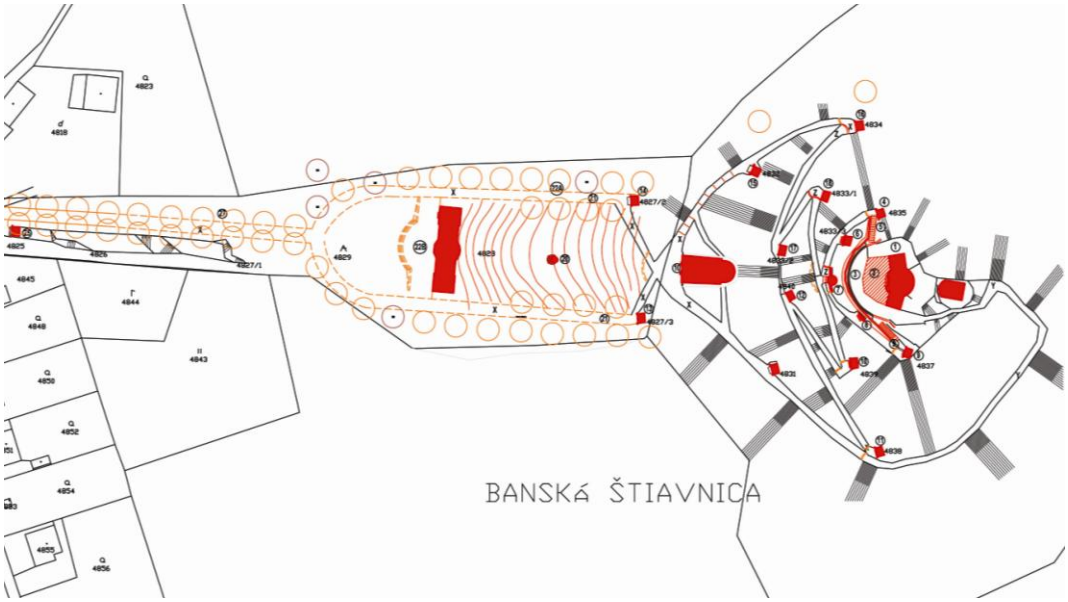

Fig. 4: Landscape architectural reconstruction – alternative 1 (based on 18th century design)

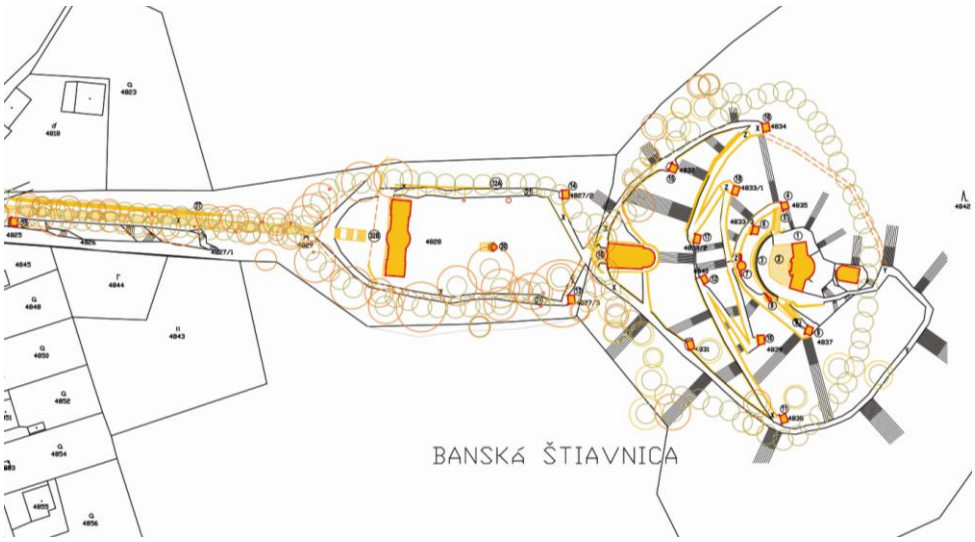

Fig. 5: Landscape architectural reconstruction – alternative 2 (based on 19th century design) source: Belčáková at al., 2009

Bibliographical References

[1] KOLLÁR, Daniel. *Štiavnické vrchy (Slovenské stredohorie),* 1st ed., Bratislava:Dajama, 2004, 159p. ISBN 80-88975-67-0

[2] ČIČO, Martin. *Kalvárie a Krížové cesty na Slovensku.* 1st ed.Bratislava: Pamiatkový úrad, 2002, 408 p., ISBN 80-968632-1-5.

[3] BENOVIC, Karol et al. *Banskoštiavnická Kalvária 1751-2001.* 1st ed. Banská Štiavnica: Rímskokatolícka cirkev, 2001, 80p., ISBN 80-968620-0-6.

[4] HERČKO, Ivan. *Banská Štiavnica na starých pohľadniciach.* 1st ed. Bratislava:Dajama, 2008, 96p., ISBN 978 -80-89226-53-5.

[5] VOŠKOVÁ, Katarína. *Banskoštiavnická Kalvária – Perspektívy revitalizácie,* 1st ed. Bratislava:FA STU, 2008, 168p. ISBN 978-80-227-2829-4

[6] BELČÁKOVÁ, Ingrid. *Revitalisation of Calvary in Banská Štiavnica*. 1st ed. Bratislava: FA STU Bratislava, 2009. 38 p.

[7] SCHÜPPEL, Steffi. *Kalvária – a vision for a cultural heritage site.* Master thesis, International Master of Landscape Architecture, Fachhochschule Weihenstephan, 2007, 129 p.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Aversa, Capri 11-12-13 June 2015

Retrofit and conservation of historical concrete buildings in Turin (Italy)

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Abstract
To design retrofit and/or conservation of existing reinforced concrete structures, the assessment of concrete strength is generally required. The current methodologies consist of destructive tests (DT), based on uniaxial compression tests performed on concrete cores extracted from a structure, and/or non-destructive tests (NDT), in which the strength of concrete is indirectly estimated by measuring other physical properties (like the ultrasonic pulse velocity). Nevertheless, in several situations (like, e.g., the seismic vulnerability assessment of long-term service structures), the traditional DT and NDT cannot be used. Hence, a new simplified approach is introduced and described in this paper. It can be applied to structures located in a precise geographical area, where the average strength of concrete (and the relative percentiles) is a function of the year of construction. Such relationship is summarized by the so-called "strength curves", statistically computed from a huge database stored in the Department of Structural and Geotechnical Engineering of Politecnico di Torino (Italy). The curves are then compared with the data measured in 860 DT, taken from several existing reinforced concrete structures, built between the years '50 and '80 in the Tuscany Region.

Keywords: old concrete strength, retrofit, conservation, buildings

1. Introduction
To perform the structural analysis of existing concrete structures, the compressive strength of concrete must be known in advance. In fact, current Building Codes [1] traditionally relate this parameter to other mechanical properties of concrete, such as tensile/flexural strength, elastic modulus, fracture energy, etc. [2].
When concrete structures built in seismic areas are taken into consideration, the structural analyses aim at:

- Assessing the structural safety, in order to improve the mechanical response of an existing structure subjected to a specific earthquake.
- Assessing the vulnerability, in order to measure the seismic risk and have a complete picture of what may happen when an earthquake occurs in a specific area [3].

In the first case, the structural analysis, carried out within the context of performance-based Limit State Design [1], consists of verifying that the design effects produced by actions, E_d , are lower than the design strength, R_d . Thus, compressive strength is directly involved in the calculation of R_d, and needs to be measured through destructive (DT) or non-destructive tests (NDT). Obviously, uniaxial compression tests performed on cores extracted from a structure represent the most reliable method to measure the strength [4]. When these DT cannot be executed, the strength of concrete is indirectly estimated by measuring other physical properties (like the ultrasonic pulse velocity) by means of NDT [5]. However, a relationship between the results of NDT and DT should be always established. In other words, it is necessary to correlate the data of

in-situ NDT, carried out in some zones of the structure, with the strength of the corresponding cores [3].
In the vulnerability analysis, the compressive strength of concrete is generally not measured with tests. Conversely, it is one of the data that have to be collected, like, for instance, the earthquake damage scenario and the geometrical properties of the existing constructions. A significant vulnerability assessment, concerning 9281 private and public buildings in Potenza (Italy) - 40% of them made with concrete structures (78% by volume), has been undertaken by Dolce et al. [3].
When such large-scale analysis needs to be performed, compressive strength (or concrete class) is not always available, especially in historical constructions. In these cases, concrete properties can be estimated indirectly and cheaply with approaches used in other disciplines. For instance, in the pediatric medicine, the physical state of children can be assessed by using the curves of growth provided by the World Health Organization (Fig.1). Based on the values of weight (or height) measured during the first years of children life, the average weight (or height) can be calculated for a precise age and in a specific geographical area[6].
In the opinion of the authors, similar curves can also be introduced to assess the strength of old concrete (i.e., the concrete cast in the past years). Specifically, by using the data stored in the historical database situated in the Department of Structural, Building and Geotechnical Engineering (DISEG) of Politecnico di Torino, new “strength curves” are herein proposed and used to estimate the compressive strength of existing concrete structures in the North-West of Italy.

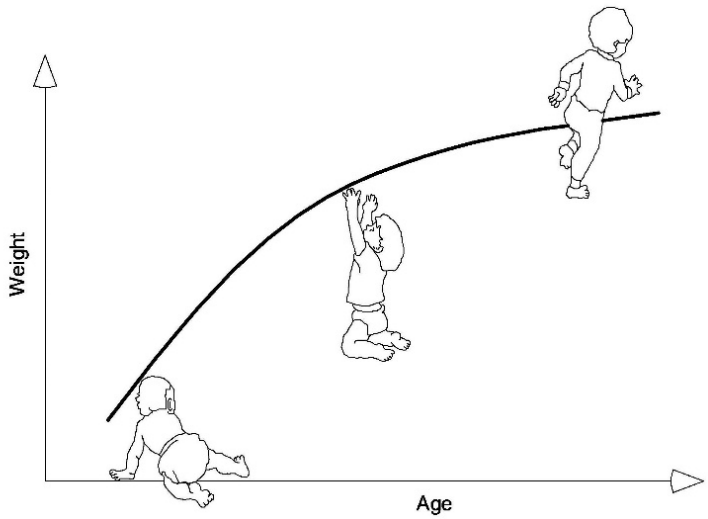


Fig. 1: The “growth curves” of children [6].

2. The database at Politecnico di Torino

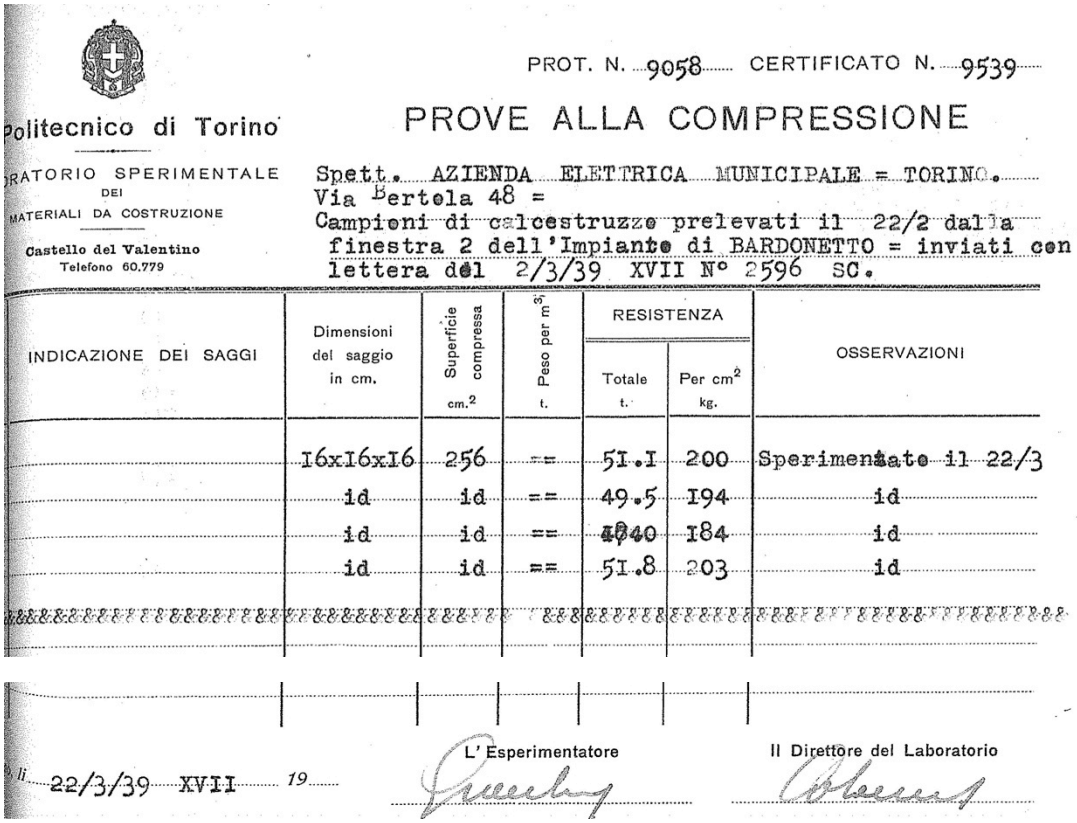
Since its foundation (1906), the laboratory of Politecnico di Torino has certified, according to Building Rules, the mechanical performances of structural materials. Among them, several specimens of reinforced concrete structures have been tested and certified with the purpose of quality control and material acceptance. Fig. 2 shows a typical certificate issued after a series of uniaxial compression tests on concrete cubes.

A single certificate contains the following data:

1. Certificate number
2. Name of the client
3. Place of concrete casting
4. Day of concrete casting
5. Sequential number of the letter
6. Name of the samples
7. Dimensions of the samples (i.e., length of the cube side - in centimeters)
8. Area of the surface where the load is applied (in square centimeters)
9. Unit weight (in kilograms over cubic centimeters)

10. Compressive strength in terms of load (in tons) or ultimate stress (in kilograms over square centimeters)
11. Observations (the date of the test is generally reported)
12. Date in which the certificate is released
13. Signatures of the experimenter and of the laboratory director.

To create the “strength curves” of the existing concretes, only the tests performed after 28 days of casting are taken into consideration in the following sections, as they can be considered significant for the long-term value of the strength.



Politecnico di Torino
RATORIO SPERIMENTALE DEI MATERIALI DA COSTRUZIONE
Castello del Valentino
Telefono 60.779

PROT. N. 9058 CERTIFICATO N. 9539

PROVE ALLA COMPRESSIONE

Spett. AZIENDA ELETTRICA MUNICIPALE = TORINO.
Via Bertola 48 =
Campioni di calcestruzzo prelevati il 22/2 dalla finestra 2 dell'Impianto di BARDONETTO = inviati con lettera del 2/3/39 XVII N° 2596 SC.

INDICAZIONE DEI SAGGI	Dimensioni del saggio in cm.	Superficie compressa cm.²	Peso per m³ t.	RESISTENZA Totale t.	RESISTENZA Per cm² kg.	OSSERVAZIONI
	16x16x16	256	==	51.1	200	Sperimentato il 22/3
	id	id	==	49.5	194	id
	id	id	==	4840	184	id
	id	id	==	51.8	203	id

li 22/3/39 XVII 19

L' Esperimentatore

Il Direttore del Laboratorio

Fig. 2: Typical certificate released by Politecnico di Torino in 1939 reporting the compressive strength measured on four concrete cubes.

3. Statistical analysis of the data

The number of compression tests performed in the years 1935, 1955, 1975, and 2002, are shown in the histogram of Fig.3. As the population of concrete strength values is large enough, a statistical analysis of the data can be implemented for each year.

The strength values of concrete cubes, R_c, measured in each year, have been grouped into 20 classes within the range 0~100 MPa. In each i-th group, the probability density fi is computed:

$$f_i = \frac{n_i}{n} \tag{1}$$

where n is the number of the tests performed in a single year and n_i is the number of tests whose strength can be included in the i-th group. For the four years herein analyzed, the distributions of the probability density are respectively reported in the four diagrams of Fig.4. In the same Figure, the normal Gaussian probability density $f(R_c)$ is also reported and compared with the test data:

$$f(R_c) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{(R_c-\mu)^2}{2\sigma^2}} \tag{2}$$

where μ and σ are, respectively, the average value of R_c and the corresponding standard deviation (referred to a single year of measurement):

$$\mu = \frac{\sum_{i=1}^{n} R_{c,i}}{n} \qquad \sigma = \frac{1}{n-1}\sum_{i=1}^{n}\left(R_{c,i} - \mu\right)^2 \tag{3}$$

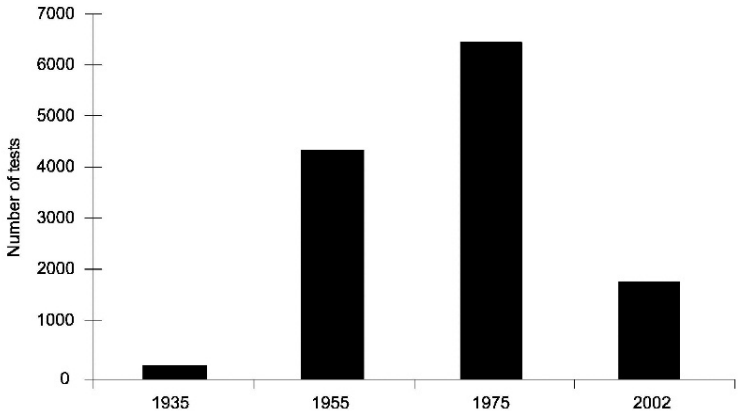


Fig. 3: The number of compression tests performed at Politecnico di Torino in some years of the past.

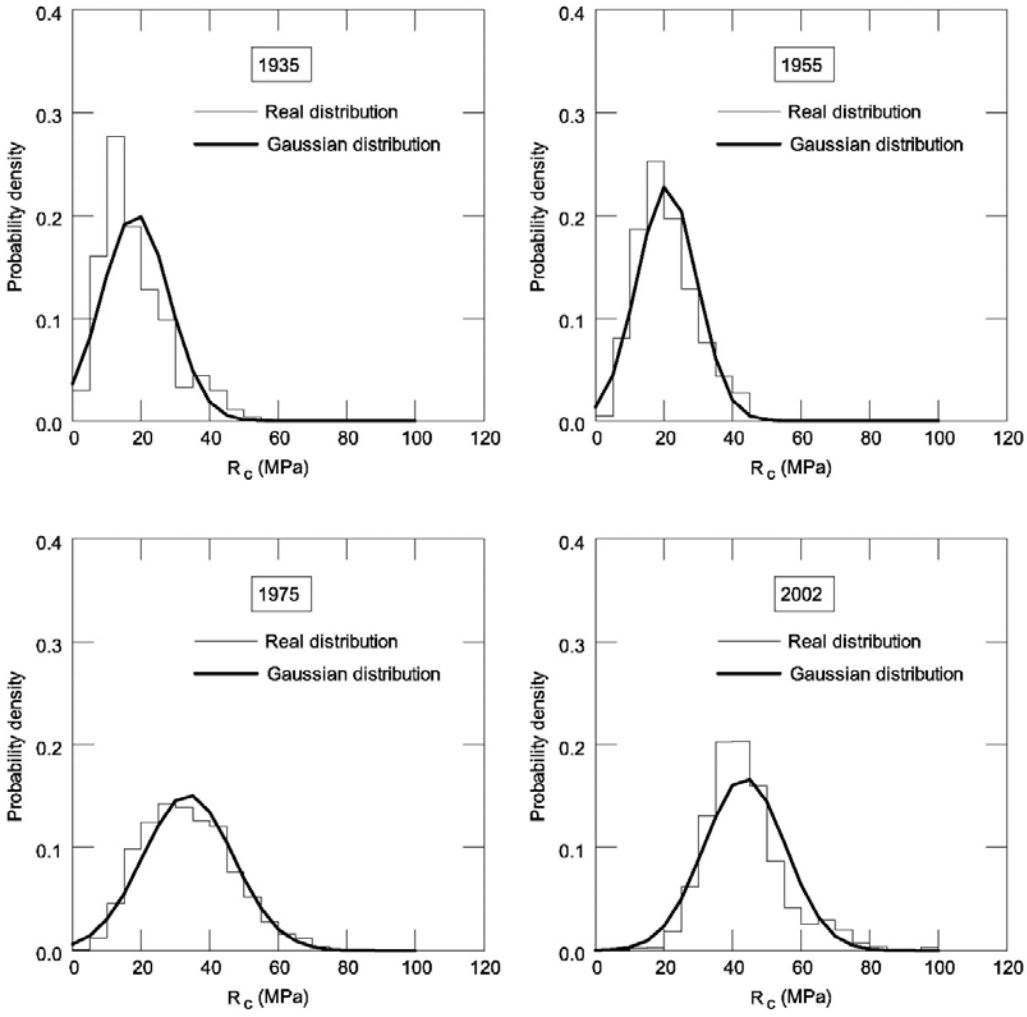


Fig. 4: Distributions of the probability density of concrete strength referred to the compression tests performed at Politecnico di Torino in the past decades.

The values of μ and σ are collected in Table 1. In the same Table, the maximum and the minimum values of R_c, as well as the values of the median and percentiles, evaluated for both the normal and the real distributions, are also reported. As is well known [7], the percentiles z_α can be calculated through Eq.(2) with the following formula:

$$z_\alpha = \mu - \gamma\sigma \qquad (4)$$

where, γ = 1.645 when α = 95%, γ = 0.674 when α = 75%, γ = -0.674 when α = 25%, and γ = -1.645 when α = 5%.

The values of the strength R_c, measured in the four years investigated, reveal a distribution of the probability density similar to the normal Gaussian law (see Table 1 and Figure 4). Accordingly, the curves of the compressive strength, and the related percentiles, are nearly similar in the case of Gaussian (Fig.5a) and real (Fig.5b) distributions, respectively.

Table 1. The results of the statistical analysis.

R_c (MPa)	1935		1955		1975		2002	
	Gauss	Real	Gauss	Real	Gauss	Real	Gauss	Real
σ	9.89	-	8.73		13.19		11.88	
Minimum		1.23		2.79		3.18		8.83
5% percentile	2.06	5.97	6.46	8.76	12.00	14.33	23.97	27.94
25% percentile	11.66	11.03	14.94	14.33	24.81	23.89	35.50	36.02
μ	18.33	18.33	20.82	20.82	33.70	33.70	43.51	43.51
75% percentile	25.00	22.78	26.70	25.88	42.60	42.21	51.52	48.75
95% percentile	34.61	39.10	35.18	37.03	55.41	56.71	63.06	67.37
Maximum		54.55		101.94		91.58		127.05
Median		15.97		19.57		32.65		42.02

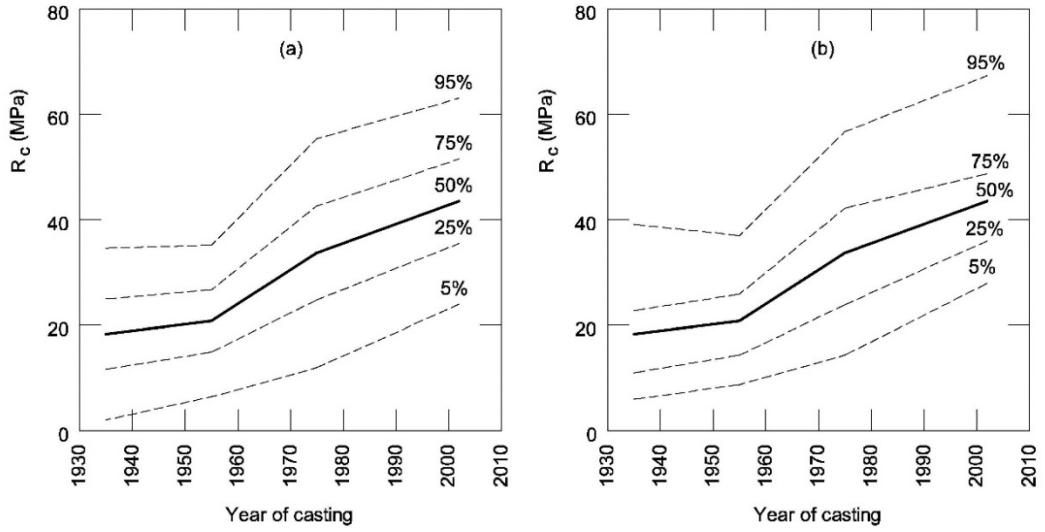


Fig. 5: The "strength curves" evaluated in the case of Gaussian (a) and real (b) distributions of probability density.

4. Comparison with some DT data [8-10]

Within the framework of VSCA (Seismic Vulnerability of Reinforced Concrete Buildings) program, the Tuscany Region performed an experimental campaign to determine the compressive strength

of concrete used in public buildings. Specifically, Cristofaro [8] analyzed 118 existing structures built during the second half of last Century (from ‘50s to ’80s), and located in the most seismic areas of Tuscany [9] (see Fig. 6). Concrete strength was measured by testing 942 cores drilled from the structural elements of the buildings [10], and the test data are reported in Table 2. In such table, buildings (and samples) are divided into four groups, depending of the decades of construction (Years ’50, ’60, ’70 and ’80). For each group, the average value of the cylindrical compressive strength f_{cm} is calculated, and the corresponding R_c (= f_c / 0.83) can be compared with the strength curves previously defined.

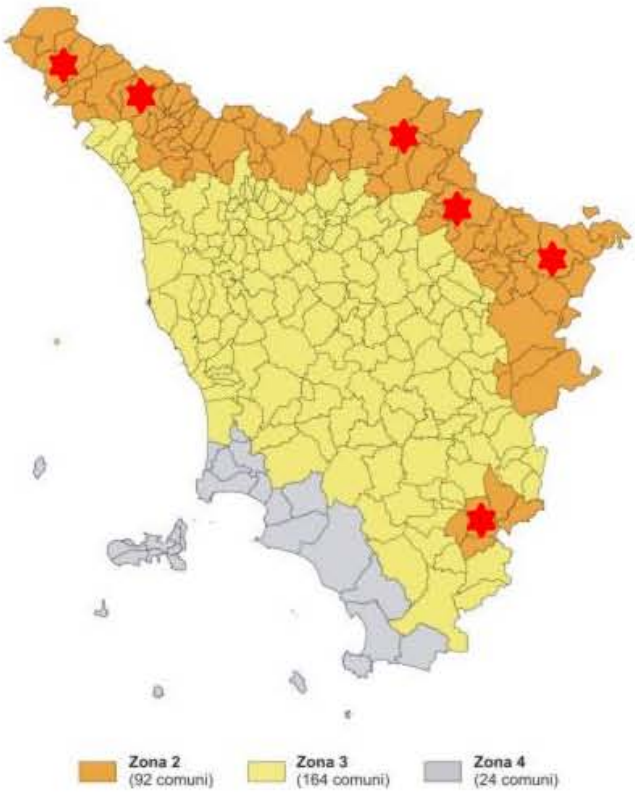


Fig. 6: The geographical position of the buildings in the Tuscany Region (Italy). All the concrete structures are localized in Zone 2, where the strongest earthquakes are expected [9] (Regional seismic map 2014. http://www.rete.toscana.it/sett/pta/sismica/03normativa/classificazione/classificazione_toscana/).

Table 2. Compressive strength measured in the concrete structures of Tuscany [10].

Years	Number of testing buildings	Number of samples	f_{cm} [MPa]
‘50	7	66	11.20
‘60	39	337	15.30
‘70	45	347	19.70
‘80	27	192	24.10
TOTAL	118	942	

As Fig.7 shows, the average values of the compressive strength, measured through the DT and referred to the four decades taken into consideration, lie on the strength curve 25% percentile, both in the case of the Gaussian (Fig.7a) and real (Fig.7b) distributions. Thus, the average strength measured with the traditional concrete cubes, specifically cast for laboratory tests, is generally higher than that measures with the cores drilled by real structures. This is due to the following reasons:

- The strength curves concern the concrete used in a zone (Piemonte Region) relatively far from Tuscany, where concrete components (i.e., type of aggregates and cement) and mixtures (e.g., water/binder ratio) could be different.
- The strength of in-situ concretes is generally lower than that of the same concrete cured in the laboratory conditions. Sometimes, the best concrete mixture is preferentially sent to the laboratory for the assessment of the material quality.
- In many cases, chemical and/or physical damages occur in concrete structures.

Although the above-mentioned difference in the concrete strength, the distance between the measured strength and the proposed curve is constant in all the decades. Moreover, the compressive strength of concrete increases of about 100% from the '50s to the '80s of the last Century. Such increment can be read on the proposed strength curves, and measured with the DT on concrete cores as well.

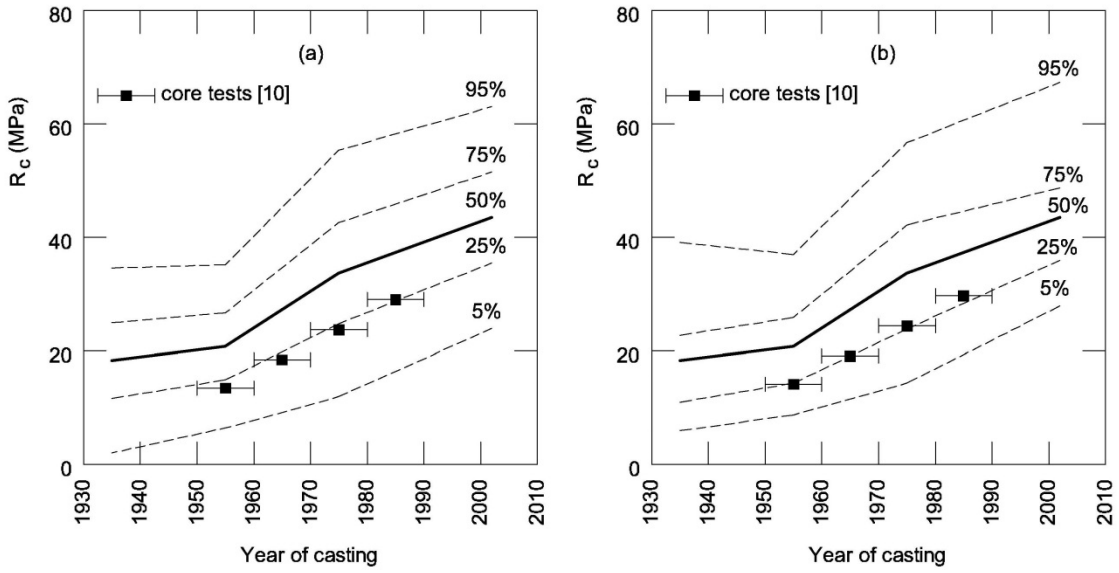


Fig. 7: The results of DT performed in concrete core of the Tuscany Region [10] compared with the proposed strength curves evaluated in the case of Gaussian (a) and real (b) distributions.

5. Conclusions

From the theoretical and experimental analyses conducted the concrete strength of existing structures, the following conclusions can be drawn:

- The data contained in some historical database, such as those stored in the Department of Structural, Building and Geotechnical Engineering (DISEG) of Politecnico di Torino, can give useful information regarding the strength of concrete and its evolution in the past years.
- In the four years investigated so far, the strength of concrete cubes approximately shows a Gaussian distribution.
- The curves herein introduced, and referred to cubes, provide values of concrete strength higher than those measured in concrete cores taken from some public buildings of the Tuscany Region.
- However, during some decades of the last Century (i.e., from the beginning of '50s to the end of '80s), both the strength curves and the core tests reveal an increment of the average compressive strength of about 2 times.

It must be finally observed that the proposed "strength curves" can only be used to assess the compressive strength of undamaged concretes. If one or more degradation phenomena are detected in the concrete structures, the estimated strength needs to be reduced. Thus, future works and researches will be devoted to the calibration of reduction factors.

6. Acknowledgments

The financial support provided by Italian Department of National Civil Protection Service (Progetto ReLUIS-DPC 2014-2018) for sustaining the research activities on historical concrete is gratefully acknowledged. The authors also thank the Italian Ministry of University and Research (PRIN 2011).

Bibliographical References

[1] fib (2012). *Model Code 2010 - Final draft*. Volume 1. Fédération internationale du béton (fib), Bulletin 65, Lausanne, Switzerland.

[2] Hilsdorf, H.K., Brameshuber, W. (1991). *Code-type formulation of fracture mechanics concepts for concrete.* International Journal of Fracture, 51, 61-72.

[3] Dolce, M., Kappos, A., Masia, A., Penelis, G., Vona, M. (2006b). *Vulnerability assessment and earthquake damage scenarios of the buildingstock of Potenza (Southern Italy) using Italian and Greek methodologies*. Engineering Structures, 28, 357–371.

[4] Giannini, R., Sguerri, L., Paolacci, F., Alessandri, S. (2014). *Assessment of concrete strength combining direct and NDT measures via Bayesian inference*. Engineering Structures, 64, 68–77.

[5] Breysse, D. (2012). *Nondestructive evaluation of concrete strength: An historical review and a new perspective by combining NDT methods*. Construction and Building Materials, 33, 139–163.

[6] WHO - World Health Organization (2006). *Child Growth Standards*. http://www.who.int/childgrowth/standards/Technical_report.pdf (Last access Nov. 2014).

[7] Mandel, J. (1964). *The statistical analysis of experimental data*. Interscience Publishers, New York.

[8] Cristofaro, M.T. (2009*). Metodi di valutazione della resistenza a compressione del calcestruzzo di strutture in c.a. esistenti*, PhD Thesis, University of Florence, Italy.

[9] Cristofaro, M.T., D'Ambrisi, A., De Stefano, M. and Tanganelli M. (2011). *Concrete compressive strength extracted from existing buildings*. In "The New Boundaries of Structural Concrete: Session D – Concrete Quality Control on Site", ACI IC – Ancona, Italy, 333 -340.

[10] Cristofaro, M.T., D'Ambrisi, A., De Stefano M., Pucinotti R. and Tanganelli M. (2011). *Analisi statistica sulla dispersione dei valori di resistenza a compressione del calcestruzzo prelevato da edifici esistenti*. IN CONCRETO, vol. 104, pp. 42-47, ISSN:2039-1218

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Turin in 1815

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Abstract
Analyze the city, considering its changes and periods decisive for the current form, find the places to verify the forms and salient passages.
With the battle of Marengo, Napoleon promulgated by Milan (23 June 1800) the edict for the complete disarmament and radical of the fortresses of Piedmont, triggering a process of profound structural changes. Turin, as elsewhere, the edict involved urban irreversible changes, which led to the birth of its expansion and the modern city.
1814, the French retired, returned Vittorio Emanuele I, who immediately restored the absolute power that existed before the French Revolution. In 1817, to encourage the development of the city I, were formed and opened the wide boulevards of the city 's ring road, in accordance with the Napoleonic projects.
In 1814, the French retired, returned Vittorio Emanuele I, who time immediately restored the absolute power That Existed before the French Revolution. In 1817, to Encourage the development of the city I, were formed and opened the wide boulevards of the city 's ring road, secondo with the Napoleonic projects.

Keywords: Turin, French Revolution, Vittorio Emanuele I

Explorer the city ,find the places to verify the form and salient steps ,considering its changes and decisive periods to reach the actual appearance.
Napoleon ,after the battle of Marengo, where he defeated the Austrians ,(23 June 1800) from Milan promulgated an edict for the radical and complete disarmament of the fortresses of Piedmont, active a process of profound structural change. Turin, as elsewhere, the edict cause irreversible changes in urban planning ,which led to the birth of the modern city and its expansion.
The new concept of the city also mean an unprecedented agreement with nature and, together, the guarantee of hygiene physical and social community, the element that is useful for understanding the politics of the green made by Napoleon. The comparison between the primary value taken from nature and the new philosophy that conformed the creation of the artwork gave a decisive turn also intent and results in urban transformation. Fundamental turned out, even for Turin, the renewal of the architectural and figurative code in the secular sense, both in the actual construction

of the new face of the city, both in the definition of its ongoing project.
The Executive Commission in 1802 took the initiative to formulate a call for new projects of city planning through an open competition, which would have to be evaluated by a jury of the subalpine Academy of history and fine arts, chaired by Carlo Botta. He came forward the report to the General Jourdan immediately after the annexation of Piedmont to France (September 11, 1802). Among the four projects presented (Ferdinando Bonsignore, Ferdinand Boyer and Lorenzo Lombardi; Giacomo Pregliasco; Carlo Randoni; Luigi Bossi), the commissioners gave the preference to that of Bonsignore, Boyer and Lombardi, praising and taking directions and cues also from the other proposals.
The project in its complexity is more attentive to the architectural dimension than to the urban; a rich repertoire of proposals fact emerging sectors and places of the city, neoclassical architecture are the towns, especially those around the doors on three main access to the city, south, east and west. The realization of an overall project still had to deal mainly with the definition of the legal ownership of the end of the fortification: already the ideas arising from the competition of 1802 had highlighted the imperative need to continue the promenades and to reorganize the city according to new coordinates project
Napoleon gave to Turin, and the Piedmont, important projects viable accommodation, among them, to Turin, the designs of the great boulevards, on the grounds of the ramparts killed but realized in the city one intervention: the construction of the bridge on the Po , completed in 1813, on the axis of Via Po, in place of p re-existing wooden bridge.
In 1814, the French retired, returned Vittorio Emanuele I, who immediately restored the absolute power that existed before the French Revolution. In 1817, to encourage the development of the city I, were formed and opened the wide boulevards of the city 's ring road, in accordance with the Napoleonic projects. It was a ring formed by the current course S. Maurizio, Corso Regina Margherita, during Prince Eugene, over England, Corso Vittorio, Corso Cairoli. The ring was broken by a large parade ground between the current street Wait and Corso Matteotti. Since 1823, under Carlo Felice, was enlarged the homonymous square and began the construction of the Borgo Nuovo and Borgo San Salvano, the sides of the avenue of the King (now Corso Vittorio Emanuele II), in the stretch Porta Nuova over Cairoli of Valentino. To the north, meanwhile, was implementing the expansion of Moscow, following the construction of the bridge of the same name on Dora, behind the present Piazza della Repubblica.
To the west, however, the citadel and military slavery related to it prevented the expansion, which will take place only in the second half of the nineteenth century following the dismantling of the citadel, deactivated in 1852. As for the accommodation of road surfaces, drains water, sewerage and water supplies, Turin was at that time in a very precarious condition.
All the streets of the center, including Piazza Castello and Via Po, and also the porches of these lands were covered only with the pavement, without guides and without paved sidewalks raised. Also there were no white channel drainage of rainwater, so is the water of the roofs of the houses, which drains the courtyards and streets were freely carried in the middle of the streets, the famous "Dore". Even the drains were very poor and in most of the cast was provided with wells blacks in the courtyards of the houses.
Water supplies were not secured by a waterworks, so every block or group of houses had to be provided with artesian wells, from which he drew water "drinking" with buckets or hand pumps. It seems evident that the hygienic situation was very precarious, with blacks wells and wells for water "drinking" contiguous, even in the same building. Only in 1827 the Municipality arranged to make the first public service of drinking water, drawing initially from a well near the Bastion Verde and supplying a dozen fountains in the Piazza Emanuele Filiberto (Porta Palazzo) and the Town Hall.
In this fundamental character is the great cultural significance of planning Napoleonic Turin (and

not only to Turin), deciding a node in the irreversible process of building the city, and for the cultural significance of the first proposals, both for the position of the values in the Plan general of 1809 and in the executive projects of the sector. With the development plan and with the projects of the Napoleonic period confronted fact closely and intersected close-ups of the Restoration of the fate of the city and for public and private clients now different in the economic and social structure.



Fig. 1: SEUTTER Matthaeus - TURIN - VILLE SUPERBE ET FORTE, 1757

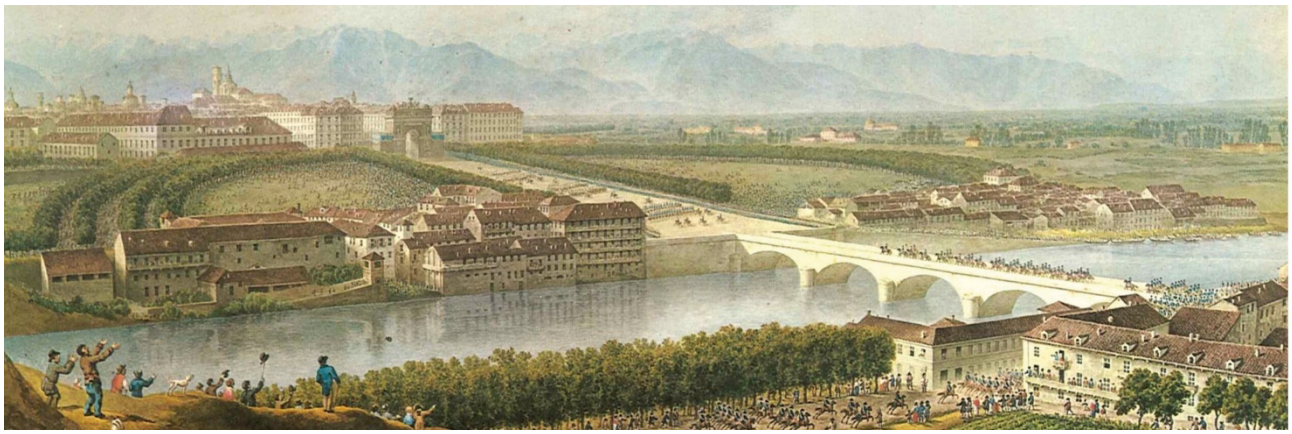

Fig. 2: G.P.BAGETTI The Return of 'happy rulers' in Turin May 20, 1814



Fig. 3: G. LOMBARDI, 1817 Master Plan of the city of Turin, and the suburbs magnification, regulation and beautification of the same

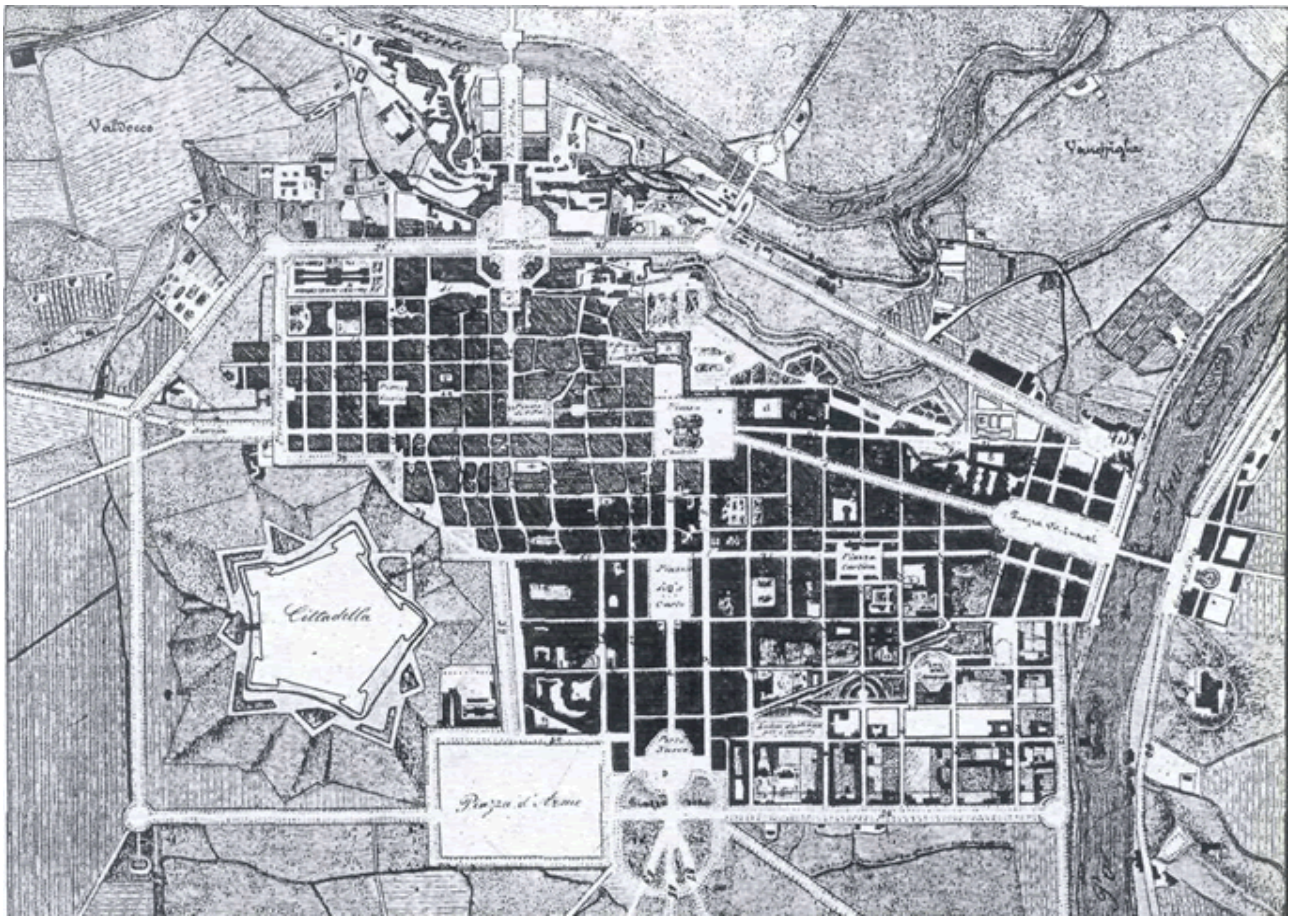

Fig. 4: the city and the territory of Turin in 1840 ,with an indication of the new ring road (map drawn by Antonio Rabbini).

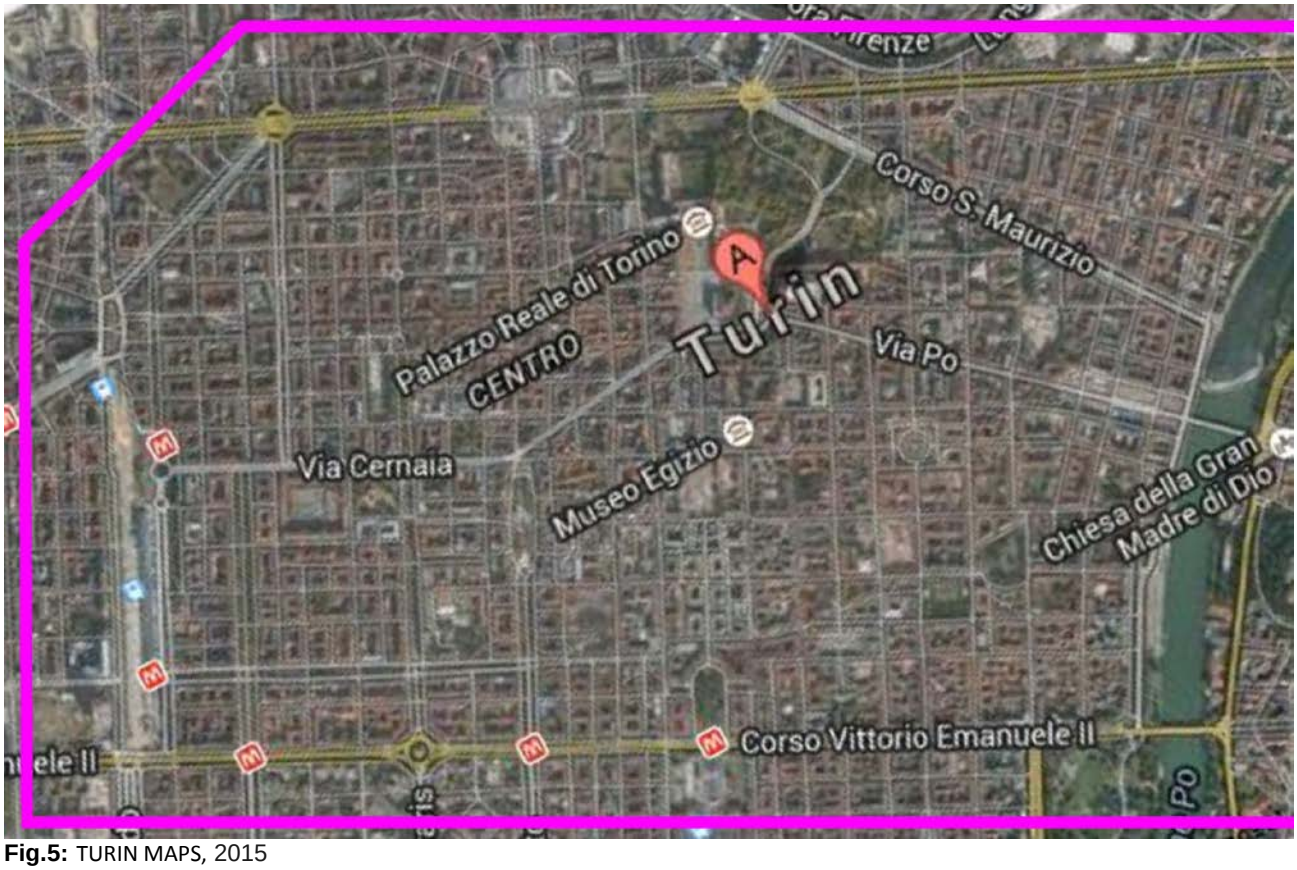

Fig.5: TURIN MAPS, 2015



Fig. 6 :The Capuchin Convent & Bridge over the Po at Turin. Litografia di Charles Joseph Hummaldel su disegno di JAMES PATTISON COCKBURN con coloritura d'epoca, Londra, 1820.



Fig.7: Avenue of the King 1915



Fig.8: photos of the author, from the Avenue of the Po 2015

Archival collections

Il fondo dell'Archivio *Conti, fabbriche e fortificazioni*, articoli 178, 203, 207 (AST, Camerale, *Conti*,Fabbriche e fortificazioni, Cittadella di Torino, art. 178, m. 2, inoltre AST, Camerale,

Conti, Fabbriche e fortificazioni, art. 203, m. 2, nn. 14, 15, 16 e AST, Camerale,

Conti, Fabbriche e fortificazioni, art. 207, m. 1, n. 3.)

ASCT, Tipi e Disegni, rotolo 15 B. Archivio Storico della Città di Torino Gaetano Lombardi, 1817 Piano regolatore della città di Torino, e sobborghi pell'ingrandimento, regolarisazione e abbellimento della medesima

ASCTo: Archivio Storico del Comune di Torino, Affari generali Lavori Pubblici, anni 1866 - 1961

AF. ASCTo: Archivio Fotografico dell'Archivio Storico del Comune di Torino

Archivio LL.PP.: Archivio Edifici Municipali, anni 1950-1960

AF FTM: Archivio Fotografico della Fondazione Torino Musei

Fondo Gabinio: Fondo Gabinio in Archivio Fotografico della Fondazione Torino Musei

AST: Archivio di Stato di Torino

Bibliographical References

[1] A.A,V.V, Piemonte e Valle D'Aosta, il Grand Tour in Italia, Touring Club Italiano, Milano 1987.

[2] Associazione Amici di Palazzo Reale, Il Palazzo Reale di Torino nelle Guide della Città, Celid, Torino,1995.

[3] AA. VV., "Le strade di Torino: alla scoperta di curiosità di una città storica a dimensione europea", Newton e Capton, Roma,1997.

[4] AA. VV., Gocce di luce. Fontane in Torino, Politecnico di Torino, 2° Facoltà di Architettura, Dipartimento Scienze e Tecniche per i Processi di Insediamento, artigrafiche DIAL, Mondovì, 2000 Amoretti, Guido, Il ducato di Savoia dal 1559 al 1713, D. Piazza Editore, Torino 1984.

[5] Bettazzi, Enrico, Bragagnolo, Giovanni, Dalle origini ad Emanuele Filiberto, in Torino nella Storia del Piemonte e d'Italia, UTET, Torino 1915.

[6] Carutti, Domenico, Storia del regno di Vittorio Amedeo II, Le monnier, Firenze 1863.

[7] Cognasso, Francesco, I Savoia, Corbaccio, Milano 1999.

Comoli, Vera, Torino, Laterza, Roma – Bari 1994.

[8] COMOLI MANDRACCI Vera, Una nuova Versailles incompiuta in COMOLI MANDRACCI Vera e ROCCIA Rosanna (a cura di) Progettare la citta. L'urbanistica di Torino tra storia e scelte alternative, Archivio Storico della citta di Torino, Torino, 2001 pp.107-109

[9] CITTÀ di TORINO, Inventario degli Alti dell'archivio comunale dal 1111 al 1848, stamperie diverse, Torino.

[10] GAMBINO, Roberto (a cura di), Turismo per il Piemonte, Associazione Piemonte Italia, Stamperia Artistica Nazionale, Torino 1974, Coli. PM 338.48 api (bea).

[11] Manno, Antonio, Dizionario feudale degli antichi stati continentali della monarchia di Savoia: Savoia, Aosta, Piemonte, Monferrato, Saluzzo, Novara, Lomellina, Nizza, Oneglia: 1720 – 1797, Forni, Bologna 1969.

[12] Merlin, Pierpaolo, Emanuele Filiberto: un principe tra il Piemonte e l'Europa, SEI, Torino 1995.

[13] Merlotti, Andrea, Vittorio Amedeo II: il Savoia che divenne re, Gribaudo 1998.

[14] Passanti, Mario, Architettura in Piemonte: da Emanuele Filiberto all'Unità d'Italia (1563 – 1870): genesi e comprensione dell'opera architettonica, U. Allemandi, Torino 1990.

[15] Pauletti, Giovanni Andrea, Storia di Torino e del Ducato di Savoia, TECA, Torino 1994.

[16] Peyrot, Ada, Viale, Vittorio, Immagini di Torino nei secoli, Tipografia Torinese Editrice, Torino1969.

[17] Pingone, Emanuele Filiberto, Augusta Taurinorum, apud haeredes Nicolai Bevilaquae, Torino1577.

[18] Symcox, Geoffrey, Vittorio Amedeo II: l'assolutismo sabaudo: 1675 – 1730, SEI, Torino 1985.

[19] TORRI, Michele, Piemonte com'era, La Stampa Ed-, Torino 1985.

HERITAGE and TECHNOLOGY
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The new and the old in the perception of cultural heritage. The language of innovative materials between conservation, protection and enjoyment

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Abstract
Cultural heritage preservation calls on the new materials increasing performances in order to pursue in an even more compelling of the conservation and enjoyment of the huge wealth of our country. The logic, which sometimes more than a request is rather a hope, shall be that of the "new" as scope for action by highest respect of the cultural heritage.
In the awareness that any of new materials, even smart ones, can fully ensure the conservation, but everyone can help to guarantee the enjoyment, possible answers are outlined, otherwise be measured, which govern cultural heritage perception, and entrusted to a dialectical relationship between new and existing.
The most innovative materials are the same project and the cultural heritage, synergistically interacting with each other. The project aside, for the potential to renew and regenerate the culture of conservation. Across the materiality of the context of the cultural, the main material, innovative inasmuch from its knowledge the choices originating that gradually organize the project.
New materials language, as usual, albeit never greater far, substantiates the perceptive experience in a balance, sometimes very fine, between the material nature of the context and the project. But especially the language of materials renews and regenerates the culture of conservation, enriching approach to the constructed of new meanings. In this way, the relationship between technological innovation and cultural heritage becomes a singular measure of due regard for the document-monument.

Keywords: The new and the old, language of cultural heritage, culture of conservation and culture of design

1. Innovative materials and conservation

"It is not the concrete, not wood,
is not the stone, is not the steel,
is not the glass element more resistant.
The strongest material in the building is the art. "
Giò Ponti [1]

The introduction of innovative materials in the field of protection of cultural heritage, means that the performance of the latter are always greater and that could perform the surgery with the highest respect of the asset itself.
Although none of the new materials, even intelligent ones, can fully guarantee the conservation, everyone can contribute to ensure its enjoyment. In this scenario you outline possible answers, which project the cultural asset in today's reality, according to a dynamic relationship between new and existing.
Giò Ponti's words resound as a sign of attention and lead to a profound reflection. There is an answer to the question “what is the most durable material for use in a given context”. And even the most innovative ever. Nor that better able to ensure the reversibility of the conservative act.
Innovative materials are the design and the cultural object itself, each interacting with each other synergistically. On the one hand the project, for the potential to renew and regenerate the culture of conservation; in fact, the materials are cut only instrumental value as the project evolves toward its defining

accomplished. On the other hand the materiality of the cultural context, the Prince, innovative material since her knowledge originates from the choices which gradually organize the project, throughout its substantial size and new language that transforms. And even in the goal of conservation there is transformation, perceptible or not, but effective and concrete.
Therefore, the new is the project. It's in the ways in which it shall ensure the materials, old or new. And it is precisely the mode of use that resides the quality of the project, which, in turn parametra the objective of conservation. Through the action of instrumental materials, including those more new, the draft measure the gap between processing and preservation.
The invasiveness of the approach is in the project, not in the material. Often in the use of the material you adopt techniques particularly invasive that undermine the quality of the project. Then it is the approach to the context built that said the rules of the intervention, thereby affecting the quality, and it is born from the perceptual experience of the cultural asset throughout its materiality.
Today a tension is gathered, a strange attended towards the tomorrow and to operate in the field of the built one, almost as if the objective of the maintenance were very near by now from the feasible being. Gregotti defines the last thirty years condition "an «academic immobilism of the incessant novelty» in addition specific character of much of contemporary culture" [2].

2. Culture of conservation and culture of design

The culture of conservation has matured in recent years a focus on historical and cultural heritage, expressed in terms of defense with respect to the culture of the new, which is considered demolishing and erasing.
There is mistrust of goals that the science reaches day by day; mistrust that is born of the fear that what has been done can be underestimated because of the willingness to continually exceed the present.
The defensive tone that sometimes stiffen the conservation arise, therefore, from the view of scientific progress is intended to overcome continuous with a end destructive tendency. But, in truth, the new adds! And knowledge is the only one that can to help you understand the relational parameters with which the new fits in the reality of the build and constructed. In the act of the overrun, voltage of this and "the soul of the progress, it adds no solution of continuity and delivery is an additional share of eternity in the past that sustains him for ever.
The destructive meaning of the innovation has a certain historical substantiation. Starting from the second half of the twentieth century, on the track "modern" since the beginning of the century, in which new technologies are presented as winning and definitive alternative than those of the past, promising to be able to govern the construction process in decisive and lasting manner, the new led to massive and irreversible approaches, to the detriment of a cultural heritage that in many cases, had been able to overcome trials and difficult challenges, thanks to a material-technological apparatus of authentic uniqueness, designed " to rule of art".
And it was always the history, the most recent, to begin a phase of reorganization of the lesson of the past. The contemporary approach began to doubly the experience of the modern, to read it to rear up to review also the contradictions. And if yesterday, in the name of "modernity", on the one hand, it is chasing an aspiration to innovation is not always rewarding, on the other hand, it is revolved around the irreplaceable role of traditions, losing sight of the deeper meaning of the term progress, rather it should be understood "in terms of fertilization between cultures, to be respected and to reactivate" [3].
Today, despite some diehard skeptics, the new culture continues in the wake of tradition. Is structured among them a relationship increasingly healthy and balanced, centered on principles of integration between the technical, performance and enhanced on returning, revised and updated, the techniques of the past. Gradually innovation is arranged along the evolutionary path of history and scientific progress that's absolutely straight and the dress more appropriate to fully grasp innovation today is retracing the track's long history of building, punctuated by centuries built.
The conservative action meets the implementing possibility more wide, true and corrected if it is set in continuity with an able plan to receive and to conjugate all the constructive cultures, that of the historical memory and that of the innovation.
Therefore the plan, in all its connotation of matter, must find a dimension of the contemporary more wide and inclusive, looking to the new and the modernity in a way to incorporate in active form also the past. In essence to become and you must continue to be. In the convergence between modification and membership it consumes a conservative approach aware of the constructed to keep transforming it. Specifically, it is quite rightly point out the possibility of handing them the memory through an interpretation of the identity and the specificity of the context in the whole, the meaning of carrier material of the project, in which the new merely shifts the balance of the existing.
Every constructive solution, which becomes the spokesperson of the new, subtends a modification that is born from a reinterpretation of the building tradition that, in the promise preservation, it gives continuity to ways to build.

Reading the built landscape and the building means to reconcile respect for the existing and in synergy today's culture. In fact the cultural object, in all its material, not only lives, but discovers new and unexpected meanings that do not evade the pre-existent, but reinterpreted in a contemporary key. The weight and the reinterpretation tones you have the measure of the conservative act in which takes the form of modification.
There is awareness in the continuity of the evolutionary process and weighs the ties that current technology interweaves with cultural and temporal contexts of yesterday, to the extent that the constructive language promises freedom on several fronts. And here intervenes, between modernity and innovation, construction techniques that, in real time, with his admittedly belong to ways to build of all time, introduces virtual thickness by a projection of the time component.
This thickness measures the exact size of the technique that must be "like soil that sustains us, not before their eyes as a destination" [4].
Therefore, it foreshadows another material, the technique, the aim of which is set by the project itself not in terms of contradiction, but as conjunction. And continuous outdo that seek solutions, the use of materials, both traditional and new, binds, through the technique, structure them to today's culture.
So, once again, the preservation of cultural heritage, in its constructive definition, it is a matter of interpretation. In fact, proceeds according to a third dimension, in the direction of justification and interpretation, in accordance with the "method" which is the path that the story drew.
Justification implies proximity and above all analysis, that must be the attitude to understand the meanings and to answer to the because. The interpretation implicates, instead, the full perception that "every new has an own antiquity" [5]. It means, therefore, to renew the material project in the sense of the continuity, without contradicting or to deny the cultural good, to already discover the new one in the existing and to bait dynamisms, at times thin and imperceptible, in the daily reality of the to build.
“Mi viene in mente il celebre scambio di battute tra Picasso e Braque a proposito di come si fabbrica un chiodo, se per mezzo del ferro o per mezzo dell’idea di chiodo. Lo sforzo del progetto moderno è stato di capire che l’idea di chiodo è essa stessa partecipe in modo inestricabile del suo essere fisico, della rifondazione dei suoi strumenti e dei suoi obiettivi, e quindi che l’invenzione non sta solo nella forma del chiodo né solo nella sua materia, ma nel ripensare l’essenza stessa del suo scopo nella specificità del caso.” [6]

3. The limits of good faith conservative

“[...] the monument is a book, which I intend to read without reductions, additions and alterations” [7].
The modification is the mouthpiece of design culture and becomes challenge every day the culture of conservation up to meet equilibria in which also the contradictions enter the ranks of materials of project. The new, in its incorrect meaning gainsaying people, offers the language has its possibility of truth, which enables the fruition of cultural asset, until their overriding the membership of the present in an active size of conservation and protection.
A false paralysis lurks in the culture of conservation that as for the reversibility, appears entrenched behind an abstraction so strict to create discontinuity with the real approach. The operation comes into conflict with theoretical assumptions on which the "methodologically correct" and forced to compromise with choices and textural language to some extent limiting. The contradiction between the underlying concept, universally recognized, and the position limit value which tend asymptotically is filled with difficulty from the awareness of the impossibility of full implementation. And among the possible answers, each, to substantiate the change in all its materiality and perceptibility, measuring conservation through qualitative parameters characterized by the same conceptual limits.
The parameters which relies on the measurement of the conservation are afflicted by the same aporia of sense, split between theoretical abstractions and real limitations. Reversibility, compatibility, and appropriateness of the materials and techniques with respect to the construction systems originating in the cultural good suffer the same dualism of the concept of conservation. Their theoretical value irrefutable identifies the size of the assumed methodological, while the action which constitutes the operation is more or less far from this absolute value. For example, the definition of reversibility as utopia necessary [8], which can be extended to other concepts, including that of conservation which is placed at a higher scale.
To reduce the gap between the theoretical concept and operation real you rely on the principles of minimum intervention expressed in the recent Guidelines for Cultural Heritage, as precaution against possible errors. Yet, in any specific intervention, reversibility, compatibility, and appropriateness however, they have an instrumental value in relation to the objective of conservation and, therefore, return in terms of quality of the project. Their review, which is subtracted from the numerical estimates, and entrusted to the knowledge tools of disciplinary fields different ranging from behavior physico-chemical materials of assessments purely aesthetic inherent in the cultural object.
But between the two extremes of theory and practice, are infinite ways to intervene really. Their variability is unpredictable, while being expected that you are away from absolute concepts. The modification that specifies the intervention among the many possible ways, depending of the ways in which the new relates to the ancient, generates unequal guidelines related to the perception and reading that accompanies it. The

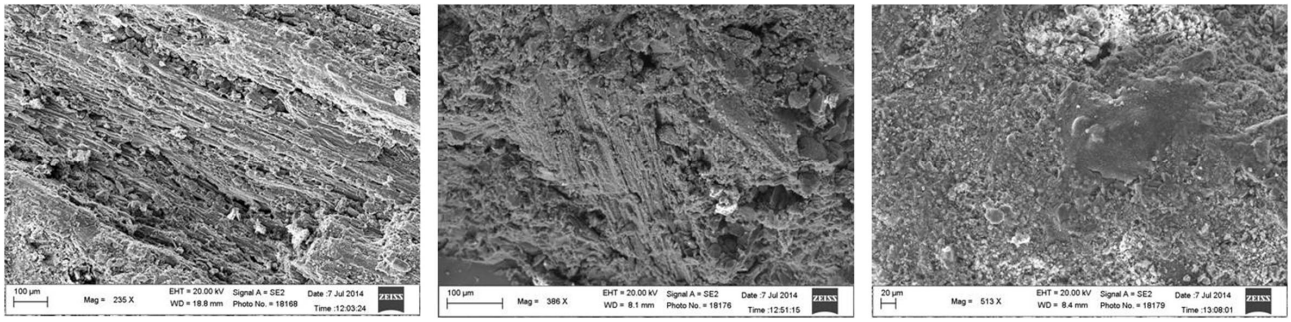

Fig.1 Scanning to SEM of green tuff samples, subjected to accelerated aging tests: a) untreated sample; b)sample treated with nano-lime; sample treated with siloxane resin.

perceptual measure of modification is not always directly proportional to the reversibility and the appropriateness of the approach on the object. Then conservation and respect are paradoxically better substantiated and declared if the new supports the approach to a not equivocabile extent.
The disparities with regard to the use of inorganic materials, moreover, raises, beyond the modification requiring assessments, the theme of conservation hopelessly denied by protective products and even superficial irreparably altering consolidating the stone surfaces face historical view (Fig. 1).
And, as if not enough, sometimes, happen to have to choose between "conservation of image" and conservation of original materials. (Fig. 2) In these cases you are forced choices, which are non-choices, to go in derogation to the most conservative principles and to authorize exceptions to the rule. So it favors only the image of the cultural property and its semantic value.
So modification has no rules. It is inherent in the storage to the point that you cannot see with the naked eye, but be invasive in dictating new behaviors that compromise the durability and life of the cultural property. Conversely, if declared, the modification can preserve and respect the material context triggering new interactive relationships with the materials of this to tell the story of yesterday and today.



Fig.2 Main spire of Milan Cathedral: replacement of marble dowels

Therefore, the conflict between conservation and mutation is often only apparent. It is in bad faith if they are supposed to be in opposition to each other. The mutation doesn't deny the conservation, but sometimes fails to prevent the loss of cultural heritage. In addition she active mechanisms of reading and dynamic communication, able to tell the story of the building over time until today. In many cases the new that is in the project is not presented as the other side of the coin, but without interruption with the old. Only when we have full awareness we can better protection our heritage.
"Costruire dove è già costruito, dove il tempo passato è leggibile nella materia e nella forma delle costruzioni, […] è per l'architetto un impegno morale difficilmente codificabile. [...] Ricordo di allora il desiderio di conservare e tramandare, e un'idea del tempo che è di contemporaneità, dove passato e presente coesistono e sono già domani". [9]

4. Modification and the language of the new

The modification doesn't know rules and references and escapes the time dimension that project should belong exclusively to possess. If the modification has the support of the project, in all its sense of new material, returns to its cultural heritage and its different possible linguistic truth.
Remove dust from the equation *Beauty* = *Truth* of Camillo Boito has a cultural connotation important because it reveals the current, and raises the issue of language in relation to the material project and the roles that the new can carve with respect to cultural heritage. Respect archaeological expressed in its

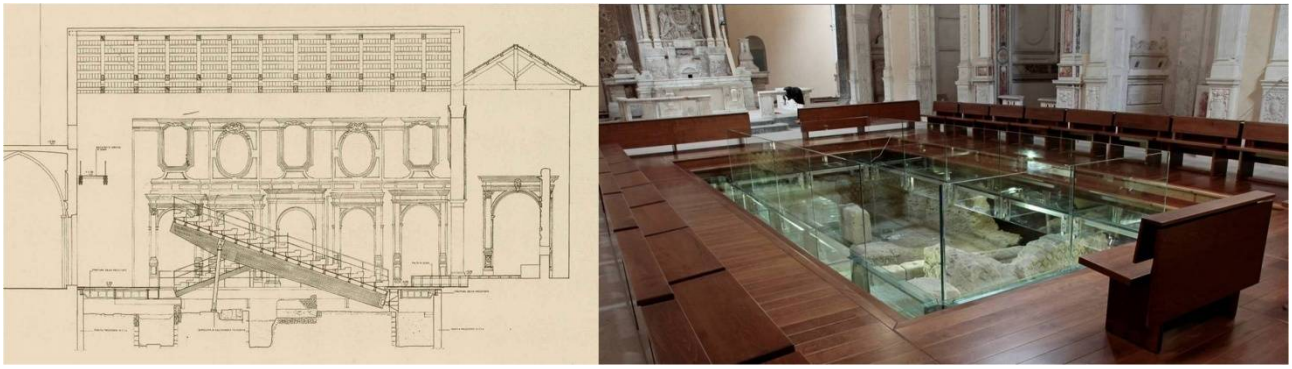

Fig.3 The project must establish a belonging to the culture of the present. Church Sant'Aniello Caponapoli (NA): laminated wood in the project of 1986 and structural glass in the project of 2008.

nineteenth-century restoration experience resonates as an ethical imperative that reintroduces the theme of morality in the reality of the construction. In some way Boito understands the validity of the approach on the existing as a matter of conscience, which still flaunts its value authenticity and regenerates the culture of conservation. Sincerity than built and than current procedures for building new links between interweaves the pre-existence and our time and becomes, therefore, a founding element of language that is structured in the relationship between technological innovation and cultural heritage.
Even the culture of the ruin, regenerated in the last thirty years as a reaction regards invasiveness of concrete, still boasts its timeliness and tends to be as a doctrine for many. But when you outline the conditions of use, as the only guarantee of the preservation of the old, the new earns its access in the historical context and at the same time the right to propose it again in a different way. The new tends to take on the difficult task of proving the intent to safeguard the existing and this is language. But it also loads of another linguistic connotation, because action must also establish a belonging to the culture of the present. It should be clear from the date of action and of the image of the mutation (Fig. 3).
Therefore, the enjoyment of the cultural heritage occurs both in a sensory both strategically. It is the image that triggers the perception, as social experience of sharing the cultural property, and its facets saturating enrich the language of ancient and modern tones.
When the mutation becomes a sine qua non for the survival of the built space you earn more freedom "operational" in the name of conservation. This puts aside the abstraction of his assumption, to prevent a loss announced. The memory space has to be lived and, therefore, must be rehabilitated in order to be remedies. It is a little like the music that must be continually revived in new key, by arrangements that the regenerate, the exalt and the sublime in a character of eternity so the spatiality of the cultural good must be commemorated through the new, because in the perception can be read with clarity his being ancient, the membership of the present and beyond, until you hear that character of eternity that is has been gaining for man's hand.
“Come ci insegna il paesaggio della grande pittura cézanniana, un’architettura deve avere la doppia qualità di sorprendere ogni volta che la si rivede e nello stesso tempo di apparire come fosse sempre stata, in quel luogo e per il mondo, come avesse da sempre fatto parte di quel paesaggio divenendo intimamente parte necessaria alla sua definizione, rivelandolo a se stesso continuamente, anche durante le sue trasformazioni.” [10]
Even the built space, as new architectures, has a right to membership of the context in the spatial and temporal sense this to be able to impress in perceptive experiences that the reading and rereading furnish and certainly manages to combine more the identity that has gained in every season of his life. The language that characterizes possesses an enormous force to inform you that the project strengthens with respect to the inherent potential of the asset. This concept of membership so dilated returns the good of humanity beyond space and time.
The ruin doesn’t reward the preservation of the cultural heritage, which remains a prisoner of its past and is destined to die slowly or more to be the object of attention of a few "museum lovers". On the other hand, it is undoubtedly the ability of the project to generate collective memory through the intervention on the ancient, up to allow that belongs to many, if not all. This is to return the original meanings to the spaces and add new, in the sense of consecrate to the living of today.
“Respect of architectural identity of a building is what makes change possible, what guarantees life.” [11]
Language regained membership and it does so using various images that generate excitement and participation in various levels. There are too many examples and each with its dose of reversibility and invasiveness shall enter into the reality of the constructed and ensures the conservation bearing the brunt of the fruition. Each answer has a picture of him and fulfils its mission to communicate by using different words.

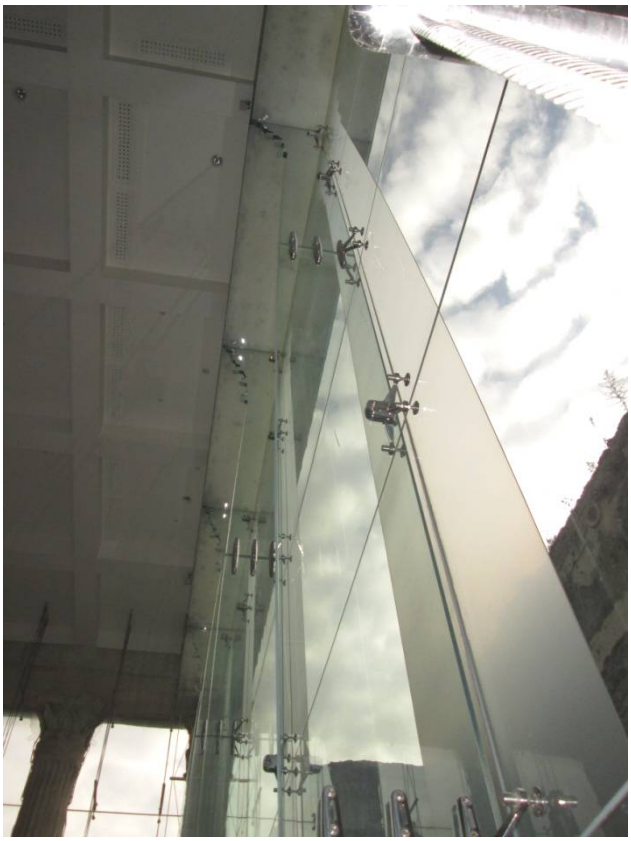


Fig.4 Columns and fins of structural glass in the cathedral of St. Proculus in Pozzuoli (NA)

The perception that it follows raises a thousand emotions and the answer strictly constructive starts to break and tends to become the response of the time. This sensory experience, which is only triggered by a substance, it interprets the spatial character and the intrinsic values through mechanisms of transition between the old and the new.
The apology of the tie rod and strut always retains its effectiveness. Symbol of the relocated under the banner of discretion and a guarantee of reversibility, also knows new connotations textural, steel, the metal alloys, the new advanced polymers. Tranquilizer in the image, new and old together, provisional apparently, almost elusive in the perception, provides security in all its primitive basic quality of static system elementary, both mechanically and visually.



Fig.5 Walkways of structural glass in the Basilica of Aquileia (UD)

The technology of structural glass, on the other hand, with its sophisticated structural technicality, discrete and innovative at the same time, today is increasingly able to introduce new spatiality in existing ones, to guarantee space built reading yesterday and the day before yesterday. From the point of view of perception redefines teams ancient material with discretion and physical perfection at the same time, up to redefine the ancient and intrinsic spatial characters translate into new (Figg. 4 e 5).
In the limits of good conservative faith, the celebrations are manifold, but the action is equally active and innovative because, in the limits of the reversibility, a mechanism of involving and vivacious perception produces it, that conceives the cultural good as an alive thing.
You earns the awareness that is still something to discover in the space of the ancient factories. In the silence of the materials it matures the feeling of manifold reasons to be of ways to live to tell and to experiment. The discovery is a spiritual quality, inherent in the materials themselves, those ancient and those new, that it transmits a sense of endless of the spatial values. Identity and memory are, therefore, regenerated spatial values and illuminated of new light. And, in a so saturated atmosphere of emotions, the new other is not that a new and peaceful paraphrase of the usual materials.
“Identité, mémoire, patrimoine: les trois mots clés de la conscience contemporaine, les trois façes du nouveau continent Culture. Trois mots voisins, fortement connotés, chargés de sense multiples qui s'appellent et s'appuient les uns les autres.” [12]

Bibliographical References

[1] http://www.chiarapecorelli.com/gio-ponti/
[2] GREGOTTI, Vittorio. *Il sublime al tempo del contemporaneo*. Torino: Passaggi Einaudi, 2013. p. VII. ISBN 9788806215699
[3] PIANO, Renzo. *Renzo Piano La responsabilità dell’architetto. Conversazione con Renzo Cassigoli*. Firenze: Passigli ed., 2000, p. 51.
[4] GREGOTTI, Vittorio. In MAROTTA, Antonello, (a cura di) *Saper credere in architettura. Cinquanta domande a Vittorio Gregotti*. Napoli: Clean, 2002, p. 65.
[5] BOTTA. Mario, *Quasi un diario, Frammenti intorno all’architettura.* Firenze: Le Lettere, 2003, p. 86.
[6] GREGOTTI, Vittorio. *Dentro l’architettura.* Torino: Bollati Boringhieri, 1991, p. 61-62.
[7] BOITO, Camillo. In CRIPPA, Maria Antonietta (a cura di). *Camillo Boito – Il nuovo e l’antico in architettura*. Milano: Jaca Book, 1988, p.110.
[8] RAVA, Antonio. *“La reversibilità, utopia necessaria”*. In Reversibilità? Concezione e interpretazione nel restauro. Memorie del Convegno, Politecnico diTorino: UTET, 2002, p. 121.
[9] BRUNO, Andrea. *Comprensione, conservazione e manutenzione*. In MASTROPIERO, Mario. *Oltre il restauro. Architetture tra conservazione e riuso: progetti e realizzazioni di Andrea Bruno (*1960 -1995). Milano: Lybra Immagine. 1996, p.12-13.
[10] GREGOTTI, Vittorio. *L' architettura di Cézanne*. Milano, Skira ed. 2011,p.32.
[11] MONEO, Rafael. *La solitudine degli edifici e altri scritti*. *Questioni intorno all’architettura*. Torino: Allemandi, 2004, Vol.1, p.154.
[12] NORA, Pierre (a cura di). *Les lieux de mémoire*. Paris: Gallimard, 1997, vol. 3, p. 4713.

HERITAGE and TECHNOLOGY
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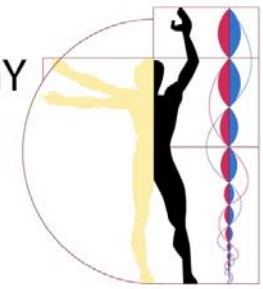

The traditional sacral wooden construction in Lithuania. An illustrated catalogue of building techniques for the safeguard and recovery of cultural heritage

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Abstract
This study aims to investigate the technological and structural aspects of Lithuanian traditional sacral wooden construction, an important corpus of heritage and landscape in Europe: we are working on the systematization of building types and we have composed an atlas of constructive techniques, useful to the knowledge and the future preservation of timber structures; we are working also to prepare schedules of the main technological solutions and to enforce the analysis of wooden buildings, also related to the damage mechanisms and detected failures.
The research proceeds, according to the direct knowledge of the building, to define the history of construction techniques, a geometric and constructive survey, the analysis of the main failures and degradations. The atlas requires the survey of technological and structural decks and the identification of the major technological units, the preparation of wooden species tables, the individuation of the coeval structural units and also of any decks introduced in subsequent periods, which works for the safety or consolidation of the building. This atlas is organized into a great number of tables that consists of the type of wooden species, kinds of craftsmanship, construction systems and process, connection types, technological units, finishing and completion parts and decoration elements.
We would equip the technician of useful result, in order to obtain good practice guidelines, for the safeguard of this technologies and heritage.

Keywords: Lithuania, wooden sacral buildings, traditional wooden construction, heritage.

1. Introduction
The oldest wooden churches began to built in Lithuania in the 13th century. Currently, there are more than 600 existing wooden sacral structures, which don't have a detailed studies about their structural and constructive aspects. This is an heritage of wooden technical culture which remains all to explore for the conservation of the valuable architecture in this Country.
The main part of these wooden churches appears into a sensible decay condition, because of the absence of the necessary attention and that technical competence, able to preserve these buildings; unfortunately, the biggest destroyer is the neglect, intensified by an inadequate maintenance. The wood degradation caused by insects and fungi attacks, also associated to structural instability derives from the absence of preservation. Sometimes badly made reconstructions contribute to the structural decay, and also the wrong choice of protective materials and furnishes, associated to the absence of ground works [1].
The industrial production could - in the past, just as today - gradually weaken, if not destroy, the richness of craftsmanship (associated with the transmission of this knowledge to the next generation); therefore it's important to recognize the value of the wooden architectural heritage and to plan its safeguard for the posterity[2].

2. Rituals and building typology: knowledge, analysis and listing

The research presents a detailed study of the wooden sacral architecture (Catholic Christian, Byzantine, Reformed, Protestant) in Lithuania: we want to find the more possible information able to add knowledge about this subject, and also to do a systematization of the all Lithuanian sacred wooden buildings, with a particular attention to the more significant examples (also performing references by analogy or contrast with the other sacred building examples derived from the widest area). These typological lists are divided in three different sections: 1) the churches that had in the past some volumetric and/or distributive or constitutive changes; 2) the churches that over the time maintained their original volumetric and/or distributive shapes; and finally, 3) the section that includes the churches no longer in existence.(Fig.1) This systemization contains a brief description of each sacred building: location, territorial organization, history, drawings and typological characteristics, dates and consistency of the main changes. Each list contains also a photographic survey, compared with the ancient iconography that we have found in archives or into publications about this topic, associated with the geometric-dimensional survey (drawings of plans, façades and architectural sections). Through the list of sacral wooden building, it will be possible to have a detailed information not only from the architectural point of view (that until now has been done), but also from a technical/constructive perspective. This list includes the development of the following information: description and general information, localization and territorial framework, short building-history and typological characters, dates of the main changes and interventions, materials and construction techniques, with the direct references to the construction techniques illustrated catalogue, that we will be introduce and better explain in the next paragraph.

This detailed description of architectural types and technical elements is necessary to give an evidence of indisputable value of these wooden religious buildings and it gives the main aspects for the further studies. It's not a coincidence, in fact, that these buildings are also the subject of UNESCO and ICOMOS interest, which noted the importance and the value of the Lithuanian wooden cultural heritage in Europe (and not only).

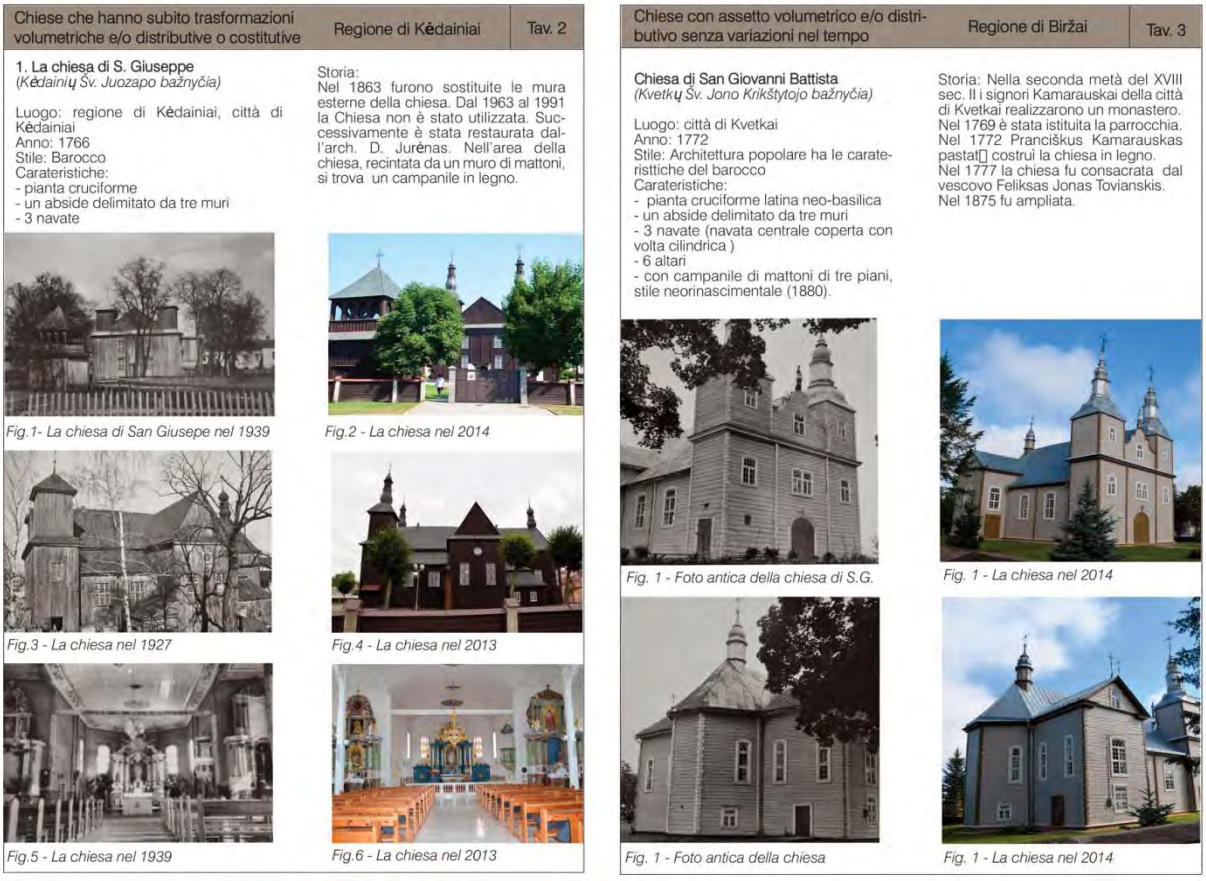

Fig. 1: Typological lists of Lithuanian wooden sacral architecture.

3. Materials and frame of wooden architecture: an illustrated catalogue of building techniques

The study proceeds - according to the direct knowledge of the architecture and through the analysis of the actual state of places and buildings - to define a geometric-dimensional, constructive and photographical survey. We do a detailed analysis of the constitutive geometries, of the history of

construction techniques, an analysis of the main failures and degradations, a retrieval of the specific literature about the churches and their construction techniques.
The organization of a general illustrated catalogue describing the Lithuanian constructive technics requires the survey of technological and structural frameworks and the identification of the major technological units, the drafting of wooden species tables, the individuation of the coeval structural units and also of any intervention introduced in subsequent periods, as safety or consolidation actions. This catalogue is organized into a great number of tables, that consist in the systematization of the principal wooden species, kinds of craftsmanship, connections, technological units, finishings, completion parts and decoration elements.
For the construction of wooden buildings in Lithuania were used all local natural resources: various types of wood, used for building construction, compact stone for foundations, clay and brick, lime mortar, the dried moss for building insulation, straw and wooden shingles for roof cladding, etc.
Some sacred architectural and structural differences were resulted by different religions and cultures. Also each region presents specific architectural features, which are often associated with different choices of constructive materials and decorative elements. Sometimes, after recovery works provoked by deteriorations of structure, we can find new materials, that had been introduced incongruous sections or that had been replaced the early structural elements. These materials are usually unrelated with the ancient technologies. Also we can find a defective workmanship of technological units, the wrong choice of protective materials and cladding. It's evident that, for the permanence of the local culture, it's necessary to increase the knowledge of the original building materials and construction technics, correctly able to maintain the restoration works.

3.1 Wooden species, wood carvings and assortments

A significant part of the constructive technics illustrated catalogue is related to this subject, in order to associate the wooden species, wood carvings and assortments to the various technological solutions encountered in technological units composing the churches.
We do a particular attention to the analysis and cataloging of the wood species and other construction materials, traditionally used for construction in Lithuania (stone, brick, mortar, metal, ...). For example, the analysis of fundamental parts of the tree are accompanied by explanatory drawings, associated with the related terminology, clearly identified and contained in the glossary filled out in three languages (Italian - English - Lithuanian).(Fig. 2)

Tav. 1,1

1.1.a - Parti principali di un albero:
a.1 - chioma - insieme della parte terminale del fusto, dei rami (a.2) e delle foglie;
a.3 - fusto - propriamente detto, da cui si ricavano tronchi destinati alla ulteriore lavorazione in segheria (Uzielli, 2001).
a.4 - radici - parte del vegetale con il compito di assorbire sostanze, minerali e acqua.
1.1.b - sezioni anatomiche - il legno presenta proprietà significativamente diverse nelle diverse direzioni:
b1 - sezione trasversale RT;
b2 - sezione radiale R;
b4 - sezione tangenziale T.
1.1.c - sezione trasversale - cambio e corteccia (c.1, c.2), normalmente vengono eliminati con le ulteriori lavorazioni del tronco; legno, costituito prevalentemente da cellule lignificate e morte (c.4, c.5); midollo (c.6), zona corrispondente alla fase iniziale di accrescimento della pianta (Uzielli, 2001).

Nr.	Italiano	Inglese	Lituano
1.1.a	parti principali di un albero	main parts of a tree	pagrindinės medžio dalys
a1	chioma	foliage	lapija
a2	rami	branches	šakos
a3	fusto	tree trunk	kamienas
a4	radici	roots	šaknys
1.1.b	sezioni anatomiche	anatomical sections	anatominiai pjūviai
b1	sezione trasversale	cross section	skerspjūvis
b2	sezione radiale	radial section	radialinis pjūvis
b3	anello annuale	growth ring	metinė rievė
b4	sezione tangenziale	tangential section	tangentinis pjūvis
b5	corteccia	bark	žievė
1.1.c	sezione trasversale	cross section	skerspjūvis
c1	cambio	cambium	epidermis
c2	corteccia morta (ritidoma)	outer bark	išorinė žievė
c3	corteccia viva	inner bark	vidinė žievė
c4	alburno	pith	šerdis
c5	durame	hearthwood	žievė
c6	midollo	sapwood	balana
1.2.a	pino	pine	pušis
1.3.a	abete rosso	redwood	eglė
1.4.a	betula	birch	beržas
1.5.a	pioppo	poplar	drebulė
1.6.a	cenere	ash	uosis
1.7.a	quercia	oak	ąžuolas
1.8.a	otano	alder	juodasis alksnis
1.9.a	tiglio	basswood/lime	liepa
1.2; 1.3	conifere	conifer	spygliuočiai
1.4-9	latifoglie	hardwood	lapuočiai

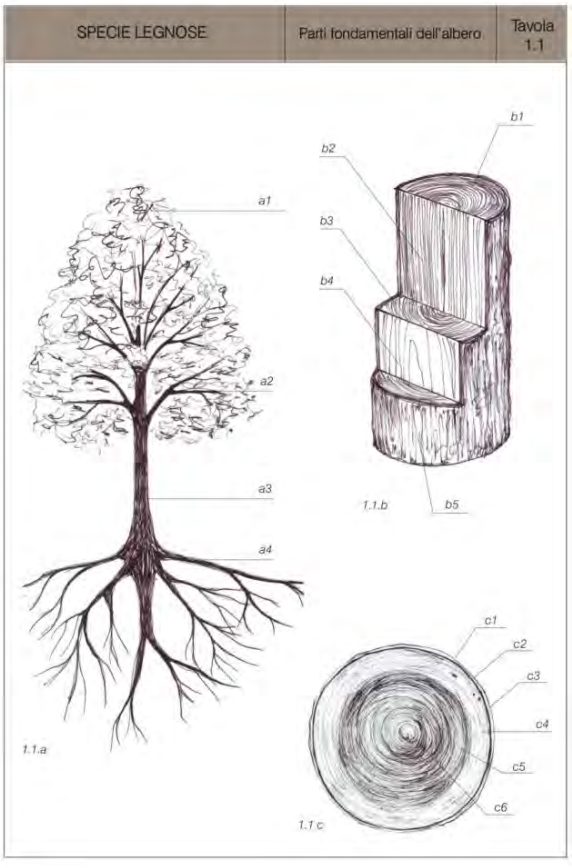

Fig.2: Tables of constructive catalogue, related to the wooden species (designed by L. Berežanskytė).

The tables, related to the woodworking process, are carried out by specific tools of local tradition, which were found in various Lithuanian ethnographic museums. These tables are useful for the knowledge of the ancient building techniques and woodworking process. Most of these carpentry tools still could be applied for the safeguard interventions using handicraft techniques.
The tables of the wood carving process are divided into various categories, useful to explain and testify: the preliminary woodworking methods, secondary and accessory works (the same categories are further divided into subsections: abatement phases, transportation, survey and measurements, realization of recesses and/or housings, trunk cutting and portioning, and –finally- completion works, as turning, planing, chiseling and carving,…). (Fig. 3)
The tables of the woodworking are useful for the direct knowledge of the wood preparations for use in constructions: cutting types, the list of wood formats, processing and classification of wood (sawn), aging techniques, ... (Fig. 4)



Fig. 3: Tables of constructive catalogue, related to the woodworking process (designed by L. Berežanskytė).

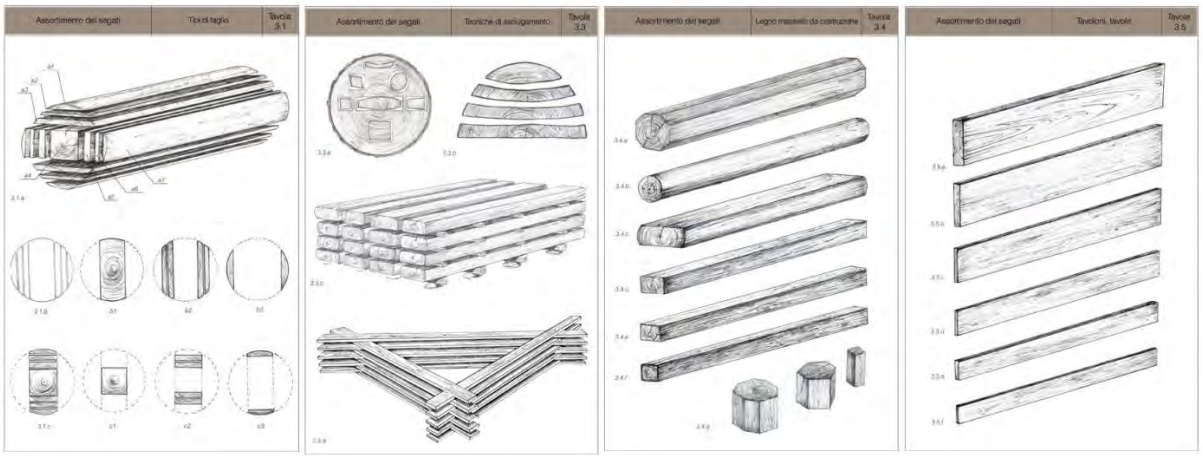

Fig. 4: Tables of constructive catalogue, describing the phases of wood preparations (by L. Berežanskytė).

3.2 Underground and ground elevation load-bearing structures

Sometimes, we can find some wooden buildings presenting foundation collapses, which are determined by the same instability of the underground structures. In these cases, it's important to deepen the knowledge of building materials used for the construction of foundations, that are usually made using large tree stumps piled in the ground, with rectangular ditches for the stone blocks inserted and put in place with or without the lime mortar or simple clay. [3] (Fig. 5)



Fig. 5: Tables examining foundations types (designed by L Berežanskytė).

Log construction was the most common building technique in Lithuania. The *Blockbau system* is one of the oldest type and it's understandable, if we consider the relatively simple implementation of this system, which requires neither complex joints and no nail connections. In ancient times, the diffusion area of this constructive method included the majority of Europe, but during the time this use was restricted to that Countries abundant of coniferous forests. The *Blockbau* construction technique requires, in fact, a large number of logs, straight and weather-resistant, all qualities mainly possessed by firs and especially larches. This fact explains why the construction system using stacked logs had been developed particularly in the Northern Europe, where a lot of coniferous forests have always ensured a limitless supply [4]. The Countries of the North-eastern part of Europe are still realizing wooden buildings, even if in a considerably smaller way. From region to region, the buildings are different for dimension and the logs used for the vertical load-bearing structures have been selected according to climate and local resources. In the regions characterized by a colder climate, the wooden wall sections are thicker compared to those used in the southern area.

The overall sizes of building were also related to the wood type (for example: conifers) with its own intrinsic characteristics (lenght and cross section of the logs) [5]. The construction technics tables of the catalogue show the evolution of wooden ground elevation load-bearing structures: from *Blockbau* constructive system with round section logs, we find after a squared-section logs system, with a large variety examples of wooden connection choices and types of structural nodes. The tables are divided into various sections: types of joints, dovetail connection systems, vertical perimeter wall stiffening and reinforcement systems; all these tables are associated and accompanied by specific details and photographic documentation. (Fig. 6)

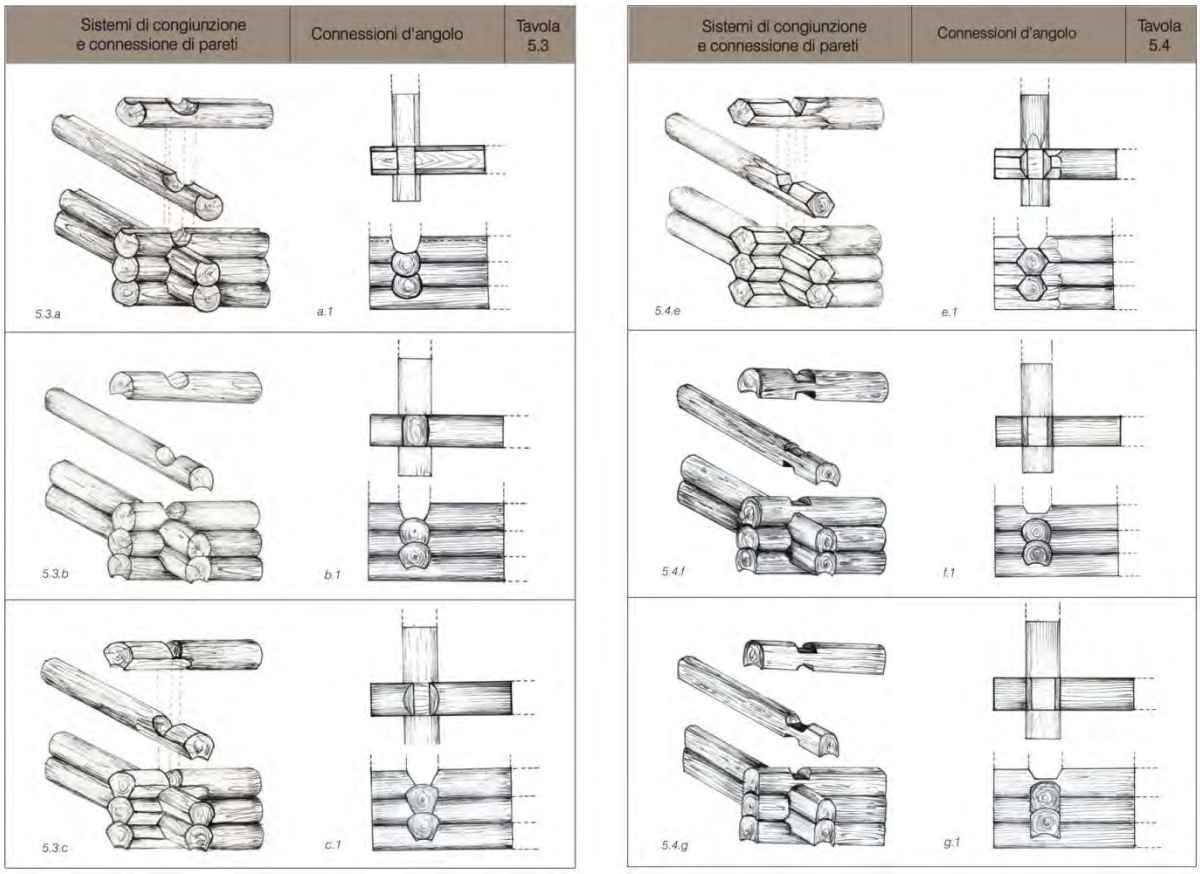

Fig. 6: The main types of *Blockbau* system construction techniques (designed by L. Berežanskytė).

3.2.1 Wooden wall claddings

The technological analysis of the external walls cladding systems has an important role, because often during the maintenance works the cladding has been precisely replaced. Originally, the exterior building walls were not covered with wooden boards; only in a second time, in order to protect them from humidity and for guarantee a better lifetime to timber structure, an external coating was adopted, using indeed wooden boards, placed in various directions. The decorations and the additional processes have been evolved when, in the second half of the eighteenth century, new utensils developed, particularly drills, chisels and different types of saws.

The wooden planks - mounted in various directions- divide the vertical surfaces in frames and compartments, creating ridges on the same surfaces and conformations useful for disposal of rainwater or for the cover-up of the connection points between the large beams of wooden walls. Often the façade cladding is divided into two zones: one near the basement area, where the planks would be harmed easier due to the water and damp, and the second one at the top part which was less affected by damp. [6] Not infrequently the recovery interventions allow to have a better knowledge of the techniques used in the past for the cladding installation, also suggesting the use of the philologically correct materials. The tables, whose specific object is external and internal walls coatings, identify the most common combinations of encountered decorative types and the methods of implementation. (Fig. 7)

3.3 Horizontal supporting and finishing structures: balconies and ceilings

The interior balconies are another constructive unit always current in Lithuanian sacral buildings; they are designed from the beginning of the church construction and have a double function: to allocate upside the pipe organ and to consitute an useful spaces for the singers. The beams of internal balconies lay on the supporting perimetral walls and inner walls, or in different case, they rest on pillars or columns. The internal balconies are useful also to divide the churches space into a main entrance and an ecclesiastical hall. (Fig. 8) The wooden ceilings of sacred buildings presents a great variety of shapes and constructive technics, representing one of the main elements that identify and characterize the interior volume. Their existence derives from the neccessity to maintain a sufficient temperature inside the building during the winter time. Usually they present a rectilinear, or vaulted or also polygonal conformation. We analize various types of ceiling, and each different shape have a peculiare constructive way. (Fig. 9)

A particular attention was paid to the connections between the ceiling and the ground elevation wooden structures, apart from also the ceiling connections to the roof structures, constisting often in wooden trusses.

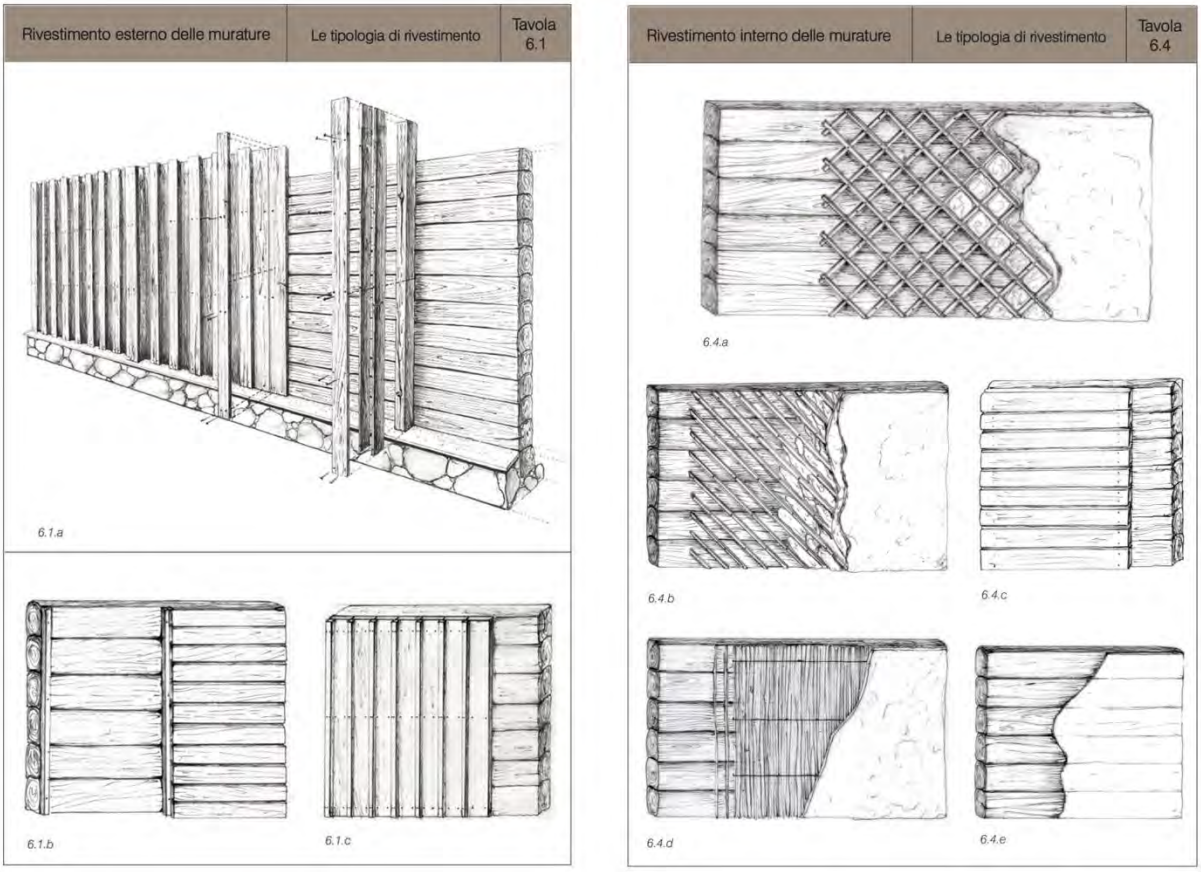

Fig. 7: External and internal wooden wall cladding (designed by L. Berežanskytė).

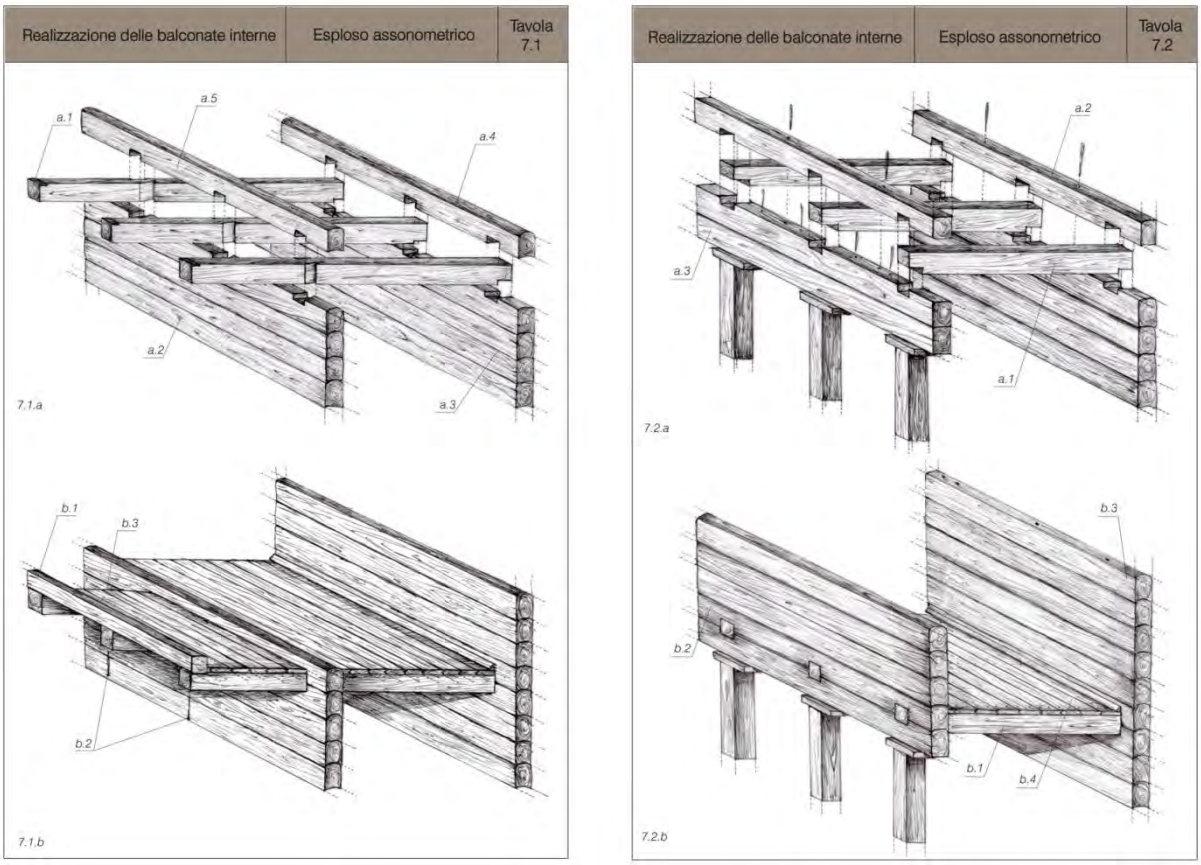

Fig. 8: Construction techniques of interior balconies (designed by L. Berežanskytė).

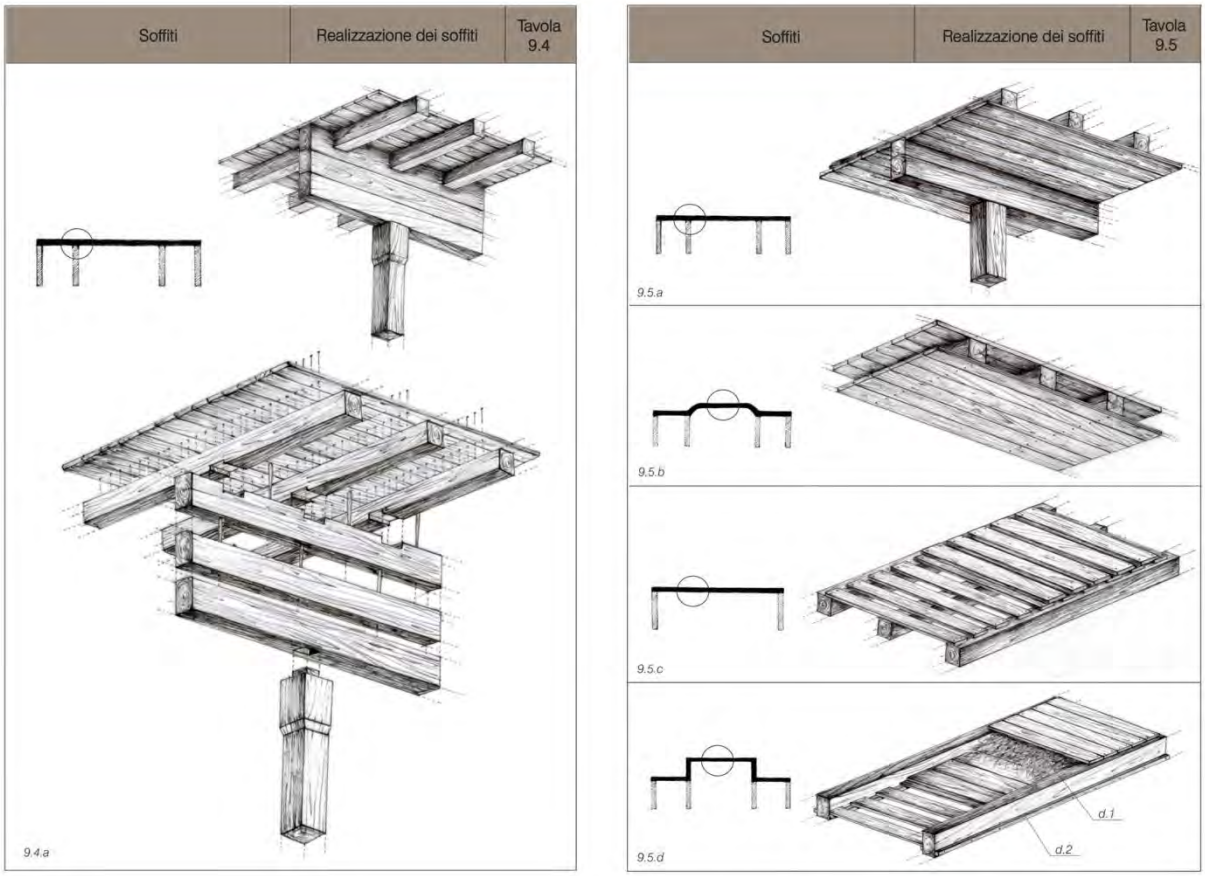

Fig. 9: Examples of interior wooden ceilings (designed by L. Berežanskytė).

3.4 Roof structures

During the roof maintenance interventions, always all attention is dedicated to the replacement of the roof covering, and rarely interventions of the roof structures were effected. A condition, this one, that -on one hand- has preserved its original quality and characters, but that -on the other hand- has often contributed to numerous failures and degradations. In case of recovery works of roof structures, we can find additional elements overlapping with the existing structures, with a difficult reading of the original parts from those that gradually were stratified, often using techniques and materials incompatible with the original ones.

The steeply pitched roofs are preferred in order to effectively dispose the large loads of rain and snow. The main structure consists in some rafters or trusses, also in this case denoting a great variety of shapes and technological choices. Over the time wooden roofs have suffered a lot of changes: the evolution of structural systems has improved the geometries and the connection systems. [7]

The detailed roof structures tables of catalogue are divided according to the various regions of Lithuania. Here we can find the analysis of the different types and conformation of trusses, the variegated connection systems of constructive nodes (for example: rafter-rafter node corresponding on roof top, wooden tie rod-rafter node, king post–rafter node, etc...). These tables are provided of axonometric explosions, documenting the principal elements of the structure, and also finishing elements with a specific references to the different types of roof coverings (straw, shingles and wooden boards, slates, metal plates, ...). (Fig. 10)

3.5 Opening typologies

The realization of the openings is made by the implementation of doorjamb liners, made using logs vertically placed and realized with a rectangular groove throughout the entire length of the log and also tied to the horizontal logs. They are well conformed, with adequate nodes to ensure the doorjamb attachment to the wooden perimetric walls of *Blockbau* system.

The opening lintel was directly consitute by the log forming the upper structure of the perimetric wooden wall, instead the windowsill is derived from the lower trunk of the same perimetric wall. On thus obtained opening space was installed the window frame, having his opening system. (Fig. 11)

The constructive tables present the catalogue of the most common doors and windows types.

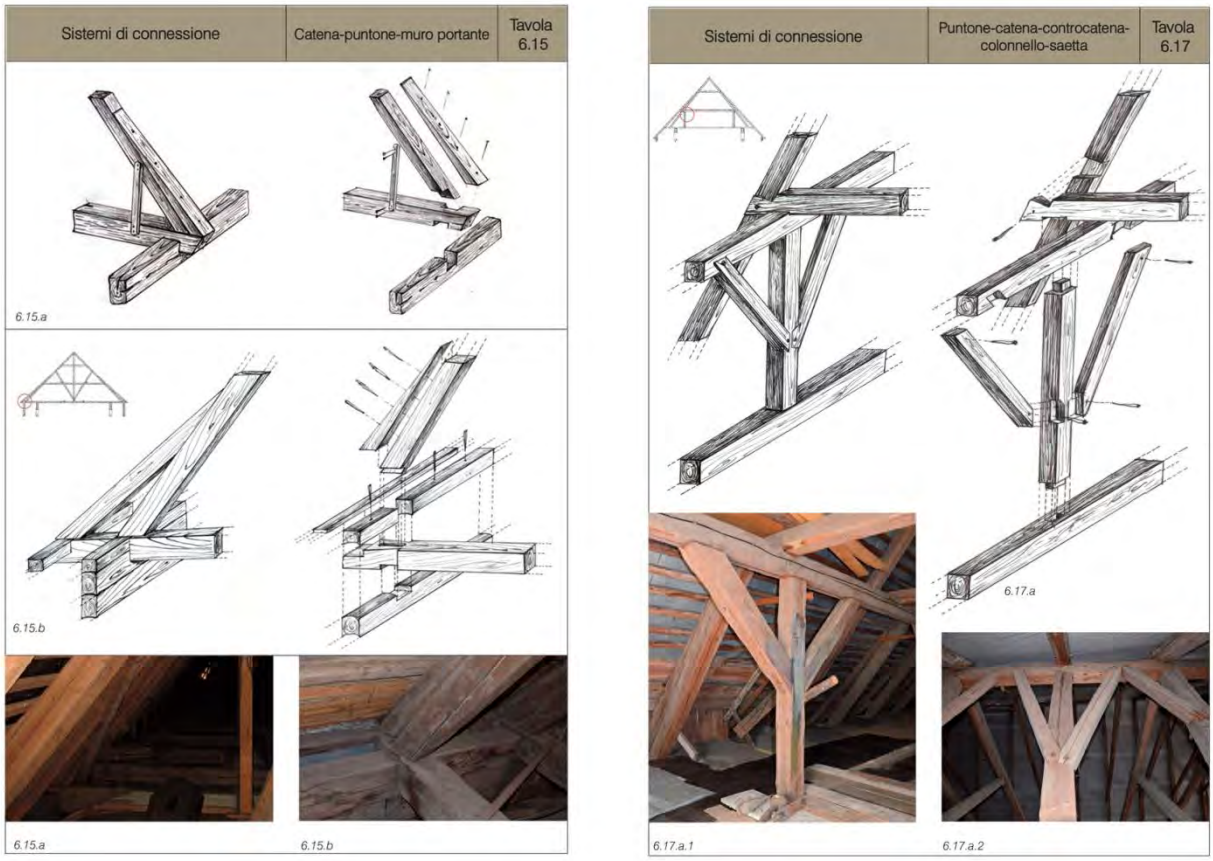

Fig. 10: Examples of truss connection systems (designed by L. Berežanskytė).

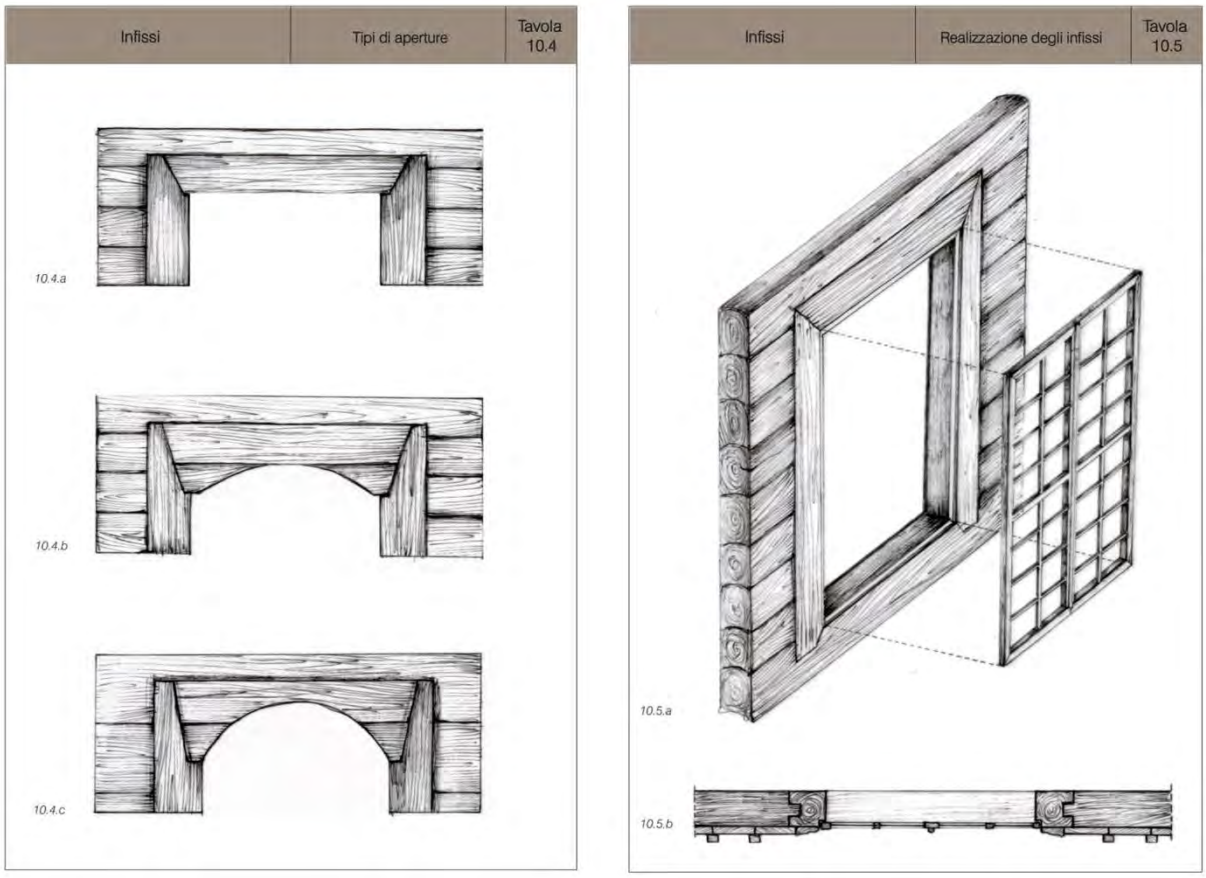

Fig. 11: Opening typologies (designed by L. Berežanskytė).

4.Conclusions

At the beginning of the nineteenth century we notice a general decline of the arts and techniques related to wooden construction throughout Europe, that never stop.

This research can give a detailed analysis and knowledge of the wooden buidings, associated to useful guidelines for technicians and workers that operate in recovery and maintenance intervention.

We hope that these intervention will be respectful of the original characters; it's still possible to use traditional technics, "rediscovered" in our constructive catalogue because they were *in situ* recognizable; we have to use the attenction of the expert eye and an appropriate value judgment; only adopting this approach we can safeguard this compendium of materials and technics.

We hope that this method can be traced an operational tool and an impulse to improve and implement the knowledge of this unique building heritage, even in its simplicity, but rich in history and established building traditions, that we have to preserve by negligence and uncultivated interventions.



Fig. 12: Drawings of Wooden churches in Lithuania (designed by L. Berežanskytė).

Bibliographical References

[1] TAMPONE Gennaro, *Conservation of historic wooden structures.* Collegio degli Ingegneri della Toscana. Vol.1, 2.Firenze, 2005.

[2]JANKEVIČIENĖ Algė, *Lietuvos medinės bažnyčios, koplyčios ir varpinės.* Vilnius: Vilniaus dailės akademijos leidykla, 2007. ISBN 978-9955-624-89-9.

[3] BEREŽANSKYTĖ Liucija, CAMPISI Tiziana, *La tradizione costruttiva degli edifici di culto in legno lituani tra XVIII e XIX secolo*. Storia dell'edilizia, delle opere pubbliche e delle infrastrutture. In 5° Convegno di Storia dell'Ingegneria – 1st International Conference on History of Engineering. Napoli: cuzzolin, 2014, ISBN: 978-88-87479-80-5, p. 875-887.

[4] DONATI Paolo, *Legno pietra e terra.* Firenze: Ed. Giunti, 1990, p. 44.

[5] BEREŽANSKYTĖ Liucija, CAMPISI Tiziana, *The traditional wooden construction in Lithuania between XVIII and XIX century: churches and bell towers*. 18th ICOMOS General Assembly and Scientific Symposium, Sustainability through traditional knowledge. Florence, 2014.

[6] TAMPONE Gennaro, SEMPLICI Michela, *Rescuing the Hidden European Wooden Churches Heritage.* Italy supported by "Culture 2000" of the European Community, Florence, Free Books S.r.l, 2006, ISBN: 0-9541183-0-8.

[7] BEREŽANSKYTĖ Liucija, CAMPISI Tiziana, La tradizione costruttiva degli edifici di culto in legno lituani tra XVIII e XIX secolo. Journal AGATHON, Palermo: Aracneeditrice, Rome, 2014, ISBN: 978-88-548-7959-1.

(*) This research was coordinate by prof. Tiziana Campisi and was conducted by eng. Liucija Berežanskytė, student of Phd Course at University of Palermo.

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Public buildings in the construction tradition of the 20th-century Italian suburbs

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Abstract
Public building construction in the Italian suburbs was among the production activities that led to national growth between the end of the 19th and the beginning of the 20th centuries; it was also the expression of the emancipating society and the values of a new cultural identity. Public buildings convey a reference system expressed in their urban role. Moreover, the technological progress involved in their construction reached the most peripheral areas of the national territory, particularly in Southern Italy where the need for modern achievements was more urgent.
The systematic knowledge of the technological principles that, together with the stylistic and functional building characters, identify the built heritage, represents a fundamental instrument for restoration projects. Built environment analysis, supported and enriched by the study of the original project papers, becomes a valuable guide for the definition of technological inventories that can also be used as regulatory instruments in case of general building restoration. In this regard, analysis activity, being involved in the later project, becomes a working method. A study case on the historical built heritage of the 20th century in Cosenza, Southern Italy, can be assumed as an example.

Keywords: 20th century Italian buildings, analysis, construction tradition, building restoration

In the Italian suburbs, the construction of public buildings that is those buildings suitable for Governmental use, represented one of the most interesting expression of national unity for more than seventy years, between the end of the 19th and the beginning of the 20th centuries, and a very significant production activity that led to national growth. It also expressed the emancipating society and the values of a new cultural identity.
Together with public building construction, public housing developed as well. It conveyed public willingness to face social housing problems and shared the same characteristics of the residential buildings of the new century.
The construction of public buildings is thus the most genuine expression of the evolution of the architectural culture in Italy, the realization of a reference system expressed by their urban role and able to create new quality residential areas in great cities and quality built heritage in smaller ones. Moreover, the technological progress involved in their construction reached the most peripheral areas of the national territory, particularly in Southern Italy where the need for modern achievements was more urgent, within a European context still benefiting from the results of the second industrial revolution.
The new materials and modern building techniques employed express the architectural evolution in the transition period from the late 19th-century neoclassic tradition to the new planning views in Modern Movement architecture during the first half of the 20th century.
The built heritage includes elements that bear cultural witness not only for their refined forms but also for some technical and architectural characters that different buildings share, though with their own architectural and functional peculiarities. These technological elements acquire, in time, significant values and become helpful instruments to build an evolving reference system for the definition of the national cultural identity. The knowledge and protection of this complex built system are thus helpful in preserving and enhancing its identity. In this context, the main goal is to acquire knowledge of the building techniques employed, and to preserve the built heritage through ad-hoc restoration interventions and functional requalification.
On the one hand, knowledge implies the interpretation of the historical development of technical and building know-how that is suggestive of the architectural characters of the time and a sign of those common values

leading to social development within tradition and community identity. On the other hand, it is necessary to be familiar with the rules and all the practical and operational aspects of construction; in this context, the collection of technical and regulatory data helpful for interventions is essential.
Attention should be focused on interventions that go beyond the peculiarities of a single unit and function as a system of actions and projects involving this built heritage as a whole.
Interventions should be aimed at preserving and bringing out urban areas that have architectural worth as single buildings, and as a technological continuum in the cases where private and public construction merges. The technical progresses of the building process were in fact boosted by government-funded private construction during the first half of the last century.
Problems arise because what it is currently known about the building techniques of the time, that is the way the "rule of the art" was interpreted, is not always sufficient to immediately identify procedures suitable for delicate restoration interventions, considering that several different roles were involved in the building process.
The great variety of *building construction handbooks* that have interpreted and divulgated the *rule of the art* for more than a century, are not sufficient. Handbooks frequently offer relative points of view because they have often been influenced by changing building practices and varying interpretations of new techniques by designers, firms and workers in the different cultural contexts forming the unified Italy: the technical languages imposed by long lasting local traditions has always influenced the building process.
Then again, "the question is to establish to what extent you can trust those who have to transmit, through their own personal creativity, the collective historical memory using new forms and images" [1]. The construction analysis based on the knowledge of the built heritage and its architectural and technological complexity, as well as its relationships with the city, is thus necessary. The analysis should be independent from any personal interpretation by those who will be appointed for building conservation or renewal.

1. A survey of the 20th-century building tradition in Cosenza, an Italian provincial town

Cosenza, the cultural center of Calabria, a significant pole of the architectural culture in the Region can be assumed as a sample area of the Italian provinces for its historical built heritage.
Cosenza old town is, within Calabria, "the only one having an almost intact ancient area, with no disastrous devastation and alteration" [2]. The shape and development of the 20th-century town area, spreading in the Crati Valley with the old city on the hills behind, is an example of the building methods that have conveyed technological progress and innovation in the construction trade, as described before.
A research on the city, aimed at the recovery of the 20th-century built heritage, has been carried out. The result of this research, supported by a great number of historical documents, was the description of the built heritage, considered as the concrete inventory of architectural building techniques. This inventory has become a sort of handbook for building recovery and renovation.
The development of the new Cosenza area [3] was planned by the 1912 Expansion Scheme [4]: the old geographic boundary, that limited the city to the hilly side, was crossed and the city begun to extend towards the newly reclaimed valley areas. The project layout was based on the orthogonal matrix for the urban structure and it creates a sequence of regular parcels suitable for new buildings. In this context, economic public houses were inserted among the new private dwellings that shaped the multi-family houses. If the *in line* houses that, during the first stage of urban development, have the form of the "palazzo", were typical of the new buildings in the most important Italian cities during the 19th century, economic housing documents the development of residential housing. This housing model shows the aggregative organization of the area, which is homogeneous and well arranged. Moreover, the new building distribution and construction imply new techniques and lodging organization; this reflects the innovative political and social views that considered the house as the place where new ethical principles became part of the life of a community.
The *Case economiche per ferrovieri (Low-cost railway workers houses)* were built in 1925 in the center of the new urban layout, while the first houses by the *Istituto autonomo per la costruzione di case popolari (Independent Institute for Public Housing)*, were erected between 1927 and 1928 in the *"Michele Bianchi"* district. Together with the *Case economiche per il personale delle ferrovie dello Stato e delle Poste (Low-cost houses for State railway workers and Post employees),* that were completed in the same area in 1929, these settlements became the core of urban growth and the expression of project, technical and building principles based on methods that were common all over Italy, independently from local modes of construction. The influence of this housing culture on the near areas was very important, and innovation developed.
In Cosenza, urban development and new construction procedures also promoted the new organization of the work places, particularly the construction sites. Reinforced concrete was employed, not in bearing frames but in combined structures, by inserting reinforced concrete framed linear elements into bearing walls to obtain a higher congruence among the parts. Pillars connected to stone brick masonry and brought closer to each other to form staircase perimeter structures, defined the intrados of wall openings and intersected lintels that went beyond the openings and formed a framed network. Edge beams outlined the structural horizontal links

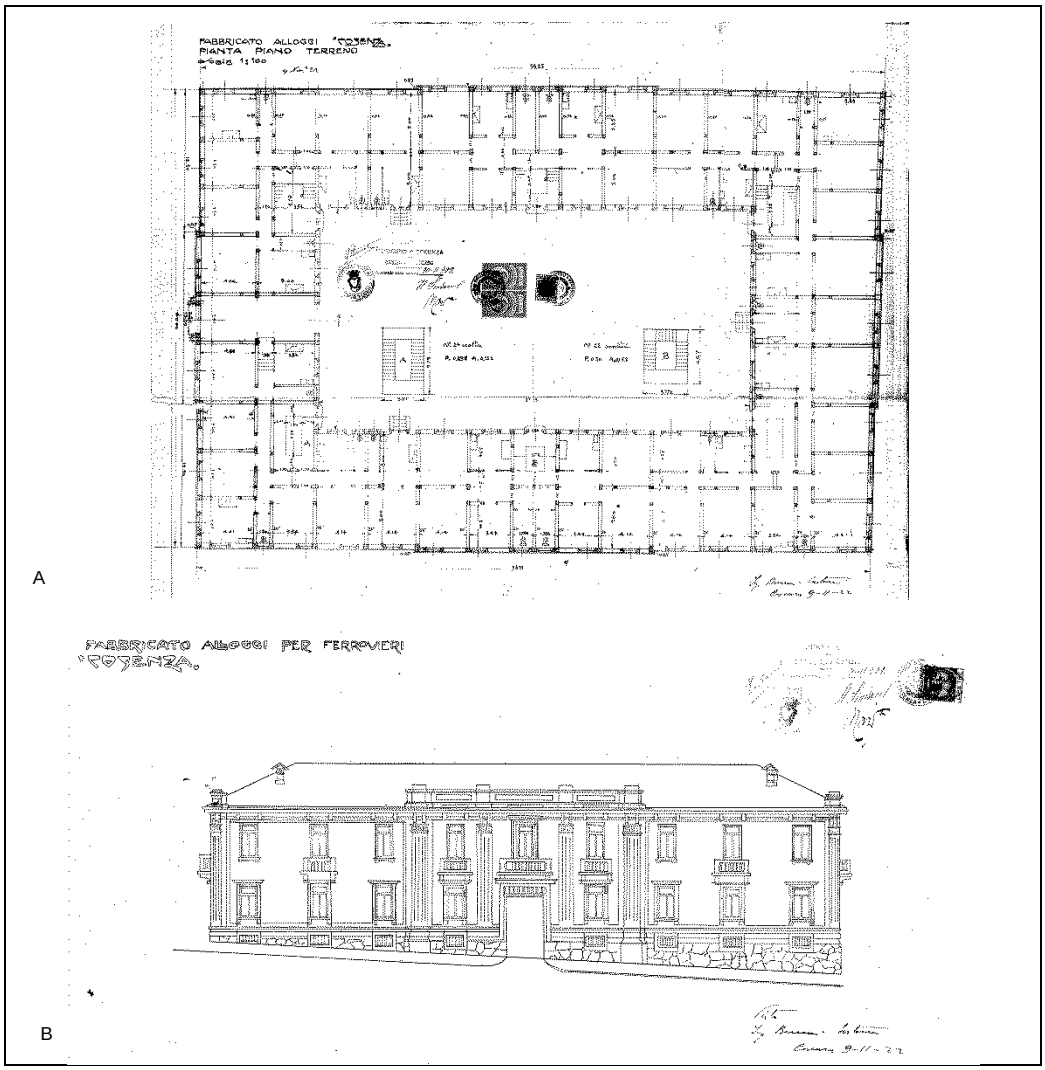

Fig. 1: A, B) *Casa dei ferrovieri (Railway workers house)* in Piave Street, map and front view, 1925.

and allowed for the adequate congruence among the walls and the new Peret-type reinforced concrete full floor slab. A new conception of water supply systems satisfied the newly required sanitary regulations for buildings. These technical principles were implemented in the railway workers houses, designed by the engineer Gaetano Bruni: the structural weight of some of the inner walls of the buildings was thus reduced, and size reduction left space for a more flexible lodging distribution. The new building method became an efficient and innovative model, particularly in a vulnerable seismic area as Calabria, and it was soon adopted in private housing as well.

The new building rules shaped new architectural forms even when they applied to the traditional bearing frame construction expressing an architectural vision still inspired by eclecticism that manifested itself in finely sculpted façades and carved wall surfaces, projecting elements and decorative architectural devices. For example, the buildings designed by Giovanni Battista Milani in the *"Michele Bianchi" District* introduced in Cosenza the serial housing that he had already experienced during his professional career in Rome [6]. The buildings present refined architectural characters, in spite of the technical and regulatory requirements of social housing, and, during the construction of the second group of buildings, the combined reinforced concrete structure was adopted. The new building rules were combined with a project planning in which the whole buildings were grouped to shape a *part of the city* within an urban form *made of different parts*: it enhanced the overall view and was inspired by the reinterpretation of the 17th-century urban space, frequently employed in the Italian architectural culture of the time. The picture of Cosenza in this period shows that it was a modern city not only for the technological innovation of the building trade but also for the research of a new organization of the urban space.

In this context, the buildings suitable for Governmental use play a significant role. The *Edifizio Postelegrafonico (The Post Office building),* designed by the architect Ricci between 1922 and 1924, has a trapezoidal layout and stands on a vast reclaimed area on the left bank of the Busento river, as the 1912

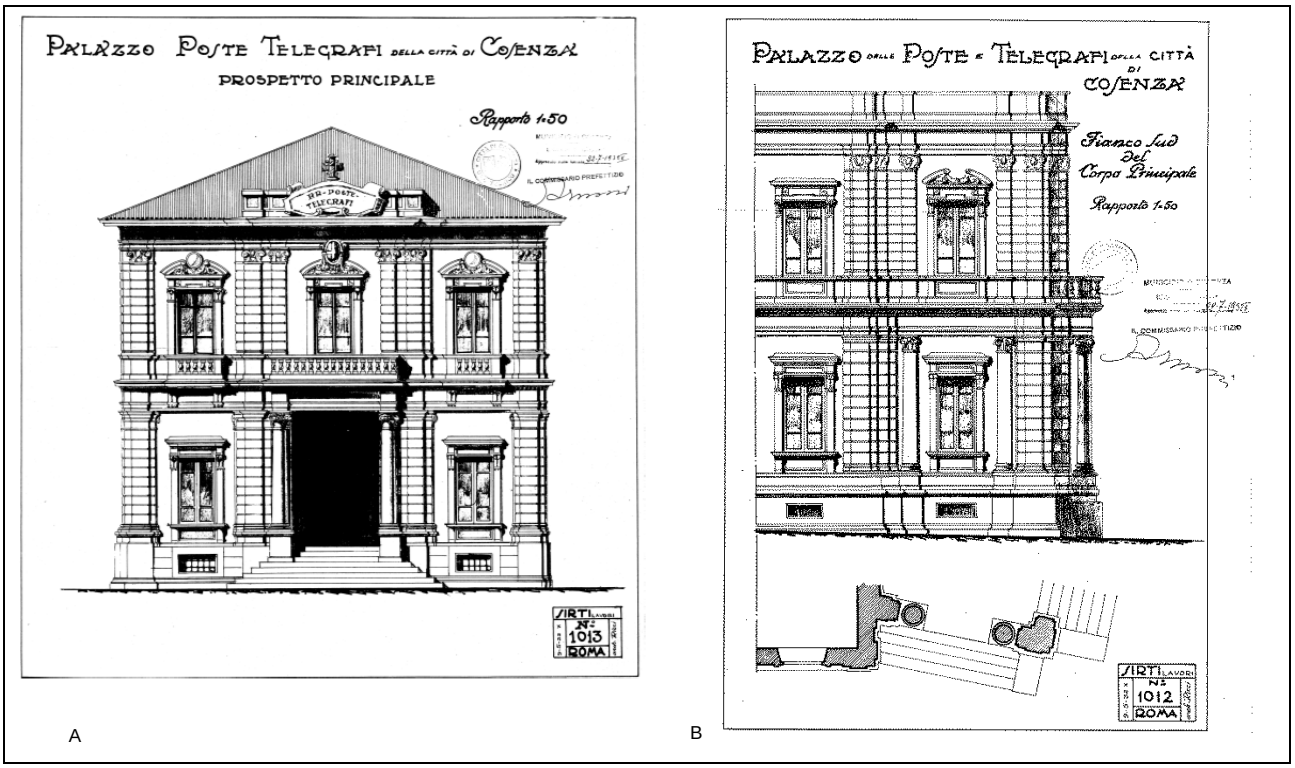

Fig. 2: *Palazzo delle Poste e Telegrafi (Post Office Building)*, A) front view B) side view, 1932.

Scheme reports. The area was very important in the urban space, being located between the old and the new city areas, in the *Rivocati District*, where many important public buildings were to be built in later years [7]. The building is imposing and the space distribution develops around an inner courtyard. Its architectural characters belong to the neo-classical tradition of the time that gradually replaced the neo-baroque trends that were imported to Cosenza from Rome when the first public buildings were constructed, designed by the Central Administration in Rome.

The *Elementary Schools in Rivocati District ,* Cosenza*,* built in 1925 and designed by the engineer Eduardo Di Pietro from the Civil Engineering Office [8], the *Provincial Seat of the Bank of Italy,* completed in 1918 in the Carmine District, the *Casa Littoria (local Fascist Party headquarters)* designed in the same period by the engineer Gino Mancini from Cosenza and built in the *"Michele Bianchi" District*, represent, together with social housing buildings, the architectural evolution from the historicist eclecticism to the so-called *architecture of neoclassic simplification*, the signs of modern architecture. The design approach retains the Classical proportions in the geometric definition of building parts and among their masses, while lesenes and pilasters become less and less visible in the alternation of solid and negative spaces. The formal reduction is sometimes marked, sometimes slight, juxtaposing traditional elements and new materials: the building practice evolves, reinforced concrete and steel are increasingly employed in the combined bearing frame that characterizes most new public buildings.

During the 30s, reinforced concrete technique increasingly evolved, in spite of the production crisis that was caused by credit crunch mainly affecting private building industry. Once again, public intervention was the driver of growth. Building construction in Cosenza produced The *Case INCIS* (dell'*Istituto Nazionale delle Case per gli Impiegati dello Stato*) (Houses owned by the *National Institute for Public Servant Houses*), built in three periods since 1931. The design culture evolved both in the technological procedure and in adopting the first formal fundamentals of modern architecture that joined the established functional approach and the living space project.

Cosenza INCIS houses reproduced the living model of the serial in line houses, particularly in the building designed by the engineer Guido Viola in '34 [9] with three stories and two or three apartments each. The imposing residential building presents a new conception of reinforced concrete bearing frame, still of the combined type, and it was compliant with the regulations "for seismic hazard areas" that classified Cosenza among the second category zones [10]. The apartments were equipped with radiator heating systems and elevators, and reinforced concrete was employed in the lightweight slabs with *Unic* tiles, stair flights, projecting balconies and cornices, and roof framework. These buildings are also remarkable because they represent the definitive overcoming of classicist architecture and the use of a new architectonic language that the architect Paolo Portoghesi describes as oriented "to the definition of a modernity (…) capable of

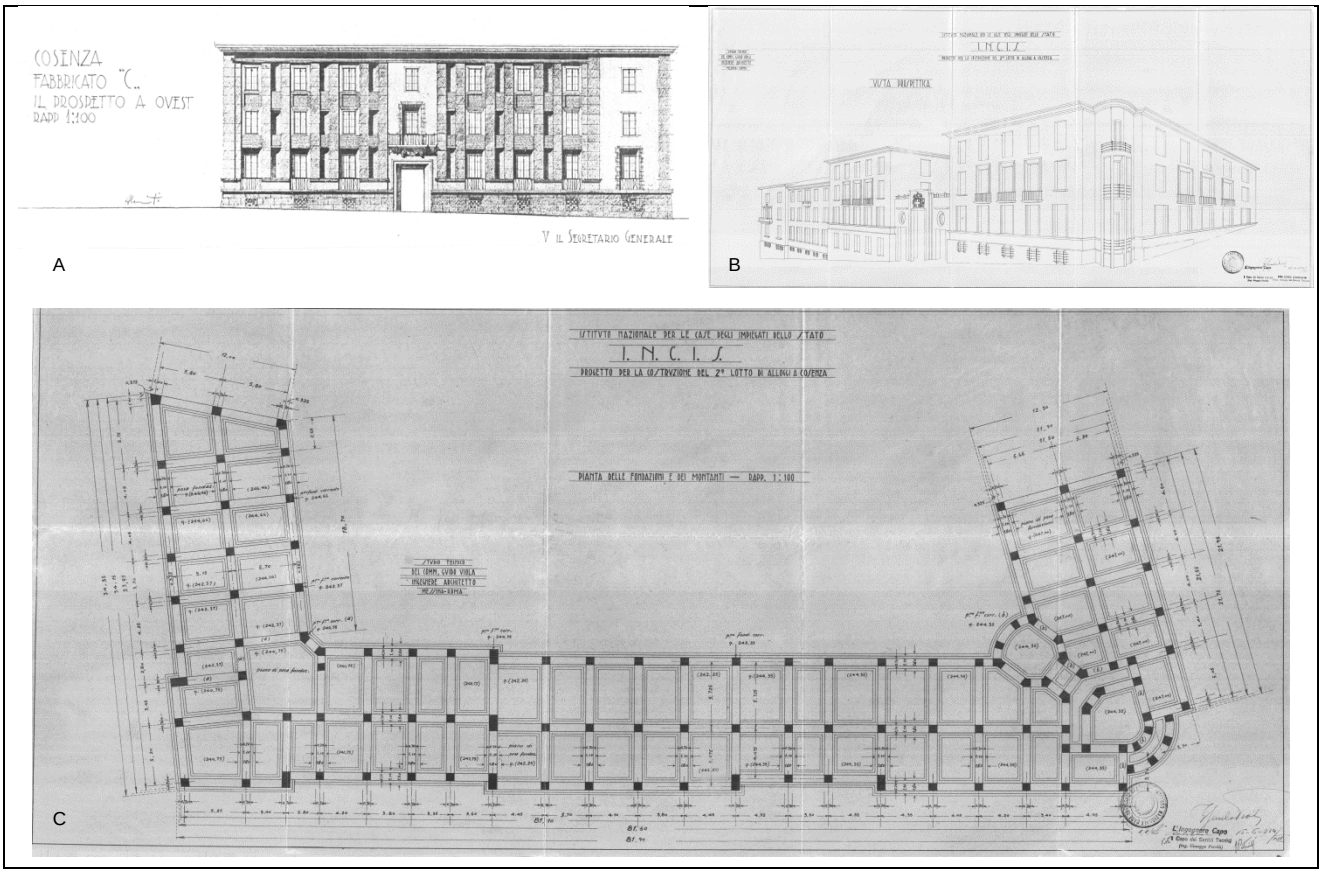

Fig. 3: *INCIS Houses*, A) front view, first parcel, 1931 – B, C) perspective view and foundations, second parcel, 1934.

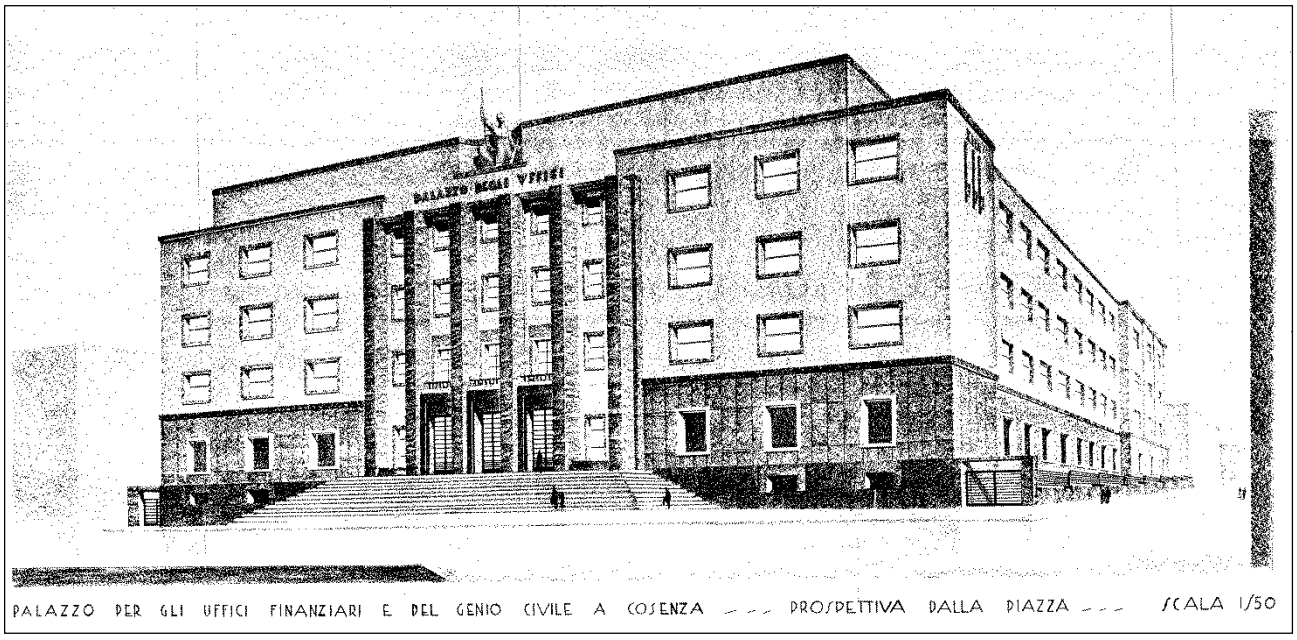

Fig. 4: *House of Financial Offices*, perspective view, 1933.

presenting itself as a “style” with its independent characteristics taken from an existing formal tradition” [11]. The design approach derives from experiences that are equally distant from the academic classicism and the extreme modernist criticism which is the expression of a cultural season that opens to the new formal principles of incoming rationalism.

In the *Palazzo degli Uffici finanziari e del Genio civile (House of Financial Offices and Civil Engineering*

Office), the same building approach employed in the INCIS houses was adopted. The reinforced concrete structure is “self-bearing” – states the *Project Relation* – the grids are quadrilateral, consisting in pillars or columns rigidly connected one to the other by horizontal frames to the base, skirt roofs and eaves, while for the wall structures filling the framework, stone and brick masonry has been adopted on each floor” [12]. The new lightweight slab floors had arched ribs in the wider rooms and, at the top floor, a wide hollow space for the thermal insulation of the roof terrace that was used as a new technical solution for roof covering. Travertine covering highlights the most significant architectural elements of the building and characterizes the main façade, the eave, the intrados and the frames of the great windows, that have new shape and technological function, with molded iron shutters, double glazing and roller blinds. These elements “as the great concrete and glass wall near the closed courtyard accompanying the inner grand curving staircase, are the particular characters of a changing design attitude” [13]. In this case too, many innovative technological elements are introduced, not only in the bearing framework of the building, but also in the construction elements, heat, water and power supply systems and elevators.

The new architectonic and construction concepts were developed in other important buildings erected or designed in the same period: the *Ospedale Sanatoriale (Sanatorium Hospital)*, commissioned by the INFPS (now called INPS, *Istituto Nazionale della Previdenza Sociale – National Social Security Service)* [14] and the local seat of the same office; the local seat of INFAIL (now called INAIL, *Italian Government Agency for the insurance against work-related injuries)*, designed by the Cosenza engineer Francesco Longobardi, who also coordinated the project group of the *Casa della madre e del bambino (House of the Mother and Child)* owned by ONMI (*Opera Nazionale Maternità e Infanzia – National Charity for the Mother and Child*) [15]; the *Ospedale Civile dell’Annunziata (Annunziata Civil Hospital) by* Tommaso Gualano, head engineer of Cosenza Municipality and in charge of the urban planning for the development of the city in the 1930s; he was also the designer of the *Istituto Magistrale Statale “Lucrezia Della Valle”* (Public *Teachers’ Institute “Lucrezia Della Valle”*) in 1939 [16], that was the seat of the GIL, *Gioventù italiana del Littorio (Italian Fascist Youth)*; the local seat of the *Consiglio dell’Economia corporativa (Corporate Economy Council)* (today’s Chamber of Commerce, Industry and Agriculture) by the Roman architects Mario De Renzi and Giorgio Calza Bini, with the engineer Franco De Luca from Cosenza [17].

The events leading to the construction of the Corporate Economy Council House are particularly interesting. A preliminary project was developed by the Local Union of the Engineers of Cosenza who had the guiding role in the contest for the definitive project. The result of this experience is a building considered as the most important architectural production of the Modern Movement in Calabria and among the most significant ones within the main cities of Italy peripheral areas.

The curving layout linked to the curtain walls orthogonally converging into the urban place creates the neat development of the convex surface of the façade characterized by bands and pure carved volumes, and made uniform by the elegant travertine covering. Each element has its right formal and structural position, the result of the strict stylistic accuracy of the designers.

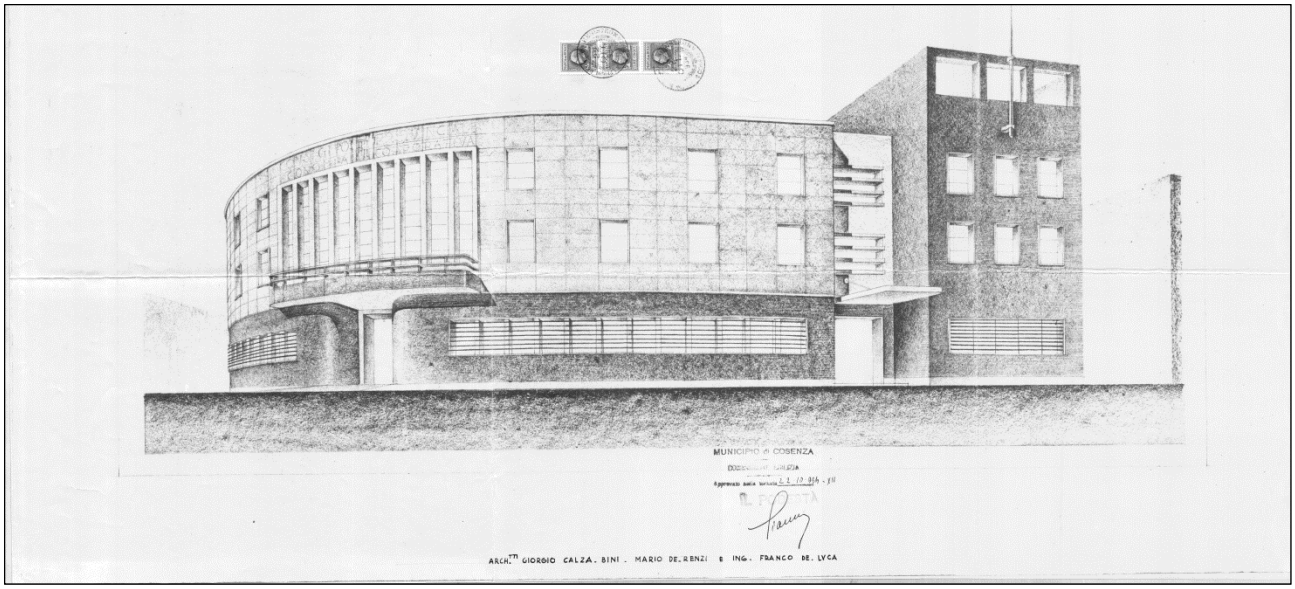

Fig. 5: *The Corporate Economy Council House*, perspective view, 1934.

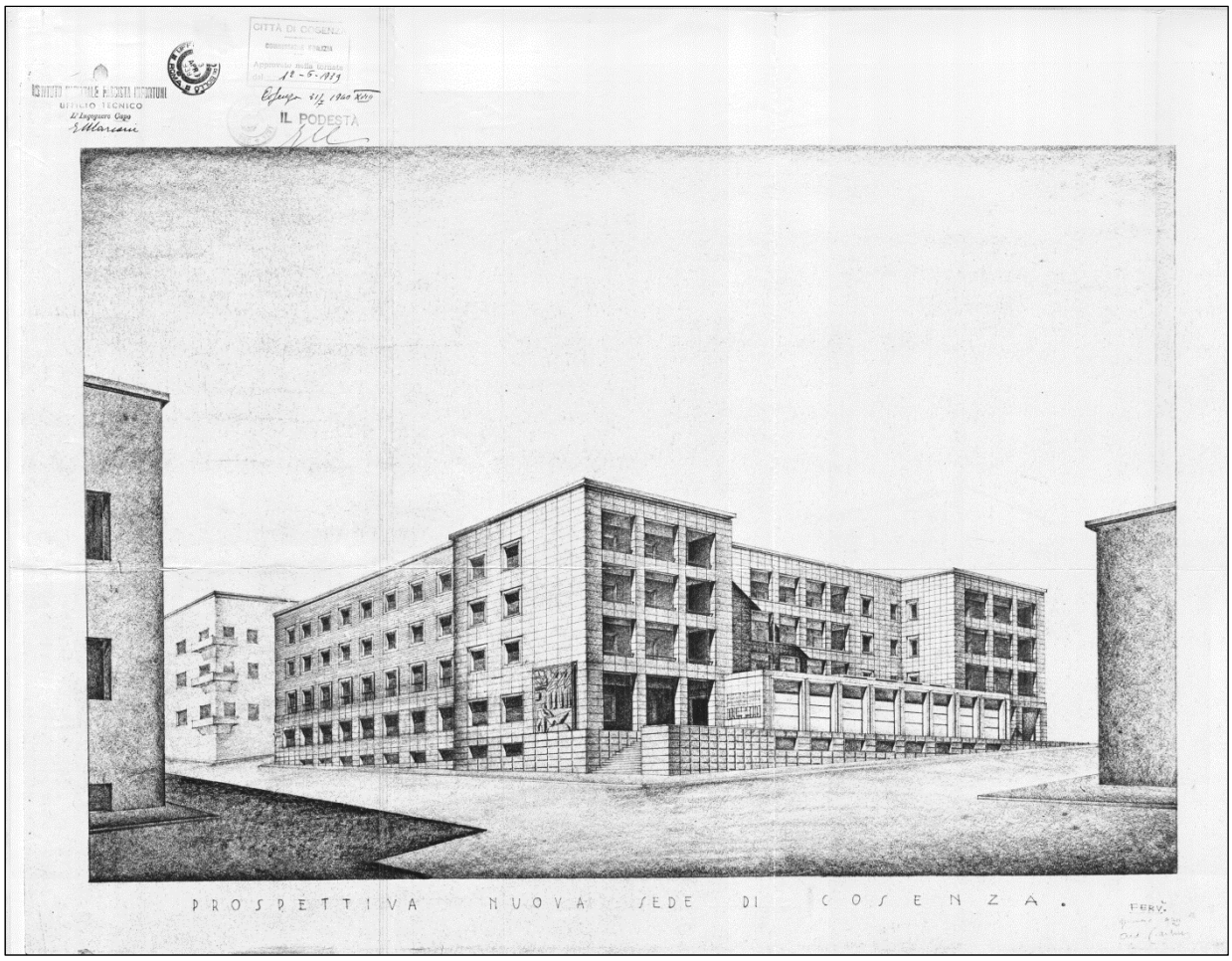

Fig. 6*: INAIL local seat,* perspective view, 1939.

Modern architecture definitively established itself in town by means of the architectural language expressed by the new buildings. Old and new construction practices coexisted and all local people who worked in building construction were conquered by them. New techniques and new designs were to be adopted by construction workers also in private buildings, mainly after the Second World War. A new generation of designers was stimulated by the new architecture and encouraged by the relentless development of the city, in spite of the economic difficulty caused by *fascism autocracy.*

References

[1] CAMPOLONGO, Alessandro, *Architettura e metodiche costruttive a Cosenza Nuova. Un'indagine per il recupero dell'edilizia del Novecento*. Roma: Gangemi Editore, 2009, 351 p. ISBN 978-88-492-1700-1. p. 56.
[2] CAMPOLONGO, A., op. cit., p. 65.
[3] New Cosenza is the place name of the 20th-century city area.
[4] Cosenza development town plan, approved in 1912, was drawn up by Francesco Camposano, head engineer of Cosenza Municipality.
[5] Archive of the *Land Planning and management* of Cosenza Municipality (Arch. Comune); b. 1921/'23, fasc. Commissione edilizia (Comm. ed.) 10 ottobre 1922, sf. *Ingegnere Gaetano Bruni per conto delle Ferrovie dello Stato*.
[6] Giovanni Battista Milani, architect and head of the Technical Architecture Chair at the RomeEngineering School, worked in Rome where he was also the designer of the IRBS houses, *Istituto Romano dei Beni Stabili*. The *Project for a new economic and popular housing district in Cosenza* can be found at the State Central Archive in Rome: Archivio Architetti, Fondo carte architetto G. B. Milani, b. 39.
[7] State Archive in Cosenza, Fondo Genio Civile (Arch. Stato, F. G. C.), *Edifici pubblici – Poste e Telegrafi*, b. 4, fasc. 8; Arch. Comune, b. 1932, fasc. Comm. ed. 22 luglio 1932, sf. *Poste e Telegrafi*.
[8] State Archive, F. G. C., *Edifici scolastici 1898-1982*, b. 4, fasc. 72.

[9] ATERP Archive, *Azienda Territoriale per l'Edilizia Residenziale Pubblica* di Cosenza: b. INCIS, fasc. *Progetto per la costruzione del 2° lotto di alloggi INCIS a Cosenza (1934)*.
[10] Reference is made to the law 22 december 1922, 1. 1838.
[11] MAZZA, Alessandro (edited by), *Giovanni Battista Milani. Progetti e architetture romane 1900-1940*. Roma: CLEAR Edizioni – ARGOS Edizioni, 1995. 421 p. in "I classici del Novecento". ISBN 88-385-0083-5. P. 98.
[12] "Verbale di consegna del Palazzo degli Uffici finanziari e del Genio Civile di Cosenza" del 16 settembre 1939; State Archive, F. G. C., *Palazzo degli Uffici*, b. 1, fasc. 1; b. 2, fasc. 2; b. 3, fasc. 4; b. 11, fasc. 35.
[13] CAMPOLONGO, A., op. cit., p. 224.
[14] State Archive, F. G. C., *Edifici pubblici – Ospedali, Ospedale Sanatoriale di Cosenza*, b. 7, fasc. 9.
[15] Municipal Archive, b. 1938/'39, fasc. Comm. ed. 12 June 1939, sf. INAIL, sf. ONMI.
[16] State Archive, F. G. C., *Edifici pubblici – Ospedali, Ospedale Civile dell'Annunziata*, b. 6, fascc. 7, 8; b. 8, fasc. 10, 12; b. 9, fasc. 12.
[17] Municipal Archive, b. 1934/'35, fasc. Comm. ed. 22 October 1934, sf. *Camera di Commercio*.

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Projectivity and the homological relationship as a verification of the computer mathematical representation.

The representation of plane and skew curves in graphical models.

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Abstract (ID nº 030)
The spatial relationships of perceptiveness and those on the level of homology enable, in graphical models, an analysis and representation of irregular figures and of intersection curves.
The graphical aid of overturning/rotating and the solution of measurement problems are essential knowledge to carry out the respective graphical models through fundamental logical steps for the 'conquest' of space by the draughtsman.
In the computer mathematical model the shapes are represented in a continuous way and with accuracy making it possible to verify the vast heritage of the knowledge of Descriptive Geometry.
Having generated and automatically visualised a curve of intersection between solids, of an apparent contour etc. its correctness can be proven building it graphically in the same virtual environment.
These types of experiences are not meant to be taken as theoretical/academic exercises but aimed at acquiring the spatial ability necessary for the dimensional control of automatically generated shapes.
This paper is a review of representation procedures of important curves in the various graphical models exploiting the accuracy of the software tool.

Keywords: homology; intersection; curves; skew; representation.

1. Scope and Methodology.

The definition in graphical models of curves through the application of descriptive geometry rules.

2. The importance of homology in the determination of the projections of curves.

The correspondence of projections Σ' e Σ" on two planes π' e π" considered coincident, of a figure Σ external to them obtained by two (sight positions) centres O and O', enables their determination through the own element of the homology: centre **U** (O'↔O"= u → U) and axis **a** (π' e π"↔ a).
Useful centres to the graphical operations are the parallel directions perpendicular to the screen (drawing board) and the substitutive direction to the overturning on the same square (Fig.1)

3 Perpectivity of the segment of minimum distance.

Having considered two projection centres belonging to two skew axes it is verified that the directions of the projections on a generic plane of the segment of minimum distance, between said axes, and the direction of the same segment, have a point in common.
The semi-lines that join the extremes of said projections concur at a point that belongs to line **u** element of the homology of the two centres O' and O".
Having considered these points found as vanishing points of two perpendicular lines and the line that joins them as a horizon line, on a fundamental line (parallel to the horizon) the projections of the segment of minimum distance result, if measured in this prospective system, in space, equal. (Fig.2)

4. Metric relationships between solids drawn close to each other.

The opportune choice of the projection centres (sight positions) and the definition of the elements of homology enables the solution and/or confirmation of the logical reasoning that brings it to it.
In the case of a solid that, rotating on a single edge, will be obstructed by another one adjacent to it, the valid consideration is that, at the end of the rotation, the dimensions must not change and the point of contact will be common to the two solids.
The problem can be tackled researching the homological relationships between the available geometrical elements. Having chosen a first centre of projection on the static solid, the point of contact will be projected on a section of the same solid (plan / plane where the projections are collected) made to belong to the plane of the hinge of the rotating solid.
A second centre of projection of the contact point is identified with the direction (view) of the overturning.
The projection of the rotating element (edge) projected from the centre positioned on the static solid on the plane where the images are collected, will have a fixed point and will result tangent to the base of the same static solid.
The researched point will belong to the curve that joins this point of tangency with the centre of projection and its height determination is obtained with the use of auxiliary views. (Fig.3)

5. Representation of the skew intersection curves.

The skew curve of intersection of cones and pyramids is located considering the band of planes that has in common the line that joins the vertices of the surfaces because their intersections with the surfaces coincide with the generating lines located in the traces points of intersection between the traces of the same planes with the directrix of the surfaces.
In the computer model it is verified, in the case of circular straight cones, a correspondence between a point of the curve of intersection, the circle section with plane perpendicular to the axis of one of the surfaces and said belonging point and the circle with radius equal to the minimum distance between the chosen point and the axis of the other surface.
The minimum distance between a point P on the curve of intersection between cones A and B and the axis of cone B is the radius of a sphere Sb whose equatorial circle on the plane perpendicular to the axis of cone B is indicated in *c*.
The point P is projected in P'- P" from the vertices of the two cones on the plane where the images are collected and are aligned, since corresponding, with centre U of the homology determined by the intersection of the joining line of the vertices of the cones with the plane of the directrix.
The circle *c* of the sphere Sb has a corresponding Σa on cone A that gets projected form the vertex of the same cone in Σa'.
Projecting *c* form the vertex of cone A in *c'* the trace of the generatrix, belonging to P, from the axis of cone B equal to radius r of the sphere Sb considered initially, is determined in the intersection with Σa'.
Furthermore *c* , considered as curve Σb if projected from the vertex of cone B in Σb' enables the determination of the trace of the generatrix of the same cone when it intersects the line P'→U.
This trace is the corresponding point P" of P'. (Fig.4)

6. Parallel and central projections as homological relationship between curves and their transformations.

To determine the apparent contours in parallel projections and in central ones the homological relationship that runs between the projections and the overturning of the same ones on the plane / screen is considered.
In the graphical model, this plane is considered coincident to the drawing paper. (Fig.5)

7. Intersection of surfaces from rotation with parallel, incident and skew axes.

In the case of parallel axes auxiliary planes are considered perpendicular to the axes that make circular sections whose intersection points determine the researched skew curve.
In the case of incident and distinct axes it is noted that, spheres with centre at the common point to the two axes will produce circular sections that in the view perpendicular to the plane formed by said axes will appear as segments perpendicular to the same axes traced by the intersections of the apparent contours of the surfaces with that of the auxiliary spheres.
The point of intersection of said segments coincides with the projections of the two points of intersection of the sections between auxiliary spheres and rotation surfaces and hence belonging to the researched curve. (Fig.6)
When the axes turn out skew two straight circular cones are chosen with the vertices on axes 1 and 2 of the surfaces, one of which coincides with the extreme 3 of the segment of minimum distance between the axes.
The plane where the images will be collected is thought to be perpendicular to the axis 2.
Point P of intersection of circles Σ1 and Σ2 is determined.
The corresponding points P1 and P2, projections of P from the vertices of the chosen cones and, with regard to P1, intersection of the projections of circles Σ1' and Σ2', joined concur at point **U** together with line **u** that joins the vertices of the auxiliary cones.
Having generated, in the computer model, other parallel circles on one of the surfaces the point of intersection with the other surface and the corresponding circle belonging to it is determined automatically.
The projections, from the vertices of the two cones, of intersection points of the various corresponding circles, joined concur at the same point **U**. (Fig.7)
The graphical problem is that of locating on one of the surfaces the circle corresponding to the one chosen arbitrarily on the other surface to determine, in their intersection a point on the skew curve of intersection of the rotation surfaces.
The straight circular cylinders C1 and C2 are considered with axes coincident to those of the surfaces and belonging respectively to the parallels Σc2,Σc1.
The circle Σc2, starting from the known level Σc1, slides on the axis of the respective rotation surface generating cylinder C1 up to the level of the next chosen parallel Σa2 determining a corresponding level (from level Σc1) on which the other circle, sliding on the axes of the other rotation surface, must end its 'run'.
After having translated (in the auxiliary view of the direction of the segment of minimum distance) the apparent contour of cylinder C1 and meridian m1 of the relative surface, along level Σc1, from the point of intersection with the same level up to the intersection, always on level Σc1, with the apparent contour of cylinder C2, are rotated up to making level Σc2 coincide with Σc1.
Parallel Σa2, after the translation and rotation, intersects meridian m1* at a point that joined to the hinge determines the shortcut of the mandatory path that circle Σc2 takes to reach the level of the next parallel Σa2 as a function of the meridian curve m1.
The level of the researched corresponding meridian Σa1 is determined, in its projection, i.e. the intersection with meridian m2 of the other surface, by the intersection of the segment that joins said hinge with the intersection between Σa2 and m1* and the corresponding level end of the 'run' of cylinder C2. (Fig.8)

Bibliographical References

MIGLIARI Riccardo. *Geometria dei modelli* .EDIZIONI KAPPA, 2003

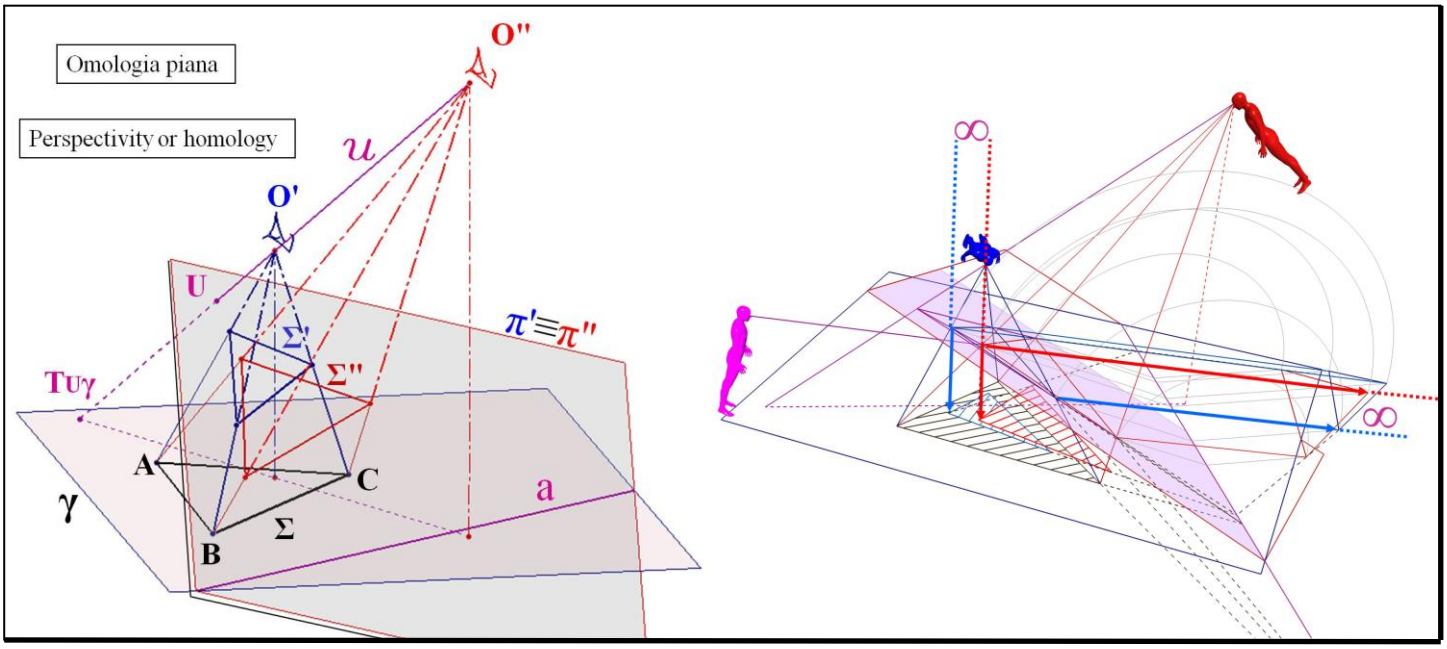

Fig. 1: Homology elements.

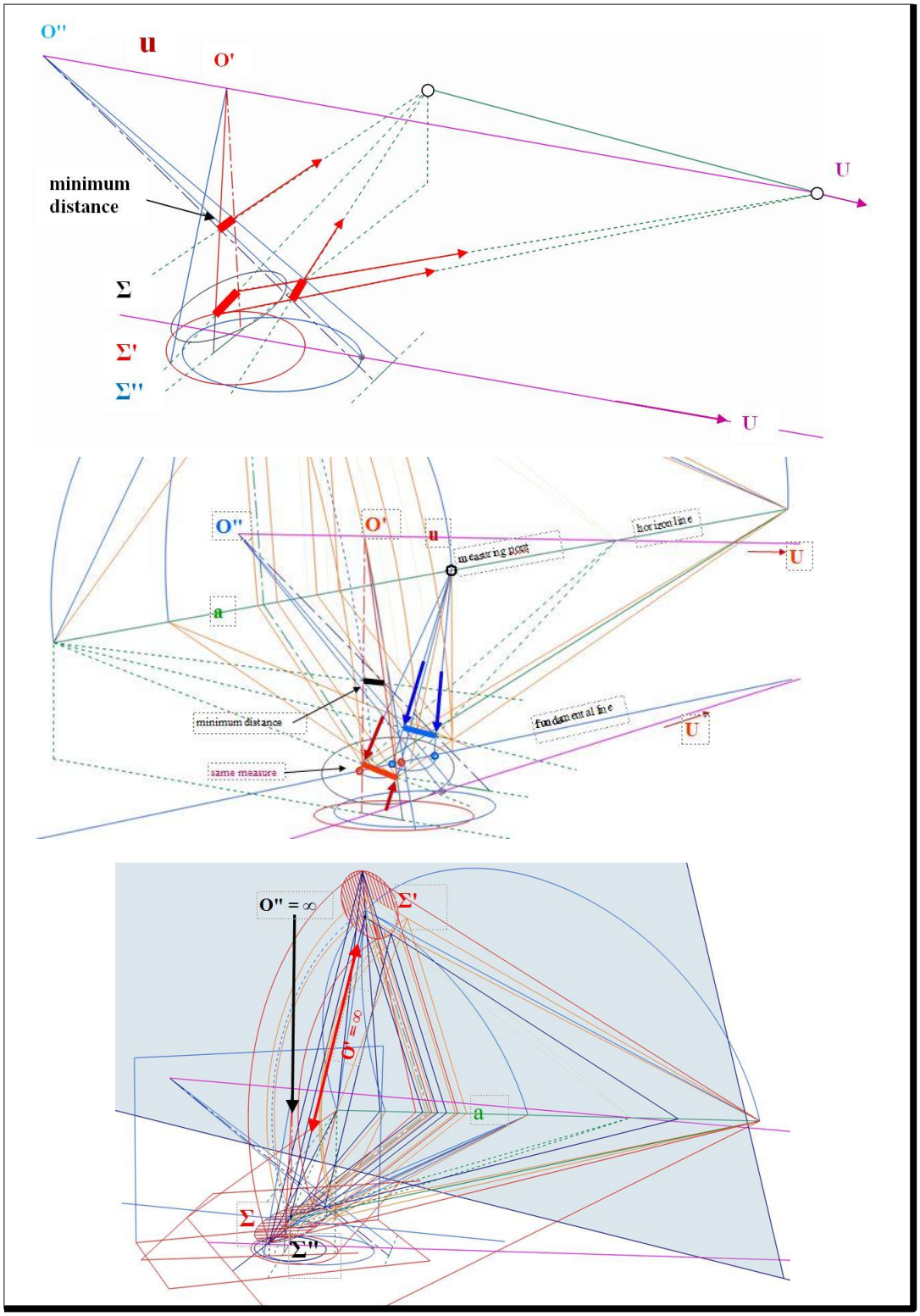

Fig. 2: Perspectivity of the minimum distance between two skew lines.

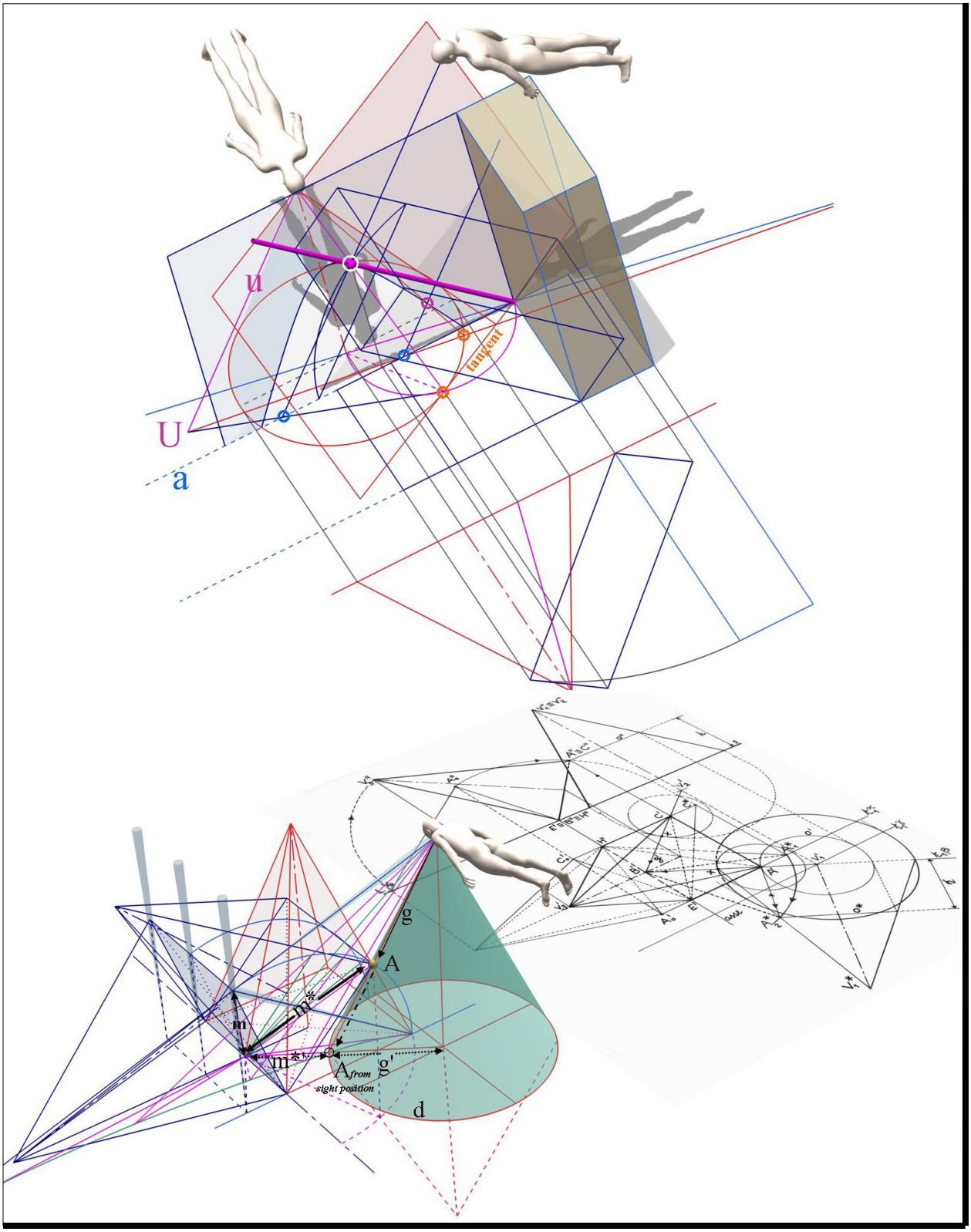

Fig. 3: Rotation to be defined.

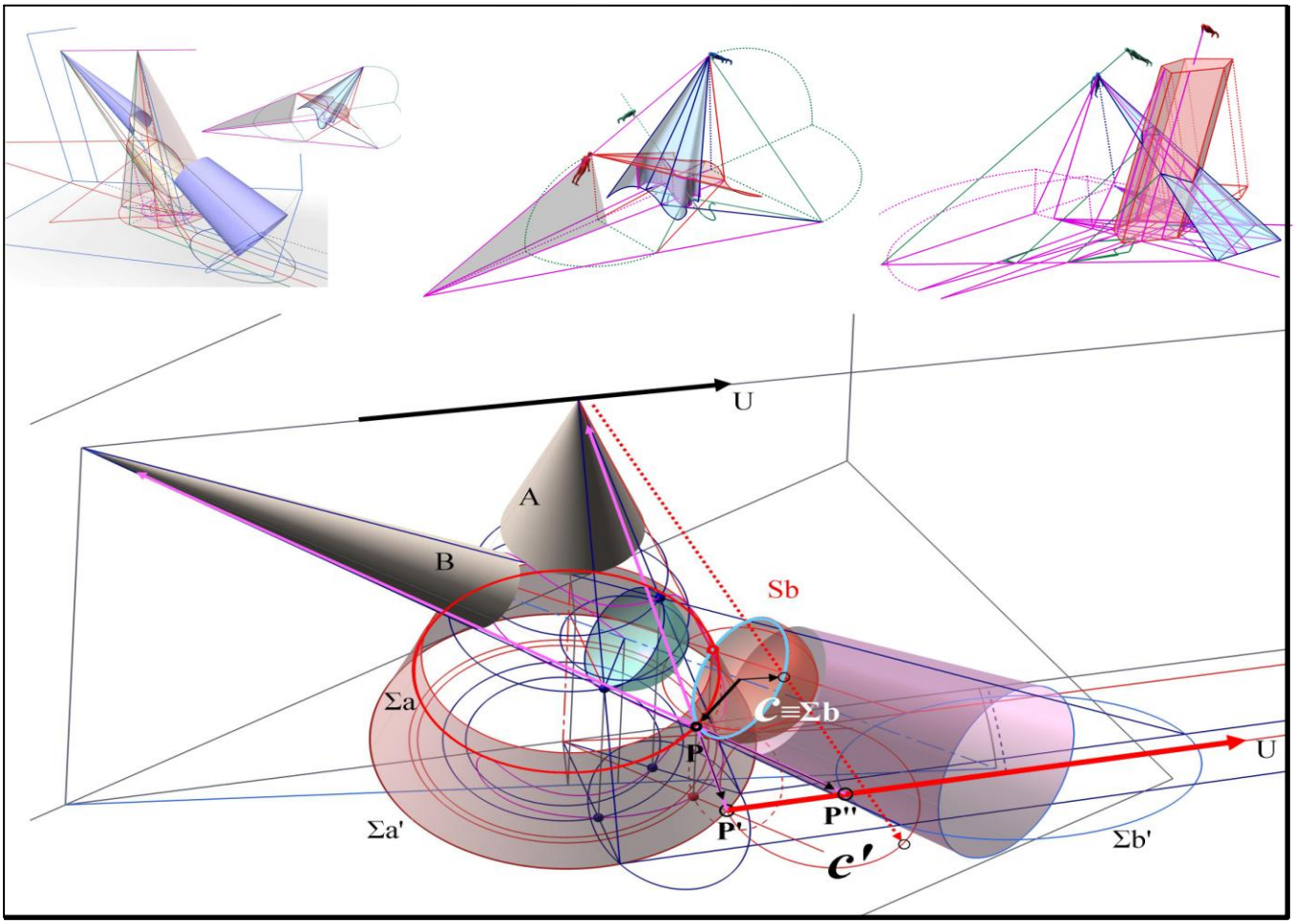

Fig. 4: Intersections of cones.

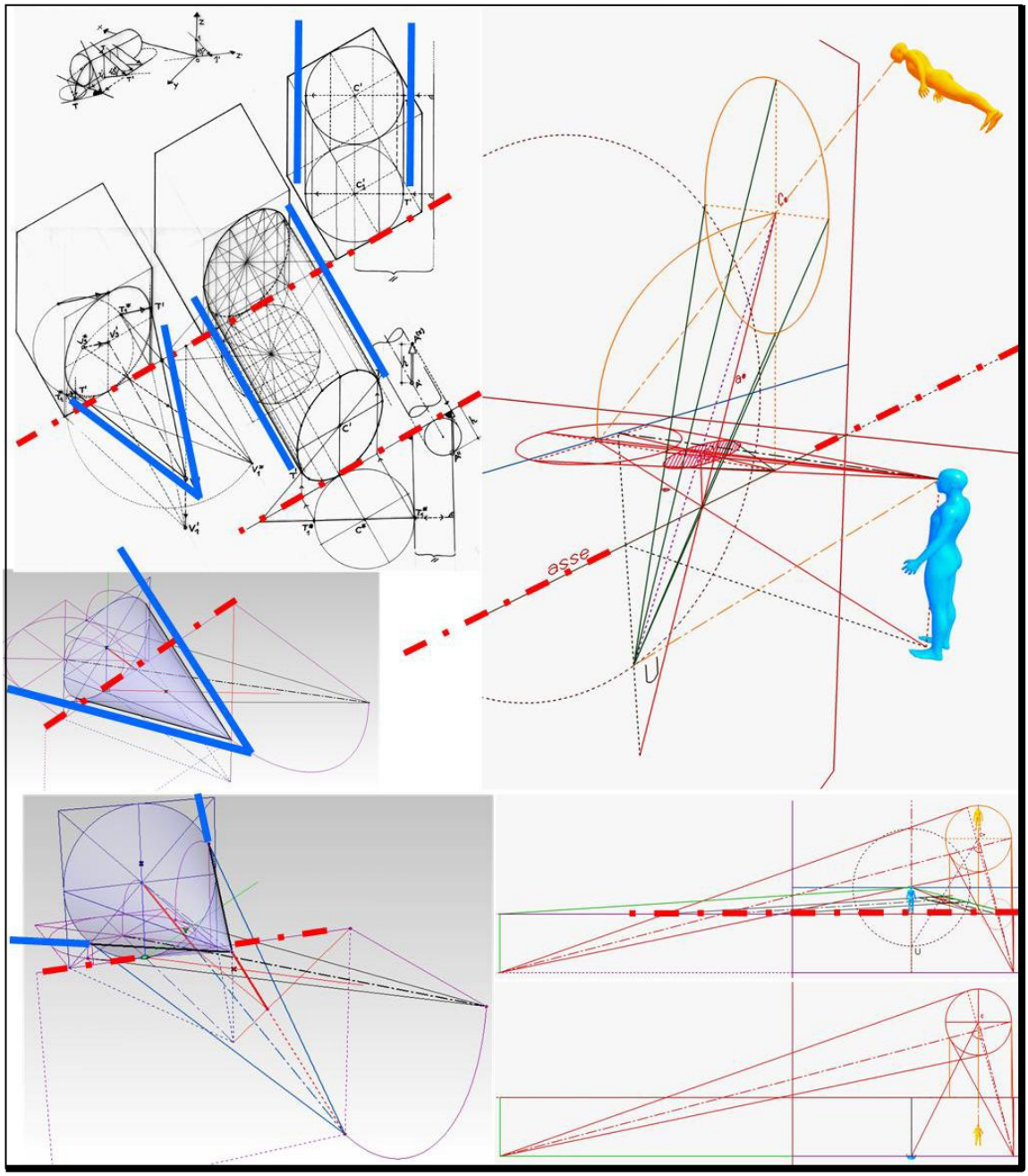

Fig. 5: Apparent contours.

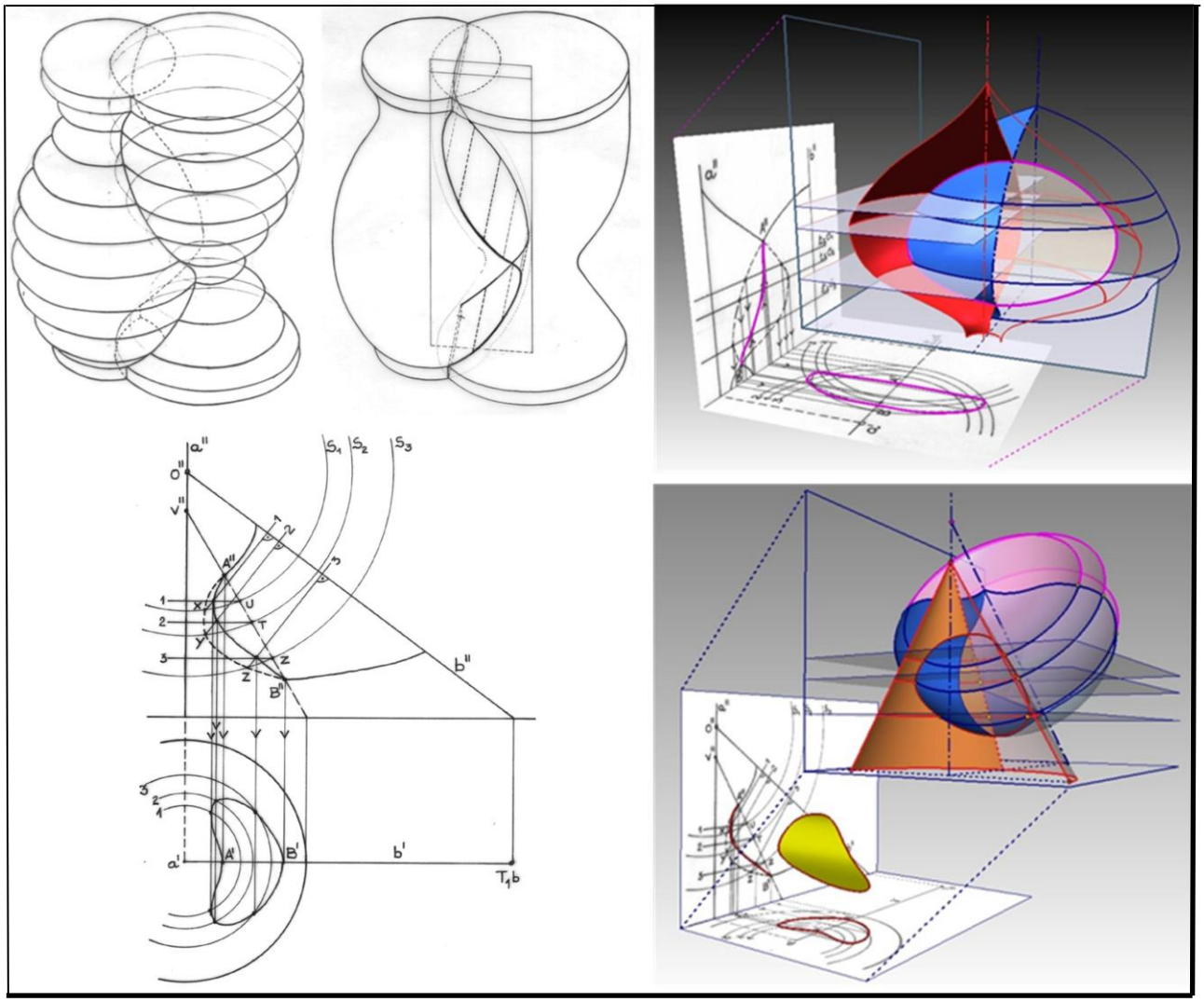

Fig. 6: Intersections of rotation surfaces with incident and parallel axes.

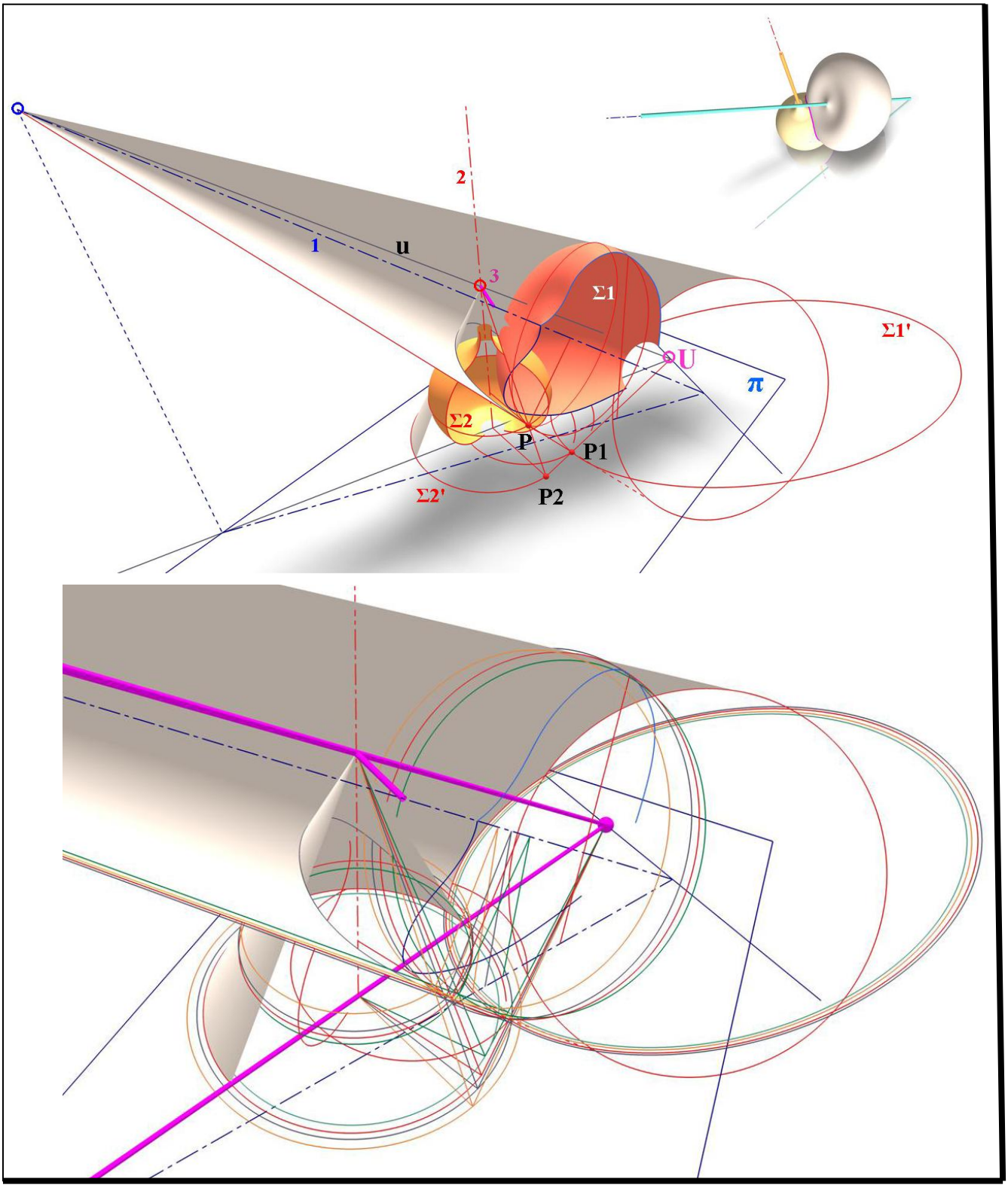

Fig. 7: Correspondence between the rotation surface parallels.

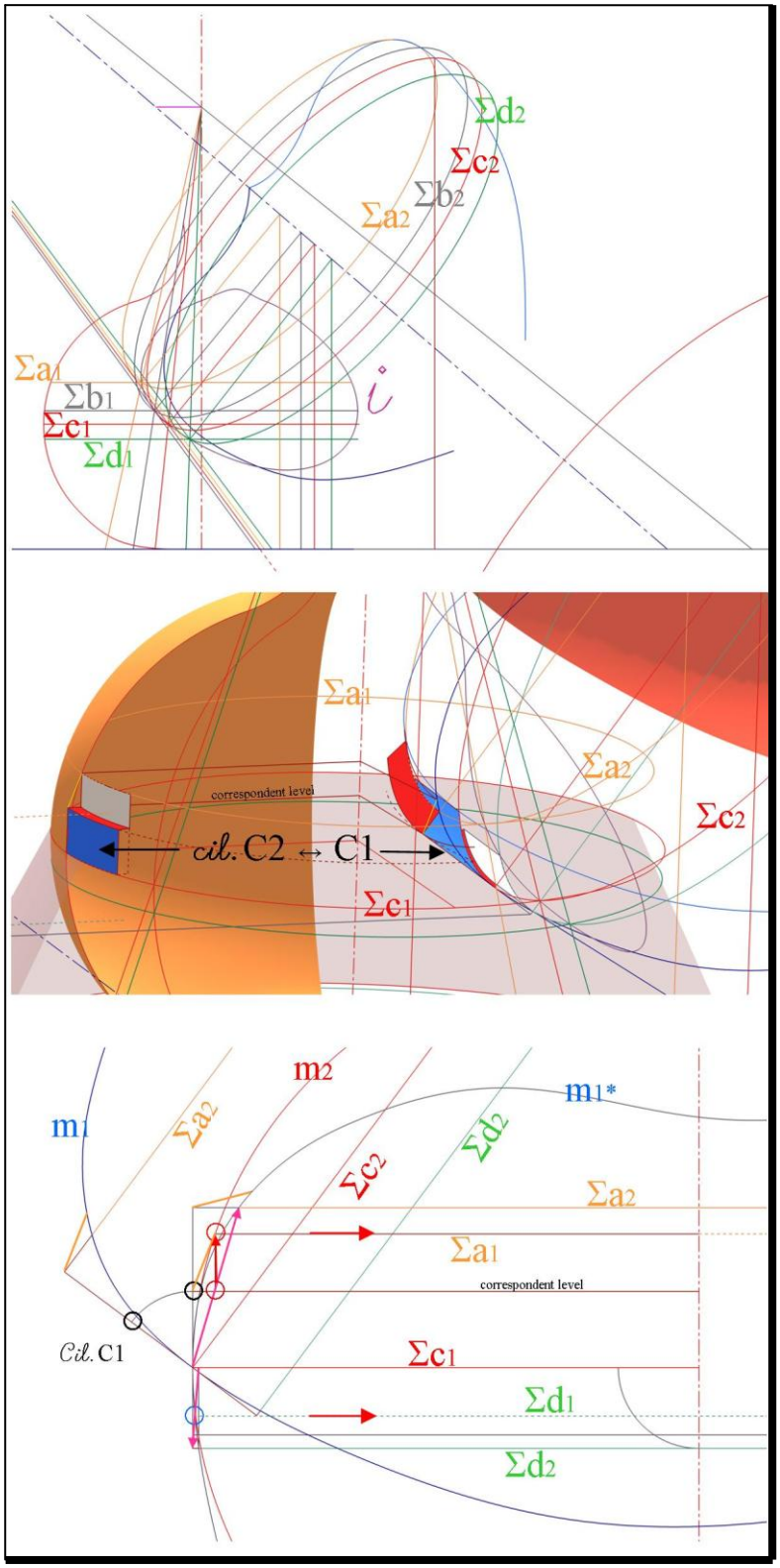

Fig. 8: Correspondence between rotation surface meridians.

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New urban models | San Pablo case /// 'Luis Buñuel'

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Abstract

The new urban ways of behaviour let us watch more and more frequently, in our streets and squares, realities that we had always considered as domestic. This also happens the other way around. Every day we have to go through situations at home, which imply relationships with people who don't belong to our familiar nucleus. The domestic design of our cities and the urban planing of indoor design seem to be adequate tools in the world we have to live in. This leads us to think that public and private spaces are simplified terms, defined according to concepts of property in order to organise the city. On the other hand, its uses and the experiences of people, its management and ways of behaviour have into somethink complex, changing the conventional terminology until it has become out-dated. In this context the 'bottom-up' actions emerge as a new paradigm or model of urban renewal. These actions understand the inhabitant's participation with an active role in the process of building up the city from the very beginning, in comparison with the former way of acting that consider the user as mere receptor of the proposals. A citizen who seems to become every time more and more radical, and an administration that seems to be afraid of the unknown, have created both almost anarchic guetto spaces and, on the other hand, spaces which have been so institutionalised, that derive into spaces associated to the administration, but also alienated from the citizen. For this reason, the co-work of both forces is consedered as crucial.

Keywords: bottom-up, urban, citizen, administration.

1. State of the art

A common place… San Pablo neighbourhood is an urban fabric with an inherited shape that must be constantly adapted and renewed, enabling its evolution and avoiding obsolescence and degradation. Nevertheless, as the existing free spaces are not enough to comply with the needs, overcoming this deficiency but keeping its urban morphology implies action on empty areas.

…But, why do I mention this?

On the one hand, San Pablo has a huge built heritage that includes from its own urban morphology to multiple examples of civil and religious buildings; and different projects are being boosted or developed at "San Pablo/Pignatelli sector, trying to contribute cultural cohesion ["Las Armas" Music Centre, places for artists, the Erasmus District…]. At the same time this neighbourhood has its own identity and character; its history and acute multiculturalism has produced a rich presence of social and cultural movements that enables an easier recruitment of individuals, collectives and entities related to the arts, culture and social realms. As a summary, there exists a "sense of neighbourhood" supported by a whole fabric of civic associations.

On the other hand, the current economic and social situation makes it impossible a boosting of complex actions; nevertheless, what could be understood as a handicap is the opportunity of intervening on the old secondary school Luis Buñuel to recover, with a minimal expenditure, a vacant

heritage and its public space. This new equipment can be considered as the gate to San Pablo neighbourhood, connected to the city scale and the river axis. The permeability of the building will be the link joining the existing public areas and containers.

And then, "bottom-up actions" come up as a new paradigm or model of urban renewal, considering social participation as an active part in the process for the construction of the city from the very beginning of the project, and opposed to the usual actions that consider users as a passive recipient of proposals, "bottom-down actions" or other daily "horizontal actions" that usually built the city.

"Bottom-up actions" or renovation from bottom up have no place as isolated urban elements but are connected to each other, producing synergies and making it possible city building. They considered as actions of urban development and connection, since its goal is to become public space booster. This question can be applied to the rest of urban processes or actions.

The capacity of adaptation demonstrated by "bottom-up actions" implies an ideological framework of reference related to the importance of building with scarce resources [recovery and/or reconstruction of urban structures into disuse] in the above mentioned urban processes, as a way for understanding the concepts of sustainability and figurative quality of what has been built. This issue can be applied to the recovery of those architectural aspects which are necessary for society.

But let´s come back to the main issue… according to the above mentioned goals, we can put forward the following **Goals, Methodology, Tools and Stages** to structure, even though the name is not important… ¿a Community Social Centre? [1] [2]

Before that, we can take a look at the past:
[The old secondary school Luis Buñuel is an empty equipment placed at plaza de Santo Domingo in San Pablo district. The original building was built between 1880 and 1890 in a section of the empty plot of the Dominicos Convent. It has been a military college, the Provincial Museum of the city, an arts school, and from 1911 and for five years, the City Hall. Months after becoming empty, it was restored as secondary School Luis Buñuel. The building was closed in 2004 and right now is an empty equipment with a deterioration degree parallel to the very many proposals of intervention that have not had continuity] [3]

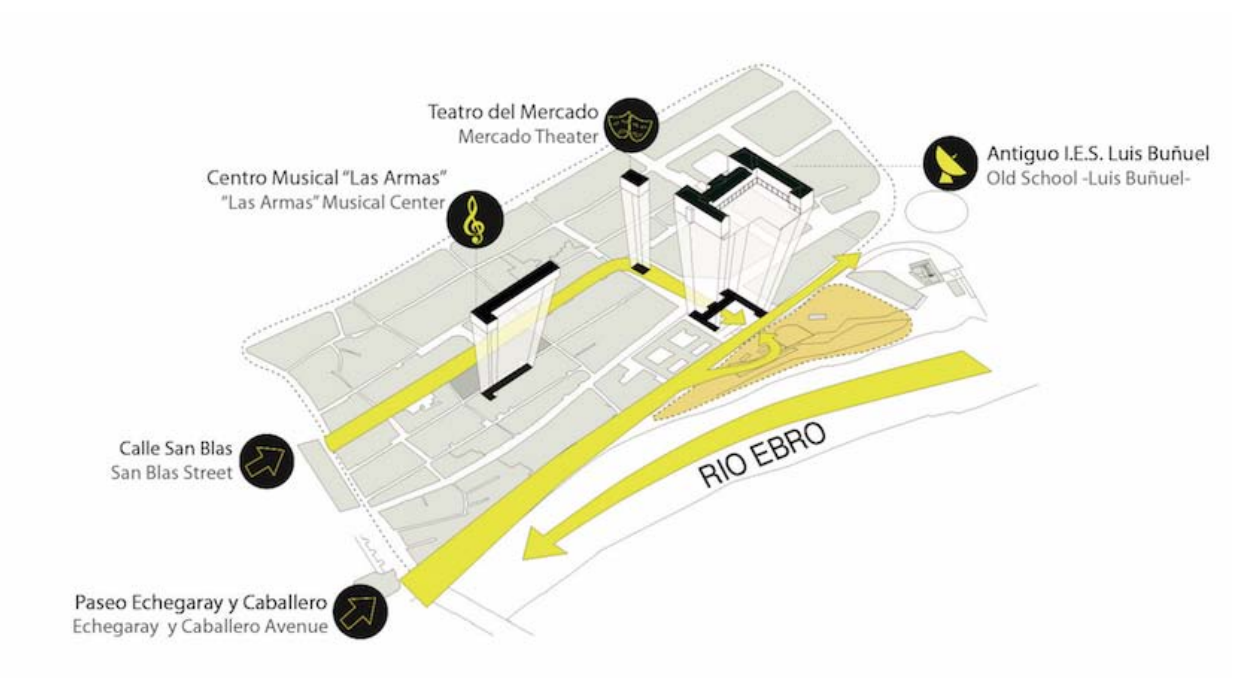

Fig. 1: San Pablo neighborhood



Fig. 2: Old school ‘Luis Buñuel’

2. One | Goals

2.1. The user

Architecture is not done for architects or for public administrators and, as a consequence, when a project is only valued for its coherence with the initial ideas and subsequent executions we are ignoring an essential issue, that the intentions of those who are going to use our creations do not have to coincide with our intentions. It is important to demand and meditate in what area of representation the users´ opinion can be taken into account, thinking about the political dimension of the place. In other words, the rights of everyone to use it, own it, and be legitimately represented by it.

2.2. ‘Spend land’

It is supposed that we own an architectural space that belongs to us because we are architects or public administrators, and we are here to build and occupy the land. The philosophy under all this remember us that we have a place and, therefore, we divide it; we divide it into lots; we build rooms ; we compartmentalize it… but is this not quite a primary anthropological act? In the face of all this, we are proposing actions that respect the environment, a positive action against domain operations that forget if we have enough right and interest, or if we are contributing enough to the intervention. The issue is to advance from a part to the whole in order to occupy more or less, according to functionality and efficiency. From the smallest scales and only through those components and its experimental verification we can see if it is worthwhile to go beyond or if we must constrain to partial fragments.

2.3. ‘Sustainability’

The concept of sustainability is a strategy that goes from the individual to the collective, and that must contain an active attitude as well as an attitude of resistance. This is the way to transmit the concept of sustainability, with the action… and after the action come discourse and theoretical reflection. Sustainability is grounded on collective intelligence...

3. Two | Method

3.1. Micro-urban developments /// Urban rehabilitation

The new urban ways of behaviour let us watch more and more frequently in our streets and squares, realities that we had always considered as domestic. This also happens the other way around. Every day we have to go through situations at home which imply relationships with people who don’t belong to our familiar nucleus. The domestic design of our cities and the urban planning of indoor design seem to be adequate tools in the world we have to live in. This leads us to think that public and private spaces are simplified terms, defined according to concepts of property in order to organise the city. On the other hand, its uses and the experiences of people, its management and ways of behaviour have something complex, changing the conventional terminology until it has become outdated.

The proposal is to launch acupuncture projects, test-tube projects where there is no possibility of mistake since they are processes and not static situations; dynamics as complex and rich as they are demanded by its users, but also able to be adapted to any kind of citizen, namely:

Building the city where there is nothing / we propose to inhabit empty urban areas, urban holes produced by different circumstances that have relegated squares, empty plots of land and buildings into oblivion; but always as a reactive proposition, designing and building proposals enabling to think the model of city // **need to inhabit the conflict** / change is born from controversy and its management, and not from its simplification. As a reaction against urban policies that get rid of

conflicts, we proposed to inhabit them // **mind the gap** / including the biggest possible number of decision-making agents, building bridges with the administration, and giving voice to forgotten minorities // **the rules of the game** / considering public space as a complex area, processes should include regulations, doors and schedules // **autonomy of the citizens** / researching into ways of opening the infrastructures to the citizens // **hybrid city** / transmedia and multiformat city with public areas that favour communication, participation, management and funding // **participatory critical space** / social empowering enabling transformation for bottom-up processes // **eventual urban development** / as big container of cultural practices and activator of social relations // **the city never was founded** / and never will be terminated, with transformation processes taking into account other time margins // **'*commons* sense'** / recovering the qualitative regulations of common sense and the scale of the neighbourhood // **open-source city** / considering the spaces with licenses of open-code creative commons; with a replying vocation, adaptability and evolution // **"hand made urban development"** / building the space through direct processes and pedagogical surroundings // **transparency and open data** / communicating every process in a explicit and transparent way // **new models of governance, tools for the future** / areas of communication between citizens and the administration, enabling a participatory building of the city, and opening processes to new urban realities for the future // **review of the authors**/ by means of designing dynamics able to get social participation // **infrastructures for the rest of the city** / intervening on specific places that become useful spaces able to set out new social processes // **customized furniture for citizens/caregivers** / designing devices for new forms of using the city, enabling social roles based on taking care of the urban space // **optimization of material resources** / with second-life policies and reusing // the **new contracts of the architect**/ as designer of services and not only of products// **loudspeaker tool** / favouring spaces for building networks in internal and external contexts, enabling the widening of citizens´ views [4]

But these guidelines can also increase, being developed or become obsolete, and be changed for others. There will be good urban spaces those able to be adapted to the users.



Fig. 3: 'Luis Buñuel' | urban workshop by 'urban.propespection.network' and University of Zaragoza

3.2. Reoccupation /// Reconstruction

In essence, this is to analyze the proposals that pretend to reuse or rebuild a structure in disuse, giving a service to the community and stopping its deterioration.

We can remember the etymology of the word **build [construere / struere "accumulate"]** accumulate small objects that can produce a use and from then on, a space through its components.

In order to obtain economic and functional sustainability, decisions able to be adapted with time must be adopted, developing different activities contained in the spaces proposed. Material sustainability related to a minimal consumption of material resources will be analyzed, as well as sustainability related to durability and linked to a minimum maintenance cost, as well as functional sustainability related to a flexible use.

We will imagine recovered constructions as permeable, enabling an acute relation with surrounding circulations. In this way, the building will work in coexistence with its situation of conflict, and will not pretend to order it, but only will enable things. It will not impose totally determined situations, becoming a flexible container without a codified language [5]

3.3. Urban links

The success of these actions must be analyzed taking into account its degree of involvement with the rest of similar equipments, creating a network of continuity and action, avoiding its expiration, and enabling also the establishment of activity links.

The issue is "thinking the city", adapting the existing urban strategies by means of a selective analysis of abstract data that will be interpreted in order to describe general structural characteristics. These analytical explorations will reveal invisible structures of our society which will enable us to understand the analysis of the architectural objects as progressive elements evolving with time, that can increase or decrease depending of the social needs of the programs at every moment.

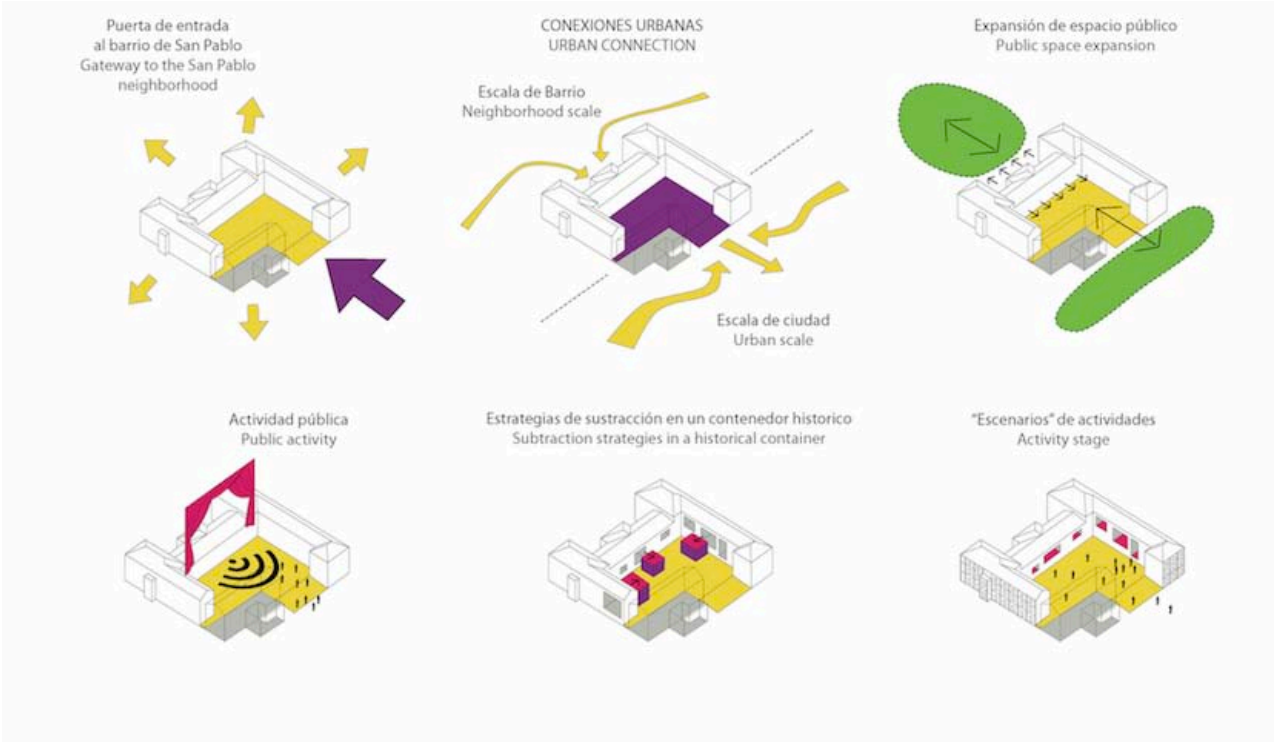

Fig. 4: 'Luis Buñuel' | urban connection



Fig. 5: 'Luis Buñuel' | workshop tools

4. Three | Tools

In order to develop the methodology is necessary a catalogue of architectural tools that can pool together all the analyzed proposals. A context of common strategies that will enable us to describe any urban action with the same codes [1]

5. Four | Stages

5.1. Micro-urbanisms /// Urban rehabilitation

We propose to legitimize Luis Buñuel courtyard by means of social workshops, with construction systems enabling a collective creation and a design produced by multiple thinking heads. The goal is to build the city from the very small and be able to think it from a very big scale. These initiatives aim at trying to research into and analize by proposing. They will plunge us more deeply in the supplying networks, in constructive local knowledge, and in surrounding conditions. The goal is to set up training workshops with research institutes, universities, neighbourhood associations or local partners. Pedagogical formats will enable us to involve many agents in the knowledge of tools and processes, working from the hybridization between technical and popular knowledge. We are proposing an upgrading of contents by updating and/or building contemporary objects that can include the possibility of being updated, evolved and adapted to changeable contexts.

Right now, a rich participatory activity is taking place at Buñuel courtyard, with workshops and cultural and social events. An example is the participatory workshop [UNIZAR/PICH/red.prospección.urbana/ Colectivos] urban.outcast.festival.

The goal… to research into the proposed micro-actions to check if they can produce changes in urban development at a city scale; and, by experimental verification, if it is worthwhile to go beyond that, proposing the reoccupation/reconstruction of containers or non-used spaces related to the activity. This question implies, necessarily, to attract the interest and the attention of the administration and business powers [6]

5.2. Reoccupation /// Reconstruction

As a first stage, it is proposed the rehabilitation of the ground floor of the old institute to incorporate a zero level to the public space of the district, taking into account: functional sustainability related to solutions on interlinked programs of independent or simultaneous activation; control of construction resources, foreseeing future conservation costs.

The goal… to determine the social and/or cultural profitability related to the economic resources invested, valuing the success of the intervention. From this could derive a proposal of rehabilitation of the upper floors, staging the advance from a part to the whole, in order to occupy, more or less, in agreement with functionality and efficiency.

5.3. Urban links

In this stage, the analysis of the architectural objects will be considered as progressive elements with an evolutionary time development that can increase and decrease at every moment, depending on the social needs of the programs.

The integration of zero level in the existing public space will create an urban link to a "neighbourhood scale" through the plaza de Santo Domingo, and a "city scale" connection through the axis "Luis Buñuel courtyard/ Echegaray Street / river bank".

The goal… the incorporation of essential social networks for boosting social innovation focusing on a sustainable, inclusive and creative development; and cultural creativity/production as booster of new economies through cultural learning. In this way, San Pablo can become an exchange node of cultural economy, even though the key will be working through the small entrepreneurial initiatives in order to give them a scale by means of its organization in all kind of tools. Culture and university will be the double booster of this district: culture as a tool to promote a proactive and innovative citizenship, and as an economic engine; university as booster of public space, knowledge, and innovation. In this stage, local networks will be essential, looking for establishing links between culture and university, dynamizing urban space and local networks. This is the opportunity to connect the "cultural containers" of the district with the future "Erasmus District, and with the rest of social equipments, being the CAT a core element for creating interdisciplinary networks and for interaction between projects and cultural and university agents [scientific and technological subjects as part of the creative process; social subjects and humanities as producers of discourse and critic thought able to inspire the projects].

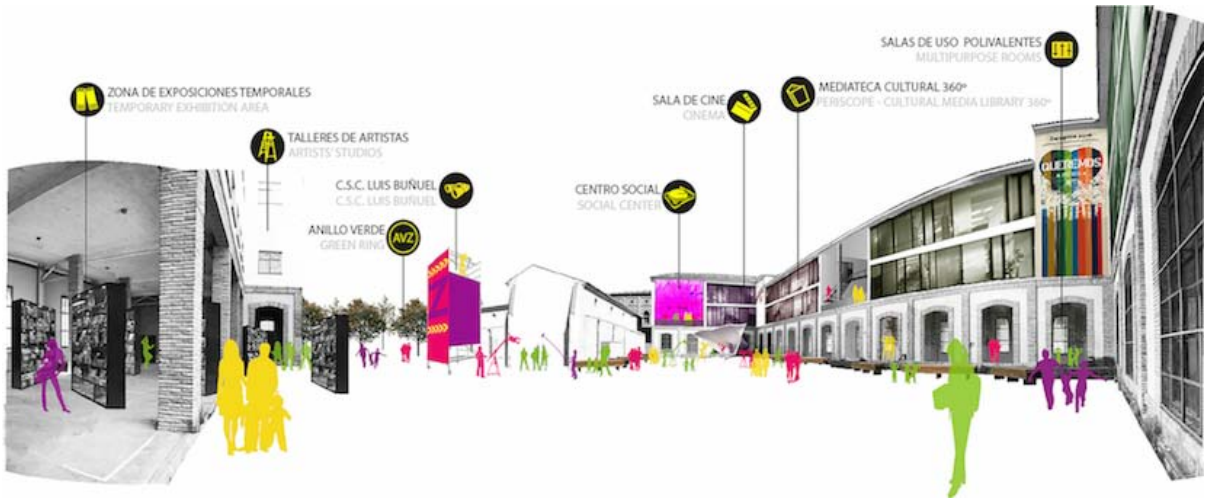

Fig. 6: 'Luis Buñuel' | program uses

6. The goal

The goal is to identify models of urban sustainability as a strategy going from the individual to the collective, essentially conveyed by action, mixing innovation and technology in multiple fields, using natural and intellectual resources in an efficient way, and considering human intelligence and above all collective intelligence as starting point and justification.



Fig. 7: ‘Luis Buñuel’ | urban workshop by ‘urban.propespection.network’ and University of Zaragoza

Bibliographical References

[1] GALLARDO ORTEGA, José Javier. *Phd.* In progress. Dir: Monjo Carrió, Juán and Moya González, Luis, UPM, Madrid.

[2] EXCMO. AYUNTAMIENTO DE ZARAGOZA. *La cultura transforma el centro*. Ed. by Zaragoza 2016. Zaragoza, 2010, p. 50-60.

[3] Database ‘City Council of Zaragoza’.

[4] *Annual report ‘Campo of Cebada’.* Zuloark team. Edition 2014.

[5] http://www.prospectionnetwork.org

[6] http://www.urbanoutcastfestival.blogspot.com

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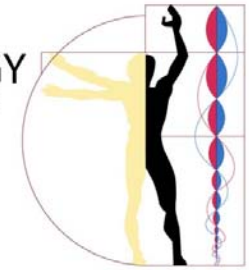

Designing by strata: notes from the underground
Hypogeous spaces and the archeological museum of Pompei
An architectural research and a tutorial workshop on hypogeum

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Abstract
The design approach tries to investigate some meanings of contemporary space for the ancient Pompeii from two ideas.
The first concerns its plan and is founded on the idea of digging: it tends to shape the project by bringing to light the excavation implicit meaning, as leading the project. Enhances the primary value of the land masses moved (or eroded) or of the layers of time - and the substance - sectioned. Expresses the idea of unearthing - of what is hidden, buried in fact - or simply implicit (as a Michelangelo "*Prison*").
Continuing, then, by the concept of spatial progression (as initiatory matrix: "*usque ad infera usque ad coelum*"), implicit in ambivalent couples of light-shade, inside-out, over-under, featuring chthonic spaces, we continue to develop the second idea concerning the specific nature of the space of the project. The sequence of courts not always in axis of the *domus*, becomes - between a succession of underground tunnels (labyrinthine memory) and above ground paths - the alternation of passages that creep between the cores of the courts that cross the horizontal spatiality of the descent layers.
The descent to the museum system, takes place, as in a well of time, alongside his various layers: from 'today' to the various archaeological levels, finally to the virgin soil. Galleries of underground ventilation (*ground cooling*) are the most technologically advanced system (and the oldest) as the most sustainable for the architectural system. The technological advancement lies in its appropriateness and correspondence to the formal and architectural system.

Keywords: Ancient spaces, hypogeous architecture, sustainable technology as traditional techniques.

1. Chthonic spaces, notes from underground
The hypogeal is, in architecture, from the origins, a kind of 'basin' of space, the place of a beginning, an early point where we enter, to go back in time, to undertake an initiation path. The generating principle of space unfolds in the cavities and interprets the nature according to the landscape that hosts them and the function they represent. Hills that lie hidden temples, architecture in the form of truncated cones or excavated trapezoids.
Liturgies, mysteries or simple devices for the collection of water, which become prototypes of space. Sacred rooms digged to reach an underground spring or stepped basins descending toward the aquifers.
Surely, the cavernous space is also an archetype, so we think about the labyrinths, whose topological figure is certainly underground, as well as symbolic and always harbinger of the interior space. Places ripped from the impossibility of rocks, hills or ridges that show bright openings that anticipate spaces and paths, horizontal cuts that reveal the outside from inside, systems like wells that penetrate down into the soil. Each underground is a threshold and is built between the two ambivalent faces of what is above ground and what is hidden.

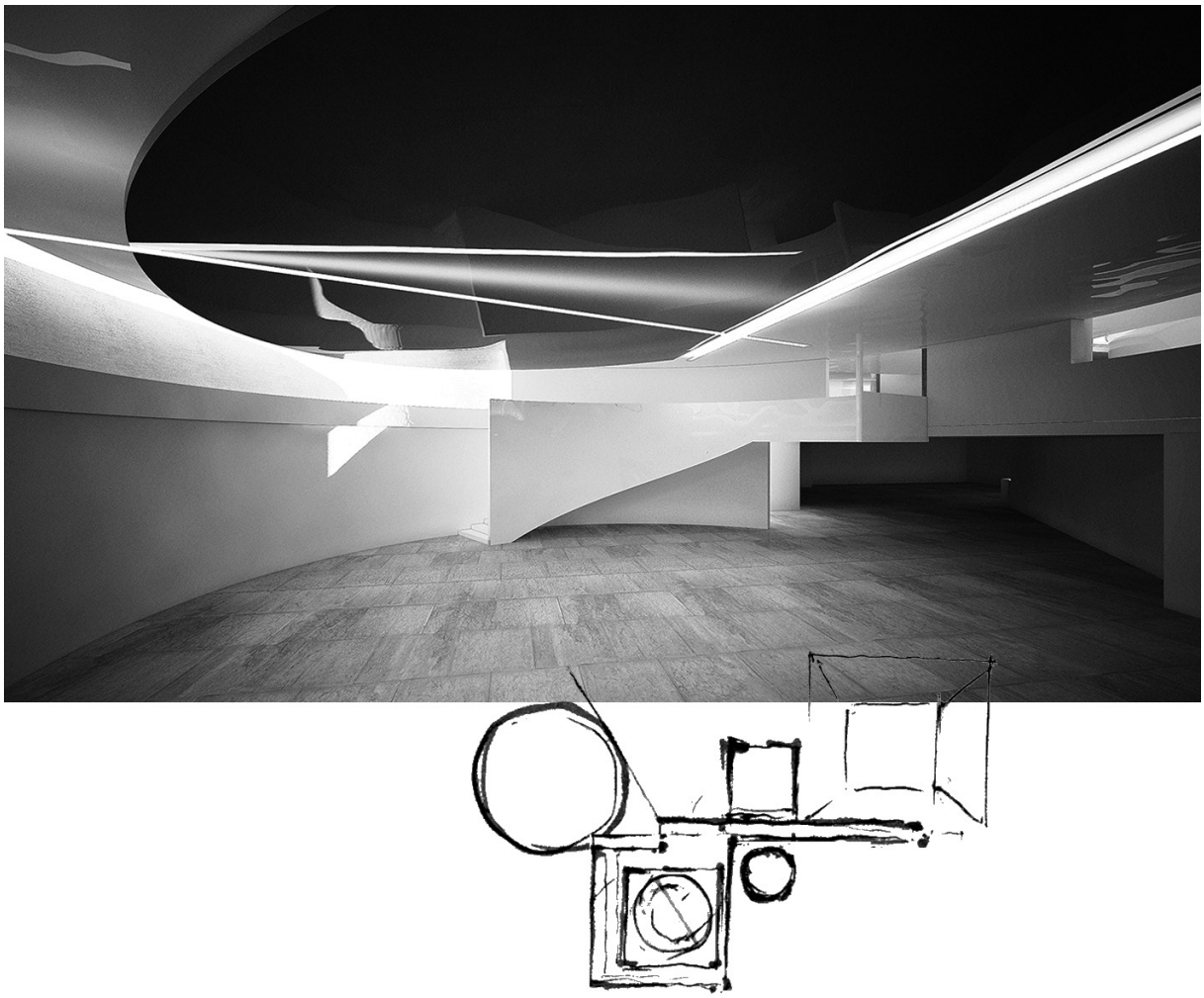


Fig. 1: *Hypogeal Hall, a Cultural center for Aversa*, project for the Workshop of Architectural Design of the 3rd year of graduation course 2011-2012. Professor: Corrado Di Domenico. Student: G. Martino. Below: Corrado Di Domenico, ***s****tudy sketch for a plan of underground exposition rooms*.

Two main models of chthonic space generated numerous architectures: the *tholos* and the carved court both collect the vertical junction located between earth and sky. The first, perhaps, comes from a circular space, crossed by a spiral ramp that connects earth and sky. As Sir Arthur Evans thought to have discovered in Crete. A giant space where «apparently, the access to the room occurred by a stepped gallery, spiral descending along the wall of the tholos and was provided with openings to the interior of the room» [1].
The second, in some cases for defensive purposes, was the only access to partially excavated patio homes. This portends the idea of a 'sleeping land' city, where the rooms - protected by the ground and climatically perfect -, are alternated with courts and accesses in the trenches. The closed excavation, covered or entirely underground, is usually circular, while the open excavation, roofless, as a digged court, is usually a quadrilateral shape.
The first usually covered with an isodomic dome, which becomes an hill, outside naturalizes and inside shows the appeals of the circular rings to close the key-dome. For instance, the *Treasury of Atreus* - discovered by Schliemann – where the room is the terminal space of a digged path.
The open-sky room, however, because isn't the point of arrival, is part of a more complex underground system and is configured as a room without roof, which gives light to other spaces that compose it. We think about the underground villages that Bernard Rudofsky located in China, or some contemporary examples by Tadao Ando as the *Chicu Art Museum* in Japan, James Turrell in the *Roden Crater Project* in Arizona, or by Nieto-Sobejano in the *Madinat al Zahra Museum* in Cordoba. In all these cases is a maze that twists underground through the halls, revealing his presence through excavated courts.
The underground spaces, complex by themselves, have - in a sense - a similarity with the labyrinths.

Certainly, the sections that characterize them are intricate: come to mind, on the one hand, the sequence of the large halls and paths with cuts in Le Corbusier's *Sainte-Baume*, where the section that extends horizontally, is a sequence of *tholos* spaces. On the other hand, the absolutely vertical section, of the well of Antonio da Sangallo in *Orvieto*.
As we said, however, the meaning of underground space is certainly, in ancient times, to hide a sacred or ritual room that in its liturgical-initiatic function represented a point of transition between two worlds. Between earth and sky, between sensible and intelligible, the cave is the plutonic place, lunar and otherworldly and architecture is played throughout the entrance device, made by labyrinthine turns or processional *dromoi*.

An extraordinary example of pure threshold of underground space is the sacred well in *Paulilatino*, Sardinia (XI century BC), perhaps the most extraordinary Nuragic example. A double low precinct defines a complex figure, as symbolically clear. An eccentric oval with a symmetry moved to the center of the small key of light on the surface of the earth, a second inner precinct, which defines the plan as a system in *dromos* culminating in a *tolos*, only hinted on the ground as tracks and, halfway, a trapezoidal (or triangular?) slit that defines the door.
A horizontal threshold playing, in an impossible geometric game, the projection of the splayed staircase on the ground floor with an obvious relationship with the sky. A horizontal portal (today there is no structure in elevation), which from the inside shows its vocation to be even threshold of heaven (no window), and at the same time it is opening of ritual steps by the incredible geometric shape and abstract spatial quality. [Fig. 4]
The act of the excavation is prior to construction; the carved spaces are as primordial acts of discovery of material and surface quality.
Thinking of the building as a subtraction rather than as addition reveals a content of architecture that perhaps it is the true keeper: the discovery of space, the removing from material to discover the qualities of a dwelling. The idea of underground space is physically the negative of architecture as tectonics, but it was also the founding principle, the place that you find by digging, the foundation pit or «*Mundus*», and the guarded crypt that is behind the origin of the secret of architecture.
I always thought that every architecture should bring its own crypt, its foundation space and that this should have the characteristics of a sacred space.
I think of a Francesco Venezia beautiful building in *Mestre*, the *IUAV testing materials laboratory*, where the 'contrast structure' for testing - which requires independent foundations - falls into an ancient-looking subterranean, thought about as it were before the construction, as an archaic crypt.

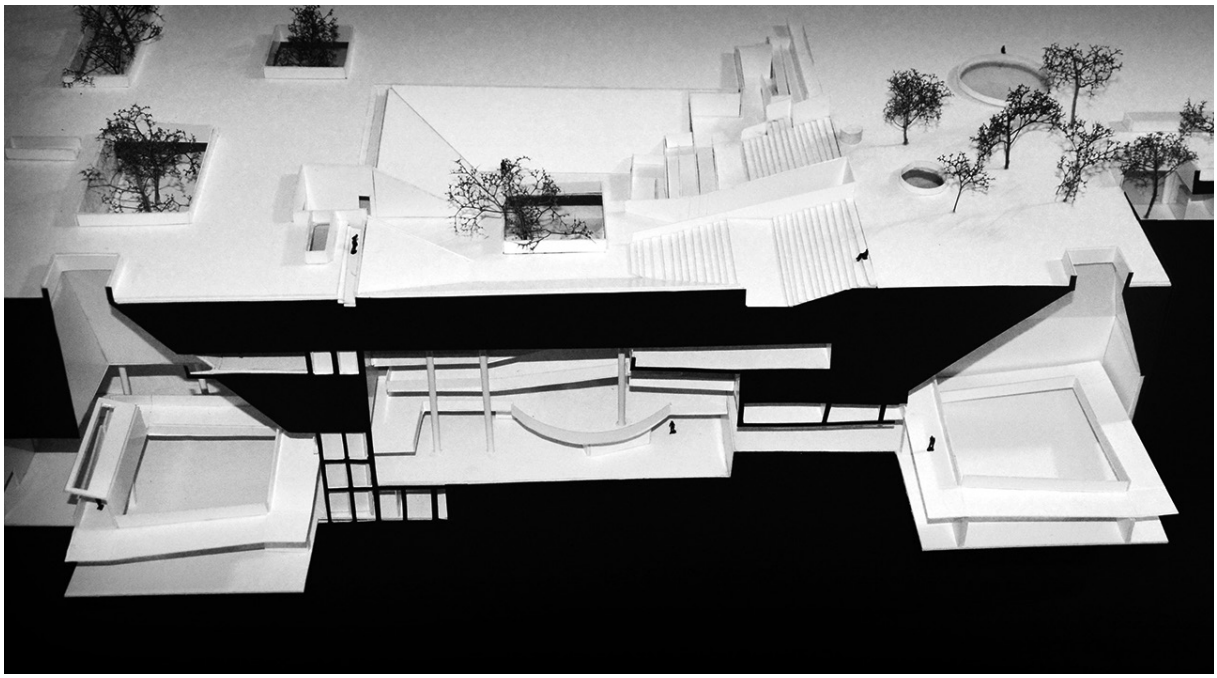


Fig. 2: *Hypogeous complex*, section of the model for the «Camelot research and visitors centre», project for a thesis in Architectural Design, 2013-2014. Professor: Corrado Di Domenico. Student: Valeria Pascucci.



Fig. 3: *Excavated pyramid with square ramp*, detail of the model for the «Camelot research and visitors centre», project for a thesis in Architectural Design, 2013-2014. Professor: Corrado Di Domenico. Student: Valeria Pascucci.

Hypogeous architectures are a real prototype of the space; every underground architecture has its origins in a spatial concept either old or cross-over time.
Two assumptions for thoughts about an underground museum for Pompeii. In the book «The imaginary point of view» [2]. I was focusing the attention to the relationship of the architectural space with the physical vertical that cross between earth and sky, making a path on some underground spaces and reading the Wright's Guggenheim Museum as a device substantially intended as carved while entirely above ground. A kind of underground museum led above the surface of the Fifth Avenue as it were a mould on negative.
At the same time, I laid attention to a draft by Utzon that ever inspires me. The *Silkeborg Museum*, fully under the ground, is the complex example of underground space as a path and container at the same time. What is under the ground is, in fact, excavated; therefore, the containing spaces keep a void, a content space. In the Utzon's design there are two ideal envelopes: the negative of the excavation and the positive of the shells that intercept the natural light, which are more internal chthonic. He works on the double underground casing. Descent spirals discover ambivalently cavities and paths joining at once a millenarian and ancestral theory.

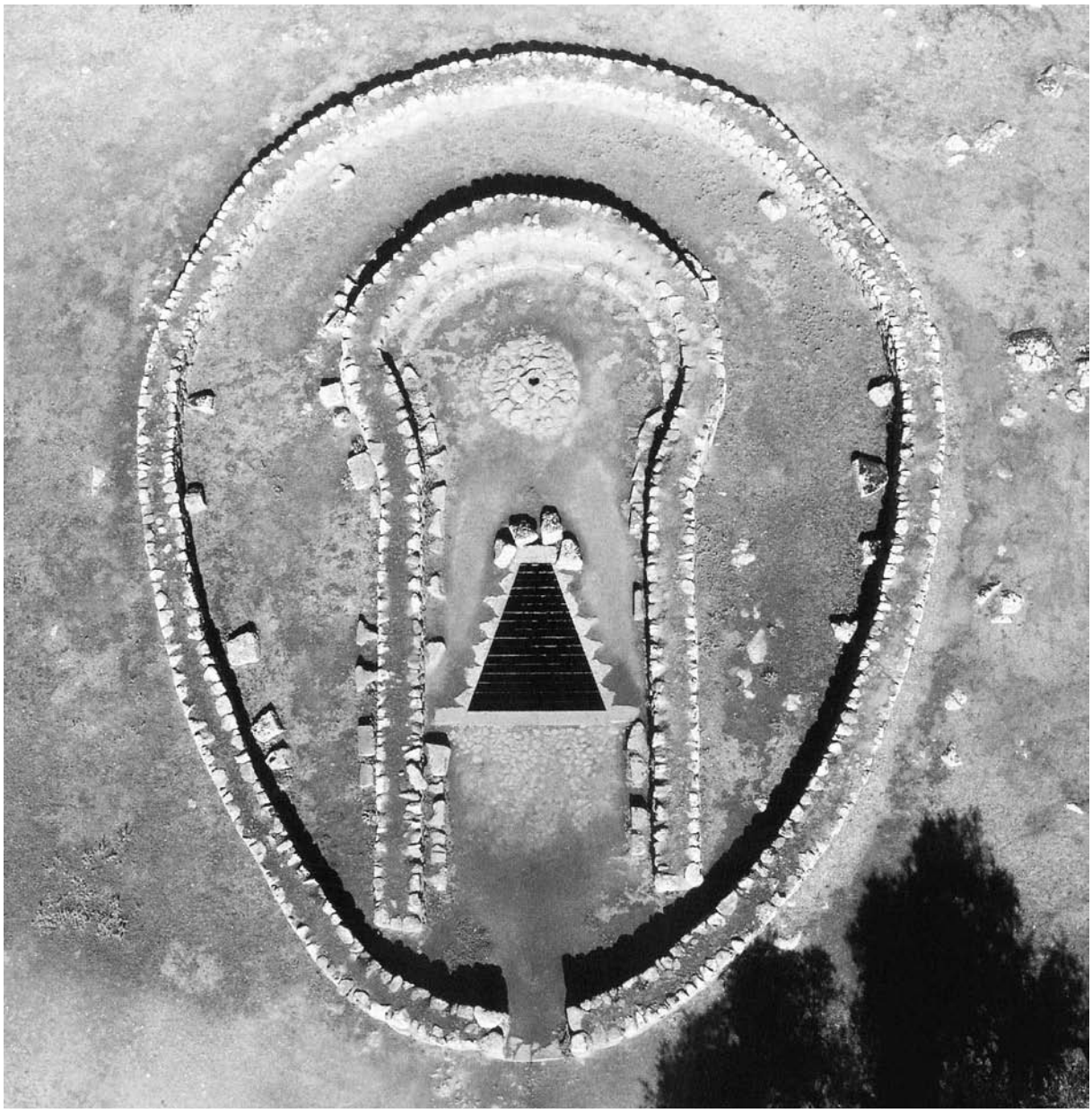


Fig. 4: *Nuragic precinct*: Sacred well of Santa Cristina in Paulilatino, Sardegna.

2. 'Re-covered' Pompeii, the excavating act

I was always fascinated by the idea of a museum-descent. An abstract and underground space that can be achieved through a section of the ground. And, consequently, that it can be configured as a section of time, where, from the ruins of the Present and from the presence of the contemporary, could progress spatially in rooms increasingly older… till you get to the primordial traces of the first man who stepped on the site.

Two concepts: the 'place' and the 'room', and two noble antecedents to support some ideas. Where the site coincides with the new city that is co-planar with the old one and where the overlap of the geometric times occurs in a very special and unique way compared to other places made of layered presence of the contemporary city and the ancient city. Take, for example, Rome and the Terragni project for the *Imperial Fora*. Here, the space-time is given by the superimposition of ancient traces on the geometry of the project and the site is conceived in its syncretism. In Pompeii, however, the layer is filled with only the memory of the ashes of the eruption. It is an addiction, more than an overlap, and the juxtaposition of the contingency Roman and contemporary plans creates a strange effect of contemporaneity of the ancient city.

The second concept, about the 'room', takes as a pretext a wonderful writing of C.G. Jung. Here he

imagines a space of the dream that develops starting from a modern setting, then down until you have even older sequences of rooms, from Baroque to Romanic, and then through a trap door falling further in the chthonic space of the ancient, with stone floor and further behind in the cave. The room is multi-spatial, it is the cave that reaches the virgin soil.
«I was in a strange house, with two floors. [...] I was on the top floor, here were a kind of living room furnished with beautiful antiques in Rococo style. On the walls were hung with ancient paintings of value. [...] I went down the stairs and I reached the ground floor. Everything was much older, and I realized that this part of the house had to go around the fifteenth or sixteenth century. The decor was medieval, and the floors were of red brick. [...] I discovered a stone staircase leading to the cellar. I descended, and I was in a room with a beautiful vaulted ceiling, exceptionally old. Examining the discovered walls, among the common blocks of stone, brick layers contained in the mortar: by this, I realized that the walls date back to Roman times. I was more interested than ever. I examined also the floor, which was made by stone slabs, and I noticed a ring: I pulled it up, and the stone slab raised, revealing another staircase, narrow stone steps leading down into the depths. I descended these steps, and entered a low cave carved into the rock. A thick layer of dust covered the floor, and in the dust were scattered bones and shards, as the remains of a primitive civilization» [3].

In many areas of the *Campania*, between Naples and Vesuvius, this descent is worth a few meters: a foot already found traces of the Roman roads, which are - in fact - outcropping, just a meter and a half or two, tracks and footprints of ancestral human show their testimony.
An archaeological museum is a descent into the layers of time, especially if it coincides with the excavation area as in Pompeii today. The site of our reasoning is behind the excavation.
The site is really unique because it is in close to the Amphitheatre, to the south, in a depression area that already reaches a lower level (about seven meters) to the ground plane of the entrance of the excavations area and in general of ancient Pompeii.
In my teaching methods, we thought then - almost in all projects followed the course taken by me -, about do not change the level of the original entrance to the archaeological park and to design the museum as a building that basically weld your jump portion of the depression. It get in, therefore, from the top and then down walking.
Here, the first spatial concept that the approaching path and the entrance device we must develop. The progression toward the lower level through the section of soil layers shows - already in the entrance *dromos* - the time sequence of different ages, as in a geological section readable along the way with visible the various sediments and the various layers of stone and soil. A path in the trenches, perpendicular to the main axis of the Amphitheatre, down from the access level to the archaeological park, dissecting in fact the new building in two, with a gently sloping ramp, to open in the first cropped and underwent court, which defines the small entrance square.

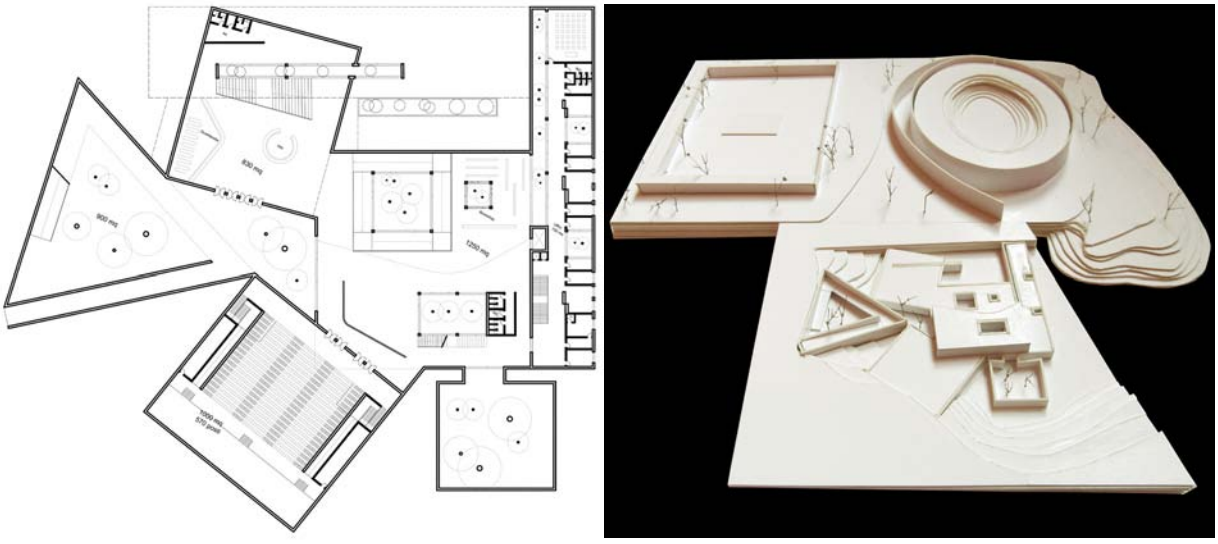


Fig. 5: *Re-covered Pompeii*, intermediate designing step of a project for a new archaeological museum in Pompeii, a thesis in Architectural Design, 2014-2015. Professor: Corrado Di Domenico. Student: Teresa Rao.

The two main ideas underlying the setting of the Design Workshop I guided are based on the idea of digging: that tends to shape the project by bringing to light the implicit meaning of the act of excavation, as base and leading idea of the project.
To enhance the primary value of the land masses moved (or eroded) or of the sectioned layers of time - and of material -. To express the idea of unearthing - of what is hidden, buried in fact - or simply implicit (as a Michelangelo *Prison*).
The project is a kind of restore level of the excavated area that is joined with the level of the excavations and - like negative - allows visiting unearthed spaces and at the same time recovered places from the mass of backfilling ash.
Continuing, then, with the concept of spatial progression of initiatory matrix (*usque ad infera usque ad coelum*) [4], implicit in ambivalent couples of light-shade, inside-out, over-under (featuring chthonic spaces), we start to develop the second idea that concerns the specific nature of the space of the project. The sequence of courts (sometimes in off-axis) of the *domus*, becomes - between a succession of underground tunnels (of labyrinthine memory) and above ground paths - the alternation of steps that worms between the courts nuclei that cross the horizontal spatial of the descent layers.

3. Geography, plastic art

A «form of inorganic art or music of plastic art», because for Schelling, «the architecture is nothing more than a return to the inorganic of plastic art; in it, the geometric regularity ... has yet to assert its own right» [5]. Unlike but same Schelling says about the «plastic art in the proper sense of the word» which «disdain to give to the proper object the exterior space», since «it brings with itself», the architecture builds landscape through the system in which is inserted and that interprets. Network of positions, distances and perspective relationships... geometry, proportions, «frozen music». Then, «the architecture appears as free and beautiful art only when it becomes an expression of ideas, and the image of the universe and of the absolute», when builds system image, landscape inside another landscape. For millennia ar-

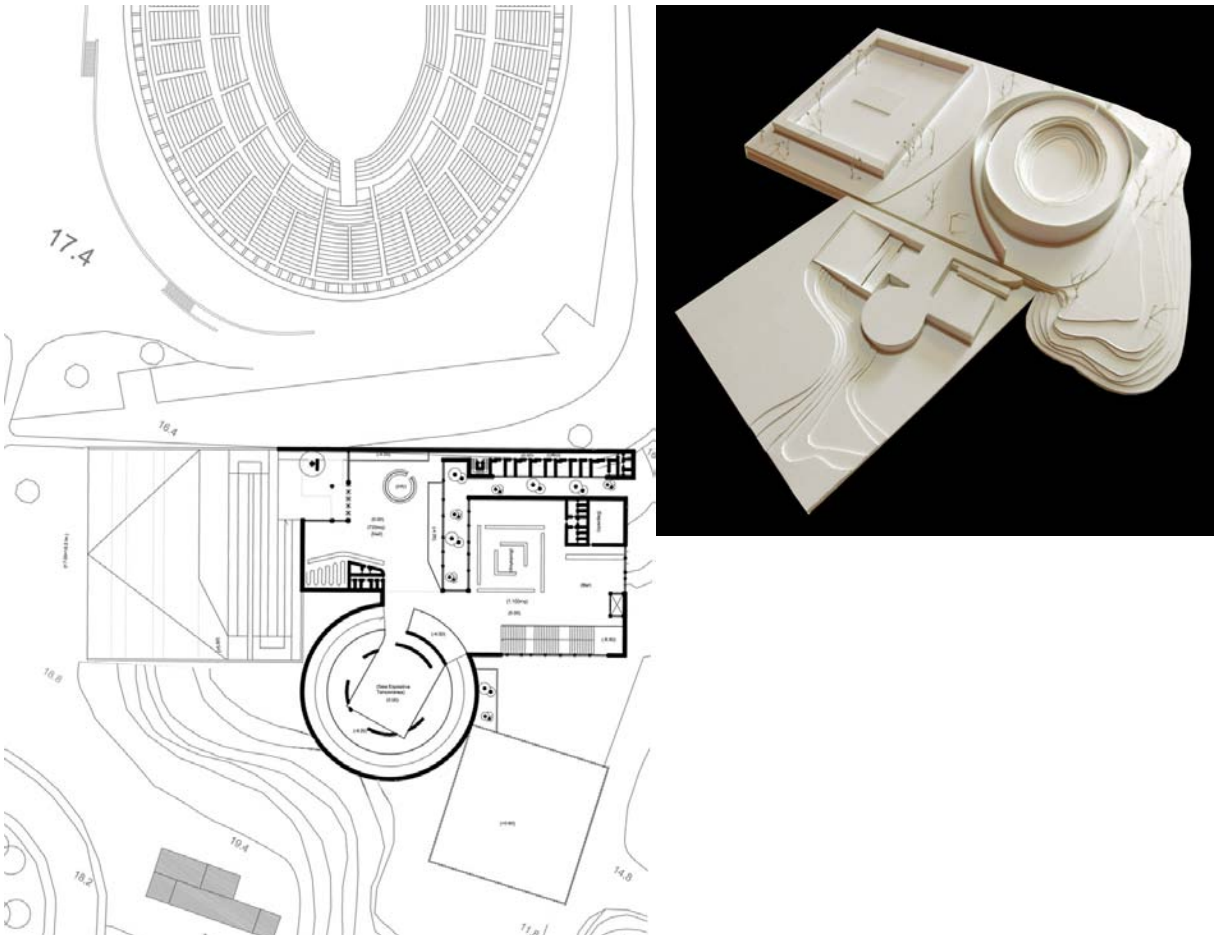
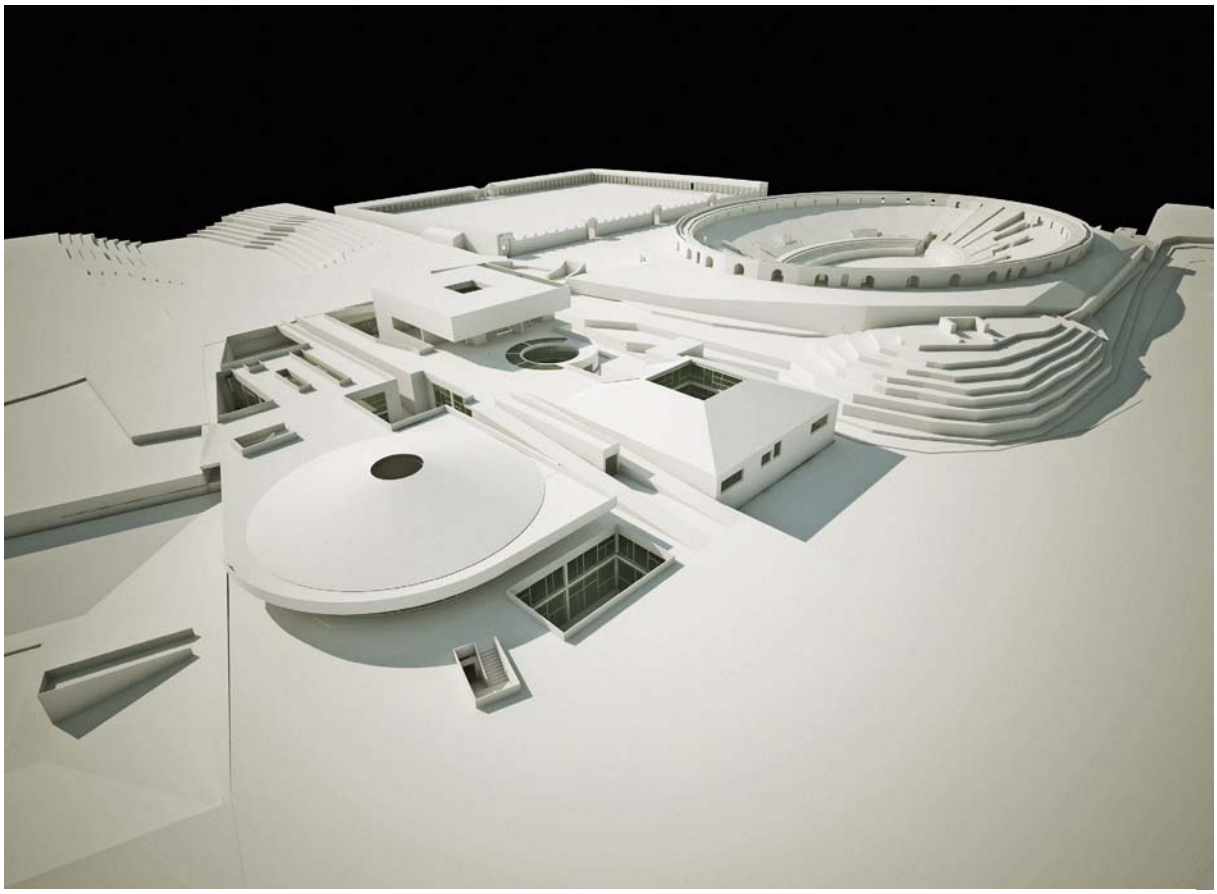


Fig. 6: *Re-covered Pompeii*, intermediate designing step of a project for a new archaeological museum in Pompeii, a thesis in Architectural Design, 2014-2015. Professor: Corrado Di Domenico. Student: Luigi Mottola.



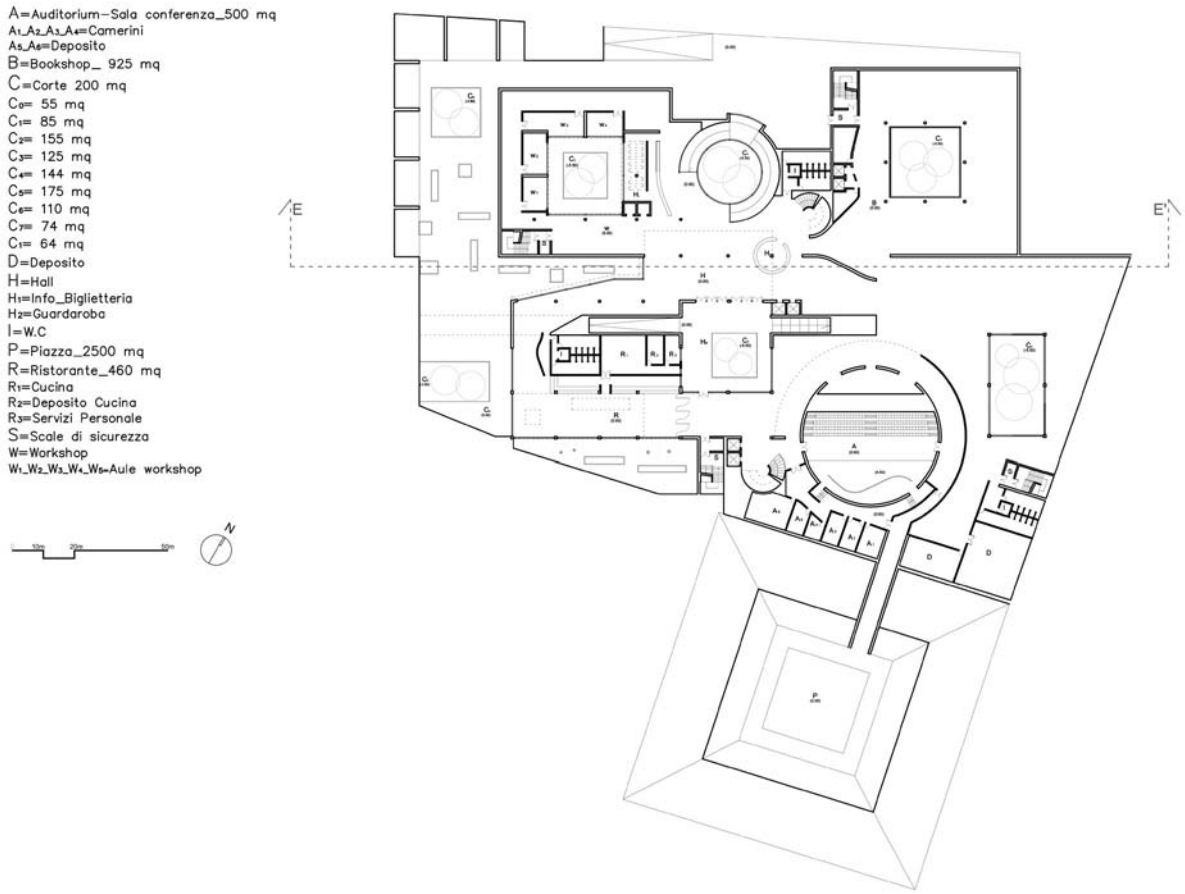


Fig. 8: *Re-covered Pompeii*, project for a new archaeological museum in Pompeii, a thesis in Architectural Design, 2014-2015. Professor: Corrado Di Domenico. Student: Mario Paribello. View of the virtual model and main level plan (-1).

chitecture informed, interpreted the landscape, without being a substitute for, but always 'contemporary' to the place in its form, constructing not the building, but the system of a wider 'inside'.

A museum to the negative showing a new and abstract landscape, artificial and moon on the plane of the archaeological park that plays its masses with the presence of the Amphitheatre and the Vesuvius. As a double landscape, the architecture of the volumes above ground repeats in assonance with the arc of geography, so in the site emerge truncated forms, rectangular basins and stereometric shapes.
The abstract of the pure volumes cuts the landscape with ancient appearances that in Pompeii are mighty. The site defines a crossing point between the 'noble' geography of Vesuvius and *Lattari Mountains* and the very different and powerful concretion of the Roman city passed down by time.
Therefore we tried to create an artificial landscape - made by hills and artificial reliefs obtained using in part the excavations soil - that arise from the new walking plane that welds the levels of the entrance to the excavations and the base of the foundations of the Amphitheatre. From the new access level (roof

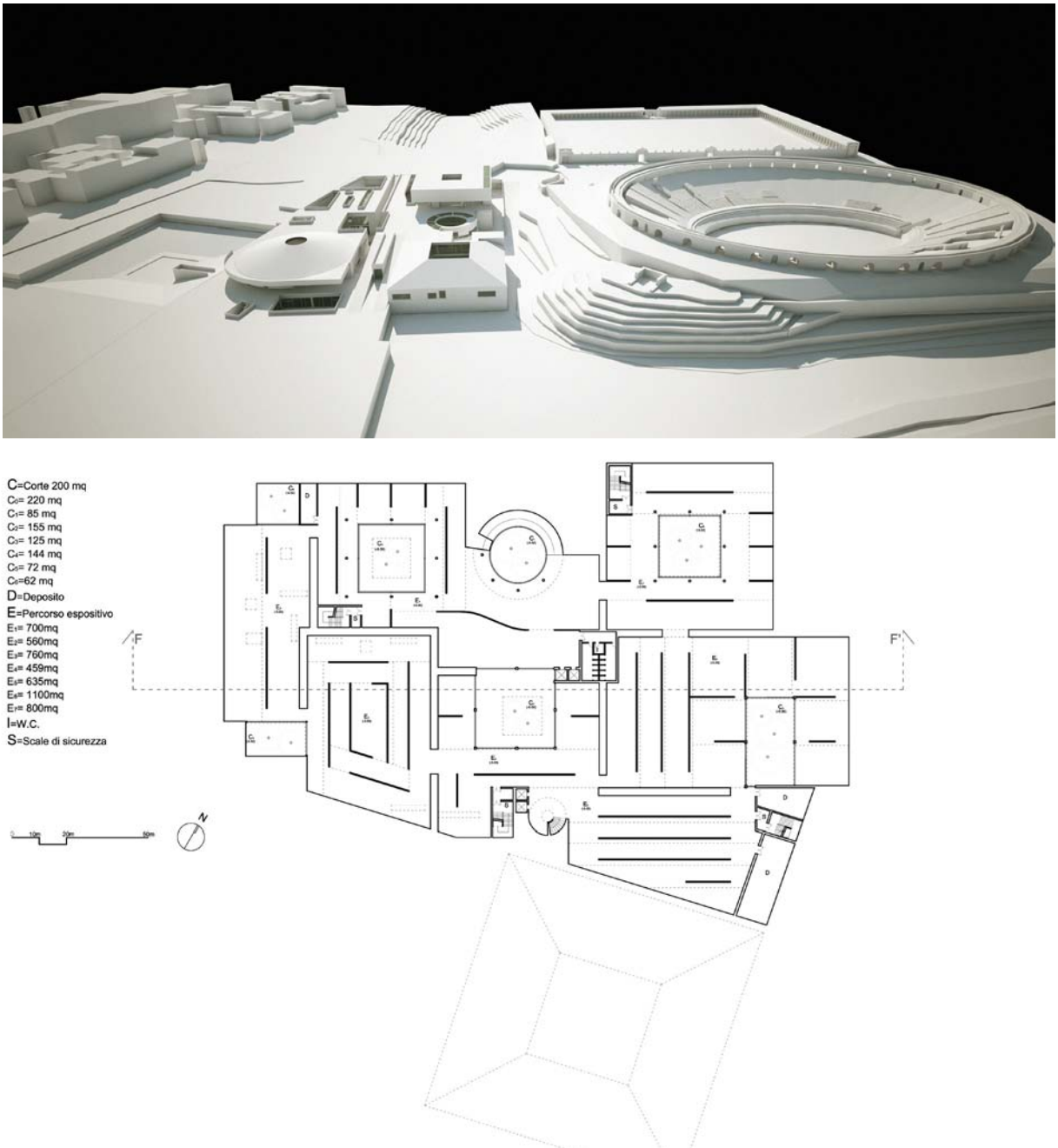


Fig. 9: *Re-covered Pompeii*, project for a new archaeological museum in Pompeii, a thesis in Architectural Design, 2014-2015. Professor: Corrado Di Domenico. Student: Mario Paribello. View of the virtual model and exposition level plan (-2).

floor of the museum), the few architectures fit cleverly, partly blending, to form a complex landscape of *nature* and *mind*.
Thus, a landscape so morphologically - and philosophically - played on the relationship between *organic* and *abstraction*: natural forms (of nature) that purify in abstract shapes (of nature and mind), or that are continued from the figures of the architecture, or where architectures fit - as abstract small blocks that interact with the masses of distant *Campania* geography. Two scales of landscape that merge in the forms of the museum as a garden in which, by the nature surrounding you pass the artifice of built forms with the same elements of nature. An example in a smaller scale of this process is the garden of the *Silver Pavilion* in Kyoto.
Four are the major elements of composition that emerge as plastic and abstract presences of a larger garden. The roof of the small theatre-auditorium makes a cone that is almost the materialization of an abstract mound of earth; in the south side, a large quadrangular *impluvium* becomes a recessed square that continues in this way the wide lawns sloping that precede the site, becoming an enhanced continuation of volumetric recession. Two more masses: a truncated pyramid that starts from the lowest level, houses part of the underground museum with storage rooms with side access from the lower level. This roof-level is carved by a square courtyard and the other mass is a suspended part of the museum, which is detached from the floor of the general roof, and from there is offered a direct view of the Amphitheatre.
The plane from were created the stereometric masses of the volumes above ground is the roof of the museum, thought to be a walking new ground, like a square-garden. Courts and trenches paths allow accesses, exits, vents and light. The general axes of the composition are aligned with the axis of the Amphitheatre and the Gymnasium, that is to say, with the cartesian arrangement of the eastern part of the ancient city.

4. Sustainable undergrounds

The building is designed as to make maximum use of the bio-climatic condition of the place for the purpose of a reduced use of energy resources. Solar protection devices and air circulation are provided, as well as various strategies for the control of internal environmental conditions.
For air circulation were provided passive cooling through, night ventilation and natural ventilation, using also the prevailing winds in the north-south direction. The building is also equipped with ventilated roof. Galleries of underground ventilation (*ground cooling*) are the most technologically advanced system (and the oldest) as the most sustainable for the architectural system. The technological advancement lies in its appropriateness and correspondence to the formal and architectural system.
The use of passive cooling systems by underground conduits of ventilation, of suitable length, allow pre-cooling of the ventilation air and the adoption of a system of control of the natural ventilation. Through the opening of the glazed systems or grids placed in façade and forced (through the ventilation system that uses underground ducts) allows you to take advantage of the favorable weather conditions and mitigate those particularly severe.

Bibliographical References

[1] PLATON, Nicolas. *Cretese-Minoico* in «*Enciclopedia dell'Arte*», Torino: UTET. Quoted by Santarcangeli, Paolo. «*Il libro dei Labirinti*». 2nd ed. Varese: Frassinelli, 1984, p.65.

[2] DI DOMENICO, Corrado. *Il punto di vista immaginario*. 1st ed. Genova: Il Melangolo, 2012, p. 141-145.

[3] JUNG, Carl Gustav. *Ricordi, Sogni, Riflessioni*. 5ft ed. Edited by A. Jaffé. Milano: BUR Rizzoli, 2002, p. 200-201.

[4] VENEZIA, Francesco. *Usque ad infera usque ad coelum*. In *«Parametro».* Issue: 261, (Gen.-Feb. 2006) Faenza, Italy: Faenza Editrice.

[5] SHELLING, Friedrich von. *Filosofia dell'arte*. In Panza, P. *«Estetica dell'architettura».* 1st ed. Milano: Guerini Studio, 1996, p. 47-48. *Cf.:* GAMBARDELLA, Cherubino. *Città mute*. In *«Parametro». Ibidem*.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Cover, overlapping and layering: protection and promotion of archaeological heritage in Paris

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Abstract

In the contemporary metropolis of Paris are still present traces of the ancient Lutèce. These are almost hidden, as if they were preserved in the historical memory of the city. Comparing old maps with contemporary planimetries, it is possible to identify the most significant architectural presence that still persist on the area of Paris. First archaeological evidence is given by the Crypt of Notre Dame, that is the space located underneath the churchyard of the famous cathedral. It is open to the public for visiting the excavation that has unearthed the ancient urban layout, housing, a thermal system of the 4th century and the old shore of the Seine. This exposition is hypogeum to allow the free use of a so representative space.
Instead, Hotel de Cluny is an important museum of medieval art and in its structural system the overlaps will clearly identify: a medieval building of 15th century is superimposed on the Roman thermal baths (of which frigidarium is perfectly preserved) plus another expansion of the 19th century. Last trace of the ancient city is the arena transformed from ancient space for shows to urban park hidden in the 5th arrondissement. Here the stratification is very interesting, in fact part of the cavea was sheared to give way to 19th century buildings. Several conservative methods, protect archaeological persistence to keep alive the memory of the origin of the city.

Keywords: Cover, overlapping, layering, archaeological heritage

1. Introduction

The protection and valorisation of the archaeological heritage are always very complex operations, not only for the relationship between new interventions and archaeological finds, but also for the compositive and constructive aspects. Evidently there are different possibilities related to the safeguard of the ruins: the realization of an archaeological crypt (as in the case of Notre-Dame) providing for hypogea museum spaces, below the street level; the subsequent construction of new buildings that overlap the ancient elevated structures (such as the *Hôtel de Cluny*) or it's possible to opt for the outdoors conservation, creating an archaeological park (as the *Arènes de Lutèce*).
Several examples of these design solutions may be discovered in Paris, raising some fundamental issues related to archaeological-urban context, first of all the relationship between the new intervention and the original form of the findings.
Analysing three case studies, it's possible to see how the processes of conservation are related to coverage, overlapping and layering. Each of these examples can be related to a specific process, which could however be considered deeply connected to the others. In fact, each operation for covering archaeological heritage can be interpreted as an overlapping, as a construction that is placed above one more ancient. Similarly, this overlying produces a stratification, in which the contemporary relates with the past.
The overall reading of the layers allows a recovery of these settlements and the integration of archaeological sites in the city in new terms with the awareness of the historical value of the testimonies to be preserved.

2. Cover: the archaeological crypt of Notre-Dame

Right in the center of Paris, on the Île de la Cité, a precious fragment of the archaeological heritage of the French capital is preserved, hidden under the big square of the cathedral of Notre-Dame. Inaugurated in 1980, the crypt was intended to present different buildings that succeeded on the site: roman and medieval ruins, which provide a unique view on the urban and architectural evolution of the Île de la Cité. Observing the surface of the square, a planimetric drawing of white stones can be recognized, in contrast to the rest of the pavement which is instead a dark grey. It corresponds to the perimeter of the old buildings that once occupied the area.

It's not easy to recognize the entrance to the crypt, located down the square, on the opposite side of the main door of the Cathedral and identifiable only by a marble slab bearing the inscription "Crypte" that precedes the stairs to the underground floor. The topic of the archaeological crypt, always presents a range of issues related to the need to cover and protect the excavation maintaining at the same time, the square accessible and usable for its public and religious functions. The difficulty is often found in achieving a coverage that may give breath to the ruins and makes them available for visiting, without altering the walking surface of the space above.

2.1 Comparison with the project of Carlo Scarpa

This same issue has also been addressed in the past by the Italian architect Carlo Scarpa, who was committed to drawing the project of the crypt of the Feltre Cathedral. The complexity of the project (in Paris as in Feltre) is in the intention to integrate archaeological persistence in the urban and architectural contemporary context. In both cases, the relationship between architecture and archaeological memories, therefore between the square and the coverage, is solved with the creation of a hypogeum space that deals with the excavation area as a museum exhibition, maintaining the urban function of the churchyard. So these operations integrate the archaeological persistence in contemporary urban conditions, with the sole aim of preserving the historical memory of the city. The situation in Paris is similar to what Carlo Scarpa has to compare in Feltre: archaeological stratifications, attributable to different epochs of the formation of the city, are located in a key point of urban and communitarian life. Their location gives a priority of attention to the continuation of the square as a public space.

With many difficulties, Scarpa had to draw different versions of the project, and in all of them the structural issue remained crucial. In fact, the aim of the Italian architect was to create a roof structure that shouldn't invade the discovered ruins and without support points inside the excavation area. Clearly the constructive problem is related to the height of the beams, that having to overcome considerable distances should require a significant thickness. In the latest version of the Scarpa's project, approved by the National Council of Culture, but never adopted, he proposed a system of "emptied" truss beams, which had a certain consistency, but at the same time, would allow the sight of the entire excavation area. Although this project was never realized and in its place a highly invasive structure of large reinforced concrete pillars was made, we have been left with an attentive consideration by Scarpa on the relationship between architecture and archaeology in an urban context.



Fig. 1: Crypt of Notre-Dame, interior views

2.2 Constructive and functional aspects

Considering the massive fruition made by tourists of the square of Notre Dame, it was essential to combine the functional issue with the conservative one, or rather the need to cover the findings. Realized between 1965 and 1972, the excavation reaches a depth of about 4.5 meters and presents ruins of different ages. In particular there are three distinct periods: the Ancient Age, which includes a thermal system, a Gallo-Roman house and the old bank of the Seine; the Middle Ages, of which remain traces of walls belonging to shops and houses; and finally the Classical Age, witnessed by a thick wall probably attributable to an home for children. What is interesting is that the stratigraphy of the remains, does not correspond to the time sequence: some archaeological persistence of the second century is preserved at a higher level than medieval ones. This suggests a complex orographic, now lost.

From the point of view of construction the coverage was achieved with a dense system of concrete beams that hold up the square and which transfer the weight to the ground through heavy reinforced concrete pillars and isolated foundations that sometimes invade the archaeological area, interfering with the vestiges.

Then an elevated route was realized (about one meter up to the plane of the excavation) that allows tourists to move in this space, alongside the ruins. So the choice of dealing with the intervention as a museum exhibition prevails and most of the attention is directed to the path and to the small exhibition areas that accompany it. Therefore, the issue on the composition of the cover is solved with an immediate and easy way of realization.



Fig. 2: Crypt of Notre-Dame, interior view

3. Overlapping: the Hôtel de Cluny

3.1 Progressive overlaps

The Hotel de Cluny is a building of the fifteenth century, a fine example of Gothic architecture, by will of the Abbots of Cluny as a representative palace and since 1843, has become the National Museum of the Middle Ages. The interventions of overlap and expansion, that have integrated into a single structure three different systems, are of particular relevance. The first is the Gallo-Roman baths (of which is well preserved and clearly recognizable the frigidarium), probably constructed around 290 and which supports the second system, or rather the Gothic mansion house built between 1485 and 1510. It could be that, the abbots used part of the ancient thermal baths as warehouses and granaries and their continued use of this structure, from the Middle Ages to present day, has allowed its extraordinary conservation. The third system consists of an extension of the nineteenth and twentieth century, which includes new museum spaces, and which has definitively connected the two previous structures, in part covering them.

The concept of overlapping is expressed here through the traces of the past that become an integral part of the building.



Fig. 3: Hotel de Cluny, “Hall of heads”

3.2 The "Hall of heads"

In the museum there is an exhibition room, by many known as the "hall of heads", because of the sculptures that are exposed in it. This allows to identify in a single space, all the three successive overlapping. In fact, two sides of the room consist of the walls of the thermal baths, clearly recognizable for the weaving of Roman origin, alternating horizontal strips of brick and opus quadratum. Another wall and the floor, belong to the Gothic building and they are made with clear stone slabs, squared and smooth. The ceiling and the last side, from which you enter in the room, are work of the twentieth century; the coverage of this space is of particular interest because it allows a natural lighting system, very effective for the enhancement of the important sculptural heritage accommodated in the exhibition hall.

It is a regular volume above the room, supported by pillars, in which you enter from the upper floor. This recent room contains in turn an exhibition hall and occupies a good part of the surface of the hall below. However, it remains a few meters distant from ancient walls, without interfering with the antecedent structure and allowing a beautiful zenithal light to penetrate and invade the environment. This distance between the two systems of different eras is protected with a light structure of steel and glass, that protects the “hall of heads” while allowing a natural and diffused lighting.

The result is fascinating, not only for the brightness of this exhibition space, but also for the opportunity to admire the successive overlapping clearly, all in the same exhibition hall.



Fig. 4: “Hall of heads”, zenithal light

4. Stratification: les Arènes de Lutèce

Between Rue Monge and Rue de Navarre, in the fifth arrondissement of Paris, an extraordinary Gallo-Roman amphitheatre, dating back to the first century AD, is guarded. Today it appears as an urban archaeological park nestled between residential buildings, widely appreciated by local residents and known as the *Arènes de Lutèce*. When la ville de Lutèce was destroyed, the theatre was abandoned and forgotten. Only in 1870, during the great works, ordered by Baron Haussmann, for the realization of the important road of Monge, the amphitheatre was rediscovered under a mound of earth. Despite this, because of the strong determination of the prefect, the project continued to be implemented without changes. What we see today is a wonderful arena, populated by children and people of all ages who use it as an ordinary urban park. A part of the auditorium (exactly the cavea) is discontinuous, because invaded by the big residential buildings (each of five floors) strongly desired by Haussmann. This strong sign of urban stratification, causes direct comparison of eras very distant in time and in architectural languages, testifying the inevitable advance of events in which buildings overlap, while still leaving space for the persistence that characterize the area. This is a piece of French history, nestled in the successive layers, and made accessible by the structure of the contemporary city. Today the *Arènes de Lutèce* is a public park, accessible by entrances on three sides. One is a passageway through the building at 47, rue Monge; the second is a long open corridor (vomitoir) accessible from rue de Navarre through a gate; the third is through the Square Capitan from its entrance at 10, rue des Arènes. Parisians can enjoy an urban park that is a place of memory and culture and where the findings can be admired by everyone.

Despite the construction of invasive nineteenth century buildings above the monument, the arena is given back to the community and it's admirable in its history, including all progressive modifications had over the centuries.



Fig. 5: Arènes de Lutèce

4.1 Urban stratifications: a similar case

It is possible to compare the case of the *Arènes de Lutèce* with a similar situation in Naples. In fact, guarded in a courtyard of a residential building, a treasure remains hidden to most people, because not visible from the street: the Ancient Theatre of Neapolis. The theater dates back to the first century BC and had to be one of the most representative buildings of the Roman city: an important centre of civic activity, together to the *Odeion*. This one, according to the reconstructions of the ancient town plan, has to be a short distance to the theatre and of which has almost completely lost all trace now.

Today, most part of the system is incorporated within the modern buildings, but studies and reliefs have allowed equally to date the theatre and to give back a drawing: one hundred meters in diameter and eighty meters of elevation, built entirely in plane. These dimensions confirm the importance of architecture in which the sources attribute even the exhibition of the Emperor Nerone at the time of the earthquake of 64 AD. With the fall of the Roman Empire, performances were suspended and consequently the theatre was gradually abandoned. Between the Fifteenth and Seventeenth centuries, the area was completely changed because of a continuous activity of construction, but the old route resisted to the events: new buildings exploited the Latin foundations for new construction. So the *cavea* became a private garden, while many of the interior spaces were re-used as cellars, warehouses, barns and some as artisan shops.

The rediscovery of the theatre was gradual. One of the first factors to bring the intuition of the hidden heritage is linked to the excavation works for the construction of sewer in 1859. The revelation of a structure so ancient, in a place where it was already forgotten the old arrangement, led to a campaign of excavations at the end of the nineteenth century, in the garden of the residential building. Thanks to the studies carried out between 1881 and 1891, it was possible to draw up the reconstruction of the plan of the complex.

Since 2009, the Ancient Theatre of Neapolis was opened to the public with guided tours organized by the Municipality of Naples. In June of 2013 a preliminary project was approved: "Ancient Theatre of Neapolis: creation of an Urban Archaeological Park". This is aimed at the protection and enhancement of the complex in its entirety, including therefore the archaeological monument and also the modern building that incorporates it. Recovered and restored the interiors, or rather the ambulatory, the *vomitoria* access to the auditorium and the great scene (cavea), the whole archaeological and architectural system will constitute a valuable record of the complex evolution of Naples.



Fig. 6: Ancient Theatre of *Neapolis*

5. 3D Reconstructions

3D reconstructions of ancient monuments of Paris, were made on the occasion of the exhibition “The Great Monuments of Paris”. Following the exhibition of the same name that took place in the archaeological crypt Parvis Notre-Dame, from January 2009 to February 2011, *Paris Museum* published a catalog of the exhibition reproductions, including 3D reconstructions made under the scientific direction of Didier Busson and Sylvie Robin. But also the new website "*Paris, ville antique*" published by the Ministry of Culture and Communication (Mission Research and Technology) and by the Centre of national monuments, required numerous 3D reconstructions. It constitutes a good example of using virtual images for the valorisation of archaeological knowledge, through multimedia.

The study of the Roman city of Lutece and its public monuments, of which only the remains are still visible from the Baths of Cluny, the *Arenes de Lutece* and buildings preserved in the archaeological crypt of Notre Dame, is really important to provide the public of 3d illustrations of the ancient part of the city. The available documentation already included some reconstructions of the city through models, watercolours or drawings, but new reconstructions outlining the latest knowledge and leveraging the specifics of the medium used. The 3d graphics is based on the realization of a digital three-dimensional model, by which it is possible to develop a set of animations and interactive sequences to promote comprehension of the object studied. For example, in the Arenes, the camera can orbit around the amphitheatre allowing the user, by controlling the flow of animation, to understand the volume of the structure and therefore to appropriate it in its entirety.

Another interesting application of this kind of graphics consists in the opportunity to show, from the same point of view, the evolution of the Roman city. It initially shows the condition of the city, mainly on *rive gauche* in the Early Roman Empire and its refocusing on the island of the centre City in the Lower Empire. The achievement involved a reconstruction of the site and its topography, so the models of public monuments, produced before, have been reintegrated into a more general model of Paris.



Fig. 6: Arènes de Lutèce 3d reconstruction

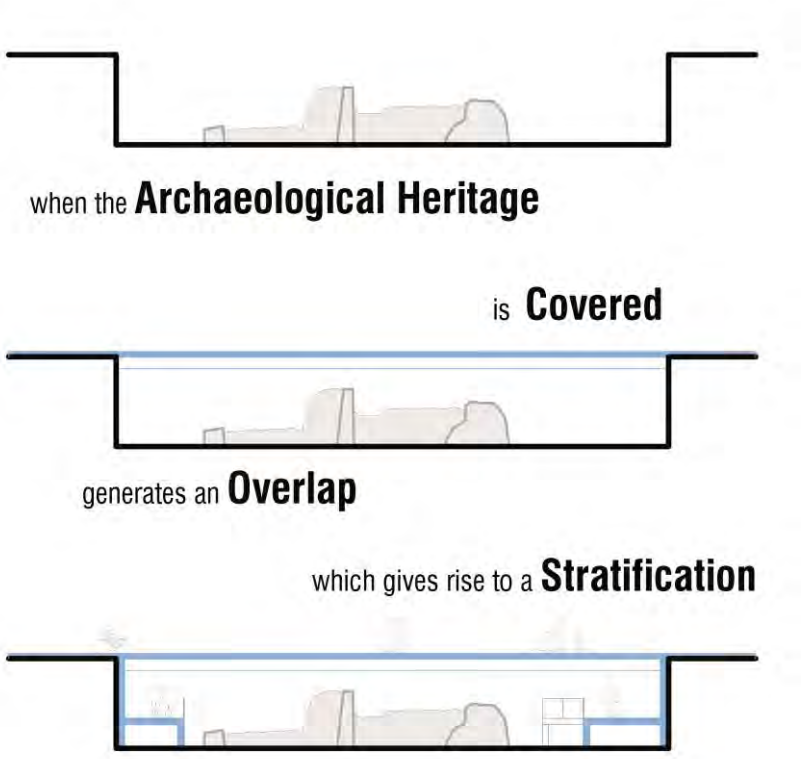


Fig. 7: Reconstruction of the bank of the Seine in the first century (Sequana Media/Olivier Lemaitre, 2012)

6. Conclusions

There are many possible project choices to intervene on the archaeological heritage, to protect it and make it accessible to the public integrating it in the urban structure of the city. Paris provides a remarkable repertoire because several approaches characterize different areas of the city, each with its own uniqueness. As we have seen, the topic of the crypt is addressed; this raises the issue of the different heights between the old and the contemporary route; then the issue of overlap, which arises from the subsequent constructions, which often try to take advantage of the existing structures as foundations or as a support; and finally the stratification, that is everywhere in European cities, but which is made visible in a few exceptional cases in Paris. In the three cases, the archaeological fragment appears to be associated with its use and probably being kept in daily life is the condition that ensures its conservation today. Consequently, the relationship between the protection and enhancement of the archaeological heritage appears to be closely related to the public service of monuments and archaeological sites, which may prove an effective tool of protection, conservation and maintenance. Each choice of enhancement comes from the need to combine urban life with the vitality of the archaeological space, avoiding to make them closed and isolated areas, but designing them according to a large, integrated urban use.

I remain of the view that these three steps (cover - overlay - stratification) are closely related to each other. Each coverage intervention constitutes in fact an overlap and a stratification at the same time. This leaves me to think that each intervention to protect an archaeological discovery, should be embedded in a city plan on a larger scale, which reads it as an integration of the heritage to contemporary urban context and not as a single operation, released from its surrounding condition. This attitude seems even more essential in European cities such as Paris, in which the urban archaeology is an issue necessary to the correct interpretation and preservation of the city and of its historical memory.



Bibliographical References

[1] AA.VV. *Emergenza sostenibile. Metodi estrategie dell'archeologia urbana.* ed. *BraDypUS communicating cultural heritage*, 2011. ISBN 9788890429422

[2] *Les Grands Monuments de Lutece. Exposition du 21 janvier 2009 au 27 février 2011*.
Crypte archéologique du parvis Notre-Dame - Dossier de presse

[3] MOUSSEAUX R., ROBIN S., *Paris disparu, Paris restitué*. *Mini guide of the ruins of the archaeological crypt*, 2012

[4] CARLI O., PARONUZZI M. *Architettura e Archeologia.* Engramma 96 - Gennaio/Febbraio 2012 ISSN 1826-901X

[5] *Culture& recherche* n°99 novembre-dicembre 2003. Corlet, ISSN : 0603B05120

[6] A.A.V.V., *Il teatro di Neapolis. Scavo e recupero urbano*, Napoli, 2010

[7] http://www.crypte.paris.fr

[8] http://pimpaud.free.fr/wordpress/?p=750

[9] http://paris.3ds.com/

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The Other Side of the Ring-Brussels

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Abstract (Arial – 11 pt – Lower case letters - Bold – left aligned)
The project site is placed close to the ring, the old walls which used to surround the city of Brussels, and in particular a part of it has been occupied by the “Canal de Charleroi” tied to regeneration that the project intends to address.
The project is divided into two parts that work together: the door of the district of Moleenbeck and the waterfront of the "Canal de Charleroi".
The site is a point of intermodal exchange since crossed by the main tram, metro and bus that put it in direct connection with the main attractions in the city of Brussels, turning it into a strategic area for the development of the city itself.
Nevertheless, the "Contract de quartier" highlights the critical points such as the lack of green spaces and kindergartens with their annexed spaces, problems related to traffic and interruption of pavements in correspondence to “Place Sainctelette” and the lack of connection with the area fairs “Tour et Taxis”.
The goal is to develop physical and not elements, that link the district to regional elements, revitalizing it and giving it importance within the crossroads where it is located.

Keywords: Regeneration, Link, Rebirth.

1. Analysis of the area

The boundary of the study area "Contract de quartier autour de Leopold II" in the region of Brussels is made of two urban scales: the one in "Boulevard Leopold II" with its big elements set eastward and along the channel, which supplies respectively circulations and a higher functions level then the local one, and the one of the very thick historical circuit in the residential district.

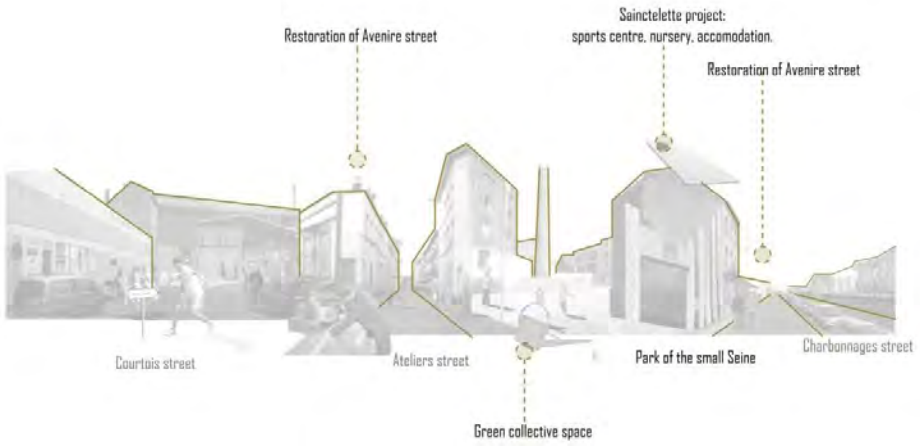

Fig. 1: Municipal Regulation

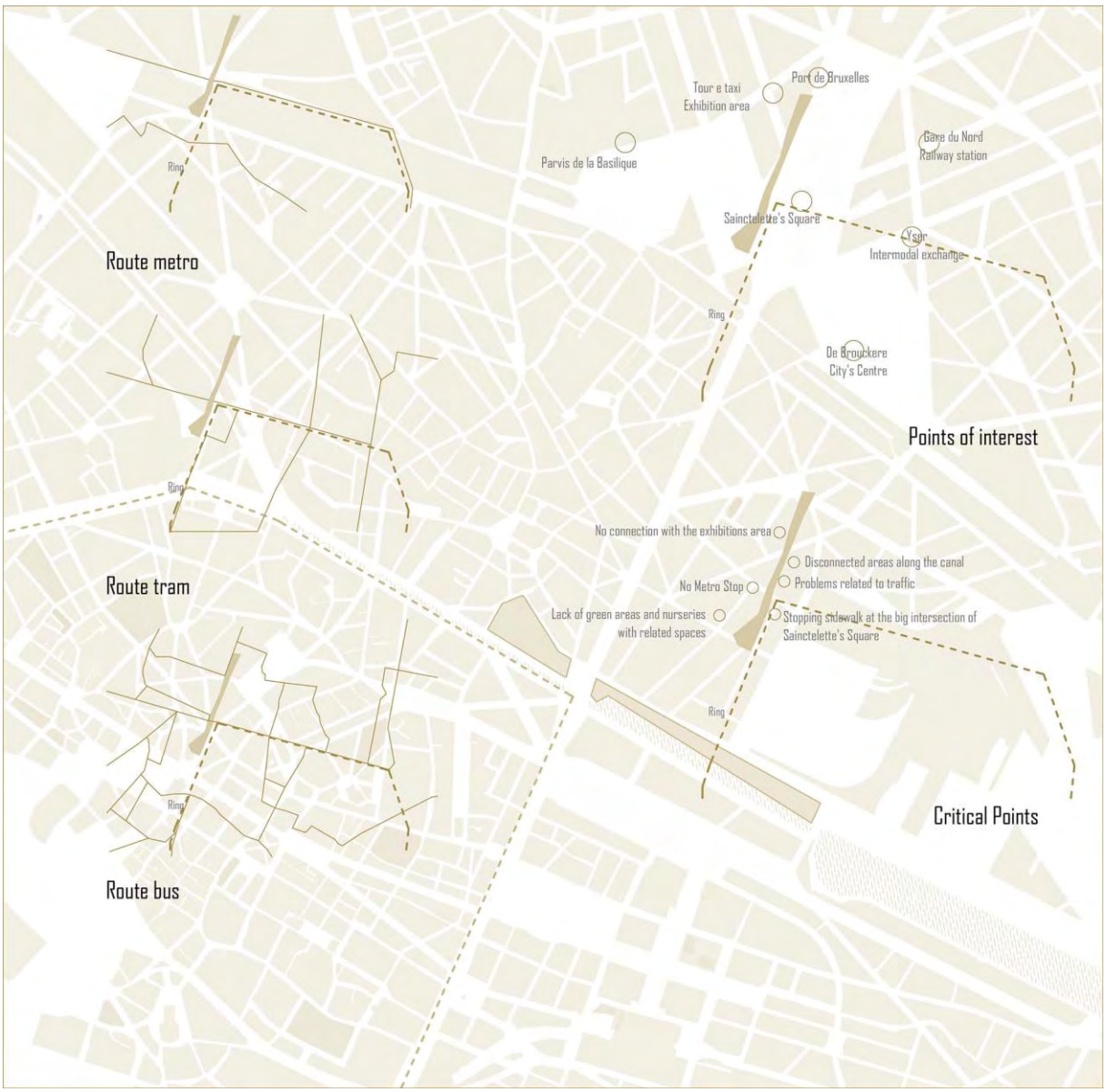

Fig. 2: Land analysis

Paying attention on the requalification of the part of the "Canale de Chaleroi" which goes from "Place Sainctelette" to the exhibition area of "Tour et Taxis", including also the entry of the district of Molenbeeck leading to the square itself, we tried to give solution to the several problems highlighted by the “Contract de Quartier”: no link with the exhibition area of "Tour et Taxis"; disconnected areas along the channel; lack of subway stops; lack of green areas and kindergarten with annexed connecting spaces; interruption of the pavement of the big intersection of "Place Sainctellette"; development of safe links which let a better connection among the several areas and activities along the channel.

The goal is to revitalize and give importance to the district including it into the melting pot where it is set to its best.

It’s a matter of fact that the side along the channel is better than the one of the old Molenbeeck. You can feel the lack of urban fabric and the related organization and the green areas dedicated to the recreational activities for the kids in the neighborhood. Road safety is absent and the structures linked to soft mobility are almost lacking.

1. Project ideas



Fig. 3: Masterplan .

Taking into account the several suggestions moved by “Bruxelles 2040”, we tried to develop spaces for the community inside the area in question, linking them to the one outside; fulfill a kindergartner, a multipurpose center to increase the flow of users aged from 25 to 50 years old and to develop safe paths which lead to a better connection among the areas, above and below as well, which characterize the area in question.

Along the " Quai des Charbonnages", going from the intersection with "Rue des Hauilleurs", is only suitable for cycling and walking, so the current street is totally absorbed by the square which surround the architectural work.

To avoid the project to turn out disconnected from the context, everything has been conceived to be linked at the best to the level of the bridge and to the one below it where the subway stop gets open again, already existing but never used, to keep in direct link the two parts of the site separated by the square with its waterfront. The project is also related to the "Petite Senne" Park and to the inner court of the buildings to make everything into a single environment through the green and the paving design.

The two levels following one another along the channel, 0.00m and -4.00m, have been overtaken with ramps, with a maximum slope of 6%, and stairways to lead to the development of the nautical events which are currently celebrating along the channel.

All the organization as follows:

- creation of the boat stop along the channel, now nonexistent in that area, to avail ourselves of the waterbus service.
- Link between the city center and the exhibition area of “Tour et Taxis” through the deviation of the tram line with the one passing in the area with the related vehicular traffic change.
- Arrangement of the current beach in Brussels through the creation of swimming pools, on the model of the current one along the German and Danish channels.

Specific attention has been lead to the multi-purpose center to fix and give importance to the neighborhood. It steps forwards as the solution to solve linkage problems related to the big intersection in "Place Sainctelette".

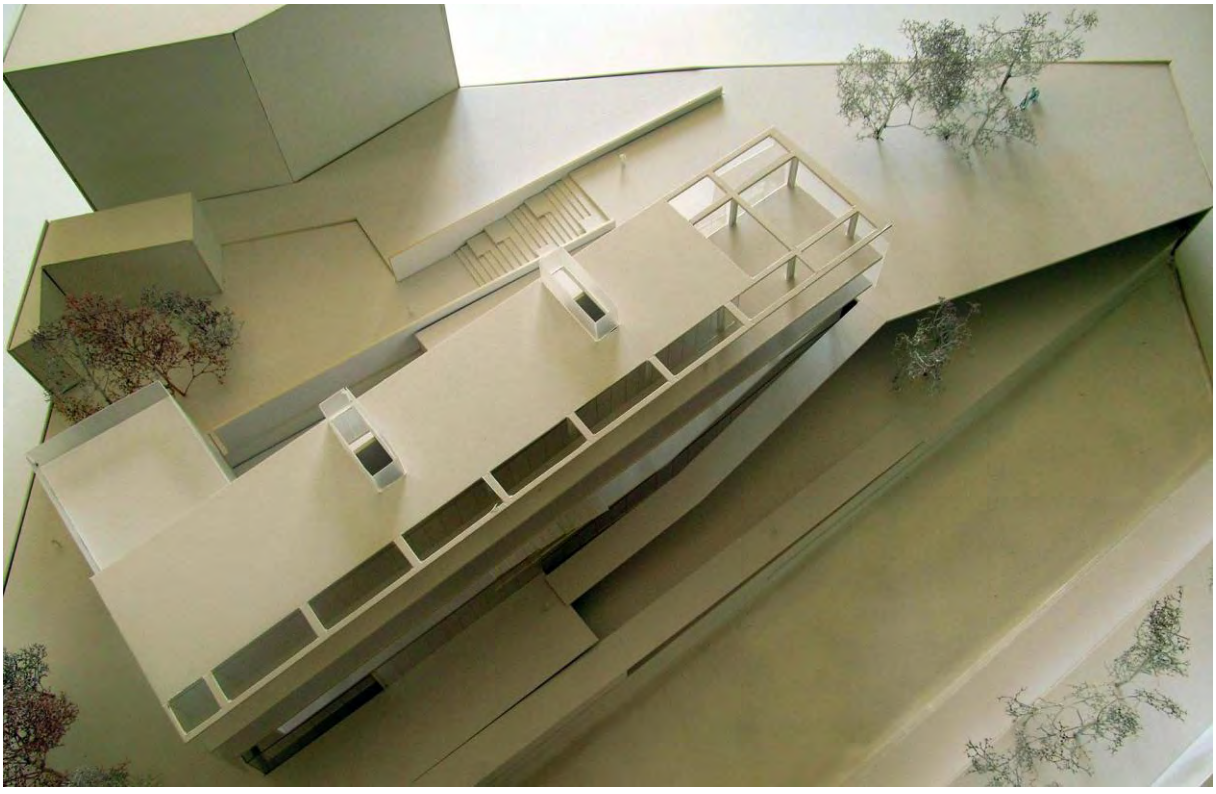

Fig. 4: Maquette area multi-purpose center.

1. Competition Site

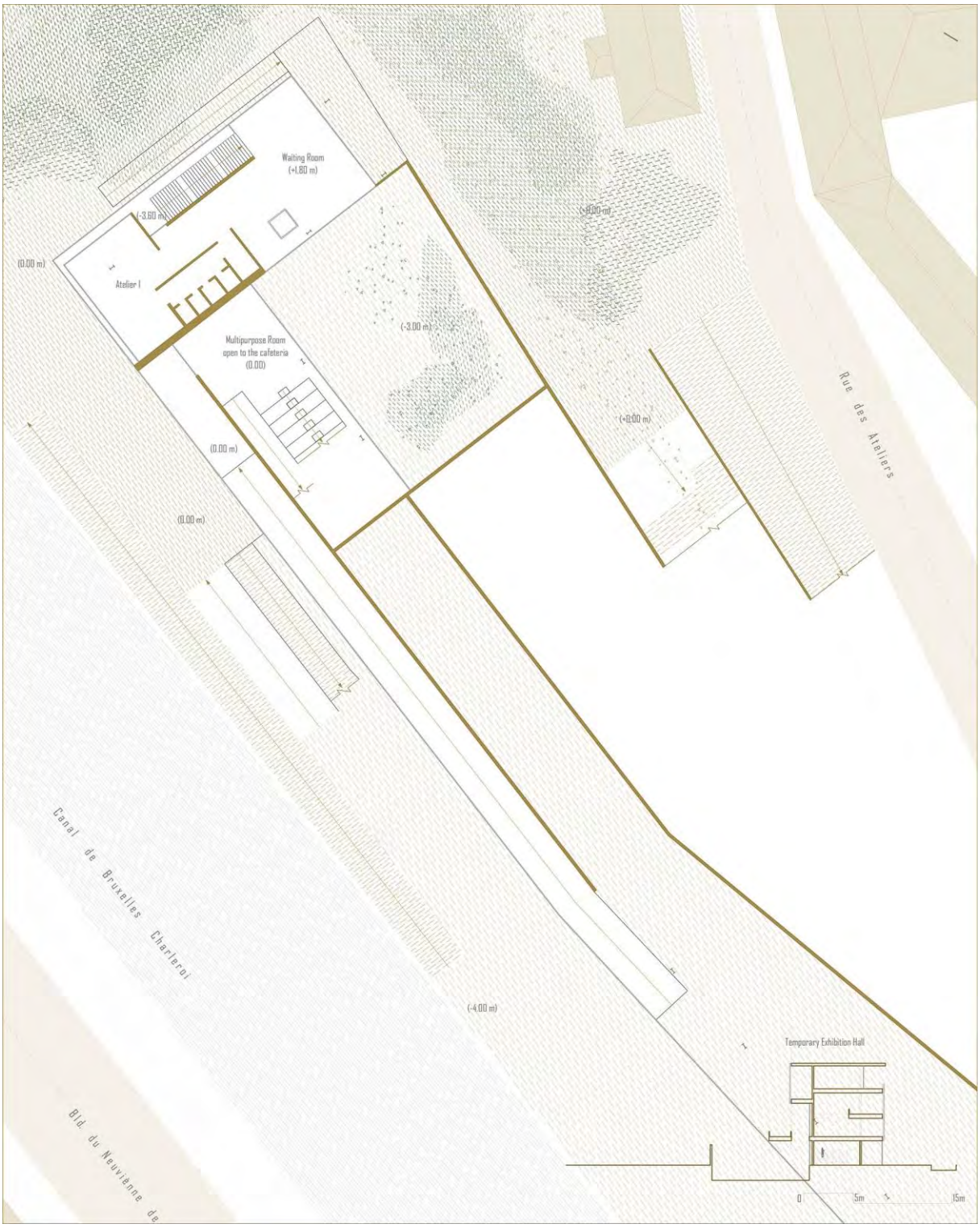

Fig. 5: Kindergartner floor plan

The entry of the café bar of the multi-purpose hall is set at the level 0.00m. A direct link is supposed to start from the same level, inner and outer as well, through a long ramp, inner and outer, and stairs.

The exit of the subway is set at level -4.00m, where temporary exhibitions and related activities are supposed to be set. (fig.5) The kindergartner is in the basement at the same level, lowered compared to the higher level of the area, +3.00m, with privet garden annexed. The first level is directly linked to the main square, which leads to the big intersection and set at the level of the bridge which links the

site with the other side of the ring. Here is a café with related events hall. From the same level it's possible to enter the exhibition hall through a direct link from the square or through a covered stairway. (fig.6)

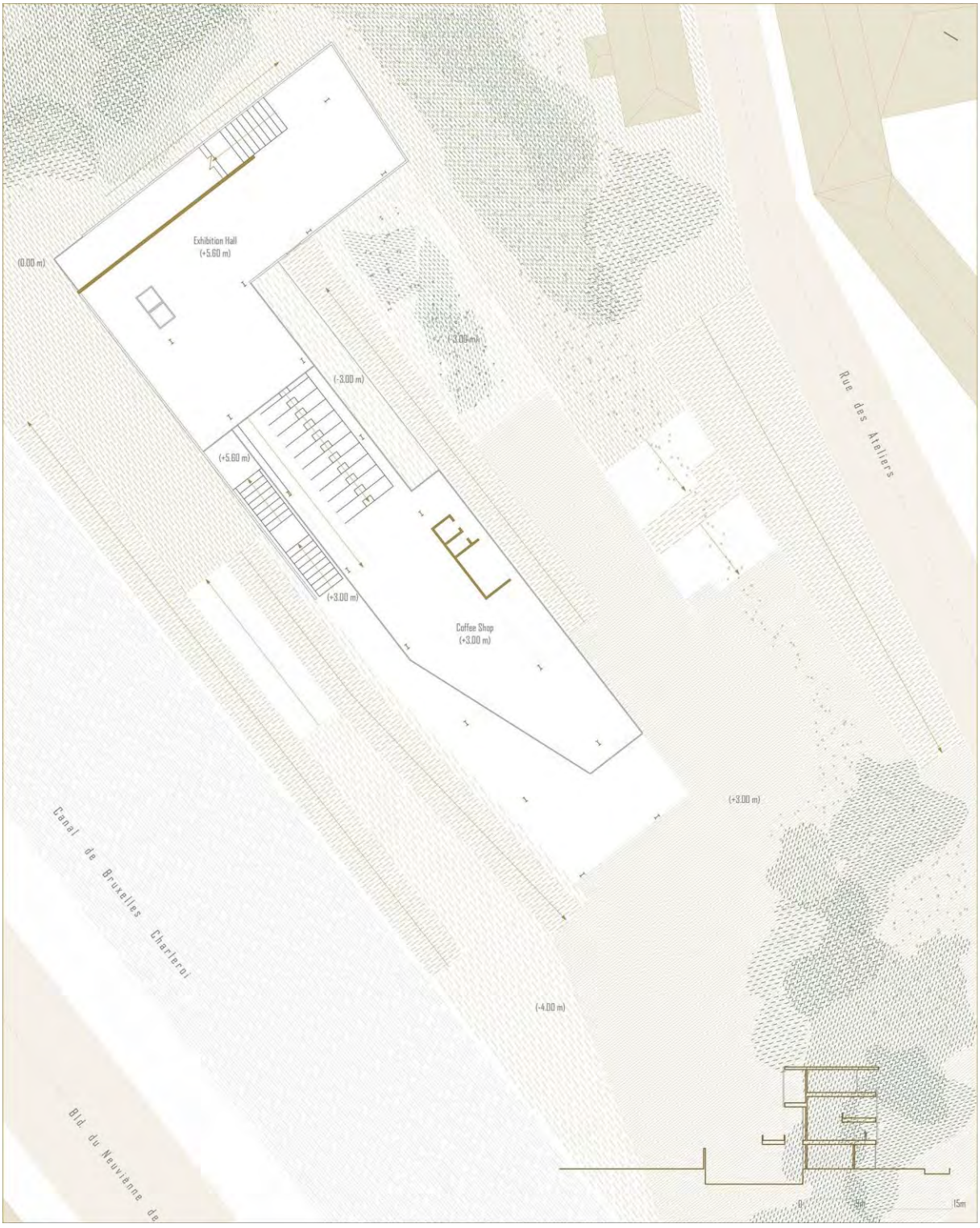

Fig. 6: First level plan

The second exhibition hall is set at the level +10.00m characterized by a very simple elaboration: the structure has been absorbed by the two aluminum sheet, so to let the space as available as possible for the temporary exhibitions. (fig.7)

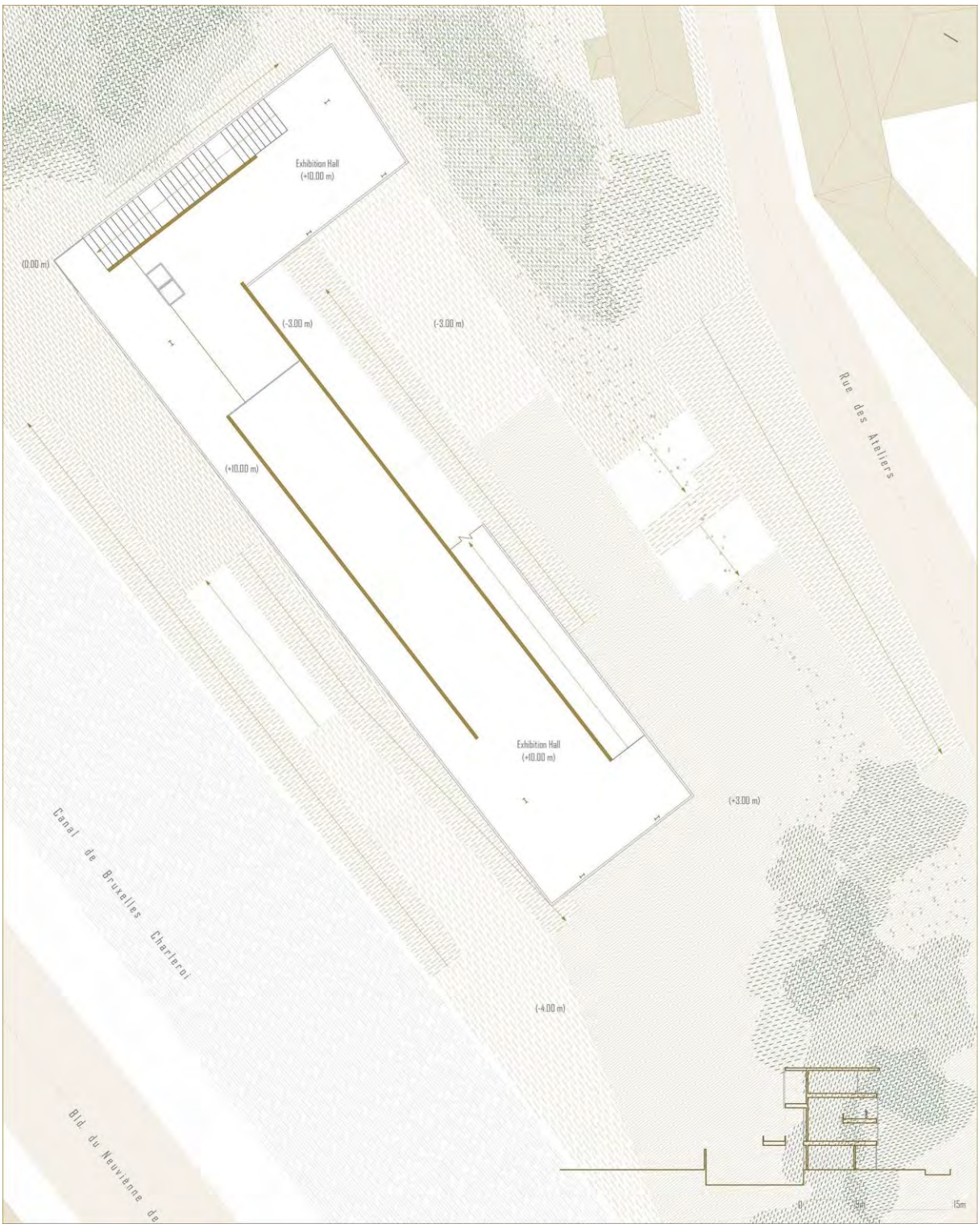

Fig. 7: Second level plan

The access at the last level is through a long ramp which, given the size, becomes integral part of the exhibition hall. At the end of them there is the coffee bar leading inside the exhibition hall, the separation is given by a vertical glass partition, and on the panoramic viewpoint at the same time. (fig.8)

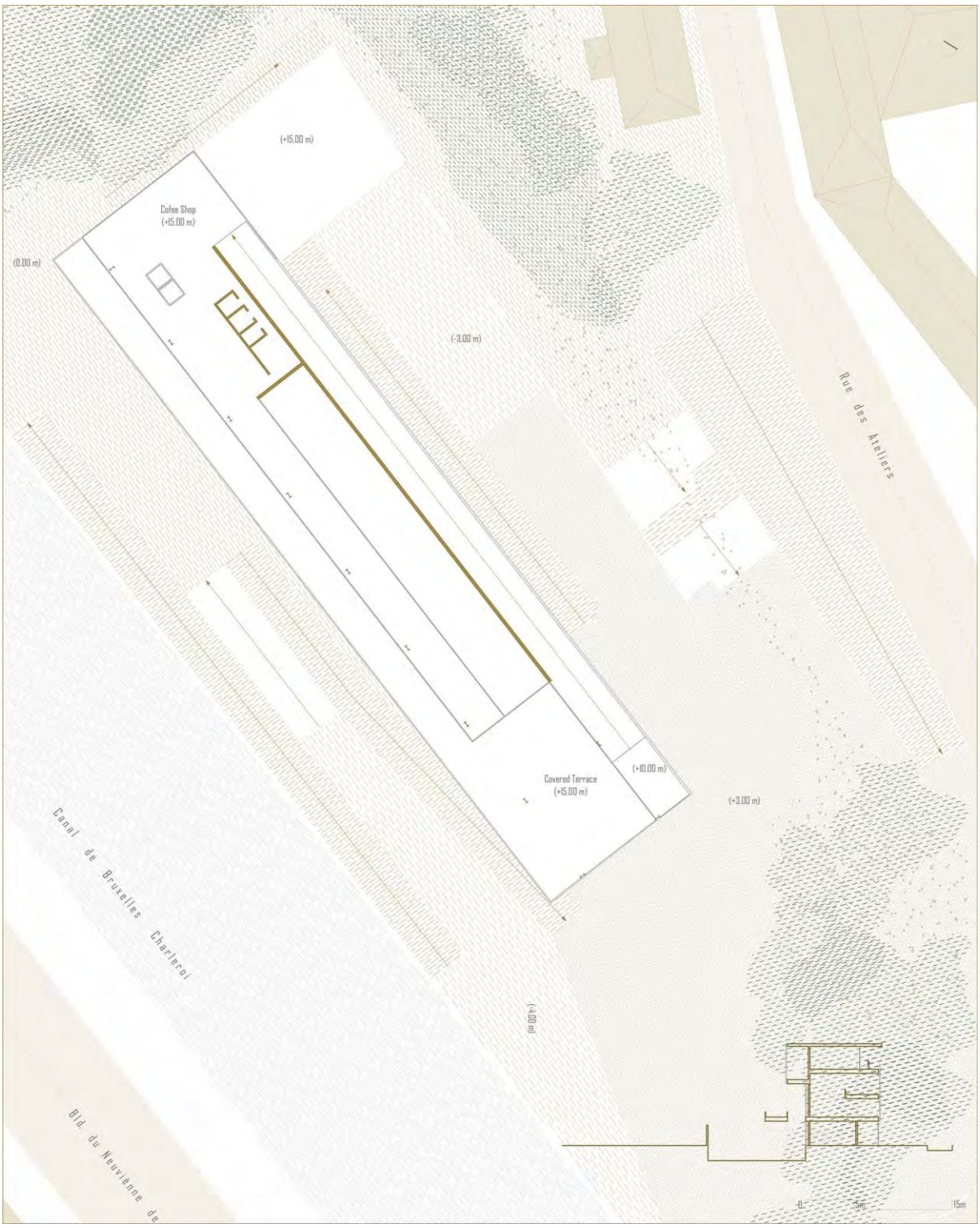

Fig. 8: Third level plan

From the sections we can see how spaces and functions communicate among them. The main exhibition hall, double height, is lightened by skylights and the glass wall, the one set at the last level and used as vertical partition between the exhibition hall and the outdoor café bar on the panoramic viewpoint. We can see the alternation of the levels to make every function independent but still connected between them.

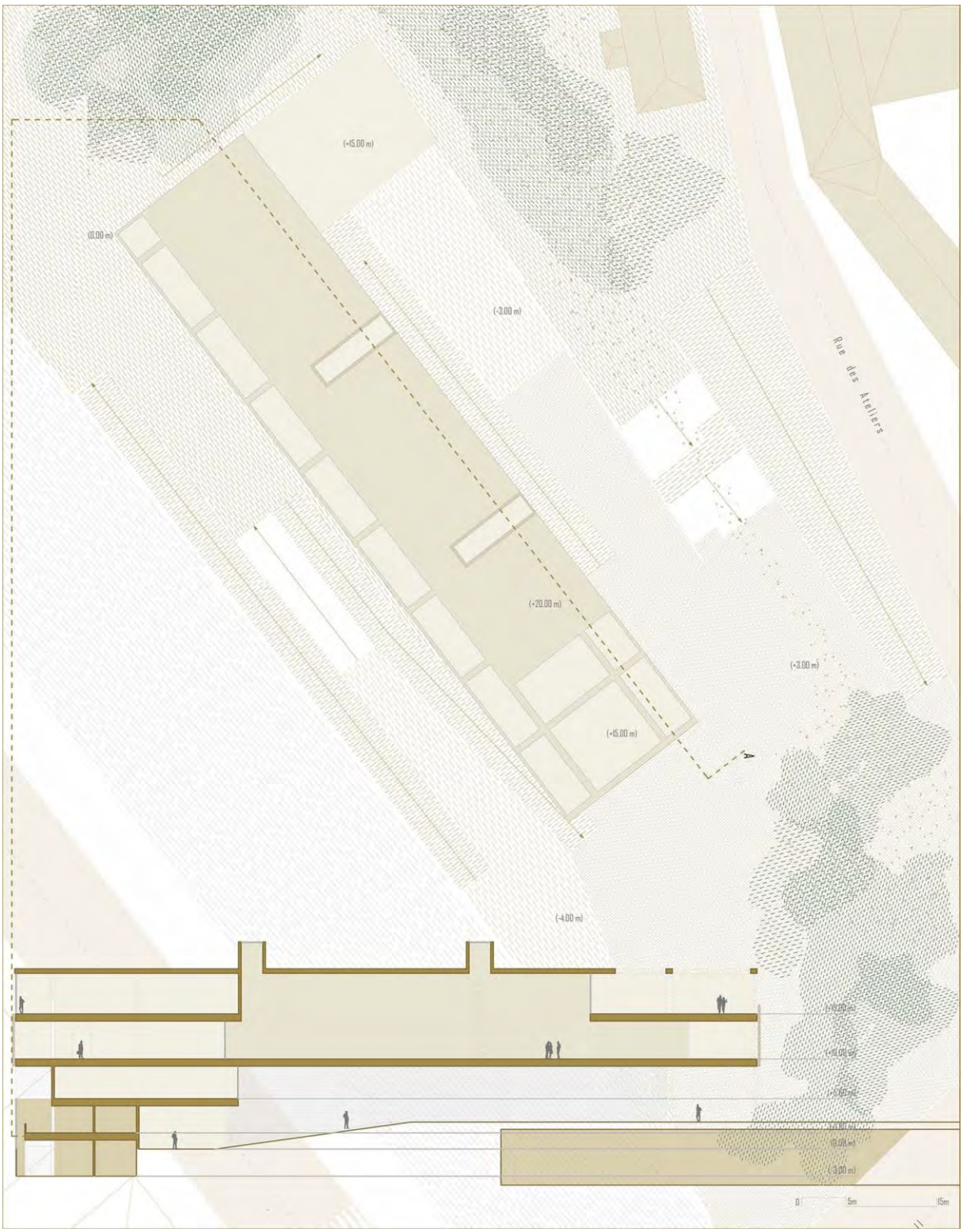

Fig. 9: Longitudinal section

About the structure, it was decided to use a “Angelina” beam of “Arcelormittal”, drag by standard section bars, H and L model, cut along the core following a sine wave line, with two T section placed again and welded till we get a height one and a half higher than the original profile. Thanks to its size, it is great to cover big lights without undermining the compositional part of the project. Given the size of the construction and the context in which the product is set, it was decided to use transparent and pretty light materials: glass for the lower part, giving almost the idea the building is hanging on air, and polycarbonate for the upper part, so that the direct light, not suitable for the exhibition halls, gets softened.

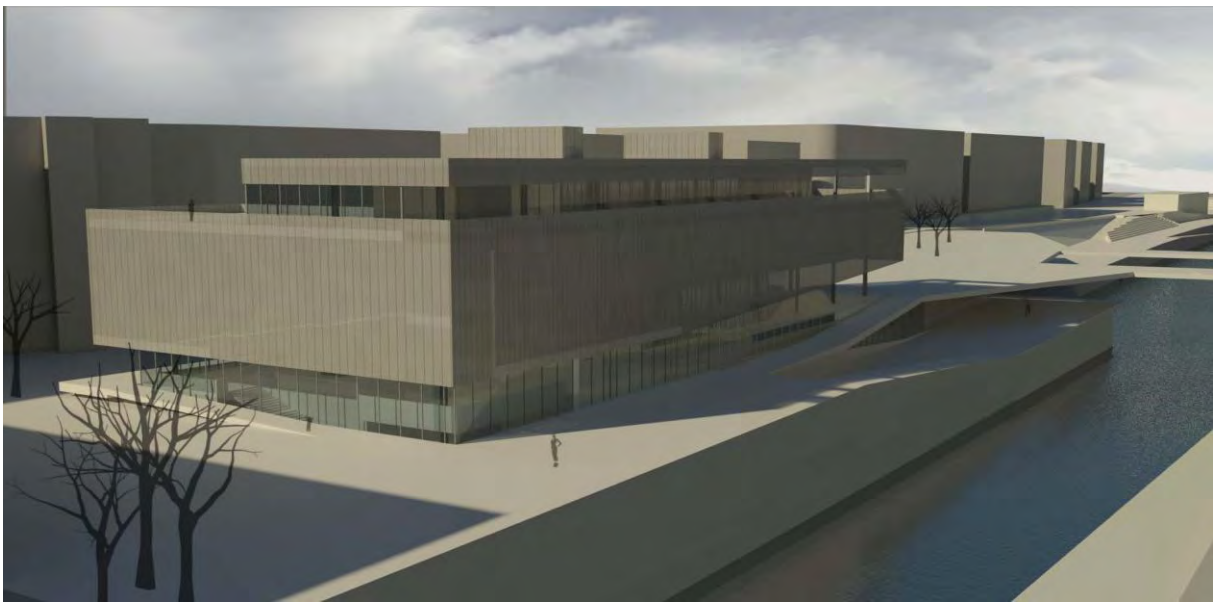

Fig. 10: View on the multi-purpose center

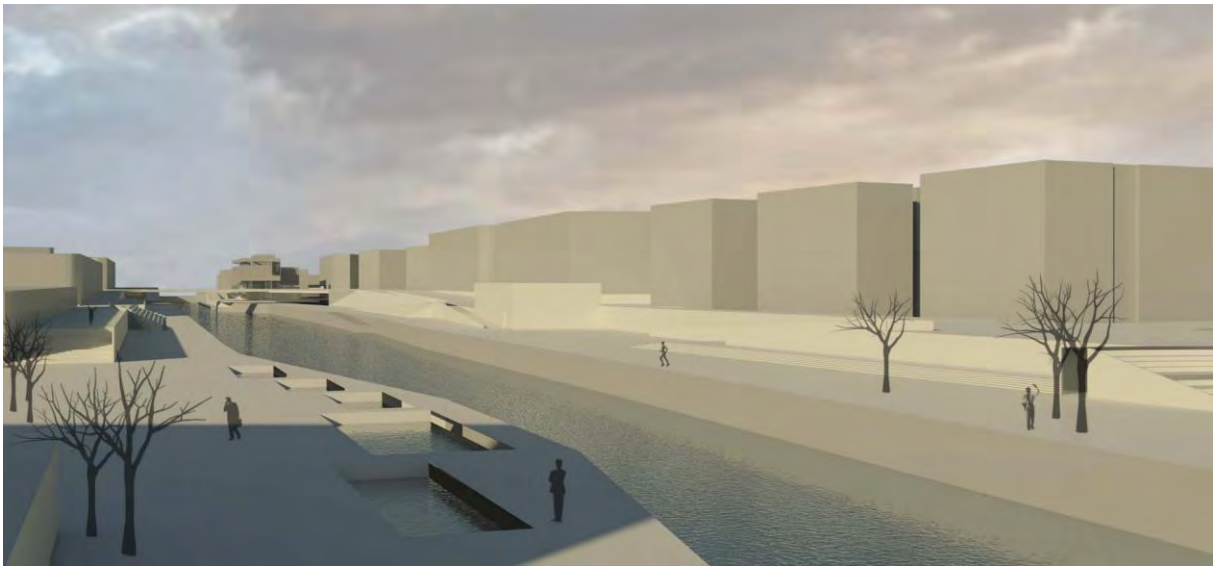

Fig. 10: View on the requalified channel

Bibliographical References (Arial – 11 pt – Lower case letters - Bold – Left aligned)

[1] SECCHI, Bernardo. *La città del ventesimo secolo.* 4ª ed. Roma: GLF editori Laterza, 2008. ISBN 9782862220642

[2] LYNCH, Kevin. *Progettare la città:la qualità della forma urbana.* Milano: ETAS, 1990. ISBN 8845304051

[3] LYNCH, Kevin. *L'immagine della città.* Venezia: Marsilio Editori, 2013. ISBN 9788831772678

[4] MC LEOD, Virginia. *Detail in Contemporary Landscape Architecture.* Laurence King, 2008. ISBN 9781780670232

[5] RéGION DE BRUXELLES CAPITALE. *Contract de Quartier Autour de Leopold II.* Bruxelles, 2012.

[6] VIGANÒ, Paola, *The Territories of Urbanism,* in "Lotus", n.150, 2012.

[7] BRUXELLES : INSTITUT SUPÉRIEUR D'ARCHITECTURE SAINT-LUC BRUXELLES. *Bruxelles Canal : enquête.* 1984

[8] BRUXELLES : INSTITUT SUPÉRIEUR D'ARCHITECTURE SAINT-LUC BRUXELLES. *Bruxelles : un boulevard, un canal.* 1988

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HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
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Metropolitan cities of Italy: law, environment and sustainable development

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Abstract
The present work deals with an actual issue that is object of great interest to the entire community, from the academic world to the halls of powers, from the great economic actors to the individual citizen, recipient and end user: sustainable requalification of metropolitan areas.

Despite the uncertain legislative provisions of the last decades, started in 1990 and apparently concluded with the “Delrio” reform (that became law in April 2014), the starring role held by metropolitan cities on the economic, institutional and social field, not jus at national but also at European and international level, is still undeniable. Metropolitan cities are “spatial concentrations of human activities and interplay”: they attract assets, investments and human resources; they offer services and employment; they combine history with technology and innovation. Notwithstanding this, they are characterized by demographic problems, economical difficulties, social gaps and above all environmental emergencies.

Therefore, a positive urban development can’t leave out of consideration an integrated and multilevel strategy dealing with urban planning, environmental resources preservation and revaluation, mobility and energy upgrading of the building asset.

Keywords: metropolitan cities, governance, requalification, sustainable development, law

1. Metropolitan cities. Historical and legislative background of a socio-urban phenomenon
In the current international scene, metropolitan cities or "big cities" are the places that represent an ideal osmotic interweaving between territory and community, identity needs and globalization processes; the complexity of the metropolitan cities has been addressed by sociologists, economists, geographers, politicians, architects, urban planners, jurists, because of the accumulation of potential subtended to those organizations which manage to appropriately combine the spatial transformation with the economic, social and cultural rights. Being strategic places, also having strong economic appeal, the public bodies in question need, in order to better their competitiveness, a governance model that is strongly representative of the territory, as well as the community that it expresses, synthesizing participatory democracy and representative democracy, public and private motions, economic growth and social integration. Metropolitan cities can be compared to a "breeding ground" where healthy public policies are forged to develop progress, and not simply to regulate or coordinate it. It is not a coincidence that the metropolitan city poses interesting challenges for the future, being able to configure itself as the public body that will mostly become the supporter of change and renewal of society. Thanks to its versatility, it will be able to smooth over social differences and inequalities, favoring the emergence of new rights and promoting sustainable development strategies, even more respectful of environmental issues related to the area of reference. However, this administrative fraught character of the metropolitan city, accompanied by the entitlement of important functions related to the development of the territory, must be combined to a necessary political dimension, to allow better dialogue with the State, with the region and with the municipalities in the care of interests which are necessarily overlapping, looking also at the European and international dimension.

The theme of the metropolitan city, of its establishment and its role within the legal system is not new to the Italian experience. The recent reform process, which began with the approval of the Law n.56/2014, guarantees, in the political debate, the centrality of the discipline of this level of local government that looks at areas of high urbanization.
The forecast and the subsequent legalization of metropolitan cities is found in the Law n. 142 of 1990, but it is with the reform of Title V of the Italian Constitution that the Metropolitan City rises to the rank of constitutionally required local government which make up the Republic, in accordance with art.114 Const., as modified by the Constitutional Law n. 3/2001. The debate around this figure of territorial government intensified during the Monti government, for reasons of spending review and to stem the crisis of the regions known as high cost public bodies; it is brought to completion, albeit after a troubled journey, by the Renzi Government, who rightfully put it in the ongoing constitutional reform draft in order to eliminate the conflicting concurring legislation State-Regions and enhance the local vast area in the activity of planning and management of European resources and local public services. The model of the metropolitan city is proposed as a structurally lightweight model of efficient governance, not burdened by excessive bureaucracy and above all capable for the functions under that Act, to act as intermediary between the size of the State and Local Government, both among the municipalities falling in the metropolitan city and the community of reference.
Notwithstanding the Law n.56/2014, the so-called "Delrio Law", establish the list of metropolitan cities, determine the territorial boundaries and the procedure for its amendment, indicate the functions of the Local de quo, election procedures as well as the composition of its organs, it does not contain the legislative definition of "metropolitan city", which is a historically recent phenomenon and especially of socio-urban matrix, with strong connotations including economic connotations. The metropolitan city becomes, in the intention of the legislature, the governing body of a socio-economic reality (which is represented by the conurbations that exist in the metropolitan area) and the governance model of a supra-municipal process of integration functions, services and land development. There isn't a legislative definition of metropolitan city, almost as if the legislature implicitly legalizes a concept that is economic, social, urban and cultural. The uncertainty of its definition is not exceeded even by the Delrio Law, which introduces the metropolitan city as an entity of the second level, as a substitute of the Province for its functions and territorial government. From an etymological analysis, it is clear that the historical foundation of the metropolitan cities is to be found in the major cities of ancient Greece; later in ancient Rome, the term was also used to indicate the provincial capitals, to identify, during the Fascist era, the territory of the central state differentiating it from the colonies. The Anglo-Saxon experience tells that the lemma refers to large urban areas or cities still characterized by strong technological and population growth, as well as a territory in which there are many factories; nevertheless, the term "metropolitan city", due to its legal concept, is part of the Italian legislative experience, although there are also European and international "governing authorities in charge on the metropolitan territory".
In Italy, metropolitan city is therefore referred to as "governing body of the metropolitan area", but the qualification of the considered territory as "metropolitan", as stated by the law in question, is purely political, not legal. Given the conceptual distinction between the legal definition of "metropolitan city" and the urban-economic definition of "metropolitan area", as factual socio-economic reality, the metropolitan area is an area surrounding an agglomeration or a conurbation, characterized by the integration of functions and services essential to the society's life, reflecting close economic, demographic, cultural and even territorial relations between the different urban areas taken into account. Although the metropolitan area cannot be uniquely defined, however, for its existence a reference may be to a series of symptomatic factors, such as a central city or metropolis, which, when expanding, would absorb the neighboring settlements even if they belong to another administrative district; a series of smaller urban centers territorially contiguous; a stable system of social and economic interrelations that arises between smaller urban centers, including rural and metropolitan center. Therefore, the territorial area thus described requires a governing body, in terms of services and functions, different from the authority "Municipality", and also different from the authority "Region", in order not to give our form of state a regionalist mark: this intermediate level of government between regions and municipalities is the metropolitan city for conurbations.
The Legislature, both of 2012 and 2014, did not make clear which sense of metropolitan area should be a reference for the establishment of the body "Metropolitan City": in the Law n.56/2014, art.1 p.6, it just said that the territory of the nine metropolitan cities provided for by the law coincides with that of the provinces having the same name, even providing the initiative of the Municipalities, under art.133 Const. (that should be abolished from the constitutional reform), for the amendment procedures of the adjoining provinces and the entry in the metropolitan city. The diversity among the different metropolitan areas which correspond to the metropolitan cities provided by the legislative reform was not emphasized, because the adopted legislation was not preceded, as has occurred in other state experiences, for example in France, from the preparatory studies that gave credit to sociological, geographical, cultural, economic, demographic and urban characteristics of the considered territories; the trust in the Statute as a tool to bring out the peculiarities of individual metropolitan cities reverses the terms of the problem, because the statute is to

legally regulate “ex post” the historical and factual diversities of different metropolitan experiences that had to be treated “ex ante", also enhancing the role of local populations. The doctrine has expressed doubts about the replacement of the metropolitan cities with the provinces, especially regarding the geographical coincidence between the province’s and the metropolitan city’s territory: it was observed that in some cases, such as Milan, Florence and Bari, it would be appropriate that the legislature would include other provinces in the metropolitan city’s territory, that definitely fall into the pre-legal notion of "metropolitan area", while in other cases, such as Bologna, Turin and Reggio Calabria, the reference to the territory of the province has effectively incorporated into the metropolitan city territories not covered by the notion of "metropolitan area”. Moreover, if the Art.133 Const. is suppressed by the current constitutional revision, the perimeter of the territory of the metropolitan city sets many problems of constitutional compatibility, because it will still have to ensure the involvement of local governments in the process of opting in and opting out the metropolitan city.

2. The functions of the metropolitan cities. The adoption of the strategic plan as an instrument of governance of the metropolitan area

Omitting important insights regarding the methodology chosen to set up the discipline to establish metropolitan cities and the transition of the provinces, as well as to the nature of the metropolitan city itself (technical-administrative and supra-municipal body or heavily politicized body), trying to delimit the field of investigation of this paper, we focused on the definition and nature of the institution "metropolitan city", as well as its consequential territorial delimitation, in order to bring out how these aspects are reflected in terms of the discipline of its functions. In fact, the legislative intervention in terms of metropolitan cities, aimed at promoting the integrated management of basic services to boost the economic and social development of the wide area, has had to avoid the fragmentation of similar expertise between traditional local authorities that, in delicate matters such as urban planning or services management in the territory, devalues the economy and will not distinguish the care of the various public interests at stake, especially if newly emerging. The metropolitan city becomes, as can be seen from the functions which it owns, the new body capable of giving satisfaction to the fundamental rights of the person, because on one hand it gives a simple answer to the problem of performances in the field of public services, on the other favors also the development of infrastructure and economy for the vast area of reference, in a continuous osmotic process. The territorial dimension of the metropolitan city affects the effective seek of its own general institutional purposes, which under article 1 p.2, Law n. 56/2014 are articulated in the "care of the strategic development of the metropolitan area; promotion and management of integrated services, infrastructure and communication networks of the Metropolitan City; care of institutional relations pertaining to their level, including those with cities and metropolitan areas of Europe ". Therefore, the metropolitan city becomes holder of the fundamental administrative functions once held by the provinces, for what concerns the government of the vast area, as well as additional functions arising from the process of reorganization of the administrative functions of the provinces in accordance with paragraphs 85-97. Under article 1 p.44 Law n. 56/2014, metropolitan cities hold proper basic functions, identified by the Delrio Law under Article 117 Const. p.2, lett.p), which are:

a) Adoption and annual update of a three year strategic plan for the metropolitan area which constitutes a guide for the body and for the exercise of the functions of municipalities and unions of municipalities included in that territory, also for the exercise of delegated functions assigned by the regions, in accordance with the laws of the regions in matters within their competence;

b) General planning, including communication facilities, network services and infrastructures of the metropolitan community, also imposing restrictions and objectives to the activity of the functions of the municipalities included in the area;

c) Organization of coordinated systems for the management of public services, organization of public services of general interest to metropolitan areas. In agreement with the municipalities concerned, the metropolitan city can perform the task of preparation of tender documents, the contracting, the monitoring of service contracts and the organization of contests and selection procedures;

d) Mobility and viability, also by ensuring compatibility and consistency of the municipal urban planning within the metropolitan contest;

e) Promotion and coordination of economic and social development, also by ensuring support for economic activities and innovative research and coherence with the vocation of the metropolitan city as outlined in the annual strategic plan of the territory referred to in letter a);

f) Promotion and coordination of computerization procedures in metropolitan sphere.

To these basic functions of the metropolitan city, there are also functions that can be attributed to them by the state and the regions, each for its expertise in implementing the principles of subsidiarity, differentiation and proportionality as foreseen in art.118 p.1 Const. This set of functions of programmatic and management nature, that were basically regional, summarizes the legislature’s will to overcome, in the model of "metropolitan city", the dialectic “government-governance”, in respect to the community’s interests: the planning and management activities appear then, in peculiar supra-municipal fields, so intertwined that they

should be entrusted to a body able to apply them in a unified way. In this way, metropolitan cities should become bodies with incisive powers of strategic planning on specific territories, that limit the role of the regions and municipalities involved. Connection models between State and Local Autonomies will be made through agreements to be reached in the Unified Conference. Among the key functions attributed to the metropolitan city of undoubted importance is the adoption and annual update of the 3 year strategic plan of the metropolitan area, which reinforces the directive nature of the metropolitan body that could well strengthen the concept of metropolitan community, in a new model of government of the territory which combines environmental protection, economic growth, sustainable urban development and enhancement of socio-cultural reference. In fact, the strategic plan is a tool of unitary governance of the territory used to build the reality of the metropolitan city, which aims to establish the policies and the dynamics of integration and continuous interrelation between the "actors" in the area, allowing the metropolitan cities to become an institution able to communicate with the local, national and international scene. The junction of the territory becomes essential to build and advance on a large scale a policy of development and coordination that can bring benefits to the whole community. By seeking a future metropolitan model and preparing a long-term growth strategy, the strategic plan could bring out the peculiarities of each metropolitan city since it represents that "territorial pact" to whose definition and realization participated all the "metropolitan actors", committed to manage the change and promote the shared development, in a point of view of supra-local competitiveness.
The strategic plan is a planning tool for local development which has been applied since the 1980s by many cities: indeed, the traditional urban and regional planning, hierarchical ladder type, whose main instrument was the building plan, was joined by a planning from below, reticular type, to enhance “local actors” and thus seek to put a stop to the widespread urban decay and the discrepancy between the center and peripheries. The strategic plan allows to build a lasting relationship network between the parties that represent the local community and who carry on its interests in order to develop the local reality through the pursuit of common goals and long-term strategies, first negotiated and then approved by all the participants in the network. With the strategic planning of the third generation, in the metropolitan city a permanent planning process is engaged, in which the preparation of the plan document represents only the initial stage: the network of “local actors”, in fact, must carry on the so-called “vision” that is the city project for the future, being able to modify or redefine goals, strategies and actions on the basis of the results obtained. With regard to the content, a third generation strategic plan can outline strategies and measures concerning economic competitiveness, social and environmental policies, urban mobility, models of governance changes to increase tourism or culture or to promote urban transformations. The strategic plan has not any prescriptive value, but enhances the purpose of the "social agreement" useful to pursue a sustainable development of the area and the community.
In particular, with regard to the concept of sustainability, we can see that today it has reached a considerable social significance and a certain "weight" in the public eye, in the academic debate, in politics and even in the economic choices of large industry players (examples are the many movements for justice and urban ecology that arise from citizen’s spontaneous initiatives).

3. Sustainable development: a new challenge for metropolitan cities

Since the metropolitan city is an area with a high concentration of fuel consumption and environmental impact, it is undeniable that it can’t be considered "sustainable" in the strict sense of the word, but, on the other hand, we must recognize that there are numerous possibilities to usefully reconcile the concepts of sustainability and metropolitan city in constant evolution and economic growth.
The decision to build a space that unites man and nature, more congenial to an ecologically sustainable urban development, is fundamentally a political choice: in this regard, it is undeniable that the "green" cities with better environmental conditions and livability are found to be even more attractive and therefore more competitive. Similarly, there is no doubt that more competitive cities posses even more resources to invest in sustainable development, so it is this "vicious circle" that make us understand that sustainability and competitiveness are closely related and overlapping concepts.
Metropolitan cities, while attracting assets, investment, human resources and providing services and jobs, are also characterized by demographic issues, economic difficulties, social imbalances and especially critical environment. Therefore, a useful urban development is not possible without an integrated and multilevel approach encompassing the areas of urban planning, promotion and protection of environmental resources, mobility, and enhancing and upgrading the energy efficiency of the building stock.
In the perspective of sustainability, the urban, economic and environmental development of the metropolitan cities cannot ignore a necessary in-depth analysis of the different yet synergistic disciplines, such as:
1. PLANNING AND SCHEDULING
2. DESIGN
3. REALIZATION
4. MANAGEMENT AND MAINTENANCE
5. KNOWLEDGE, COMMUNICATION AND PARTICIPATION

Therefore, it seems clear that the laws and the instruments of urban planning represent and realize those economic and political choices, which are essential for the sustainable development of the urban metropolitan context. This way, it seems to be necessary to combine these regulatory and planning tools with useful evaluating activities that have the task to verify the effectiveness and responsiveness of society and citizens' real needs.
The reasons behind urban transformations cannot only be the financial speculations inspired by the principle of profit maximization, instead it is necessary to combine the indispensable cost and revenue analysis to a costs and social - environmental benefits analysis. The construction of new districts can definitely generate income and profits, but at the same time it could lead to disharmony in the urban context. Purely financial analysis of a single project, in fact, does not take into account issues such as air quality, noise pollution and air pollution, road conditions, the sunshine, ventilation etc. For example, although big shopping centers in the suburbs generate income and employment, they can lead to considerable costs: environmental (if we consider the increase of air pollution caused by cars in order to reach them); economic and social (if we consider the rise of alienated residential dormitories, with lack of services and poorly integrated into the urban complex).
Unfortunately, not only political or programming choices affect the sustainability of the large metropolitan contexts, but also other factors such as the relationship between location of residence and place of work, the high cost of rents in the centre and semi-centre of the big cities or even the non-efficiency of public transport.
But this does not justify the inadequacy of the regulatory instruments which, especially in Italy are widespread, often through exemptions, building amnesties, house plans, unregulated overbuilding of agricultural areas or sites for urban green public spaces. Urban transformations were allowed to succumb to the financial market by using the purchase of land that later become areas for construction notwithstanding speculation against the environment and the real needs of the community.
The city is a common good, and its sustainable government cannot be subservient to the financial market and to mere economic interests; on the contrary, it must be directed at meeting the needs of the community and must be based on the respect for the environment.
The big cities host millions of people and are inevitably responsible for most of the polluting emissions and energy consumption. In light of increasingly evident environmental, social and economic issues such as climate change, the hydrogeological instability and energy safety, major metropolitan cities have begun to undertake a process of reform and development in the direction of self-sufficiency, security and development of new infrastructure systems.
Self-sufficiency obviously concerns the necessary water and energy resources, which have traditionally been gathered from the territories that were far from the nucleus of the city and in which also the waste was disposed.
Today, change is moving in the direction of reducing the dependency on external infrastructure and promote self-reliance through endogenous local resources, renewable energy and recycling of waste.
Concerning safeguard taken, it can be said that large urban metropolitan contexts have begun to react to the effects of climate change and the consequent constraints of natural resources by developing systems for water protection, green infrastructure and strategies in response to thermal increase.
The third "direction" is the development of new systems of collective urban mobility through the use of new technologies, through mobility "sweet systems" as pedestrian and cycle paths integrated to a network of public transport and finally through awareness campaigns that encourage citizens to the use of public transport or low environmental impact transport.
Urban ecology extends naturally to sustainability, as it aims to achieve efficient use of resources. In this context, an innovative and intelligent urban planning can play a vital role in sustainable development. Unlike the conventional one, "ecological" planning operates on three levels: subsoil, soil and above soil, allowing the realization of crucial interventions for the sustainability. For example, the biodiversity recovery which has been lost due to runaway construction, can be realized through green roofs linking the upper biodiversity layer to the lower one made of trees and the other urban green; the minimization of fuel consumption can be achieved through the realization of passive systems because of the solar or Aeolian energy efficiency; sustainability can be promoted by means of an integrated public network of mass transit, the re-use of abandoned buildings, the multiplication of the uses and functions of public spaces at ground level by returning to citizens those areas occupied by traffic and parking.
In other words, it is clear that the redevelopment of the urban environment is the first step towards a sustainable city-oriented development, and therefore a process that must take place with the active involvement and participation of citizens. Citizens themselves have to trigger the city regeneration, supported by highly qualified professionals charged with seeking protection of natural areas and management of the recovery of abandoned spaces and remediation of contaminated sites.
The community's participation must play a key role in creating a new model of sustainable urban development. In other words, the urban planning should not be imposed by the Administration and by the technicians, but should rather start from the bottom, responding to the needs of citizens who daily live those spaces. The key factors of participation are:

- A correct information which is not just a propaganda of political and administrative decisions, but that stimulates dialogue and purposeful debate.
- Consultation, which realizes comparison between citizens, technicians and directors. All this can be realized by means of questionnaires, interviews and even online forums.
- The active involvement of citizens in the formation of plans and projects for the territorial redevelopment of the city, especially concerning the formation of the strategic plan, which is to materialize the vision of sustainable development that the metropolitan city should pursue for its growth and its competitive improvement.

Even the enhancement of the public assets and the redevelopment of disused strategic areas significantly contribute to the sustainable development of large metropolitan cities. The "stop" to new land use would produce environmental, social and economic benefits for the Administration, which would not be forced to bear the costs arising from the expansion of the city and from all services inevitably connected.

The development of urban sustainability in metropolitan contexts cannot be separated from innovation and rethinking of the concept of mobility to which we are traditionally accustomed.

The citizen must begin to change his transportation habits, moving away from car dependency and approaching the collective transport.

Unfortunately, to date there is poor coordination within the processes of urban planning, urban development, infrastructure and transport services. Also the management and decision models adopted in reference to the regulatory, fiscal and financial context are often oriented in contrary to sustainable development, considering the social and cultural context from which these decisions have come from.

Although there is a gradual emerging of citizen's environmental sensitivity and the adoption of regulatory measures at the local level in the sense of reducing air pollution and traffic, the negative effects of mobility are not limited.

Individual regulatory actions at the local level are not sufficient by themselves: there should be a general renewal of policies in the area of mobility and a citizens' change of mentality and lifestyle. The current economic crisis may paradoxically be an effective stimulus and a great opportunity for the ecological conversion of mobility, even for the development of good practices as intermodal transport, innovative services for mobility, information technology and innovations.

In conclusion, on the basis of a renewed concept of urban living that is asserting in the mindset of citizens, this paper wanted to highlight how Legislature's and Administration's well-thought choices can actually revolutionize what physically is around us in our daily lives, directing us towards a "sustainable" future both on environmental, social and governance issues.



Fig. 1: *Smart city e sviluppo sostenibile: il futuro passa dall'innovazione* di Rosangela Todaro, sikilynews.it, 2013.



Fig. 2: *La città del futuro, come la vorrei* di Alessandro Peticchia, lotsunami.blogspot.it, 2013.

Bibliographical References

[1] LUCARELLI, Alberto. *La città metropolitana. Ripensare la forma di Stato ed il ruolo di regioni ed enti locali: il modello a piramide rovesciata*. Federalismi.it, June 25, 2014.

[2] SASSEN, Saskia. *The global city*. Princeton, Princeton University Press, 1991.

[3] BRENNER, Neil. *New state spaces: urban governance and the rescaling of Statehood*. Oxford, Oxford University Press, 2004.

[4] BENVENUTI, Luigi. *Riflessioni in tema di città metropolitana*. Federalismi.it, February 27, 2013.

[5] CARAVITA DI TORITTO, Beniamino. *Città metropolitana ed area vasta: peculiarità ed esigenze del territorio italiano*. Federalismi.it, Osservatorio Città metropolitane, n.3/2014.

[6] PATRONI GRIFFI, Filippo. *La città metropolitana nel disegno generale del riordino del* territorio. Federalismi.it, Osservatorio Città metropolitane, n.3/2014.

[7] PATRONI GRIFFI, Andrea. *Città metropolitana: per un nuovo governo del territorio*, Confronti Costituzionali, June 23, 2014.

[8] SERGES, Giuliano. *Alla ricerca di una definizione giuridica di città metropolitana. Dalla metropolitan culture dei primi del '900 alla riforma Delrio*. Federalismi.it, July 28, 2014, p. 3 and ss.

[9] NOVA. Enciclopedia Utet, Entry *"metropoli"*, vol.6. Torino, 2002.

[10] AQUARONE, Alberto. *Grandi città e aree metropolitane in Italia*. Bologna, 1961.

[11] LUCREZIO, Giuseppe. *Il fenomeno urbano*. Roma, 1970.

[12] ROTELLI, Ettore. *Le aree metropolitane in Italia. Una questione istituzionale insoluta*. Edited by MARTINOTTI, Guido. *La dimensione metropolitana*. Bologna, 1999

[13] BATTAGLIA, Attilio. *Area e città metropolitana. Approfondimenti giuridici, istituzionali e socio-economici*. Reggio Calabria, 2011.

[14] AA.VV. *Il nuovo governo dell'area vasta. Commento alla legge 7 aprile 2014, n.56*. Edited by STERPA, Alessandro. Napoli, 2014.

[15] FABRIZZI Federica, SALERNO Giulio. *La riforma delle autonomie territoriali nella legge Delrio*. Jovene, 2014.

[16] MONE, Daniela. *Città metropolitane. Spunti per una lettura del principio autonomistico come strumento di affermazione dei diritti fondamentali della persona*. Federalismi.it, n.3/2014.

[17] Contribution to the group ASTRID on "L'istituzione della Città metropolitana". Working group "pianificazione strategica urbana" coordinated by Raffaella Florio, ReCS - Rete delle città strategiche.

[18] GIBELLI, Maria Cristina. *Tre famiglie di pani strategici: verso un modello reticolare e visionario* in CURTI Fausto, GIBELLI Maria Cristina. *Pianificazione strategica e gestione dello sviluppo urbano*. Florence, 1996.

[19] PERULLI, Paolo. *Piani strategici. Governare le città europee*. Milan, 2004.

[20] SALZANO, Edoardo. *Le nuove leggi urbanistiche: l'opportunità per costruire nuove strategie territoriali e nuove relazioni tra istituzioni, cittadini e operatori economici*. Fondamenti di urbanistica, Bari, 2003.

[21] CRIVELLO, Silvia. *La città competitiva e sostenibile: alcune riflessioni sul rapporto fra i due discorsi*. AIS Italian Association of Sociology, Sociological Section of Environment and Territory, Annual Conference 2010, p.6.

[22] PLATT, Rutherford. *Land use and society*. Island Press, Washington, DC, 2004.

[23] CAMAGNI, Roberto. *On the concept of territorial competitiveness: sound or misleading?* Urban Studies, 2002, v. 39, n. 13, p. 2395-2411.

[24] MELA, Alfredo. *Sociologia delle città*. Carocci, Rome, 2006.

[25] CORONAS, Fabio. *L'urbanistica sostenibile per la città e l'area vasta* in *La riqualificazione sostenibile dei contesti urbani metropolitani*. Edited by CORONAS, Gianfranco. *I libri del Fondo sociale europeo 182*, ISFOL, 2013.

[26] BERDINI Paolo, NALBONE Daniele. *Le mani sulla città*. Rome, Edizioni Alegre, 2011.

[27] ANDERMATT, Conley Verena. *Urban Ecological Practices in Ecological Urbanism*. Harvard University, 2011.

[28] CARMINUCCI Carlo, TREPPIEDI Luca. *Le politiche per la mobilità urbana sostenibile: esempi di strategie in Europa e confronti con l'Italia*. Isfort, 2008.

[29] MORABITO Giovanni, TERRANOVA Ferdinando. *Edilizia, ambiente e società*. Edited by GRAZIANI, Alessandra. Florence, Alinea Editrice, 2006.

[30] Euromobility (under the patronage of the Ministry of Environment). *La mobilità sostenibile in Italia. Indagine sulle principali 50 città*. 2011 Edition. Formello (Rome), Miligraf, 2012.

[31] BERTUCCIO, Lorenzo. *La mobilità sostenibile nei contesti urbani metropolitani* in *La riqualificazione sostenibile dei contesti urbani metropolitani*. Edited by CORONAS, Gianfranco. *I libri del Fondo sociale europeo 182*, ISFOL, 2013.

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Urban landscape and new venustas

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Abstract
For a long period, town planners didn't wonder anymore about the aesthetic value of the city. This lasting omission has manifold and complex causes. But it isn't so much the analysis of these causes that is important, but starting to see in beauty again - if we are able to - an important, maybe essential requirement of the city. Nevertheless, history teaches that in realizing beautiful cities men and ages took into account some rules, some canons that - even if not codified - were however shared and that strongly reduced the subjectivity of the esthetic judgment. In fact coherence making any *beautiful* city unique and recognizable lies in the relationship of tight integration between the parties and the whole. After the long lethargy of a town planning founded on quantitative and distributive reductionist often ineffective rituals, it is the moment to search and pursue urban beauty by trying to identify few but clear rules and above all by stopping project individualism that makes many post-industrial cities an unbalanced stretch of ugly things or of mediocrities surrounding events drawn by big names, but completely and often constrainedly self-referential. We must return and reason on beauty in the cities and on what kind of beauty, for whom and how to obtain it, with the awareness that the achievement of beauty is a casual event, since it depends on many luckily concomitant and hardly programmable causes, but also with the awareness that to obtain beauty in the cities we need to develop methods (urban aesthetics) like tools in order to ensure at least minimum conditions.

Keywords: Venustas, Urban Landscape, Urban Planning, Urban Design

1. Introduction
Recently the issue of city's beauty has taken a renewed powerful attention in the scientific debate. The issue is appealing but it is not a novelty: it is a rediscovery. The search for beauty unites all arts, but attention to the city's beauty, of the city that can be produced today, does not depend on one or few persons. In a complex society like modern society, it depends on the capacity of integrating and coordinating various skills and responsibilities, be it political, economic, cultural, administrative and planning at the different levels. Therefore, collaborative abilities between institutions and between citizens and institutions become prejudicial: by widening the subjects involved in building the city, canons of urban aesthetics, that once the prince's architect was depositary of, require sharing and can impress planning only as a consequence of a complex dialectical maturation between all the parties involved. In the last decades, town planners have considered the aesthetic value of the city as secondary to quantitative emergences that appeared in the second after-war period. Today it is important to recognize beauty as the city's essential requirement. History teaches that in realizing beautiful cities men and ages took into account some rules, some canons that - even if not codified - were however shared and that strongly reduced the subjectivity of the esthetic judgment. And those rules were valid even for a single building. In fact coherence making any beautiful city unique and recognizable lies in the relationship of tight integration between the parties and the whole.
After the long lethargy of a town planning founded on quantitative and distributive - reductionist - often ineffective rituals, it is the moment to search and pursue urban beauty by trying to identify few but clear rules and above all by stopping project individualism that makes many post-industrial cities an unbalanced stretch of ugly things or of mediocrities surrounding events drawn by big names, but completely and often constrainedly self-referential.

2. The beautiful city in tradition

Villages, municipalities and city-states conform on the basis of unwritten rules, either according to shared principles of a tight integration and compatibility between the building scale and the urban scale (Classical Greece - Middle Ages) or as a creation of the artist-scientist legitimated by the prince (Renaissance, Absolutism) (Figg. 1-2).

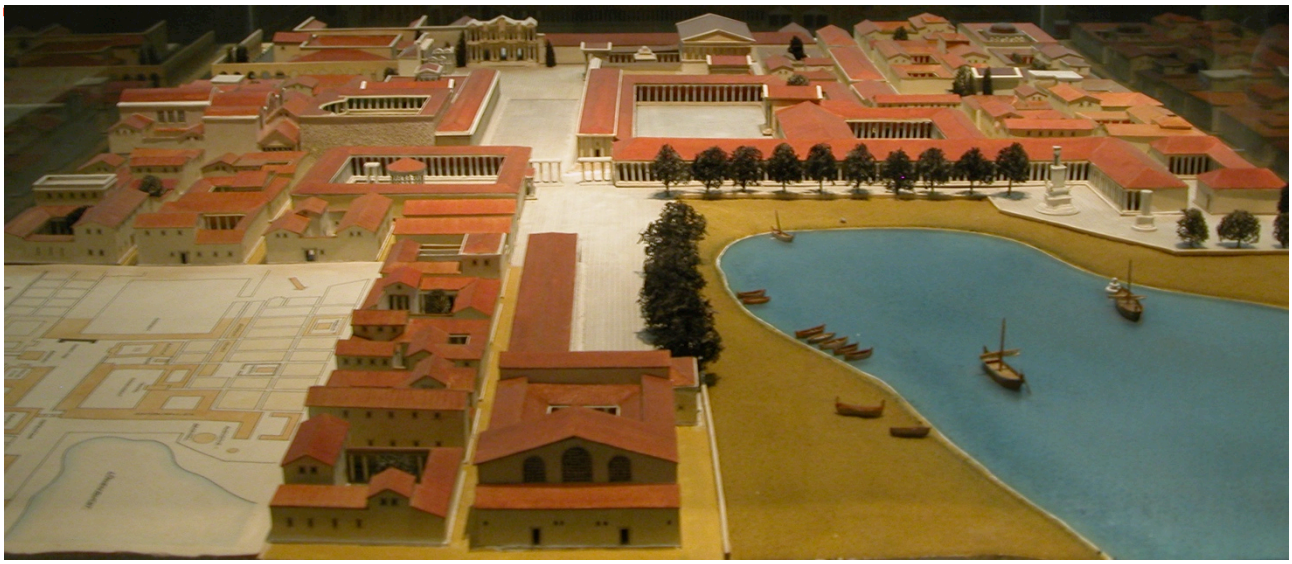

Fig. 1: Mileto, model of the town, Pergamon Museum, Berlin.

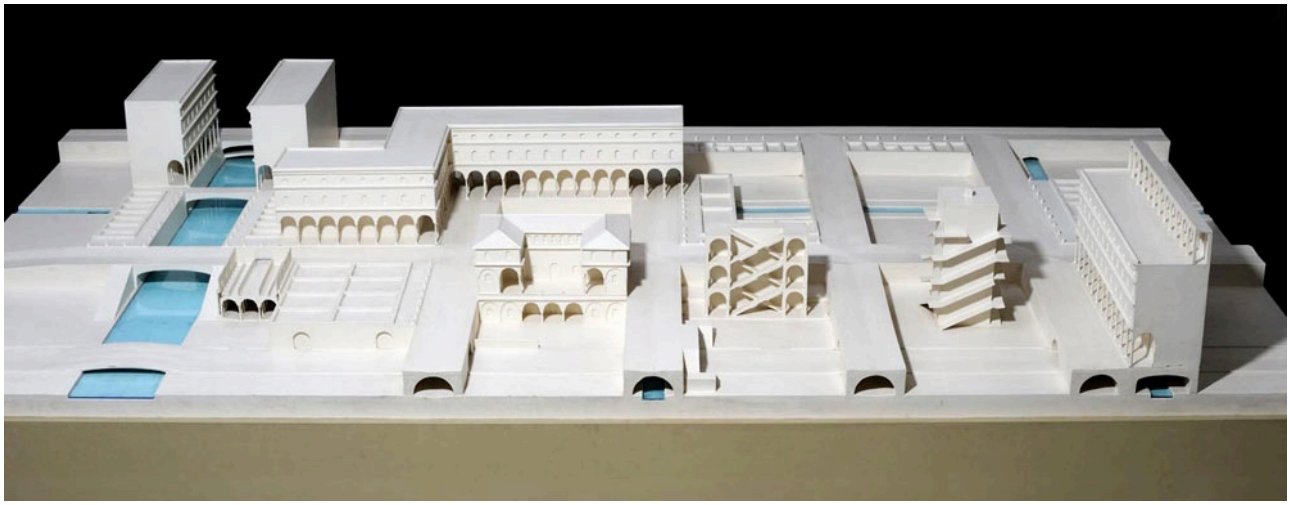

Fig. 2: Leonardo da Vinci model of an ideal town, reconstruction from the drawings of Manuscript B, Institut de France, National Museum Science and Technology, Milan.

But, in order to make all this happen, definite and acknowledged canons were necessary, establishing themselves in periods of political stability and flourishing economy and culture, characterized by processes of progress in arts and techniques with the consequent stabilization of rules, not by chance systematically registered in the various treaties either of classical age and of Humanism. Although the Greek city is made up of different parts according to their function - acropolis, agora - it is defined by a compact, nature-friendly, well recognizable and measurable urban landscape, making it a unique being in which public buildings take a key role in urban setting; the features of uniqueness, of articulation and of balance with nature make the Greek city a universal model. Throughout history, periods of prosperity followed periods of political, economic and social uncertainty that have contributed to the loss of the rules and principles shaping and making city recognizable, hence giving it beauty. Just remember the period after the fall of the Roman Empire, when cities began to lose unity and the dialectical relationship with natural landscape that became an undefined space to protect from. *The search for the city's shape, based on big public settlement works failed and was replaced by a familiarity with imperfection, a tolerance to irregularity, to incompleteness, to*

contrast, that will remain lasting features of European cities (Benevolo). Europe of the second half of the XVIth century is characterized by a rebalance, and economic and technological advances together with new private interests contribute to a change in urban planning. The search for urban perception's forms is renewed and perspective is used as a tool to represent and perceive space (Rome, Palermo, etc.). The XIXth century marks the beginning of the separation between art and technique; in this period of big reforms, discoveries and economic liberalism, in which dynamism and speed of changes are more and more evident, the primacy of private property consolidates and the role of public power becomes more and more marginal. The decrease in the possibility of controlling these huge changes makes cities grow and grow creating a chaotic and disconcerting landscape. A strong need to shape the city prevailed with the birth of the industrial suburbs. They were made up of unliveable lodgings because of the lack of hygiene and services. Both for the rapid growth and for the particular soil consumption imposed by the new typologies of the factories, and also for the mixing of the workers' dwellings and the factories, traditional morphological canons turn out to be inadequate. Inviolability of private property does not allow a real possibility of replanning city, thus resulting in the utopian experiences of Owen, Fourier and Godin. At the turn of the twentieth century, after the utopian reaction to the industrial revolution, reformist theories inspired to morphological models that from post-Howardian formulations by R. Unwin and P. Wolf and from Ciudad lineal by A. Soria y Mata come to the colonization scheme (monofunctional poles) by Gloden (1923), to the city by radial sectors by A.T. Edwards and to the Cité industrielle itself by T. Garnier. Leaving aside functional contents generating the shape, the failure of the theoretical references considering the spatial planning of human settlement is followed by the functionalist approach of the modern movement, recognizing its epistemological base in the integration between shape and function. Le Corbusier denounces the presence of a *town planning still in arms and that has remained quite retrospective, museographical, mimetic, worried above all of a scenery considered as an ornament, clothing of zones, towns or villages: not a functional clothing, but a representation clothing*. The city's shape – hence its beauty – is given by: the attribution of specific spaces to each of the four urban functions par excellence – living, working, moving, taking care of one's body and mind -; from the reversal of the relationship between building and household typical of the post-liberal reformist city which replaces the generative element of the urban tissue – the intensive building subdivided into lodgings – with the household, dimensioned according to functional minimal points aggregated in housing units. These units are arranged to form a broken-line continuous ribbon (the city for three million inhabitants, *la ville radieuse*, the radiant city, Berlin's and Antwerp's plans), in order to remove the corridor road.

3. … for the modern city

Knowledge and research have always had a dynamic essence; they are constantly evolving. But in the past, evolution times were relatively long and allowed moments of accumulation, with the possibility of periodical systematizations and of stabilization of results and of their coding. Absolutely uncontrollable times of contemporary change do not allow moments of adjustments, of rethinking, of maturation and of synthesis. *Environment and daily life are defective in their imperfect state and in their dry need. Hence art becomes a shelter. In art people looks for beauty, harmony, which are missing in life and in environment. Thus beauty and harmony have become an unrealizable ideal: placed in art, they have been excluded from life and from environment* (Benevolo). It is no coincidence that urban landscape becomes a paradigmatic subject for expressionist, symbolist, futurist and metaphysical painters and drawers denouncing urban unease of the whole past century: just think to the expressionist sketches by Kettelhut for the famous Metropolis by Fritz Lang; to the suggestive futuristic view by the architects Sant' Elia and Chiattone (1914), by Marchi (Fantastic City, 1919), by Andreoni (Sketch for metropolis, 1928), by Sironi and Depero, or to the squares and colonnades by De Chirico, where the spirit of Pontine cities and of the rationalist purism hovers; and also to the famous Stiglmaier square in Monaco (Heise, 1935) or to Twilight in Manhattan (Peruzzi, 1943) (Fig. 3).

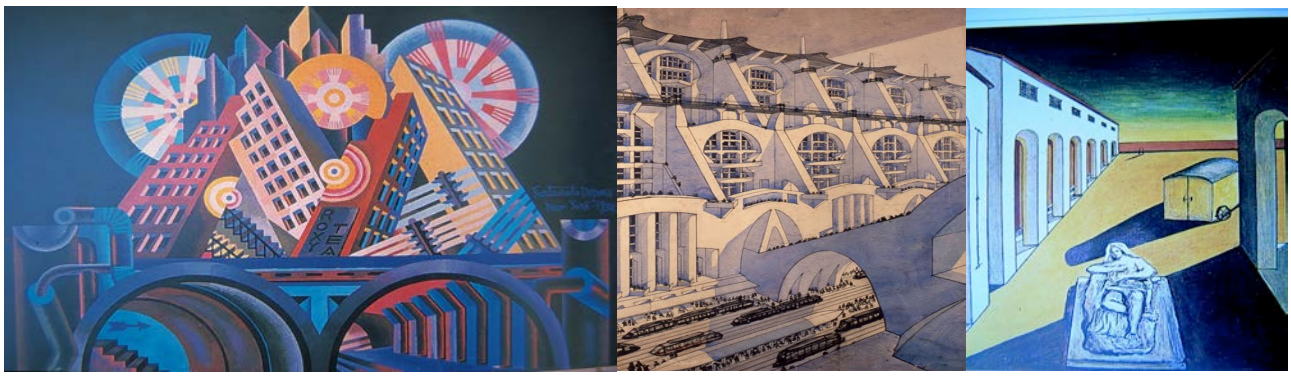

Fig. 3: Depero, Skyscrapers and tunnel - Marchi, Fantastic city - De Chirico, Piazza d'Italia with statue and caravan.

With the coming up of the quick urbanization, space in the city becomes contended; its centrality takes a defined market value from the economic point of view. The logic of the city's typically additive growth becomes indifferent to the possible physical relationships of both nodal and areal connection-continuity with the preexistent urban fabric. Centralized urban activities and functions increase; as a consequence also urban population dwelling in the borders of the settlement increases, with the consequent processes of spread, concentration and interstitial saturation. However the development of this additional part of the city presents some physical and social features that can be found as invariants in the different European geographical realities: the break of continuity with the preexistent city, the decrease in building density, the lack of connection of the urban fabric, low housing quality, monofunctionality, degradation and social monoculture of the inhabitants, the presence of disorder and casualness, the indeterminacy of peripheries, public space characterized by structural and morphological weaknesses and the consequent lack of identity and identifiability of places. The functionalist scheme proposed by the modern movement to face the new problems turns out in the reductionist model of zoning, which, interprets city as the sum of simple parts by setting a biunique relationship between place – the homogeneous zone – and function, under the delusion that the mechanistic tree logical model can represent the alternative to the ungovernable complexity. On the other hand, if we observe zonings of some proposals made on Le Courbusier's example, we can find the use of a *morphological* and not only *quantitative-monofunctional zoning*. In the rationalist notion of city, the refusal of the existing city – or tabula rasa – stems from the urgent need of post-war reconstruction and from the rapid urbanization, giving the opportunity to experiment new urban shapes, to plan and realize cities and parts of it from the beginning. A Town Planning sees the light privileging quantitative aspects rather that qualitative ones. In the ordinary professional praxis, less as culturally sensible interpreters and more as experts-bureaucrats, the simplified application of these principles to the city's expansion has represented the theoretic assumption of planning and building of *urban parts* that caused *the break of genetic and endogenous elements of urban growth and the introduction of exogenous criteria to the site* (De Carlo). Again, this was followed by the trend to control urban shape by quantities, ratios and parameters; but, although the illuminist value they were given, their unsuitability has been long understood, in particular in the passage from the town planning scale to the building scale. Starting from the after-war period, the devastation of so many cities has been made possible because of the delegation with unrestricted powers by weak and/or collusive institutions to a group of speculators with no scruples. Hence the detachment of politics from culture has irreversibly compromised the balance between nature of places and the settlement shape that has made many Italian cities and their surroundings famous in the world as they had come to the second world war.

4. From shape to Contemporary Urban Landscape

For many years outskirts have represented a fundamental and marginal part of the city, from which only recently, in a post-industrial age – a new stage of modernity? – the problem of redesign was posed. The unsolved issue of outskirts could turn into the reconfiguration of the urban shape not by adding, but by requalifying existing spaces, without pursuing their homologation to the center's features, but by applying new rules, by making use also of extensive demolitions in order to transform shapeless expansions. This challenge is made possible by the big transformations of production and of its plants and applies to suburban areas that, unlike consolidated city, where renovation scopes have been drastically reduced, become the transformation context par excellence of contemporary city. Urban voids, abandoned areas, are not only marginal; they often are central places once occupied by big plants and present a higher degree of difficulty in resolving addresses. Timekeeping of interventions and relationships with the surrounding fabric have suggested the way of the (town) plan as an alternative chance to the plan, that has also been charged of the inability to ensure the continuity in the scale passage from the city to its parts, - inter alia because of the excessive dependence from quantitative parameters rather than qualitative indicators. However the beautiful city cannot be the summation of circumscribed, though wide and above all signed, episodes of redesign. There is the need of different rules in order to return to the city as a unitary and coherent system. The study and the control of the city's shape is an elective research field for town planners and architects, but except the few cases of the foundation cores contextually designed, the shape itself is never the result of a single project, but the consequence of a continuous and heterogeneous aggregative process in causes and effects. Therefore it is necessary to clarify if it is possible or correct to point out the features of the beautiful city, in the absence of canons and general references. To this purpose some remarks on shape and urban landscape could be useful. The shape of an object is the external appearance given by its outlines and, in the case of several objects, the shape of their complex is the figure they compose. On the contrary the notion of landscape is related to the way a place is felt, in particular with sight (looking/seeing) but also with the other senses, to the sensory and mental elaboration of what is felt after seeing, listening, experimenting. It is a synthesis' process allowing the name of a city to correspond to a set of images in our minds, that cannot be classified according to opposed categories of esthetic judgment - beautiful/ugly - but deriving from suggestions induced by the environmental complexity (composed of streets and means of transport, paths,

buildings, traffic, signs, human presences and attitudes, materials and colors, noise, prevailing weather conditions) and personally experimented through our presence in that city or through the images we have seen of it. Hence, while shape is an objective property of place, landscape is the way the shape of the place appears, is caught and felt by the observer. This is particularly evident in the different way the nature of different cultures is perceived. In fact, for some of them – just see central and northern Europe – nature is the welcome place (mother) of man, while for others – just see the South of Italy – it is a stepmother and hostile to the life of its inhabitants. Recent studies on landscape tend to reduce the distance between objectivity of shape and subjectivity of landscape through methods of reading and evaluation founded on objective criteria and procedures, like the analysis of characters, of invariants and of constituting elements. With reference to a defined territory, either natural, urban or the former and the latter put together, the two notions of shape and of landscape take a dynamic connotation because the territory is a constantly changing system. The different consolidated interpretations of the notion of landscape can be brought back to two big trains of thoughts of the XXth century: the idealistic-spiritualistic thought– following Croce's aesthetics – and the geographic-naturalistic thought of positivism, based on the analytical knowledge of physical, biological and anthropic elements (Humboldt). The aesthetic notion of landscape makes the search for instruments of judgment in order to define natural beauty and landscape itself difficult although attention to its changeability and dynamism had already revealed themselves in the 60s'. Thereafter the approach to reading and interpreting landscape based on sensorial perception, in particular visual perception has prevailed. In this perception, the cognitive datum is processed through the observer's cultural tools by making a synthesis between the material datum and his/her knowledge. Later on the distinction between *natural* and *anthropized landscape* arises, specifying that the *anthropized landscape* par excellence is the urban landscape, although to date wide non urban landscapes are anthropized. Recently landscape has been included among environmental components as cause and effect of complexity. Hence the term landscape acquires many overlapping meanings: the one of sensible expression of the ecosystemic order and of its evolution and the result of the interaction between natural and cultural elements or again of overlap and of alternation of concentrated human activities. Urban landscape is dynamic and as the city is the artificial place par excellence, where the impact with nature has already taken place and has already been overcome, it contains in its origins themselves the assumptions for the rapid change through growth, gathering and transformation. It is for this reason that it keeps its strong characterization and constitutes a landscape in the landscape. Subjectivity of perception can make the city appear dramatic – that is attractive – for its dynamism and greatness in a tragic meaning, for example because of the abnormal spread of favelas – exalting – the big cities of historic renown, harmonious, for the balance between its parts and the inclusion in the context – irritating – for the aggressive spread of speculative building close to the historical center and to the prejudice of surrounding natural areas – chaotic – for the unrecognizableness of development criteria – inaccessible – for the meticulous routes with no free or green areas, medinas). *Shape* and *landscape* are strongly interdependent: man defines the former but perceives the latter; while urban shape is the result of a work of many hands, where now and then some creating individuality can be detected, landscape is not completely configured by man, but prevalently by the relationships between artificial and natural spaces. The environmental awareness obtained has broadened the attention to territorial transformations; with the birth of environmental right, landscape and shape of the territory rise to issues of public interest. Unlike other historical periods, contemporary difficulties are not creating new utopias, but each time they put qualitative and quantitative evaluation tools side by side to traditional tools. They point at active and direct participation of citizens to some decisional processes, in the perspective of a social share granting choices the right authoritativeness due to the pursuit of public interest. Thus, listening, communicating and their interpreting synthesis fall within the new town planner's jobs as contribution to his/her *expertise*. A new notion of beauty has to be related to these dynamics of transformation, that cannot be based on an aesthetic contemplation of *Croce's idealistic root*, but has to draw on the urban space's capacity to represent the essence of the time we are living. Many people recognize in fragmentation the characteristic feature of contemporaneity and relate to it both the increasingly growing gap between community and society, and the difficulty of the former to produce and recognize itself in shared forms of the latter. The difficulty to define common rules for civilized living remains the unavoidable assumption and becomes the real obstacle to recognize shared rules to regulate the building and/or transformation of the physical environment.

5. Towards the new beauty

In times of cultural fragmentation and nihilist individualism, it becomes an ethical duty for people on the ground to propose settled community some guidelines to pursue the lost beauty of contemporary urban landscape. They must not and cannot consist of pre-established rules that nobody could be strong enough to impose, but could consist of general directions to adjust to local contexts and to the peculiarities of the cases. Heterogeneity and disorder are characteristic features of contemporary landscape. But this can be considered as a huge experimental laboratory, where original forms of compatibility and mixtures are to be found, through new relationships between the parties. Contemporary landscape can be compared to a flexible body, that can offer higher degrees of freedom to invent places that have not yet been realized in

order to allow a dialogue with the actors of the change. But this requires a common language, interpreting and addressing users towards solutions of project contributing to living quality by overcoming the episodic nature to involve the whole urban system. Cultural and operational complexity of the building process of places must be positively reconquered to plan and to project, by relating some aspects of beauty to the integration between natural and artificial components, that is between: *landscape movements*; *attitude*; *natural reliefs*; *green areas*; *river flows and the sea* (legible order) and: *the identification-reinterpretation of places* aiming at their *identity* (limits, conformations, geometries); the *change* in the way of accepting *functions* and their possible combinations in order to improve their efficiency; the *strengthening* of compositive and morphological distinction between public spaces (civil architecture) and private spaces (new living shapes), *redrawing* and redistributing open spaces; *rethinking* spaces for mobility; *optimizing* productive functions; *using* abandoned areas; *recovering* borders and peri-urban areas; *measuring* and re-dimensioning existing areas; *coherence* between urban and architectonic scale; the *city's design* (alignments, heights, voids/solids relationships); *quality of architecture*. Beauty can independently belong to natural or artificial components; while the integration of both components causes a multiplying effect and makes the site unique and unrepeatable (Unesco sites). The new beauty cannot represent an autonomous quality of city neither can it exist leaving aside other connotations to be considered as essential such as recognizability, functionality, liveability, comfort, that are far from traditional perceivable aesthetic values.
It can turn out to be easier to identify all that the beautiful city must not be. A list of principles aiming at pursuing the new beauty would be nicer. Nonetheless, the risk has to be run. It would be useful for this conference to end with the beginning of a long and difficult research work, of a necessary challenge that has to be accepted by all those who are tired of the long disciplinary idleness on this front. It is legitimate that culture pursues ambitious objectives, that it dreams. Hence, together with the criteria that will come out from the other contributions, it is possible to propose some general criteria to the examination of the disciplinary debate as *macro-objectives* of the planning tools (plans) to entrust the task of identifying the right choices for the specific territory:

- the *recovery* and active safeguard of historical fabrics (also by identifying rules guaranteeing a suitable inclusion of contemporary architecture);
- the *preservation* of identifiable borders and the configuration of uncertain borders for a harmonic integration of natural and artificial components towards the definition of contemporary landscape (Fig. 4);
- the *reduction* in building sprawl in landscape (Fig. 5);
- the *acknowledgment* of landscape units as guideline criteria for safeguard and improvement;
- the *landscape-environmental restoration* of endangered natural areas to restore upset balances and identifying the possible evolutions;
- the *coordination* and *territorialization* of big infrastructures, of primary urbanizations and of technological plants.

In contemporary city, beauty has become a rare quality: the role of plan as unitary design has failed; coherence/continuity between the architectonic and urban scale has failed; quality of architecture, if present, has not guaranteed the quality of city. Contemplative beauty of idealistic/spiritualistic matrix of the first years of the XXth century must be replaced by a landscape's beauty where the settled community can identify itself, maybe placed at the intersection between environmental patterns and the legitimate aspiration to beauty, which is peculiar of each culture.

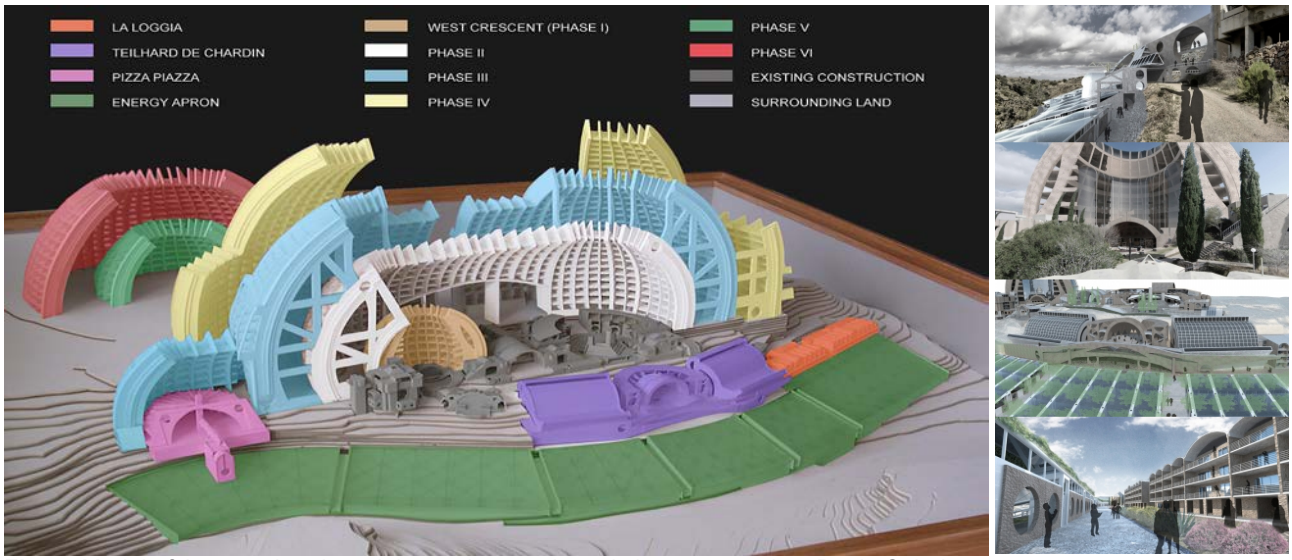

Fig. 4: Model of Arcosanti project, Arizona, in grey the existing construction, Paolo Soleri.

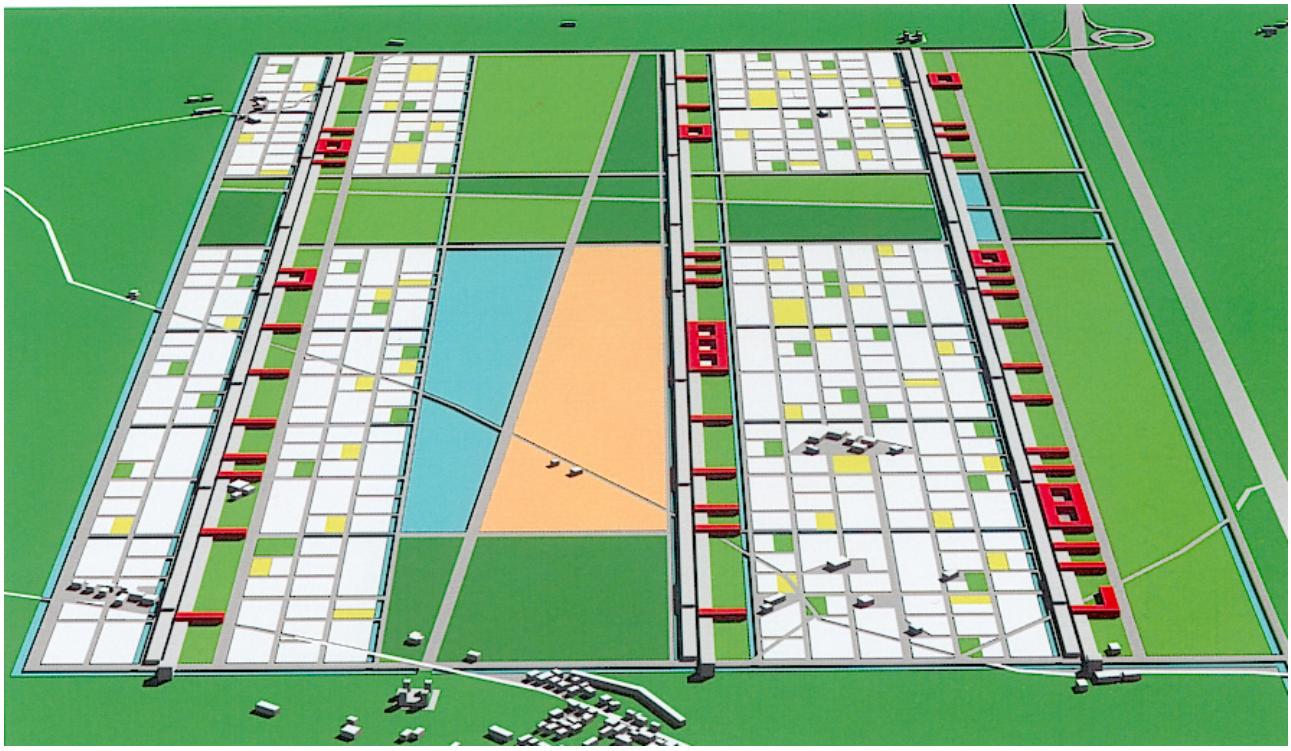

Fig. 5: Model of **VE**rona-**MA**ntova, city for 30.000 inhabitants, Tenth International Exposition of Architecture Venice 2006.

Bibliographical References

[1] AA.VV. Rassegna di Architettura e Urbanistica: Paesaggi della nuova città esistente (Review of Architecture and Town Planning: Landscapes of the New Existing City), Kappa, Rome, 1995.

[2] ASSUNTO R. *Il paesaggio e l'estetica* (*Landscape and Aesthetics*), Giannini, Naples, 1973

[3] BENEVOLO L. *La città nella storia d'Europa* (*City in Europe's History*), Laterza, Rome – Bari, 2001

[4] BENEVOLO L. *Storia della città. 1. La città antica* (*History of the City. 1. The Old City*), Laterza, Rome-Bari, 1993

[5] BENEVOLO L. *L'Italia da costruire: un programma per il territorio* (*Italy to Build: a Program for the Territory*), Laterza, Rome-Bari, 1996

[6] BENEVOLO L. *Storia della città* (*History of the City*), Laterza, Rome-Bari, 1986

[7] BOSCHI A., BONACCHI A. *Questioni di forma...urbana* (*Issues of Urban....Shape*), Alinea, Florence, 1999

[8] CAGNARDI A. *Un senso nuovo del piano. Piani Regolatori Gregotti Associati* (*A New Sense of Plan. Gregotti Associati Master Plans*), EtasLibri, Milan, 1995

[9] CAPUTO, P. (edited by) *Le architetture dello spazio pubblico* (*Architectures of Public Space*), Electa, Milan, 1997

[10] CERVELLATI P.L. *L'arte di curare la città* (*The Art of Taking Care of the City*), Il Mulino, Bologna, 2000

[11] CERVELLATI P.L. *La città bella* (*The Beautiful City*), Il Mulino, Bologna, 1991

[12] COLAROSSI P., LATINI P. L. (edited by) *Regole della forma e qualità urbana*, Urbanistica Dossier n. 22 (Rules of Urban Shape and Quality, Town Planning Dossier nr.22), INU Edizioni, 1999

[13] DI FIDIO M. *Dizionario di ecologia* (*Dictionary of Ecology*), Pirola, Milan, 1986

[14] FABBRI R. *Introduzione al paesaggio come categoria quantificabile* (Introduction to Landscape as Quantifiable Category), CELID, Turin, 1981

[15] FERRARA G. *L'architettura del paesaggio italiano* (*Architecture of Italian Landscape*), Marsilio, Padua, 1968

[16] GAMBINO R. *Progetti per l'ambiente* (Projects for the Environment), FrancoAngeli, Milan, 1996

[17] GIRARDI F. *Morfologia territoriale e urbana* (Territorial and Urban Morphology), Casa del libro, Rome, 1983

[18] LE CORBUSIER *Maniera di pensare l'urbanistica* (Ways of thinking Town Planning), Laterza, Rome - Bari, 2001

[19] LO PICCOLO F. (edited by) *Identità urbana: materiali per un dibattito* (*Urban Identity: Materials for a Debate*), Gangemi, Rome 1995

[20] MACCHIA CASSIA C. *Il progetto del territorio urbano* (*The Project of Urban Territory*), FrancoAngeli, Milan, 1998.

[21] MACIOCCO G. (edited by) *Le dimensioni ambientali della pianificazione urbana* (Environmental Dimensions of Town Planning), FrancoAngeli, Milan, 1991.

[22] MARIANI TRAVI E. *La città moderna vista dai pittori* (*Modern City seen by Painters*), Testo&Immagine, Turin, 1996

[23] MATTOGNO C. *Idee di spazio, lo spazio nelle idee, metropoli contemporanee e spazi pubblici* (*Ideas of Space, the space in Ideas, Contemporary Metropolis and Public Spaces*), FrancoAngeli, Milan, 2002

[24] MAZZA L. (edited by) *Le città del mondo e il futuro delle metropoli. Partecipazioni internazionali* (*Cities of the World and Future of Metropolis. International Participations*), Electa, Milan, 1988

[25] MORETTI A. *Le strade. Un progetto a molte dimensioni* (*Streets. A Project by Many Dimensions*), FrancoAngeli, Milan, 1996

[26] PAVIA R. *L'idea di città. Teorie urbanistiche della città tradizionale* (*The Idea of City. Town Planning Theories of Traditional City*), FrancoAngeli, Milan, 1994

[27] PIRODDI E. *Le regole della ricomposizione urbana* (*Rules of Urban Recomposition*), FrancoAngeli, Milan, 2000.

[28] RANIERI R. *Paesaggio, Regione, Economia* (*Landscape, Region, Economy*), Creazzati, Bari, 1963

[29] ROMANO M. *L'estetica della città europea (The aesthetics of European cities)*, Torino, Einaudi 2005 (1993)

[30] ROMANO M. *Costruire le città (Build cities)*, Milano, Skira, 2004

[31] ROSETI C. *Il progetto della piazza* (*The Design of the Square*), Gangemi, Rome, 1985

[32] ROSINI R. (edited by) *L'urbanistica delle aree metropolitane* (*Town Planning of Metropolitan Areas*), Alinea, Florence, 1992

[33] SCANDURRA E. *La città che non c'è. La pianificazione al tramonto* (*The City that doesn't exist. Town Planning at its Sunset*), Dedalo, Rome, 1999

[34] SPIGAI V. *L'architettura della non città. Ridisegnare le periferie* (*Architecture of non-Cities. Redesigning Outskirts*), CittàStudi, Milan, 1995

[35] TALIA M. L*a metropoli e il piano. Processi, teorie, politiche e strumenti nel governo delle grandi aree urbane* (*The Metropolis and the Plan. Processes, Theories, Politics and Tools in Managing Big Urban Areas*), Gangemi, Rome, 1990

[36] TREBBI G. (edited by) *La rinascita della città. La trasformazione urbana* (*The Rebirth of City. The Urban Transformation*), Alinea, Florence, 1987

[37] UNWIN R. *La pratica della progettazione urbana* (*Town Design in Practice*), Il Saggiatore, Milan, 1971

[38] ZOPPI M. & Co. *Progettare con il verde*.*Vuoti urbani 2* (*Designing with Green Areas*), Alinea, Florence, 1989

[39] http://www.esteticadellacitta.it

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The Technology of an Early Reinforced Concrete Structure in Turkey: The Great Storehouse of the Kayseri Sümerbank Textile Factory (1932-1935)

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Abstract
The former Kayseri Sümerbank Textile Factory (1932-1935) designed and funded by the U.S.S.R. was among the first large-scaled industrial establishments in Turkey. The so-called Great Storehouse as well as the rest of the complex constitutes an interesting case study as an early example of large-scaled reinforced concrete construction in a provincial center for Turkish and Soviet technological history.
The long and narrow building measuring 135x45m is constructed in four sections with wide spanning axes based on a skeletal system, supported with slender columns and beams. The columns rise 5-6.5m from the original floor level and reach 9m along the raised central nave. The foundations are composed of double layers of square footings joined with tie beams. The partition walls are constructed with bricks while the exterior walls are tuff. All the masonry walls are held together with a weak mortar based on cement, lime and sand, and with steel reinforcing bars placed horizontally in the horizontal courses and tied to thicker steel bars vertically along the columns. Horizontal strip windows located in the upper part of the exterior walls and along the high central nave provide natural light. There are steel hangar doors along the east and west walls in almost each grid as well as two central doorways located on the short east and west façades. The reinforced concrete surfaces are left exposed while the brick walls and the interior surfaces of the tuff walls are plastered.

Keywords: reinforced concrete technology, industrial heritage, modern architecture, construction history, Kayseri.

1. Kayseri Sümerbank Textile Factory (1932-1935)
Following the foundation of the Turkish Republic in 1923, state policies focused on the modernization and secularization of the society at large, public education, socio-cultural development, democratization, industrialization and economic growth. Mustafa Kemal defined this concept as “attaining the cultural level of contemporary civilizations”. The modest national economic growth in the 1920s was cut short when in 1929 the global crisis as well as the Great Depression that ensued took their toll on Turkey as well. Available funds were directed towards industrialization and the development of necessary public infrastructure such as railways as illustrated by the first five-year development plan prepared in 1932-1933 and dated January 1934. [1] The first major investments based on this plan were the textile factories in Kayseri and Nazilli, the architectural and production design for which were developed with U.S.S.R. (Soviet) consultancy and financial and technological aid (Fig. 1).
The Kayseri Sümerbank Textile Factory was not only a major industrial investment but also a socio-cultural one directed at the urban and economic development of a provincial center in Turkey. This was a further boost for Kayseri where various strategic investments were already made such as the airplane factory with German partnership and the tank montage and repair works with Soviet partnership (1926), the Ankara-Kayseri railway line (1927), the Bünyan hydroelectric and carpet yarn plants (1929), and the Kayseri-Sivas-Samsun and Kayseri-Ulukışla railway lines (1930). [2]

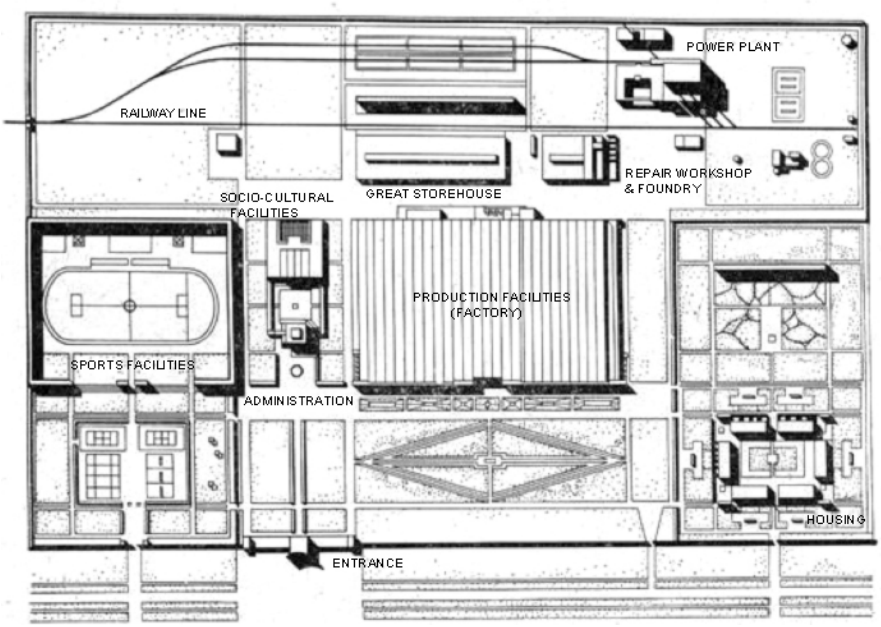

Fig. 1: The original layout of the Kayseri Sümerbank Textile Factory, 1932-1935. [16]

The Soviet experts proposed the textile plant after field studies in 1932. Architect Professor Ivan Nikolaev, who was also one of these experts, became the chief designer of the plant through Turkstroj, a commercial trust founded for this purpose in Moscow in 1933. The 20-year Soviet loan was received in 1934 and the construction of the complex was completed in 1935 by Abdurrahman Naci Bey, a Turkish contractor. [3] There is almost no information about this personality, who undertook such a major project. He was not listed among the contractors and engineers in the yearbooks of the period, such as the *Annuaire Oriental* volumes dated to 1927 and 1928, and the İzmir Guide of 1926. [4]

The complex is located on the northern development axis of the city, close to the railroad. Its total area reached 922,500m^2. The production plant had an enclosed area of 34,262m^2 and the rest of the built area reached 185,000m^2, including administrative, storage, service, and socio-cultural facilities as well as housing for administrative and technical staff and workers. 2,100 workers and 155 administrative and technical staff were employed at the complex when it was completed in 1935. [5]

The socialist influence of the Soviet design is readable in the spatial organization and management; the complex itself formed a metropolis, where the productive, administrative, dwelling, entertainment and training activities were supervised by a central authority. [6] The driving style behind the design is rationalist and functionalist. The early 1930s was a period of transformation in European Modernism and saw the end of the *avant-garde* modernisms, which included utopic and heroic attempts to rebuild a revolution- and war-torn continent and to renew the society. In U.S.S.R. all autonomous professional architectural groups were dispersed excluding VOPRA, which was under Stalin's control in 1932. [7] This marked the abrupt end of Constructivism with all of its social and cultural aspects while the now state-employed architects sought a new and politically correct rationality and standardization in their work. This, in its turn, led to a new style of modern monumental historicist classicism, illustrated by B. Iofan's project for the Palace of the Soviets (1931-1933). Industrial architecture acquired a monumental classicism as well where symmetry and monumentality overrode pure functionalism. The design of the complex in Kayseri belongs to this period of transition, reflecting both the formal monumental classicism and the relatively informal Constructivism in its different parts. (Figs 1, 2) For example, there are similarities to Vesnin Borthers' "housing planning model for Soviet industrial settlements", which reflect the rectilinear, rationalist monumentality in classical proportions. However, the forms as well as the life style presented with these buildings was revolutionary for a closed vernacular urban society such as Kayseri. Many users of the houses and apartments in Kayseri emphasized novelties such as non-stationary furniture, central heating, water, sewage and electricity systems and geometric plans. [8] The simple, small but functional plans of these two- or three-roomed houses may be related with the architectural tendencies and theories of the avant-garde movements of the 1920s and 1930s, such as Soviet Constructivism and the social housing schemes from the Weimar Republic like Ernst May's *Siedlungen* in Frankfurt and his theory of *Existenzminimum*.

In 1996, Turkey decided to cease all production activity in state factories. Kayseri Sümerbank Textile Factory was accordingly closed down in 1999. However, the complex was kept from privatization due to the recognition of its national significance and was allotted to Erciyes University. It was designated as a national monument in 2003 with the effort of DOCOMOMO Turkey. Nevertheless, it was generally in ruins due to

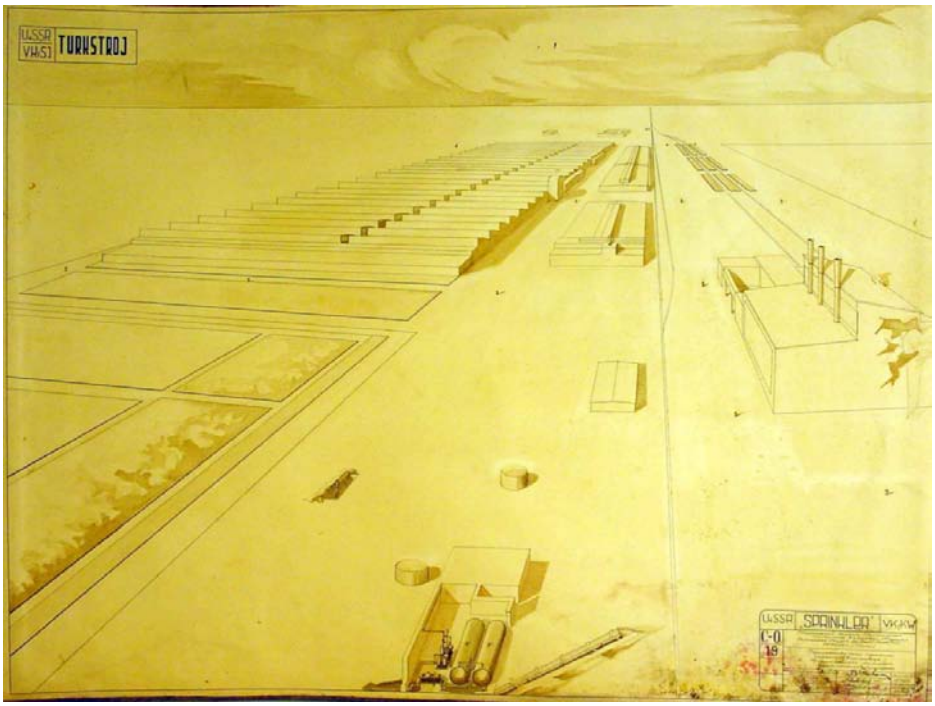

Fig. 2: Turkstroj drawing showing the original layout of the Kayseri Sümerbank Textile Factory, 1932-1935. The Great Storehouse is back center with the Repair Workshop and Foundry in front, the main Production facilities on the left and the Power Plant on the right; the railway line is running at the centre. (Kayseri Sümerbank Textile Factory Archive)

neglect and vandalism when it was allotted to Abdullah Gul University in 2012 to be used as the urban campus of this recently founded institution. [5, 6]

2. The Great Storehouse

The Great Storehouse, designed and constructed with the rest of the complex in 1932-1935, is located on the western edge of the built area along the railway line. The complex was originally organized on a system similar to a modular grid plan, and the larger buildings were located in parallel strips separated by wide alleys. The Storehouse faces the Production Facilities (Factory) on the east and is flanked by the Repair Workshop and Foundry on the north. (Figs 1, 2) Storehouses were added on the west, on the other side of the railway line later in the 1960s. Despite a number of renovations, the Great Storehouse has not been completely altered in terms of its structural system, original materials and construction technology. The only major intervention during the life of the building has been the re-modeling of the plan and spatial lay out of the northern section as a lunch hall for the workers in 1970. During the allocation of the complex to Erciyes University, the southernmost section was renovated as an earthquake research laboratory for the Department of Civil Engineering. This was a severer intervention, and not only changed the original layout of this part of the building but also resulted in the demolition and reconstruction of some of the partition walls and a change in the foundations. (Fig. 3) Nevertheless, the building has survived to our day with a great deal of information concerning the building technology in the 1930s. As a crossbreed between Soviet design and Turkish local manufacture, this is an interesting example, presenting many design principles and construction details of its period.

2.1 The Structural System and Walls

The long and narrow building measuring 135x45m and 6,000m^2 was planned as a single-storey space divided with transversal walls. It is constructed in four sections separated with construction joints, forming a grid of 20 axes separated into four groups of five in the north-south direction. There are no construction joints along the width of the building in the east-west direction. The reinforced concrete skeletal system has wide spanning axes, supported with columns 35x35cm and beams 20x35cm in section. The axes span 550cm in the east-west direction in all of the construction sections. The span differs however in the north-south direction. In the two northern sections, the axes span 590cm in the north-south direction while they span 800cm in the two southern sections. This situation must have been related to the type and size of the goods stored in the different sections. The slender columns rise 5-6.5m from the original floor level excluding the depth of the foundations. The tallest columns in the raised central nave in the north-south direction reach 9m in height. A semi-open colonnade runs along the western side of the building facing the railway. This was probably utilized as a loading and unloading platform for raw materials arriving and the produced goods

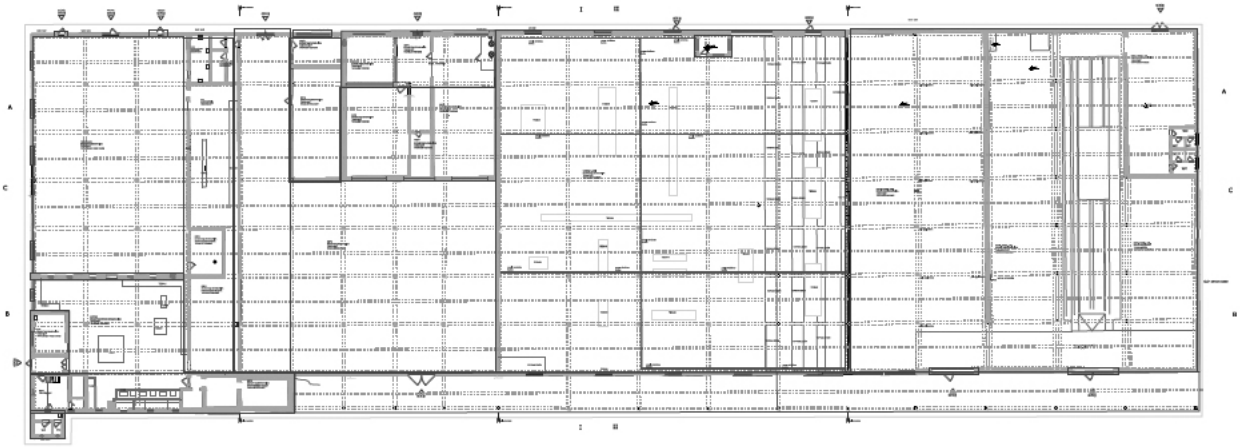

Fig. 3: The Great Storehouse, survey plan, 2012.

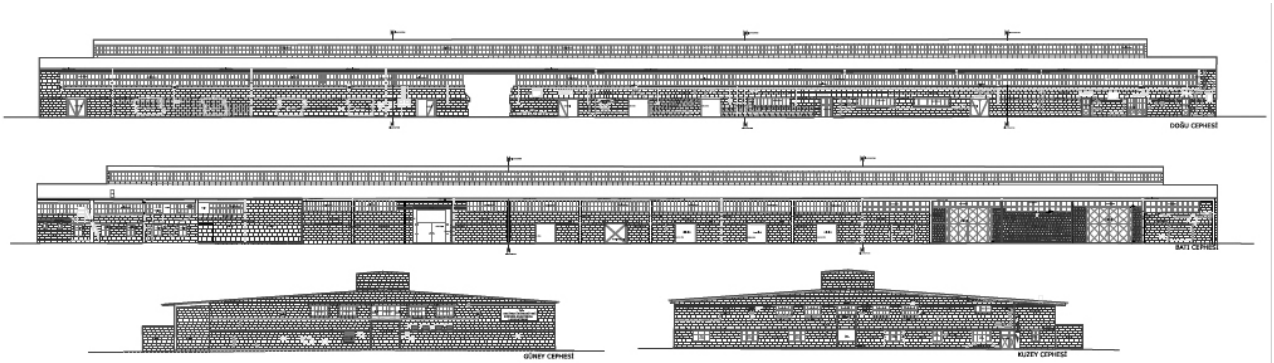

Fig. 4: The Great Storehouse, survey elevations, 2012.

being sent by train. (Fig. 3, 4) The reinforced concrete roof slabs between the beams are 8cm in thickness with cantilever awnings on all sides. The pitching of the slabs in the east-west direction made the construction of a timber roof unnecessary, and the original roof covering was composed of metal sheets as far as it could be understood from old photographs.

The foundations are 1.30-1.45m deep from the original floor level and are composed of two layers of square footings underneath the columns. The top footing measures 80x80cm and the bottom one 115x115cm. They are about 35cm in thickness. There are reinforced concrete joining beams between the footings along alternate axes, measuring 50x35cm. There are unreinforced solid concrete walls between the footings along the axes where there are partition walls, reaching the original floor level in height. These provide a flexible footing for the walls. The spaces between the footings are filled with earth and a simple floor is designed with a rubble stone hard core covered with a cement finish on top, reaching 15cm in thickness. (Fig. 5)

The interior partition walls are constructed with bricks measuring 65x200x100mm. During the survey of the building at least four different brands of original bricks have been identified. The highest quality brick among these is marked “D.K. Büyükdere” on one face and with a bee on the other. These were probably imported from a brick factory in Sarıyer, Istanbul. These are similar in size (except for the thickness) and shape to “bricks, called polished of Marseille, with sunken faces” described by Raymond. [9] However the factory in Büyükdere or the initials D. K. cannot be associated with any of the lists in Raymond or the yearbooks dated to the first quarter of the 20th century. [10] The other three brands that have been identified are rougher in appearance but similar in shape and size. These were marked with simple signs resembling mason’s marks: “R”, “A” and “H” or “ψ”. These could not have been associated with any local or national producers either.

The exterior walls are constructed with local tuff or tufa stone and are 25cm in thickness. The stones were cut and shaped, and left exposed on the outside but left rough on the inside, and the inside surfaces were plastered. The courses were arranged at 24cm and 30cm height, the narrower courses corresponding to the lintels over doors and windowsills. The building stones around Kayseri are generally named after their quarry locations. However, it was not possible to identify the quarry in this case as most of the quarries used in the first half of the 20th century are no longer in use. The building stones have been identified as andesitic tuff, which are exceedingly common, red or brown in color, and contain scoria fragments of all sizes from huge blocks down to minute granular dust. [11] Chemically tuffs are composed mostly of silicates (~70%) and

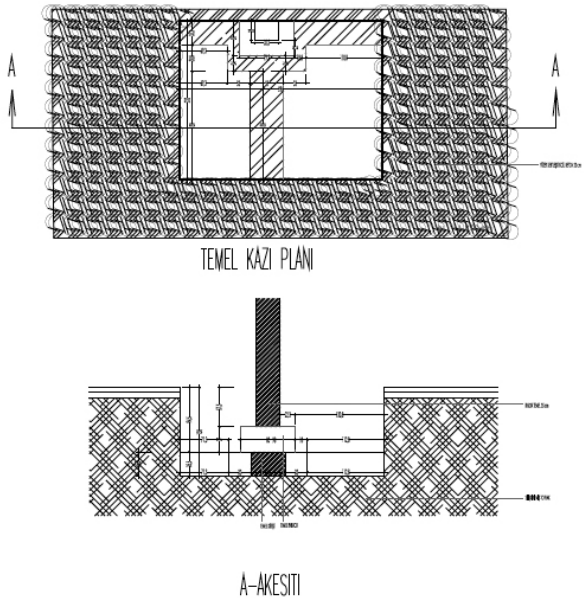

Fig. 5: The Great Storehouse, structural foundation detail, 2014. (İsttasyon Architecture)

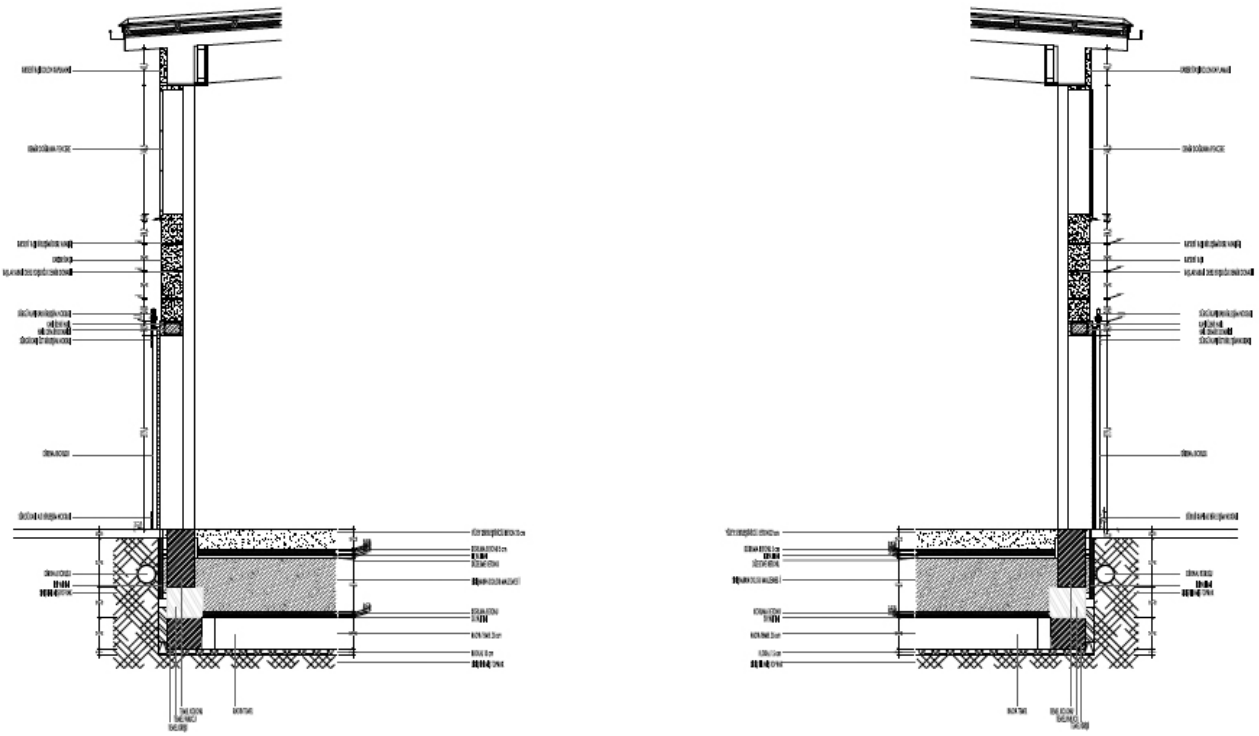

Fig. 6: The Great Storehouse, typical section details, 2014. (İsttasyon Architecture)

aluminates (~15%); quartz, plagioclase and feldspar minerals are visible in thin sections. They are more porous (~20-35%) compared to other types of building stone and thus have lower specific gravities (~1.50) and thermal conductivity values. Their water absorption capacity is high (~9-16%) but so is their drying rate. They are water-logged and soft when quarried but they harden and become lighter as they dry. In terms of mechanical strength, their compressive strength (~30-35 N/mm^2) is lower than that of other buildings stones while their bending (~7 n/mm^2) and shear (~-10 N/mm^2) strengths are comparable with other building stones and higher than those of limestone and travertine. [12]

All the masonry walls are held together with a weak mortar based on equivalent quantities of Portland cement and lime and small sand grains (Ø < 1mm). The extreme weakness of the mortar, illustrated by its breakability by hand, indicates that the cement did not react. The strength of the mortar is very low, and reminiscent of that of a pure air lime mortar without any indication of hydraulic binder reaction. It was possible that unslaked air lime was used with the cement, and that the lime absorbed all of the water in the mortar mixture, leaving the cement grains dry and not able to react chemically. The light color of the mortar matrix suggests that hydraulic additives such as brick or tile dust were not used. Local tuffs and volcanic earths also show puzzolanic activity [13] although tests indicate that it is very low, and they need to be utilized in large quantities to reach the required mechanical strengths [14]. The use of such an additive with the air lime binder might have caused the unusual weakness of the mortar as well.
What holds the masonry units together are the steel reinforcing bars (Ø6mm) placed horizontally at 25cm intervals within the courses between the stones and every other course between the bricks, and tied to thicker steel bars (Ø9mm) vertically along the reinforced concrete columns. This technology has created thin and versatile partition and exterior walls that only carry their own load. Unlike regular masonry, they also have the tensile load bearing capacity against lateral loads like reinforced concrete elements. (Figs 6, 7)

2.2 The Architectural Elements

Natural light is provided through horizontal strip windows located in the upper part of the exterior walls. These are 140cm in height and run along the full length of the east and west façades. The windows are manufactured from T- and L-shaped iron strips. The height of the window is divided horizontally into two and vertically into five equivalent sections. The glazed areas form regular rectangles measuring 65x37cm. Each window frame composed of 5x2 glazed partitions are joined with 6cm iron strips. The windows are continuous along the exterior walls and run in front of the columns and beams. There are special details to ensure waterproofing at the sill and lintel levels. The window frame itself is located at a sligth angle on the exterior façade to let water flow more easily. (Figs 8, 10) This simple framing system has few opening casements.
There are a series of doors along the east and west façades which provided the access of goods. Nearly each grid has an opening. The doors are also made of iron with L-shaped strips defining the edges. Those on the west façade facing the train and loading platform are sliding hangar doors with low ramps outside. They measure 230x230cm, have tracks both at the bottom and at the top, and are hung from large hooks that slide along the top track. Those on the west façade have two opening wings, each measuring 220x110cm, and thus creating 220x220cm squares when closed. (Fig. 10) The doors and windows located



Fig. 7: The masonry units are held together the steel reinforcing bars placed horizontally within the courses between the stones and every other course between the bricks; these are tied to thicker steel bars vertically along the reinforced concrete columns. This technology has created thin and versatile partition and exterior walls.

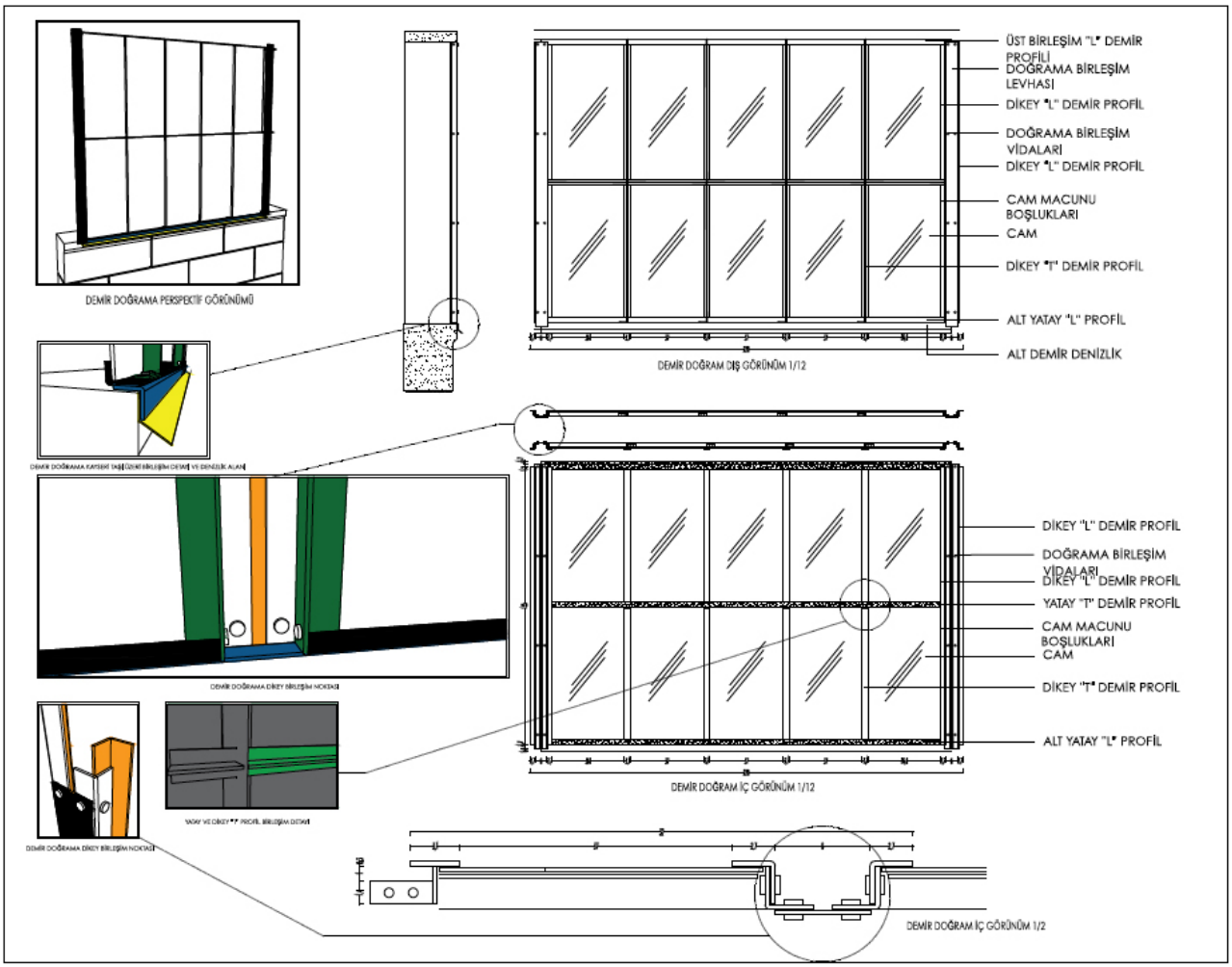

Fig. 8: The Great Storehouse, typical window details, 2014. (İsttasyon Architecture)



Fig. 9: The Great Storehouse, fire alarm bells bearing the words “СПРНКЛЕР / sprinkler” and “Москва / Moscow” in the Cyrillic alphabet, 2014.

centrally on the north and south façades are different in shape and size. This vertically elongated 500x220cm opening was composed of windows on the top and the sides with a door opening at the center. The whole system was closed with iron shutters, similar in design to the door wings on the east façade but probably composed of two giant wings measuring 500x110cm. The original arrangements on the north and south façade have not survived to our day and may only be understood from the traces on the building.

The architectural finishes are generally very simple. The reinforced concrete surfaces of the columns, beams and the roof slab are left exposed, and there is no cladding on the cement finish floor. The brick partition walls are plastered and so are the insides of the exterior stone walls. This plaster is also very soft and

probably lime based, bearing the characteristics of the mortar described above. No trace of the original pointing mortar remains on the exterior faces of the stone walls; this was probably similar to the wall mortar and was not very durable. Service elements like the original fire extinguishing system based on sprinklers attached to the roof slab and with two red bells still bearing the words “sprinkler” and “Moscow” in the Cyrillic alphabet (Fig. 9), electrical equipment such as the fuse boxes and the lighting fixtures appear as the only decorative elements in this purely functional building.

3. Conclusion

The former Kayseri Sümerbank Textile Factory (1932-1935) designed and funded by the U.S.S.R. through the Turkstroj trust was among the first large-scaled industrial establishments in Turkey. This was not only a major industrial investment but also a socio-cultural one directed at the urban and economic development of a provincial center in Turkey. The complex with a total area of 922,500m^2 and a total built area reaching 185,000m^2 including administrative, storage, service, and socio-cultural facilities as well as housing for administrative and technical staff and workers, was in gigantic proportions for its period. The employees reaching 2,500 in number meant that an increase of 10,000 for the city’s population, which was only around 70,000 in 1935 [15]. The complex itself formed a secondary center and metropolis in Kayseri, where all required functions were housed in a self-sufficient manner.

The driving style behind the design is rationalist and functionalist but also monumental and classicist. The early 1930s was a turning point and a period of transformation in European Modernism, and the complex illustrates this period very well with its combination of symmetry and monumentality with functionalism and rationalism, also including certain touches of Constructivism. The forms as well as the life style presented with the complex were certainly revolutionary for a closed provincial urban society such as Kayseri.

The factory complex played an important role in the cultural and economic life of the city as well as the country [3] until 1996, when Turkey decided to cease all production activity in state factories. However, the recognition of its national significance made its preservation possible. It was allotted to Abdullah Gül University in 2012, and has been in a period of transformation since with new functions, identifying, preserving and highlighting its intrinsic architectural heritage values.

The Great Storehouse as well as the rest of the complex constitute an interesting case study as an early example of large-scaled reinforced concrete construction in a provincial center for Turkish and Soviet technological history. The details that have come out during the survey of the building in 2012-2013 as well as the restoration process in 2014-2015 provide a formerly unknown chapter in material and construction history. The laying out of these interesting features will form the foundation for a 20th century technological history of architecture while making comparisons with other period Soviet and European examples possible.



Fig. 10: The Great Storehouse, east elevation and the high central nave.

Bibliographical References

[1] İLKİN, S. Birinci Sanayi Planı’nın Hazırlanışında Sovyet Uzmanlarının Rolü, *Cumhuriyetin Harcı 2 – Köktenci Modernitenin Ekonomik Politikasının Gelişimi*. İstanbul: İstanbul Bilgi Üniversitesi Yayınları, 2004, p. 201-238. ISBN 9789756857656.

[2] BATURYOĞLU YÖNEY, N. Devlet Eliyle Modernizm: Kayseri'deki Kamu Yapıları, Kent Belleğindeki Yerleri ve Miras Nitelikleri Üzerine Bir Değerlendirme, *Kayseri'nin Yirminci Yüzyılı,* B. Asiliskender, B. Ceylan, A. E. Tozoğlu (eds), Kayseri: Abdullah Gül Üniversitesi Yayınları, 2012, p. 31-54. ISBN 9786054658008.

[3] ASİLİSKENDER, B. *Cumhuriyetin İlk Yıllarında Mimaride 'Modern' Kimlik Arayışı: Sümerbank Kayseri Bez Fabrikası Örneği*, unpublished master's thesis, Istanbul: Istanbul Technical University, 2002.

[4] CERVATI, R. C. *Annuaire Oriental du Commerce, de l'Industrie, de l'Administration et de la Magistrature,* Constantinople, 1927; CERVATI, R. C. *Annuaire Oriental du Commerce, de l'Industrie, de l'Administration et de la Magistrature*, Constantinople, 1928; *Ticârî ve İktisâdî İzmir Rehberi*, [reprinted from *Türkiye Salon ve İlanât Gazetesi*, 1926], S. Yetkin (ed.), İzmir: İzmir Büyükşehir Belediyesi Kent Kitaplığı 28, 2002.

[5] ASİLİSKENDER, B. Erken Cumhuriyet Mirası Sümerbank Kayseri Bez Fabrikası Tehdit Altında, *Arkitera e-Bülten / Almanak 08*, no. 189, 2008. ISSN 1303-6874. Web: http://v3.arkitera.com/h29424-erken-cumhuriyet-mirasi-sumerbank-kayseri-bez-fabrikasi-tehdit-altinda.html.

[6] ASİLİSKENDER, B. From Industrial Site to University Campus: Sümerbank Kayseri Textile Factory, *DOCOMOMO Journal* 49, 2013/2, Barcelona: Fundaçio Mies van der Rohe, p. 86-89. ISSN 1380-3204.

[7] COLQUHOUN, A. *Modern Architecture,* Oxford: Oxford University Press, 2002. p. 133-135. ISBN 9780192842268.

[8] ASİLİSKENDER, B. *Modernleşme ve Konut: Cumhuriyet'in Sanayi Yatırımları ile Kayseri'de Mekansal ve Toplumsal Değişim*, unpublished Ph.D. dissertation, Istanbul: Istanbul Technical University, 2008, p. 47-48.

[9] RAYMOND, A. M. *Notes Pratiques et Résumés sur l'Art du Constructeur en Turquie (Contenant 180 Croquis et 15 Planches hors Texte)*, Alexandrie: Typo-Lithogrphie Centrale I. Della Rocca, 1908, p. 192, Fig. 140.

[10] RAYMOND, A. M. *Notes Pratiques et Résumés sur l'Art du Constructeur en Turquie (Contenant 180 Croquis et 15 Planches hors Texte)*, Alexandrie: Typo-Lithogrphie Centrale I. Della Rocca, 1908, p. 250; CERVATI, R. C. *Annuaire Oriental du Commerce, de l'Industrie, de l'Administration et de la Magistrature,* Constantinople, 1909, 1912, 1913, 1927, 1928; *Ticârî ve İktisâdî İzmir Rehberi*, [reprinted from *Türkiye Salon ve İlanât Gazetesi*, 1926], S. Yetkin (ed.), İzmir: İzmir Büyükşehir Belediyesi Kent Kitaplığı 28, 2002.

[11] Web: http://en.wikipedia.org/wiki/Tuff accessed on March 12, 2014.

[12] ÇORAPÇIOĞLU, K. *et al*. *Kayseri Kırsalında Yöresel Mimari Özelliklerin Belirlenmesi 3: Rehber Kitap*, T.C. Bayındırlık ve İskan Bakanlığı Teknik Araştırma ve Uygulama Genel Müdürlüğü, İstanbul: Mimar Sinan Güzel Sanatlar Üniversitesi Döner Sermaye İşletmesi Müdürlüğü, 2008, p. 18-22, 49-53, Table 2.1; ÇORAPÇIOĞLU, K. *et al*. *Kırsal Alanda Yöresel Mimari Özelliklerin Belirlenmesi 5: Proje Raporları*, T.C. Bayındırlık ve İskan Bakanlığı Teknik Araştırma ve Uygulama Genel Müdürlüğü, İstanbul: Mimar Sinan Güzel Sanatlar Üniversitesi Döner Sermaye İşletmesi Müdürlüğü, 2008, p. 35-58, 68-73; ERGUVANLI, K., S. MALİK, *Türkiye'nin Mermerleri ve İnşaat Taşları*, İ stanbul: İ stanbul Teknik Üniversitesi Maden Fakültesi, 1962, p. 132; KOZLU, H. *Kayseri Yöresindeki Tarihi Harçların Karakterizasyonu ve Onarım Harçlarının Özellikleri*, unpublished Ph.D. dissertation, Istanbul: Istanbul Technical University, 2010, p. 50-53; YAŞAR, E. *et al*. Industrial Usage of Nevşehir-Kayseri (Turkey) Tuff Stone, *World Applied Sciences Journal* 7 (3), 2009, p. 271-284.

[13] ÇORAPÇIOĞLU, K. *et al*. *Kırsal Alanda Yöresel Mimari Özelliklerin Belirlenmesi 5: Proje Raporları*, T.C. Bayındırlık ve İskan Bakanlığı Teknik Araştırma ve Uygulama Genel Müdürlüğü, İstanbul: Mimar Sinan Güzel Sanatlar Üniversitesi Döner Sermaye İşletmesi Müdürlüğü, 2008, p. 68, 72.

[14] KOZLU, H. *Kayseri Yöresindeki Tarihi Harçların Karakterizasyonu ve Onarım Harçlarının Özellikleri*, unpublished Ph.D. dissertation, Istanbul: Istanbul Technical University, 2010, p. 55-56, 146, 183-193, 210-212.

[15] Web: http://tr.wikipedia.org/wiki/Kayseri#Demografi accessed on March 20, 2015.

[16] NIKOLAEV, I. *Архитектурная Типология Промышленных Предприятий (Architectural Typology of Industrial Enterprises),* Moscow: Stroyisdat, 1975 (reprinted 2002).

HERITAGE and TECHNOLOGY
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Fedele Fischetti and the Gallery of the Casino of Carditello

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Abstract
The estate of Carditello and its Royal “Casino” is considered one of the most beautiful and architecturally refined "Royal Delights" made by King Ferdinando of Borbone House. Much loved by the king, he commissioned - from the spring of 1784 - the creation of comfortable rurals needed to housing the animals, processing the products, and homing his staff. From 1787, the work began on building up the small “Casino” designed by Francesco Collecini. Fully furnished, the Real Site made a display of beautiful curtains, a rich art gallery and a multitude of books, as documented by the first inventory of the site, drawn up immediately after its completion in 1792. In the official documents called *Amministrazione di Carditello e Calvi - Conti e Cautele (Administration Carditello and Calvi - Accounts and Cautions)*, preserved in the archives of the Royal Palace of Caserta, there are various proves that attests as to the payments of works done at the apartment of the king in "Cardito" by Fedele Fischetti, and thanks to them we have reconstructed the existence - in the gallery Casino - of works by the Neapolitan Fischetti. The Gallery of the Casino Carditello, the main hall of the building was commissioned and meant as the more opulent and rich space in the apartment where Fedele Fischetti frescoed the vault, drew the preparatory models of tapestries and perhaps prepared the designs for the magnificent and expensive furniture of French production.

Keywords: The Royal Casino of Carditello, Bourbon House, Fedele Fischetti, Neapolitan painting of the late eighteenth century, the Historical Archives of the Royal Palace, (archival documents)



D'Anna, *Veduta del Real Casino di Carditello*, Napoli Museo di San Martino

1. Introduction

From the study of some archival documents found in the Historical Archive of the Royal Palace of Caserta, in particular in the archivegroup called Administration Carditello and Calvi - Accounts and Cautions, can be traced the payments of the work done at the apartment of the king in the royal site of Carditello by the Neapolitan painter Fedele Fischetti. By analyzing them, we reconstructed the existence - in the Gallery of the Casino –of a Fischetti's real body of work.

Made by Ferdinando of Borbon House the Carditello estate, the Casino Royal is considered among the most beautiful and architecturally refined "Royal Delights", it is located in a vast flat territory belonging, to the family of the Earl of Acerra Ferdinando III de Cardenas [1]since 1628.

The Site in "Terra di Lavoro", (Earth Work) not far from the town of San Tammaro (CE), was considered by Charles of Borbon House especially suitable to perfecting the breed of horses [2]. Since 1744, «took it in busy for 2800 ducats»[3].

Ferdinand IV continued the paternal project extending the estate with various territories, "either by purchasing them or taking advantages of the rights that the laws granted him" He loved Carditello and from the spring of 1784 [4] commissioned the creation of a comfortable rural needed for housing animals, processing of products and the homes of staff [5]. In 1787 began the building up of the small Casino Royal, designed by Francesco Collecini (Rome 1723 - Caserta 1804) [6]. The royal apartment which is centrally located, is flanked by buildings devoted to agriculture and farms, all peculiarity from the Bourbon style. Also this royal residence - as occurs in San Leucio, but in a completely different field - sees the coexistence of farmers, dairymen and farmers in the same space of the apartments of the sovereigns. In five years, from 1787 to 1792, the works in the Casino of Carditello were completed.

The classically decorated facades gave it, then as now, a harmonic vision. Fully furnished, the Real Site flaunted of precious curtains, an extensive art gallery and a multitude of books, as is documented by the first inventory of the site drafted immediately after its completion: the " General Inventory Of the Royal Site of Cardito hand fulfilled on May 25, 1792 Real Casino of Carditello "[7].

The German painter Jacob Philipp Hackert was entrusted with the art direction of the decoration and furnishings of the Casino of Carditello, a clear sign of a change of taste in the Neapolitan culture, which marked the last two decades of the eighteenth century. Taking into account the primitive idea of creating Carditello as a "possible dream", a proper model farm for agricultural cultivation and breeding of fine breeds of horses and cattle, the only leitmotiv of the entire plant decorative was a rural world and hunting.

He influenced many painters of yet rococo style, some of which were his valid collaborators in the decoration of Carditello including painter Fedele Fischetti (Naples, 1732-1792), already author of pictorial cycles the Royal Palace of Caserta and San Leucio. He - who grew up in Naples and was tought by Francesco De Mura and Giuseppe Bonito,may have completed his training in Rome, and came to be "the exponent of an artistic synthesis that will comply with increasing success to international trends advocated especially by Queen Maria Carolina".

His work at the palace of Caserta, in Carditello and elsewhere are the best testimony of a progressive and happy adjustment to the changes introduced in the Caserta plan environment not only by Mengs, but also by a number of painters associated with German and international artistic culture [8]. Luigi Vanvitelli himself judged his painting "tasteful, witty in the inventions, with the union of many qualities" [9]. He was among the few who enjoyed the Neapolitan court's preferences for its ability to combine some aspects of local tradition with recent instances of late Baroque classicist. He enriched his language with inserts taken from the examples of figurative painting of Pompeii and Herculaneum, which in those years come to light, made with a rich palette of the preciousness of color ranges.

2. The decoration and furnishings of the Gallery of Royal Casino

The Gallery of the Casino Carditello - in the central part of the apartment on the south side - is the main hall of the building. Willed as the most opulent and rich environment of the entire apartment, is presented with valuable tapestries on the doors: the hangings of the six «were draperies at the windows of *amuer* green, each consisting of three parts decorated with yellow silk fringe, composed of two parts made of *amuer* violet» as is it can clearly be seen from the 1792 inventory.

Ferdinand – respecting his predecessors' taste -his grandfather Philip V of Spain and his father Charles - decided that the gallery's walls were to be decorated with tapestries, and with a spirit of exaltation of the Bourbon dynasty and the virtues of his ancestors, he therefore dedicated this cycle to the stories of Henry IV of Bourbon King of France, founder of the dynasty (King of France and Navarre Pau, 1553- Paris, 1610). Exclusively for this environment and for the bedroom, he also chose - next to the furniture Neapolitan manufacturing–a magnificent and expensive furniture of French production, now exhibited at the Museum of Capodimonte, Naples.

Ferdinand IV also commissioned in 1791 [10] the luxurious furniture to the French traders who in those years were committed in various European royal residences - the *Marchands-Merciers* of rue Saint-Honoré in

Paris: Dominique Daguerre and Martin-Eloy Lignereux. [11] . This furniture, now in the National Museum of Capodimonte in Naples, already assigned by Palacios in 1979 to Francesco Girardi, author of the restoration carried out in 1800 after the damages suffered in the revolution of 1799, is today attributed by the same scholar at George Jacob (1739-1814). Regardless of who is the craftsman who made the original furniture gallery, what is interesting to clarify to whom is the invention attributed, to the architect Collecini, to Fedele Fischetti, or even to the same Hackert.

For the central and symbolic space decoration of the Gallery, were commissioned to Fedele Fischetti both pictorial models (now disappeared) of the series of tapestries destined to decorate the walls, and the ceiling fresco. Of the pictorial models we find a thorough description in "Carditello Real Site Genera Inventory of 1792", and the expert opinions of payment, which shows the list of paintings and painted panels above and serve for models of tapestries, at the Real Neapolitan Tapestries with the direction of Pietro Duranti, in 1791 (the tapestries, silk and wool, are on display - along with the furnishings mentioned - at the Museum of Capodimonte inv. Carditello of 1911-12, n. 8-13).

The documents bring us a description of the subjects and show us the characters depicted in the events that narrate episodes from the life of King Henry IV of France; in a note of 1796 relative to the paintings of Fischetti used as a model of the tapestries, becomes clear the identification of subjects and places: *King Henry IV is reconciled with the minister Sully*; *Three Knights lost in the Woods, which will find the King; King Henry IV is lost and encounters a gamekeeper in the woods*; *The king in the kitchen of woodsman; The king recognized in the kitchen of woodsman; Henry IV receives the minister Sully who welcomes his return before the courtiers.* Events that tell "steps" of his significant rise on the throne, as it is said in Voltraire's youthfull poem[12] *The Henriade* published in 1728, in which he recounts the events of Henry IV and the religious conflict between Catholics and Calvinists. Henry is told bewildered in search of the road to take in order to restore peace in France. He was always supported by his trustworthy friend the Duke of Sully, who, in 1523, advised him to convert to Catholicism to become King of France and bring peace to the kingdom. The tapestries, therefore, lead us to the knowledge of the protagonist of the whole decoration of the gallery so as to fully understand its exaltation of celebration at the center of the fresco.



Georges Jacob (attr. To, custom Daguerre and Lignereux), armchair, mahogany carved and sculpted with tapestries of the Royal Tapestry Factory ca. 1792, Naples Museum of Capodimonte

3. The ceiling fresco, last work of Fedele Fischetti

Fedele Fischetti realizes his last working the vault of the Gallery, before his death which took place in Naples January 25, 1792 [13], he carried out "just before the events of the Neapolitan Republic were to push to fleeing international ambassadors, worldly adventurers, collectors, artists, travelers and men of study that had made in the previous decade, the court of Ferdinand and Maria Carolina, the most extraordinary cosmopolitan limelight end of the century, and as is came out, from an artistic standpoint, the most advanced experimental laboratory of those years »[14].

The Fresco painter enhances the dynasty represented by Charles and Ferdinand - "... greater part of the Bourbon branch of Naples ..." and the birth of the Bourbon House dynasty [15], this issue is only represented here with regard to the Bourbon House Neapolitans Royal Sites: "the peaceful world symbolized by the two rainbows - parallel to each other – symbolize the Bourbons of Naples and then the founder of their dynasty" [16] Henry IV of Bourbon. With the expertise of the fresco of Fischetti of May 1791, signed by Tischbein, Hackert and Collecini, the whole iconography of the work be comes clear: «Apotheosis of a fourth Errigo enriched with various virtues, and Allegorical figures, together with the descendants of Bourbon ', the latter represented by the group of bystanders where we recognize: first, Ferdinand IV of Bourbon, then reigning, Charles III of Bourbon founder of the branch of Naples and Philip V of Bourbon founder of the branch of Spain, wearing cloaks, bearing gifts and the scepter, but they do not wear the crown.



Fedele Fischetti, *The Apotheosis of Henry IV*, fresco on the ceiling of the Gallery of the Real Casino of Carditello, particularly

«Ferdinand is also depicted with a sword and a book, symbolizing that his government is founded on justice and wisdom; he is in the foreground because his kingdom is present, with an eye toward the virtues and glories of its founder, Henry IV, while both the father Carles, and the grandfather Filipp look at Ferdinand, as if to indicate him as the designated heir». With their other two characters that complete the descendants of the Bourbons house: the first on the far left - with youthful features - and the other, slightly detached from the group, represented in old age, both dressed in seventeenth century style. The study of the iconography of the tapestries allowed us to identify the young person on the left as Henry III of Valois [17] –the last member of the Valois dynasty - King of France under the name of Henry III from 1574 to 1589 (when, August 1st was stabbed at the hands of the Catholic League). In the same year Henry III took over – being the presumptive heir after the death of the Duke of Anjou - Henry IV of Bourbon, King of Navarre, officially acclaimed in Paris - only in 1594 - after Huguenot recantation of the faith: ascends the throne the first king of the Bourbon branch of the Capetian dynasty. Henry III, therefore, is represented in the act of deposing the crown offered to him by "winged boy" and pointing with hand at his successor, Henry IV: the future of France and the Bourbon dynasty. In the fresco Gallery of Henry IV is represented: in a plane slightly back to the group of sovereign, at the far right with the scepter, the crown and the royal coat, as a clear ecstatic attitude, ready for ascension. He begins to walk the "path of light", to undertake the path towards glory. Fedele Fischetti built his work starting on the left with an enchanting female figure, draped in a regal coat, claiming in her left hand a sort of trumpet; behind her is placed an architectural floor plan, maybe a temple. The woman's face is turned towards the observer, while the right index indicates the protagonist of Ascension bathed in light; at her feet, the painter puts the tools the symbolize all the arts [18]. All Liberal Arts are closely juxtaposed to a cornucopia, symbol of abundance, overflowing with buds, leaves and ripe fruits, pomegranates both closed and open, pears and apples, grapes and so much a branch with ripe cherries. Fruits and plenty symbolizing the Campania Felix beloved first by Charles and then by Ferdinand: a clear will of the Bourbon kings to present themselves as reformers, protagonists of the Age of Enlightenment in a land still ruled by rigid patterns and laws of feudal legacy, where their initiate innovations that express broad cultural openness.

Many of the symbols described above reflect on obvious references to Masonic culture [19]. Freemasonry during the seventies of the eighteenth century was largely rooted in the southern areas of the aristocracy, fully supported by Queen Maria Carolina: so it can be assumed that the female figure in the foreground, which appears to be wrapped in a royal coat, is identifiable with the Queen herself, who - through her support to artists and nobles at the "Lodge of Free Masons" - she would be one of the "authors" of the new and good Bourbon government.
The merits that led Henry to that elevation are identifiable in the group on the right. The symbolic figures and the same tools that are prominent, confirm that Henry, has exercised "justice", has joined the people with the example of "righteousness, "temperance" and "fairness". These virtues are represented by a female figure holding a pair of scales in her right hand, with here left she embraces a Roman bundle. Henry has also conquered and loved "beauty", represented by the swan that is always close to virtue, because beauty is born from the union of all the virtues. Along the frieze of the fresco are read "six groups of genii with birds ', in particular - just below the depiction of the Liberal Arts - we can see a winged figure, which feeds a swan, representation which refers to the classic iconography. The painter Andrea Chelli, in 1791, performed in Lamia gallery "a painting of architecture consisting of a penthouse with various part of pillars, and smashed and several ornate carvings" [20].
Next to the image of Justice stands acrowned woman with a scepter in her hand, perhaps one of the Fates, namely Clotho, the spinner or perhaps Queen Maria Carolina herself; beside her there stands the figure of a lion, the symbol of "fortress". A large gap does not allow us to complete the reading (you can see only a winged figure holding up a trumpet) characterized by a particular color scheme where yellow, burgundy and green highlight the monumental figures, wrapped in a bright light and diffuse.
In the highest part of the time there is a winged and crowned genius, perhaps representing Victory, here a figure with the head surrounded by a laurel crown. Henry is conducted towards this group, as with his deeds, his policies of peace and tolerance, has reached the supreme beauty, which coincides with "wisdom". Its merit is that he created a dynasty, he laid the foundations for a history of good governance and justice, he is destined for the Apotheosis, the Gloria. At the base of the group is placed a burning bush with the Phoenix: sacred bird, which is always reborn from its ashes: the Apotheosis is thus synonymous of Immortality conquered by Henry IV and hoped for all the kings of his dynasty.



Fedele Fischetti, *The Apotheosis of Henry IV*, fresco on the ceiling of the Gallery of the Real Site of Carditello, 1791.

4. Conclusions

The fresco on the ceiling of the gallery Carditello is in my opinion one of the most outstanding examples of the ability shown by Fischetti to reconcile, in old age, instances of local characters and decorative demuriana tradition of ancestry with new and recent classicist elegance from “batoniana” and “mengsiana” style. A document of the inclination gained by the painter - in the eighties - to balance the decoration and bright light of rococo style with European classicism. «The costumes of the protagonists of the images are of Fischetti neoclassical, and although in their general approach" there is a strong German touch", as would Vanvitelli say, a very individualized zest for life and anempathic freshness animate an elegant and cultured painting, which is the emblem of the Neapolitan street to the classicism of the century »[21].
So to Fischetti is given the task to symbolize the celebration of the House of Bourbon in that place, the Gallery in the Casino Royal Site of Carditello, which is undoubtedly the most shining symbol of the "enlightened" monarchy and of that "good governance "which - through the modernization of agriculture and farming - would bring wealth and prosperity to the people.

Bibliographical References

[1] CAPORALE G., *Memorie storico-diplomatiche della città di Acerra e dei Conti che la tennero in feudo,* Napoli, 1890.
[2] ALISIO G., *I siti reali dei Borbone*, Napoli, 1976.
[3] Archive Royal Palace of Caserta (hereinafter ARC), *Plataea the Royal Site of Caserta formed by order of S M. Francis I, Chief cavalier Sancho*, vol. IV State Carditello and Calvi, v. 3571, post 1834. The document contains general descriptions of the Royal Site of Carditello and existing buildings in the same.
[4] In the fund called *Administration Carditello and Calvi - Accounts and Cautions*, kept at the ARC, shows expenses of the workers, the technical expertise of the work done and the contracts. The numerous documents allow us to identify the different workers involved; see. MIGLIACCIO L., *Rivisitando Carditello. Nuove acquisizioni archivistiche*, in *“Bollettino di informazione: tutela, restauro, contributi, iniziative, mostre, manifestazioni”*, n. 4, Caserta 1998.
[5] IACONO M.R., *La reale tenuta agricola di Carditello: fonti archivistiche* in, *Un elefante a corte: allevamenti, cacce ed esotismi alla reggia di Caserta*, Napoli 1992.
[6] SERRAGLIO R., *Francesco Collecini. Architettura del secondo Settecento nell’area casertana*, Napoli 2001 and references cited therein.
[7] ARC, *General Inventory of the Royal Casino of Carditello, the Casino of Cavallerizze, and the Tower of St. Anthony*, , b. 34a, f.7, year 1792; see. DIANA A., *Il Real Casino di Carditello di Ferdinando IV: gli arredi-gli arazzi,* in“*Siti Reali e Territorio*”, rivista Soprintendenza BAAPSAE di Caserta e Benevento, numero speciale Carditello, Roma 2014, and MIGLIACCIO L., *Appendice documentaria*, in“*Siti Reali e Territorio*”, rivista Soprintendenza BAAPSAE di Caserta e Benevento, numero speciale Carditello, Roma 2014.
[8] LATTUADA R., *La pittura napoletana nei suoi rapporti con Luigi Vanvitelli e la corte di Caserta*, in *Casa di Re*. *Un secolo di Storia alla Reggia di Caserta 1752-1860,* (a c.d.) CIOFFI R., Milano 2004, p. 95
[9] SPINOSA N., *Luigi Vanvitelli e i pittori attivi a Napoli nella seconda metà del Settecento. Lettere e documenti inediti*, in *Storia dell’Arte*, 14, 1972, p. 208.
[10] DIANA A., *Il Real Casino di Carditello di Ferdinando IV*, in *“Siti Reali e Territorio”,* cit. p.32; PALACIOS A. G., *Nostalgia e invenzione, Arredi e arti decorative a Roma e Napoli nel Settecento*, Milano 2010, p. 124.
[11] The greater marchand-mercier Paris, Dominique Daguerre (? - London 1796) was associated, since 1772, with the famous merchant Simon- Philippe Poirier at the store site in the rue Saint-Honoré, A la Couronne d'or, where he provided the courts and the aristocracy of half Europe. Sole proprietor of the shop in 1777, since 1787 he visited London to open a shop of Sevres porcelain.In May of 1789 with a contract of association with Martin-Eloy Lignereux (1750-1809). Daguerre sensed the climate in France after the fall of the Bastille and the relentless fall of the ancien regime, therefore began to take the necessary steps to expand its business outside France. The career of our merchants that we can define extraordinary, for they are the first merchants of luxury at the court in Paris and within the Russian and English empires Their prices and their taste was considered exceptional and the secret - in the tradition of Poirier –was that of using only the most precious materials and the collaboration of the best architects of Paris, such as cabinetmakers Martin Carlin and Adam Weisweiler and bronze workers Pierre Gouthière and François Remond.
[12] *The deeds of Henry IV*, in the original language of Francois Marie Arouet The Henriade de Voltaire (Paris 1694 - 1778 therein). Youthful poem, published clandestinely and in abbreviated form in 1722-23 under the title "La Ligue ou Henry Le Grand ..."

[13] A signature of Wilhelm Tischbein, Philipp Hackert and Francesco Collecini - dated May 2 1791- is the skill in which «rating for 2600 ducats the frescoes by Fischetti in Lamia gallery casino Carditello, depicting the Apotheosis of Errico IV». ARC, series *Administration Carditello and Calvi*, v. 622, f. 9, v. 623, f. 40-41, already in MIGLIACCIO L., *Rivisitando Carditello. Nuove acquisizioni archivistiche*, cit., p. 79, nota 33.
[14] MAZZOCCA F., *Un'officina internazionale: artisti stranieri alla corte di Ferdinando IV e Maria Carolina,* in *Casa di re*, cit. p. 121
[15] ACTON H., *I Borboni di Napoli*, Milano, 1960; G. Coniglio, *I Borboni di Napoli*, Milano, 1999.
[16] DIANA A., *La nascita della dinastia borbonica nella volta della Galleria di Carditello*, in "*Siti Reali e Territorio"*, cit.
[17] (September 19, 1551-1589) son of Catherine de' Medici and Henry II. With the religious war broke out in France between 1562 and 1598, after the Edict of Amboise and the events of the night of St. Bartholomew, we are witnessing the so-called "War of the Three Henrys", an internal conflict that between 1585 and 1589 involving Henry III, Henry of Guise (voice of intransigent Catholicism) and Henry of Navarre, a Huguenot and, later, the first representative to the throne of the Bourbon family. The events of the conflict, which will murder Henry of Guise and Henry III, will be resolved only with the promulgation of the Edict of Nantes in 1598. The civil and religious war that divided France between 1562 and 1598 was one of the most dramatic religious wars that plagued Europe in the sixteenth and seventeenth centuries. Consequence of the Lutheran Reformation, and especially Calvinist, the war between Huguenots and Catholics that occurred in France, also represented a conflict between political factions for the control of the country and one of the most significant moments of the process that led to the formation of a state.
[18] «Almost to specify that the Bourbon dynasty was not born by chance but was the result of a "higher" project, wanted by the true "Light", which refers to the female figure as a witness signifier: architecture (team, compass and levels), sculpture (hammer and chisel), painting (palette and brushes), science (globe and telescope), knowledge (an open book and another closed) and the art of war (a sword and a helmet)».
[19] «Obvious references to Masonic culture are: the signs of the zodiac, the number five, the numbers of the Bourbon kings represented, the book, the acacia branch, the temple. In particular the construction of a temple ideal based on the exercise of virtue - whose design is inspired by that of King Solomon in Jerusalem - is one of the ultimate goals of the ideology and commitment of Masonic Masons, as it is known, is the building of the temple the ideal of their existence, a temple that was to be built through the exercise of reason, the practice of virtue and brotherhood » in A. Diana
[20] ARC, series *Administration Carditello and Calvi*, v. 622, f. 38
[21] LATTUADA R., *La pittura napoletana nei suoi rapporti con Luigi Vanvitelli e la corte di Caserta*, cit., p. 95. STRAZZULLO F., *Le lettere di Luigi Vanvitelli della Biblioteca Palatina di Caserta*, vol. II, p. 459, letter n.707.

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Contemporary design drawings as cultural heritage: interpretation and communication. Towards a digital archive of Rosani's industrial projects.

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Abstract
Contemporary design drawings represent an immense and quite complex cultural heritage to be interpreted, communicated, preserved and publicised. Digital technologies - and the convergence they provide - have much to offer, for example in safeguarding the iconographic heritage ascribed to the field of so-called minor architecture, otherwise in danger of oblivion.
Among the prerogatives of digital representation, archive drawings could be used to create models, animations and dynamic interactive exploration tools, which could then be applied to selected examples. This methodology would allow us to reconstruct different design hypotheses, to break down buildings into thematic interpretations and to provide access to otherwise inaccessible buildings.
This essay intends to develop these considerations and to propose applications for digital technologies in relation to the Rosani Industrial Architecture Studio Archive, our case study. The Rosani Architecture Studio was founded by Nino Rosani, who received his training in the technical department of the Lancia automobile company in Turin, and later taken over by his son Paolo.
In continuity with Nino's prior experience, the studio was mainly involved in projects for major and medium-sized industries based in Italy and abroad. It obtained prestigious assignments and collaborated with several masters of contemporary architecture, such as Giò Ponti on the design of Lancia Office Building in Turin (1954-'57).

Keywords: 3D modeling, digital animation, design drawings, digital archive, Rosani's archive

1. Introduction (Roberta Spallone)
Architectural design archives of the 20th century are probably the latest and the hugest collections of architectural documents on paper. Their conservation depends largely on the discovery, analysis, comprehension and interpretation of their value as a useful heritage to understand the historical-architectural period in which they arose and to preserve their memory.
Knowledge is so the motive to their safeguard, study and communication.
Archives produced by great masters of the XX century are usually digitized: their drawings on paper are shared in the web at scholars' disposal, although the limits due to the low quality of photo-reproduction and visualization, to the shortage of tools of digital archives for measure and scale, and to the lacking standardization of metadata. In case that archives were produced by the so-called "minor" architects, even economic reasons related to the preservation and the dissemination become often unchallengeable. In this way, too many drawings – as in the case-study of this paper, risk the oblivion because they are unknown, usually roughly catalogued, lost in storages in public and private institutes, like the case-study of this paper, which consists of 138 linear meters of documents (as stated by the *Sistema Informativo Unificato delle Soprintendenze Archivistiche SIUSA*), guarded in the Laboratorio Beni Culturali (Cultural Heritage Laboratory) at the Politecnico di Torino.

Doing choices up against such hefty collections is essential regarding projects to be enhanced, contriving a real narrative process that could reveal the interpretation of the architect's work in its entirely by an accurate exam of the sources. Such enhancement could take advantage firstly of the graphical analysis tools towards a deeper knowledge of geometrical, proportional and modular matrices of the projected building, secondarily of the three dimensional modeling as opportunity of synthesis and geometrical, architectural and thematic interpretation. Furthermore, the possibility to create itineraries around and inside the virtual model or, even more, to allow users free explorations could give fresh views of the object.
The digital reconstruction could be referred to works considered emblematic or exemplar within the architects' activity, or to buildings that have been demolished, transformed or unfaithfully realized in comparison with the original design idea, even to inaccessible structures because of their use – in the case of industrial buildings such problem is particularly considerable. The different morphological hypothesis regarding previous phases of executive processing could be evaluated and explored, even contemplating their territorial impact.
The case study and digital strategies for its conservation, interpretation and communication are the subject of the PhD thesis by Francesca Paluan, supervised by prof. Roberta Spallone and prof. Chiara Aghemo.

2. The state-of-the-art: digital archives (Francesca Paluan)

Archives created by architects and engineers since the 20th century are unique and significant sources for scientific research, in relation with multiple disciplines: history of architecture and representation, conservation, urbanism and landscape. If they are considered from the strict archival point of view, they belong to the wide category of private and professional archives, upon which the Archival Superintendences apply protection and safeguard activities.

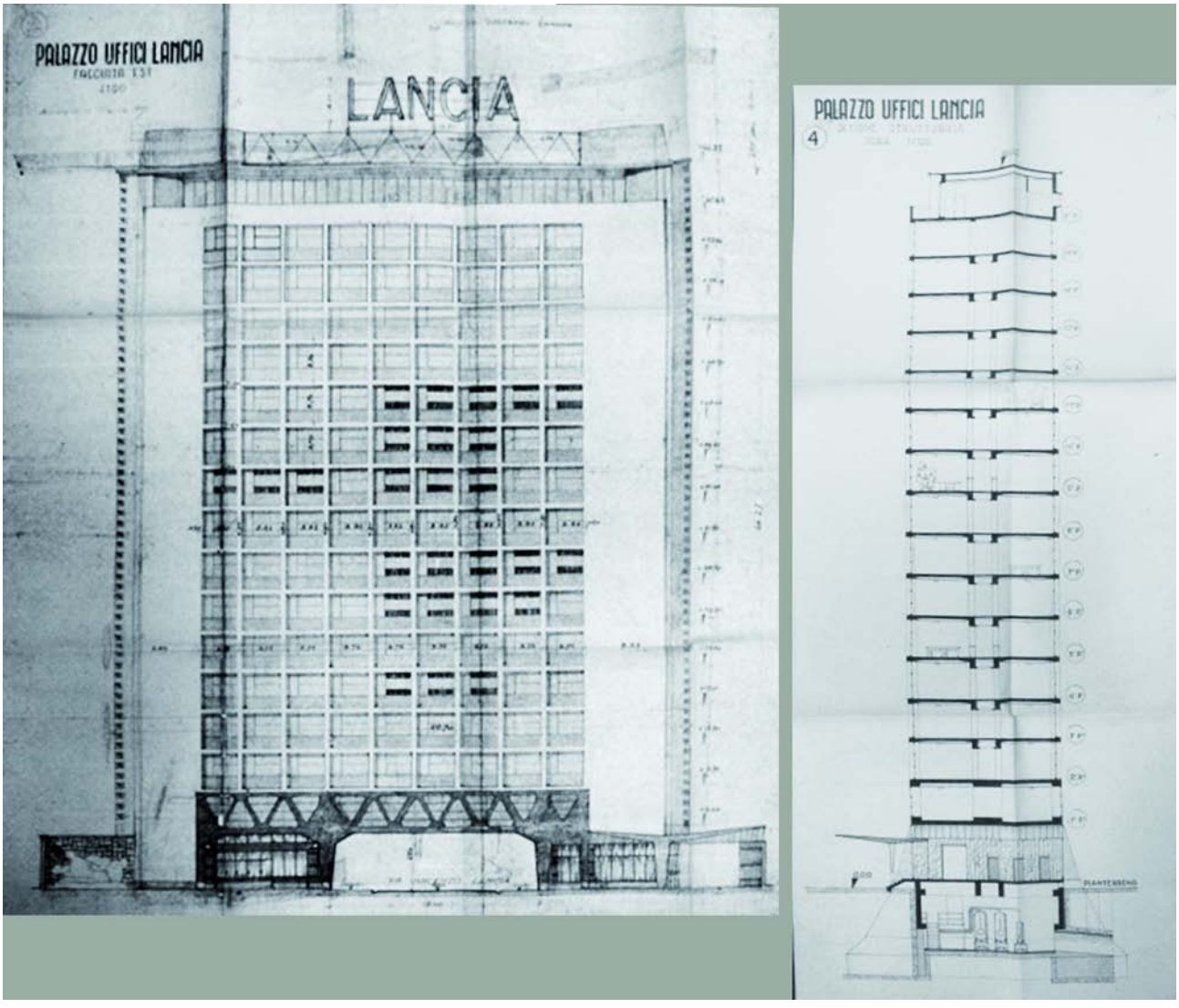

Fig. 1: Lancia Office Building, 1954, elevation and cross section (Laboratorio Beni Culturali - Politecnico di Torino)

Contemporary architectural archives constitute more than a documental heritage, recently recognized and validated: the first exhaustive and persuasive definition of “Architectural document” was formulated only in 1982, in which clarification architectural drawings belong to [1]. Since the end of the Seventies, effectively, the principal North-American and North-European institutions engaged in the knowledge and diffusion of Architecture are working hard and more carefully into conservation and enhancement of contemporary planning drawings, which need specific standards for their description, preservation and fruition guaranteed by international associations, like the ICAM and the ICA since 1979.
The materials collected in contemporary architectural archives, in their physical components and iconographical message, constitute a heterogeneous documentation, whose analysis is sometimes too complicated. The use of traditional materials is associated to the employment of new supports, like polyester and acetate films; the iconographical message is also devolved to different graphical techniques, from the most conventional ones - like inks and lead - to the more recent ones - like halftone screens. Furthermore, architectural archives include an overloaded, and sometimes redundant, *corpus* of copies, coming from the need to modify the project and to show it to the different subjects involved in the realization of the building. The traditional techniques of reproduction, like the use of the contact paper upon which the drawing is retraced, have been supplanted by the recent techniques of photo-reproduction making possible the mechanization of the copying process.
Contemporary architectural archives, as a documentary evidence, contain relations which cannot easily be read and contextualized because of the documents organization: documents often find a collocation threatening and making difficult the analyses of the planning path because of the archival necessities, the lacking adequate spaces and the archival bound defined by the producer. According to the archival science, giving a new order to documents is forbidden even if it could be helpful for their analyses, so the use of digital databases allows the contextualization of the archival data, in order to elaborate information and acquire relations. The digital database runs at microscopic scale, when it is applied to the archival unit containing the single project; at macroscopic scale it makes possible some inconceivable operations within analogical archives: the cross research and the connection between different documents and archives.
The digitation of contemporary architectural archives becomes one of the best practices of sources communication, making possible the visualization of the original documentation through remote mode, and of the preservation, reducing direct manipulation. This process has been started since the beginning of the 21th century by institution preserving contemporary architectural archive, that have benefited from this way: low cost for the digital documents production; the sharing of sources to a wider public; the possibility to underline relationships inside and outside the archive group. However, the use of digital images not always pledges a high definition during the images visualization, inducing the loss of resolution and relationship between scale and content, and problem of orientation. The digitation, moreover, supposes a constant update for data, software and hardware in order to prevent the continuous, inexorable and inevitable process of technological evolution, from which organizations and individuals cannot escape without risking the loss of accessibility of contents and the guaranties of the sources integrity.
The digitation of architectural archives is also a favorable management methodology to the new policy of sharing documents, but digital archived appeared ten years later the use of automatic design software in architectural firms. Digital files risk to remain silent if they are not translated in the analogical form as physical traces, or if their format is not changed into others more popular *(.pdf*, *.tiff*, *.jpeg*, *.png*) or they need a

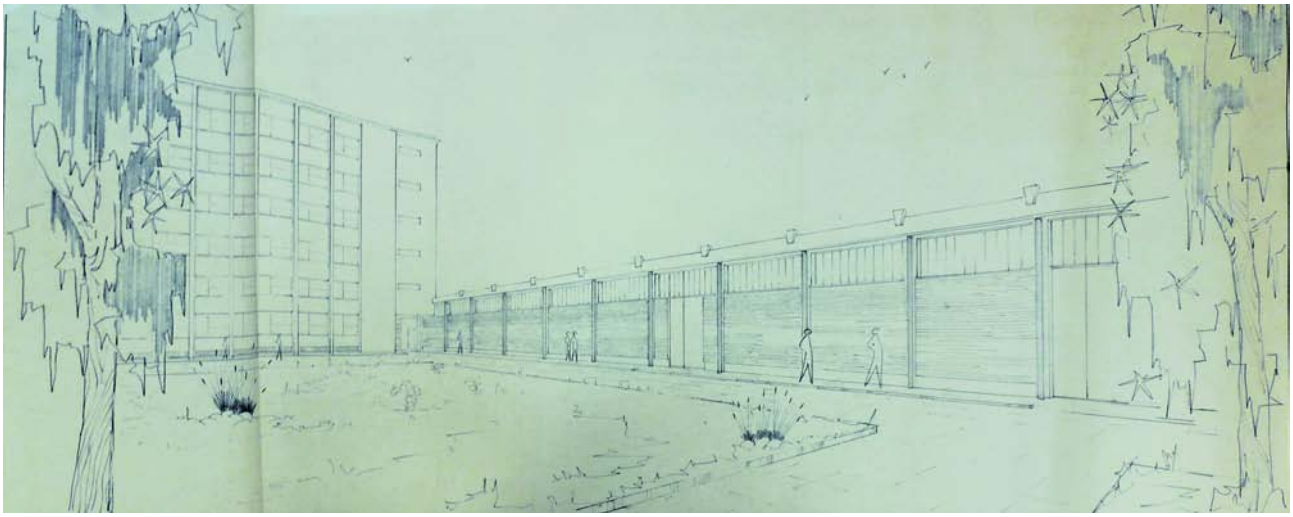

Fig. 2: L'Oréal-Saipo plants in Settimo Torinese, 1959, perspective view (Laboratorio Beni Culturali - Politecnico di Torino)

hardware that can support their original format (.*dwg*). Probably, digital archives were born also as consequence of digital files production during the planning phase: institutions collecting contemporary architectural archives mobilized their efforts in digitation at the beginning of 21th century, adopting different solutions because standards about format, description and catalogue had not been established yet [2].
At the same time that projects about the digital archives production and preservation were financed by European Community - like Gau:di programs (the first one in 2002 – '04 and the second one in 2005 – '08), North American museums, archives and archives/museums of Contemporary Architecture managed the same research, coming to same conclusions: the need of interdisciplinary actions between archivists, architects, restorers and computer technicians; the need of a digital format "preserving" the original characteristics of documents and making it usable by the public in the same time, as best it can; the impossibility to foresee how much technological evolution could be a double-edged sword about preservation and enhancement strategies; the reach of change conveyed by ICT from a static to a dynamic model, made possible thanks to users. In this sense, the development of a network for contemporary architectural archives represents an auxiliary tool not only for institutions engaged with data management, but for the users too, who could have a great heritage at their disposal upon which an individual methodology of analysis could be applied.
Archives network becomes indispensable in the Italian situation: the archival heritage is diffused in the territory, collected in different kinds of centers, like the institutional ones – State and Municipality archives -, the specialized ones – the architectural museums -, and research centers – universities, academies, etc. Their coordination is guaranteed by the *Associazione nazionale Archivi di Architettura Contemporanea* (AAA/Italia) since 1999, which organizes census, conferences and expositions.
This polyedric model finds a digital collocation in the portal *Archivi degli Architetti* SAN (*Sistema Archivistico Nazionale*), which has involved in the unitary access to information about an increasing number of archives created by engineers and architects since 2009. As declared in the homepage [3], "the portal, promoted by the *Direzione generale per gli Archivi*, on the basis of a national project previously begun, is the result of a strict collaboration between Archival Superintendences, Regions, cultural Institutions and Universities which have directed cooperatively safeguarding and conservative actions for such archives risking the dispersion long since".
The portal is configured as the access point for non-experts to archival databases, but also as a place of confluence of the results from multiple activities, executed for archival heritage by different institutions presided by the Archival Superintendents. The resources on which the portal is based therefore derive primarily from the census coordinated by the Regional Superintendences, with the addition of inventories and digital images of drawings and objects. Databases, images, multimedia, interviews and historical footage produced by *Istituto Luce* are now available on-line and were elaborated by the Regions – in particular by Piedmont and Lombardy -, Athenaeums like Politecnico di Torino and Politecnico di Milano, cultural and training institutions like the Accademia di San Luca in Rome, the Brera Academy of Fine Arts in Milan and the Academy of Fine Arts in Venice, the Archivio del Moderno in Mondrisio, the CASVA (Centro studi arti visive) in Milan, the AAA/Italia, the Fondazione MAXXI, the Association of Architects in Rome [4].
The portal has several access key-words as the protagonists' biographies, the guided tours, and projects allowing both to start easily a basic search about "light" archival contents, or a more specific search, outlining connections between materials described in the SAN. The portal has an editorial and graphical aspect obligated and a reduced possibility to use particularly innovative technological solutions: the rules for the accessibility of public websites limit the readability of the information [5]. Its value does not lie therefore in the modern technology employed or in the aesthetic results, but in making easily available a really significant amount of data and in showing the many connections and peculiarities of such a very little known and heterogeneous documentary heritage.
A thematic section of the portal that deserves mention is related to the Archives of Enterprise (*Archivi di Impresa*) [6], in which users can find architectural documents such as historical evidence of the transformations undergone by productive buildings in the secondary and tertiary sectors.
The portal of the Architectural Archives, therefor, was born because of the need to enlarge the knowledge of a widespread heritage, but very inaccessible and at the high risk of dispersion; it is also planning an evolution aimed in particular on two directions: widening the "specific funds contained in the technical offices of many institutions, even the municipal ones, the public and private companies" [6]; connection to other European archives.

3. Interpretation and communication of digital archive's contents: the Representation discipline's contribution (Roberta Spallone)

As said before, the simple digitization of archival drawings seems not to be sufficient to transmit the potential of knowledge and meaning that it was caught by the direct study of the sources.
The knowledge data, resulting from documentation analysis, needs to be interpreted, represented, and communicated.

Digital models are the most useful database for collecting and synthesizing these analyses.
The extreme care in implementing 3D reconstructions is the final result of a new attention paid by the stakeholders to the communication capability of information technologies, both as for the large audience and the narrow scientific community. The simplest language is required to the producers of these models [7], in order to share and diffuse information in a readily understandable form to a wide-ranging spectrum of public.
Thanks to these models, the era of graphic papers that only specialists can decipher is over.
In the present research project, we propose methodologies and techniques that can actively contribute to widen the knowledge and the understanding of Archival Drawings intended as Cultural Heritage and support its sharing, in the firm conviction that safeguard and fruition should go together.
The analytical activities start from reconstruction, through the re-drawing of the archival drawings, possibly supplemented by other documentary sources, which can enrich the mainly geometric data arising from technical drawings, and could provide information on materials, colors, building techniques and characteristics of the original surrounding environment.
When the building is still in existence, direct surveys, extended to the context, provide the exact measures which can be compared with the dimensions of drawings.
During this representation phase, the re-drawing of plans, elevations and sections involves the check of projective correspondences, aimed to three-dimensional synthesis, and the possible need to interpret inconsistencies and blanks. In this way the act of modeling may enhance knowledge acquisition, not only for others, but for the modeler as well [8].
Regarding the next stages of modeling, the drawings created are the basis of the "blue-prints" technique, in which the two-dimensional drawings which write-up archive drawings in vector format, are placed on orthogonal planes in the space of the digital work, so they can directly infer the geometric and dimensional references.
2D drawings could also be the basis of graphical analysis, inspired to Pagnano and Docci's methods [9], aimed at finding regulator patterns, harmonic proportions and modular grids that belonged to the cultural background and methodology of architects in the period considered.
The transformation of several technical drawings into a 3D digital model is a process which changes one model into another and deserves some attention. It is, as a matter of fact, not a simple variation without alteration of contents, but it modifies, each time, "the wealth of the model, its expressive potentiality. In fact, the transmutations of the models are moved by the interpretative intent of the scholar, and they converge, therefore, toward an abstract model... that we can identify in the project idea" [10].
Since all the models are simplifications and schematizations of the reality, there is always a difference between the real and the level of details included in the model.
This is true not only in comparison with the reality: 3D model level of detail, compared to the ratio between scale and contents of the original 2D drawings, conveys the geometric simplifications necessary to avoid excessive modeling times, considering the distance from the object of projection's centers, static or dynamic, to be set in the visualization phase [11].
The creation of a 3D digital model offers, as a result, infinite possibilities of observation - which means also survey -: from the objective visualization of a cylindrical projection, orthographic or isometric, to the subjective visualization of a conical projection, perspective [12]. The model thus becomes an essential tool to



Fig. 3: L'Oreal-Monsavon plants in Aulnay-sous-Bois, 1958, perspective view (Laboratorio Beni Culturali - Politecnico di Torino)

check and control the validity of reconstructive hypotheses and the congruence between the building elements.
During the render phase we prefer to apply plaster material to the opaque parts of the model and glass to the transparent ones and eventually differentiate its colors, according to build or natural elements, and finally to light the model with sunlight.
In any case we share Gaiani's opinion: "the fundamental attribute of the digital models is not as much that of photorealistic simulation of the reality, or of formal prefiguration or structural and/or functional simulation mean, as that of being capable to function as a real virtual prototypes" [13], endowed with similarity of behavior and performance, foremost topologic, geometric and perceptive, capable to allow us to observe, to simulate and to analyze the project in a much better way than the analogical technology.
As Moriconi said, and in a sense foresaw, over a decade ago, with info-graphic support, digital drawing simulates a hypothetical reality, goes beyond the limitations of the static and allows interaction with any type of sign. Through the creation of virtual images, info-graphic technology represents what is perhaps the most appropriate tool for the interpretation of the complexity of reality [14].
Thanks to the most recent technological developments in the field of computer graphics, dynamic and hyper-medial visualizations have burst on the scene of architectural representation methods, traditionally static. Several digitally based techniques, such as 3D modeling, animation, montage, virtual and augmented reality are establishing as primary emerging modes of architectural representation and could be effectively applied to the communication of archival heritage.
The ability to access the fourth dimension, through the construction of a sequence of images, constitutes a specific prerogative of digital representation, which goes beyond the static constraint imposed by conventional methods of representation [15].
In this phase of the research, the production of walk-through and fly-through is evaluated to allow scholars to explore the 3D modeled buildings.

4. The case study "Rosani's Archive": characteristics of the drawings and materials (Francesca Paluan)

4.1 Rosani's Industrial Architectural Studio, Turin

The case study, on which an evaluation about the most appropriate strategies of enhancement and preservation is carried out, is the professional archive produced by Nino and Paolo Rosani, preserved at the *Laboratorio di Beni Culturali* at the *Politecnico di Torino*, since November 2011. It had been one of the most prolific industrial architectural firms in Piedmont, operant since 1958, when it was founded by Nino Rosani (1909-2000), until 2010, when his son Paolo (1939) gave up working. The Industrial Architecture Rosani's Studio worked for big names of Italian firms, designing factories, industrial plants and offices not only in Italy but also abroad. Nino started working as an architect after he had worked in the technical department of the Lancia automobile company in Turin for thirty years, directing the Systems and Constructions Service with the responsibility of the design and maintenance of the Italian and foreign offices. The task that gave him fame was committed in 1954 by the same Giovanni Lancia, for whom Nino planned the *Palazzo Uffici*

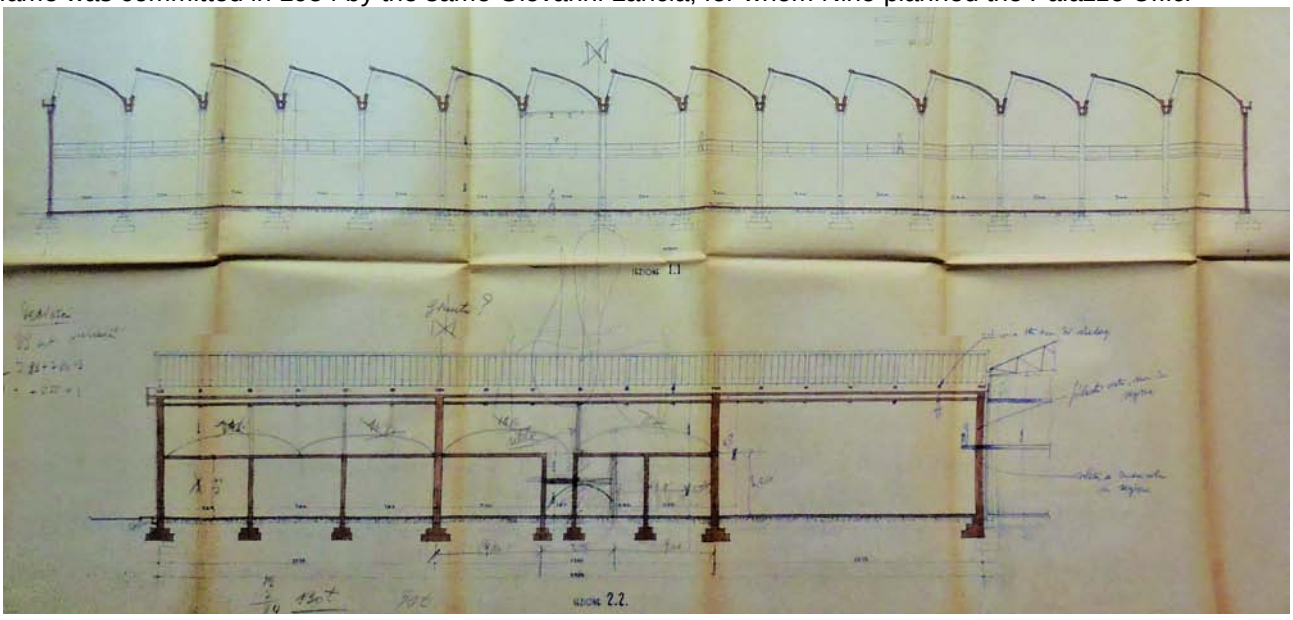

Fig. 4: L'Oreal-Monsavon plants in Aulnay-sous-Bois, 1958, sections (Laboratorio Beni Culturali - Politecnico di Torino)

Lancia, known as the Lancia skyscraper (Figure 1), in collaboration with Nino Gio Ponti, Antonio Fornaroli and Alberto Rosselli [16]. The building, now for residential use, at the time was the second highest structure of Turin (after the *Mole Antonelliana*), constituted by 17 floors, conceived to overpass Vincenzo Lancia Street as a liaison - bridge between the two lots occupied by the factory. After the enterprise and the open of a professional studio at the civic number 12 in Corso Tassoni, Nino remained in contact with the Lancia family, receiving private commissions in the aftermath.
Since 1958, Nino Rosani had received important assignments for the city of Turin, the planning of INA INCIS houses in Corso Sebastopoli, in collaboration with the *Studio Architetti Riuniti* (Carlo Alberto Bordogna, Franco Campo, Carlo Graffi, Francesco Dolza) directed by the architect Carlo Mollino [17].
Another great work he received was the plant for L'Oréal-Saipo (1959) in Settimo Torinese (Figure 2), whose design was initially undertaken by Pier Luigi Nervi [18]; it is an important example of the way in which Rosani was able to manage so large spaces dominating them with shed roofs [19], approached by elevated structures for office use. This scheme resulted from the combination of the horizontal manufacturing structure with the vertical administrative one was recalled the following year by the same Rosani for L'Oreal-Monsavon (1958) in Aulnay-sous-Bois (Figures 3-4), made in collaboration with the French architect Alain Leon. Rosani planned other representative offices for L'Oréal in the city center of Turin, Rome, Padua, Naples, Messina, Madrid and Lisbon, caring even the interior design. In the first decade, Nino was involved with the planning of other extended structures for the big industries, like the saltworks in Araya (Venezuela), the tanneries CIR in Pescara, the new headquarters and the Centre of Research CSELT for SIP-Telecom in Turin, the Centre of Research for Pininfarina in Grugliasco. At the same time, he was working for medium and small enterprises, above all in Piedmont - i.e. Colongo, Carello, Universal, De Coster (Figure 5) -.
Nino was flanked by his son Paolo at the beginning of the Seventies, as proved by the correspondence; in the same years the study was transferred into a new address (51, Corso Galileo Ferraris, Turin). Even at that time they undertook other important commissions, including establishments expansions designed and made in the previous years (for example CSELT and L'Oréal-Saipo) and new headquarters in San Giorgio Canavese and Cambiano, the Wind Tunnel in Grugliasco for Pininfarina [20].

4.2 Rosani's Archive: drawings and materials

Nino and Paolo's intense activity, from 1958 until 2010, is collected in their archive, donated in 2011 by Paolo Rosani and his wife to the Politecnico di Torino. The archive, inserted into SIUSA (*Sistema Informativo Unificato per le Soprintendenze Archivistiche*), is considered expression of historical and cultural interest.
Overall, the preserved documentation consists of nearly 300 planning practices, numbered and collected by the same architects. In most cases, for each practice there is a binder containing the technical documentation, correspondence and photographic material, which corresponds to a container with graphic documents. Unfortunately, some of the documents, especially those related to Nino's beginning as an architect freelancer, had been lost or drawings are rolled miscellaneously, without any documentation.
Rosani's archive collects only preliminary plans and executive drawings: sketches, studies and conceptual drawings are missing, perhaps trashed by the same architects once the project had been completed, refused or the construction had been started. The lack of this type of drawings is indicative of the architects' extremely rational "personality", whose interest was only dedicated in storing the technical drawings, useful for the building; this aspect, however, determines a gap for the planning knowledge, so it is not possible the analysis of the first stage generating the idea and the evolution of the project. Even second thoughts, especially about the size of the building in its interior spaces, are present only in copies of the executives stored separately within paper documents.
Among the drawings preserved, there are those related to the informational documentation: maps, geographic maps, floor plans, surveys, geological and hydrogeological studies. In sporadic cases, there are preliminary drawings to be approved by the customer and to have permissions or building concessions. The preponderant part of the info-graphic material regards the executive plans related to different parts - architectural, structural and plant - necessary for structural calculations, cost estimates and for the execution of the building. Documents drawn are definitive plans, technical drawings about the architectural and structural aspects, the electrical, plumbing and heating system, and detail drawings of architectural parts or completions.
The techniques of representation of the executive compositions are plans, elevations, sections and axonometry; on the other hand, projects about a building or an interior preparation were communicated through photomontages or perspectives drawn on numberless and sometimes in watercolors or pastels.
The archive contains Rosani's drawings whose execution covers a time span of fifty years, during which the materials and techniques of photo reproduction had been changed, as evidenced by the documentation kept. The great variety of supports and graphic techniques is common among the contemporary architectural archives, but the knowledge of contemporary materials is perilously in danger: often, architects used alternative media to paper and contact paper, so the recognition is difficult even by experts, archivists, conservators and architects themselves. Rosani's archive collects, among many contact papers, a considerable amount of radex, unknown by young architects, but used until the previous two generations.

This type of documents is the product of the heliographic reproduction technique on contact paper or on polyester film: the method allows making copies characterized by gray or brown signs on a brownish-gray background [1].
Usually transferable films and halftone screens are also applied to the translucent supports, not interfering with the reading of the iconographic message, although they are one of the causes of the drawings degradation. The interaction between materials and graphic and reproduction techniques with the environment, in fact, causes the onset of chemical and physical degradation. The preservation of a contemporary architectural archive, therefore, appears to be extremely complicated not only because of the great variety of materials used, but also because each archive is unique: therefore, the application of the guidelines devices is only one of the operations to be performed, in addition to the evaluation of the previous conditions of the archive.
Rosani's Studio of Industrial Architecture used also computer-aided design software in the last decade of activity; only prints are preserved in the archive, while the digital media (for example floppy, CD, hardware), and consequently the files too, are not present.
For reasons of space, drawings are stored in separate containers: each project, therefore, appears to be split into its info-graphics data and complementary data (for example technical, etc.): this physical separation of documents can be virtually filled, conducting a data analysis for the reconstruction of the project and for the following phase - the synthetic model development - as the result of an interpretation, with the intent to communicate the documents.

5. Meta-project of a digital archive for Rosani's drawings (Francesca Paluan)

Rosani's archive collects a historical and cultural heritage in danger of dispersion and forgetfulness: consultation is reserved for few experts, a non-specialist potential audience cannot immediately understand the data, the planned buildings are earmarked mainly for the industrial use, so they are difficultly communicable because they represent an economic and social logic little different from the Cultural Heritage is generally subjected to. The hypothesis of a physical exhibition of the drawings considered the most exemplar would be a temporary event that will surely enhance the archive, but then it could not guarantee a return of interest from the public.
These reasons let hypothesize and, if possible, apply the strategies considered the most suitable for the enhancement and the safeguard, through the representation techniques and methodologies for the interpretation and communication of the projects, and through the physical conservation techniques for the exposition of the drawings. These objectives, under development, will be the basis of a meta-project Rosani's archive will be made ready for.
The importance of ICT in the communication phase of Cultural Heritage is renowned; referring to the case study, ICT aided the analysis of the projects.

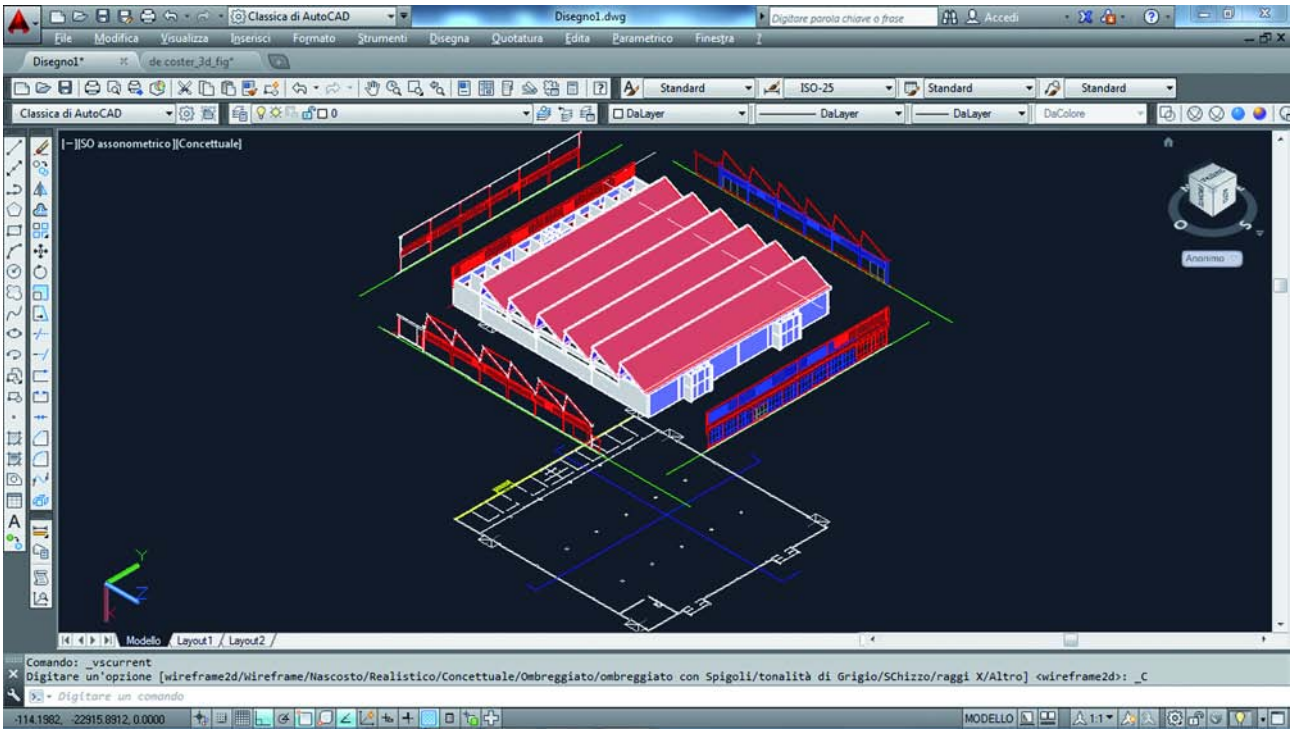

Fig. 5: Blue-prints and 3D modeling of De Coster plants (Digital drawings an 3D model by Francesca Paluan)

The magnitude of the archival collection obliged to focus only on some of the most significant projects by Nino Rosani. The selection was conducted according to certain parameters: the exemplarity of the plans; the existence of design variants; the inaccessibility of the existing building (because it is still in use), and the importance of transformations and expansions on the structure over time.
The method to be pursued, adopted at the end of the consultation of all the projects by Nino Rosani and of a part of Paolo's projects, consists of a detailed analysis of the documentation, drafting a form containing the metadata related to the drawings. These forms are related to a more concise inventory in which all the projects are included and divided into categories according to the typology of customers. Such a division, as well as outlining the different types of use of the buildings planned by the Rosani during their business, has given a virtual order to the archival units, crucial to make emerge how much the first commissions have induced the Rosani's architectural Studio fortune: the first customers, in fact, turned repeatedly to Rosani not only for extensions of their establishments, but also for other types of works (for example, the accommodation for the SIP-Telecom workers in Gressoney, Aosta).
The projects selected as case studies become, therefore, the subject of a trial communication using the tools of the digital representation. Among them, the project for L'Oréal - Monsavon in France and L'Oréal - Saipo in Settimo Torinese were preliminarily selected for several reasons: as confirmed the exemplarity of these plans as stated by bibliographical references [21], the French case presents a transformation of the structure different from the plan at our disposal; in the Italian case, however, the preservation of all documentation, including the various design solutions and the two following expansions, allows to reconstruct the architectural evolution both in terms of design and through the comparison with what was actually achieved.
The phase of re-drawing the project is preparatory to the following modeling, creating models of cognitive synthesis of the documentation and processing thematic readings paths. Buildings surveyed, in fact, can be decoded according to different interpretations: the geometric and dimensional one, taken from the Drawing disciplines, can support a historical reading, which deals with the changes of the building and of its different uses over time.
These different interpretations are possible because of the peculiarity of the case study: industrial architecture, in fact, has a particular propensity to the critic analysis in its historical, manufacturing and social meanings. The inaccessibility to the structures constitutes a further reason for which the modeling, as well as being a heuristic practice, becomes indispensable for the project communication. The virtual model, therefore, has been already conceived in its future online presentation to a non-expert public, shown like an "experience" through the use of animation and the possibility to run virtual visits, assisted and not. The addition of the fourth dimension becomes, therefore, the life-giving and participant element, in line with the changes undergone by the information technology and web communication: from the static meaning of the 2.0 web to the dynamic meaning of the 3.0, where the user from passive spectator becomes actor, moving in its own scene and actively consulting the system.
Another possibility of communication using ICT involves the employment of the Augmented Reality (AR): the virtual model is displayed on a mobile devices monitor. Presumably, the ARtags will be installed in the real archive, so that they allow the immediate understanding of the content in the folders and, therefore, to convince users to continue the consultation and exploration of the material, both in its analog form and in that digitized.
This proposal, therefore, intends to add a new interpretative value to those found in digital archives: not only documents scanned will be viewable, but the purpose is to make consultable the drawings, allowing to measure the scanned drawing in its original size when the dimensions are missing; synthesis models will be shared on the network and made surfable in the way they were conceived; virtual reality will be applied to the original document, offering a snapshot of the plan through the AR techniques. All these operations require the primary objective of the enhancement of documents, avoiding providing further degradation, and the increasing of exposure and knowledge of such a cultural heritage at high risk of misunderstanding and loss.

Bibliographical References

[1] DOMENICHINI, Riccardo, TONICELLO, Anna. *Il disegno di architettura. Guida alla descrizione*. Padova: Il Poligrafo, 2004.

[2] PEYCERÉ David, WIERRE, Florence. *Architecture et archives numériques: l'architecture à l'ère numérique: un enjeu de mémoire*. Gollion: Infolio, 2008.

[3] http://www.architetti.san.beniculturali.it/web/architetti/portale/portale

[4] TERENZONI, Erilde, *L'archivio in rete: digitale e virtuale tra criticità e valorizzazione, il portale tematico degli architetti nel sistema archivistico nazionale,* in DigItalia, Roma: ICCU, anno VII, n. 2, 2012, pp. 67-83 http://digitalia.sbn.it/article/view/581/411

[5] *Linee guida per i siti web delle pubbliche amministrazioni*, in *Direttiva del Ministro per la pubblica amministrazione e l'innovazione*, art. 4, 26 novembre 2009, n. 8.

[6] http://www.imprese.san.beniculturali.it/web/imprese/home

[7] DE FRANCESCO, Giuliana, D'ANDREA, Andrea. Standards and guidelines for quality digital cultural three-dimensional content creation. In *Proceedings of 14th VSMM 2008. Digital Heritage*, 2008, pp. 229-233.

[8] VANDEVYVERE, Han, NEUCKERMANS, Herman, DE JONGE, Krista. Digital historical reconstruction: case studies of an interdisciplinary task. In *Proceedings of EuropIA.10, Augmented Heritag*e, Damascus 13-15 September 2005. 2005.

[9] PAGNANO,Giuseppe. Presentazione. In *Ikhnos. Analisi grafica e storia della rappresentazione*, Siracusa: Lombardi, 2003, pp. 7-10. DOCCI, Mario. *Disegno e analisi grafica*. Roma-Bari: Laterza, 2009.

[10] MIGLIARI, Riccardo. *Disegno come modello*. Roma: Edizioni Kappa, 2004, p. 86.

[11] SPALLONE, Roberta, BRUNO jr., Andrea. Patrimoni e memoria. Ricostruzioni digitali di architetture minori degli anni Trenta in area torinese / Heritage and memory. Digital reconstructions of minor architectures of the Thirties in Turin area. In *Proceedings of XXXV Convegno Internazionale dei Docenti della Rappresentazione Patrimoni e siti Unesco. Memoria, misura e armonia / Heritage and Unesco sites. Memory, measure and Harmony*, Matera. Roma: Gangemi, 2013, pp. 909-916.

[12] SPALLONE, Roberta. 3D digital modelling as a method for the reconstruction of the historical image of the city: the case of piazza Bodoni in Turin (Italy) at the end of nineteenth century. In *Proceedings of 21st International CIPA Symposium. Anticipating the Future of the Cultural Past*, Athens, 2007.

[13] GAIANI, Marco. Del disegno e del modello: rappresentazioni per il disegno industriale / About the drawing and the model: representation for industrial design. In Migliari, Riccardo, Edt. *Disegno come modello / Drawing as Model.* Roma: Edizioni Kappa, 2004, p. 96.

[14] MORICONI, Claudio. Il modello virtuale. In Soletti, Adriana, Belardi, Paolo, Cataliotti, Francesca. *Claudio Moriconi professione infografico*. Perugia: Università degli Studi di Perugia, 2001, pp. 20-30.

[15] GARZINO, Giorgio, SPALLONE, Roberta, LO TURCO, Massimiliano. Strategie digitali per modelli conoscitivi / Digital strategies for knowledge based models. In Garzino, Giorgio, Edt. *Disegno (e) in_formazione. Disegno politecnico / Drawing (and) information. Polytechnic drawing*. Sant'Arcangelo di Romagna: Maggioli, 2011, pp 70-111.

[16] POLITECNICO DI TORINO, DIPARTIMENTO CASA CITTÀ. *Beni Culturali ambientali nel Comune di Torino*. Torino: Società degli Ingegneri e degli Architetti in Torino, 1984, Vol. 1, p. 377.

[17] PACE, Sergio. *Oltre Falchera. L'INA-Casa a Torino e dintorni*. In DI BIAGI, Paola, *La grande ricostruzione. Il piano Ina-Casa e l'Italia degli anni cinquanta*. Roma: Donzelli, 2001.

[18] D'ATTORRE, Rita. *Dopo Torino Esposizioni. Studi di coperture per progetti "minori" (1948-1959)*, in PACE, Sergio, *Pier Luigi Nervi. Torino, la committenza industriale, le culture architettoniche e politecniche italiane*. Milano: Silvana Editoriale, 2011, pp. 43-47.

[19] MAGNAGHI, Agostino, MONGE, Mariolina, RE, Luciano. *Guida all'architettura moderna di Torino.* Torino: Designers riuniti, 1982, p. 294.

[20] BODRATO, Enrica. *Nino e Paolo Rosani, Studio di Architettura Industriale (Torino1958-2010)*. In AAA/ITALIA, Bollettino n. 11, Bologna: Bononia University Press SpA, 2012, p. 49.

[21] GABETTI, Roberto. *Architettura Industria Piemonte negli ultimi cinquant'anni*. Torino: Cassa di Risparmio di Torino, 1977, pp. 278-280.

HERITAGE and TECHNOLOGY
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Exploring and interpreting the landscape using technological innovative systems

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Abstract
Nowadays what fascinates us particularly is the ability to read nature, interpreting it deeply enough to understand its inner essence. Of course it is very difficult to achieve this goal, but once achieved, it lets all the subsequent activities be in complete synchrony with the pre-existent landscape and logically aimed at either maintaining what is worth, or restoring the lost balance.
A careful reading, whose aim is to investigate both into the Sicilian coasts and the hinterland, should point out not only the anomalies (any devastating interventions) which have altered quite irreversibly the coastline, but also the feared imbalances made by men on the mountainous areas, along the rock massifs.
Man-made interventions have caused great wounds which should be cancelled through a consistent plan of interventions aiming at rebuilding what has been destroyed over the time. Only in this way this analysis can be addressed to the study of the processes which preside to the sustainability of the plans of territorial re-organization.
This research intends to identify the strategies to restore the lost balance sometimes trying to be congruent with the pre-existent fortified systems in either the neighbouring or the summit areas.

Keywords: earth, border, water, landscape, *topos*

1. An atavistic fractality. The border between land and water. *(G. Taibi)*
The keen survey of our areas is highly symbolic as well as the effort to preserve and safeguard the balance between nature and those sites which have been able to resist to wild interventions.
The landscape, regarded both as the array of objective values such as massive, natural, chromatic values, and as an entity able to express and transmit emotions and feelings, is an environment characterized by an intrinsic complexity which is very difficult to read, study and depict. Therefore it is necessary to make use of an alphabet of the natural array, made up of different symbols, which can depict the values of the scenic space and the signs of the site on its whole.
It is consequently more and more difficult to be able to create an approach system to the graphic criterion, even with new technological systems, for the epistemological reading of that site, taking into account its values, qualities and intrinsic relationships.
That becomes more difficult when the site is on the coast or an island, as the point of view is not on the mainland; in these cases the possibility of observing the landscape from the sea, by the way inshore or the circumnavigation, underlines the difficulty of assessing the quality of the landscape; in these cases the possibility of observing the landscape from the sea, by the way inshore or the circumnavigation, underlines the difficulty of assessing the quality of the landscape.
The single contributions determined by the buildings facing the coast, regarded as a synergistic will, represent the quality of the site as a common asset. For this reason it is important to grasp its shades and transmit feelings and emotions. The continuous mingling of feelings and chromatic effects gives the site its sense of chromatic harmony.

In order to evaluate that landscape system, it is necessary to establish an introspective process which can lead to a balance between the fluid sea and the solid morphology of the mass.



Fig. 1: Color effects in the scenic cliffs of Dover.

It becomes of fundamental importance to clearly define the borderline between the fluid mass and the solid mass. These latter massive morphologies and places of stone geometries are not formally harmonic facades but, when reflecting on the sea water, they try to find a relationship of homogeneity and calmness as if they wanted to get rid of their heterogeneity.
Actually there is a clear evidence between what exists and what does not.
It is a very formal, strong scenic line, which stands out with strength and dignity and, although it is eroded by the fluctuating sea water, it maintains its role of clear separation line.



Fig. 2: Pantelleria and Lampedusa: environmental qualities.

It is a line that has an intrinsic energy and seriousness of a scientific exactness, probably deriving from the fact that it is the embodiment of the mathematical concept of the fractal.
The suggested strategy makes use of innovative technologies and of different points of view, that, linked together, can build an unique image of the territory; it is based on a multiple register which connects the geographical landscape to the aesthetic one, and the static reading methodologies to the dynamic ones.
As a result, in order to obtain the recomposition of the territory, it is necessary to focus on the restoration of the perceptive values of the landscape, on the aesthetic dimension of the journey and on the key concept of the sequential reading of the image, deriving from the relationship between the landscape system and the integrated system of the fluid mass.
Moreover it is necessary to create a multidimensional atlas which can be used in an interactive way and can allow the exploration of the landscape from different points of view, both visual and communicative. It allows to reconstruct an immersive experience in the landscape, through a natural and tangible interface.
The fact that the coastline dramatically climbs and becomes at the same time a massive built complex, rich in both overt and underlying peculiarities, becomes more and more important
The careful scholar's eye, helped by modern technology and by scientific exactness, examines and interrogates.

2. The process of modifications between nature and artifice: a methodology for its control *(R. Valenti)*

The study of landscape, in its broadest meaning, necessarily examines any historical and evolving character concerning the dynamic modifications occurred over time with the aim of monitoring the great interventions of transformation.
One of the most complex themes, specifically, is the dialogue between nature and artifice, established by the continuous mediation, sometimes wise other times intrusive, set up through human action. The rejection of the new is improbable, just because it seems unnatural considering how human ambition tends towards a continuous development; consequently, we can affirm that the evolution of a territory originates from the comparison of two different natures, the evolution of the place itself nourished with the spontaneous and naturalistic aspects and the human evolution which tends to dominate and modify nature itself.
"The narrative of time, of memory , of nature, of the body fused with the desire of transforming the face of the world" are the aspects which deal with architecture, "the construction of objects mixes time into space. The space that hosts us makes us forget time, each space being memory and future"[1].



Fig. 3: Time and space along the lines of intersection between the sea and the land.

As such, the system complexity has to be found in the force of signs which characterizes the space-territory : it is the continuous correction of the lines which determines the metamorphosis in the course of time, within processes which are both chaotic and well-ordered.

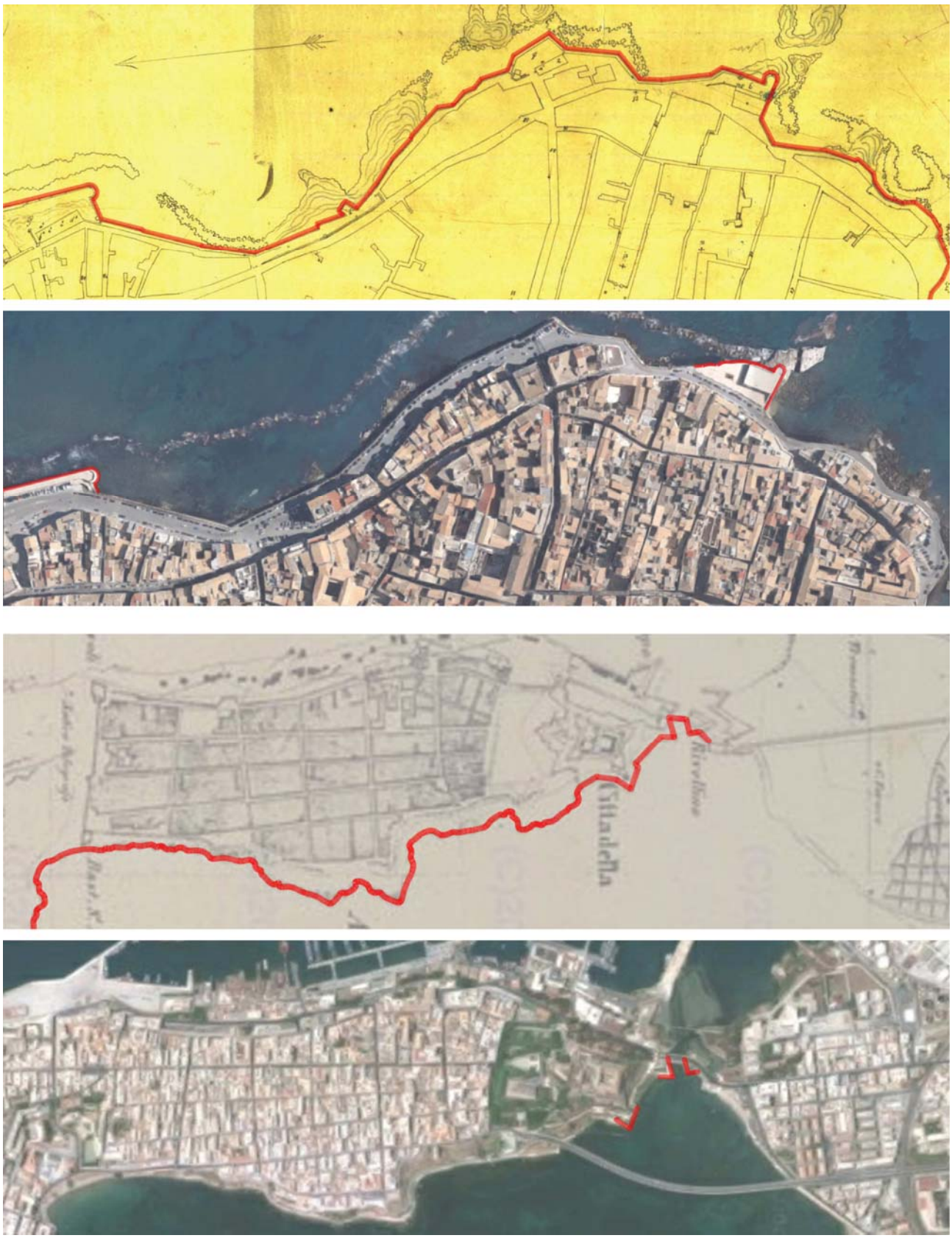

Fig. 4: The lost lines of history and the interrupted lines: Siracusa and Augusta.

The analysis of the evolution of the transformative dynamics is a fundamental operation in order to understand a place, not only under the morphological and conformative aspect but also from the socio-cultural and integrated point of view, according to the required performance and the historical period.
In particular, the drawing of mutations along the lines which determine the spatial and material definition of an enclosed landscape, involves reasoning about the logic behind the interventions which settling in the course of the centuries have determined the hermeneutical approach to self recovery.
The lost lines which have always made the materially detectable signs of a place are not often signs produced by nature itself but those impressed by the urgency of history.
The coastline, being a collection of vulnerable points for the defense of the territory since the ancient past, has been strongly modified by human activities, a product of science and of manual skills, of study relating to the evolution of offensive techniques and of a continuous action to adapt the previous existence of man-made structures.
The ramparts along the Sicilian coasts are the visible results of enormous economic sacrifices and their perceptive image and their historical memory depends on the fortified systems, an imposing presence over the millennia.
The present study is based on the fundamental theoretical and scientific heritage supported by a multiple research methodology which uses innovative technological approaches.
Specifically, the research is monitoring all the transformations which took place along the line of intersection between the sea and the land, through the digital drawing technology which integrates and converts the traceable information into historical and critical information about material evolution.
The fractality of the system is in this case arranged as a form of integration between nature and artifice; a unique concept where “the project artifice” shares the physical reality and the apparent chaos of nature.
In such a scenery the fractus is evidently identified with the interrupted lines of Euclidean fortifications which were demolished during the XIX century for expansionist reasons.
The careful observation of the devastating actions is not negligible since it allows the comparison with a different reality which was rejected in a particular historical period and which still brings along the concrete signs of the lived experience of a bygone era.
The new balance determines a “new place” where the geodynamic forces of nature, identifying the structure whose artifice is based upon, reconstruct landscape in a kind of unique morphological syncretism.
A form which, referring to uncontaminated environments, is submitted to a dynamic alteration due to the effects of natural phenomena (erosion, earthquakes, landslides); transforming processes which determine spatial-temporal variations, expression of a kind of dynamism of the matter.
A form, which in the integrated systems of nature and architecture analyzed in this study, signals important shifts and raises questions about the planned actions which have led to the demolition of entire passages of fortifications.
The declared intention to “ remove any aspect of fortifications from the works which we are now ceding, either demolishing or transforming them”[2] with the aim of eliminating “ an obstacle for the development of the country”, has actually produced an urban setting which maintains, in spite of all, the intangible signs even if perceptibly visible on the geometry of the interrupted defensive line.
The use of satellite images and of instrumental surveys carried out with the modern technologies and compared with the historical maps, with the zenithal maps of the XIX century in particular, allows a possible interpretation of the measure of the landscape according to spatial mutations; the ancient drawings of perspective views of the landscape narrate the visible perception of the places where the dominant theme is the synthesis between nature and artifice, which placed next to the present representations become sensitive indicators of the visual variation gradient of the urbis border lines.



Fig. 5: The measure of the landscape: the visual variation gradient of the urbis border lines.

Nowadays it is possible to uncover the historic environment through an effort of the mind which gathers all the remaining tangible signs; the 3D modelling reconstruction technique and the management of data through G.I.S. implement a methodological and critical process of objective knowledge about the project decisions made in the course of time.
The study dedicated to the intersectional lines between the sea and the land represents a vital instrument for the control and the fully aware exploitation of the signs surviving to the political and social decisions.

3. A question for dominating the anthropic-natural intertwining lines *(M. Liuzzo)*

"The landscape is the big "sufferer" in Italy. Just look out the windows: nowadays we find terraced houses in places where in the past dunes, beaches and pinewoods used to be; there are attics on roofs which used to be neat ... We will see woods, lawns and the countryside drawing back because of the invasion of sad blocks of flats; the bright coastline and green valleys will be devoured by incongruous houses and soulless buildings...".[3]
This is a quote from Salvatore Settis who denounces a *" blind, suicidal devastation of the space we live in"* which *"would not happen if people were aware of the value of the landscape and of the irreversibility of its consumption".*[4]
Therefore the question is how to allow the innovative technology to obtain a clear, punctual and shared knowledge of the space we live in, through the use of images which can transmit the same recognisability and evaluation, both quantitative and qualitative, of the multiple elements contributing to the definition of its inner essence.

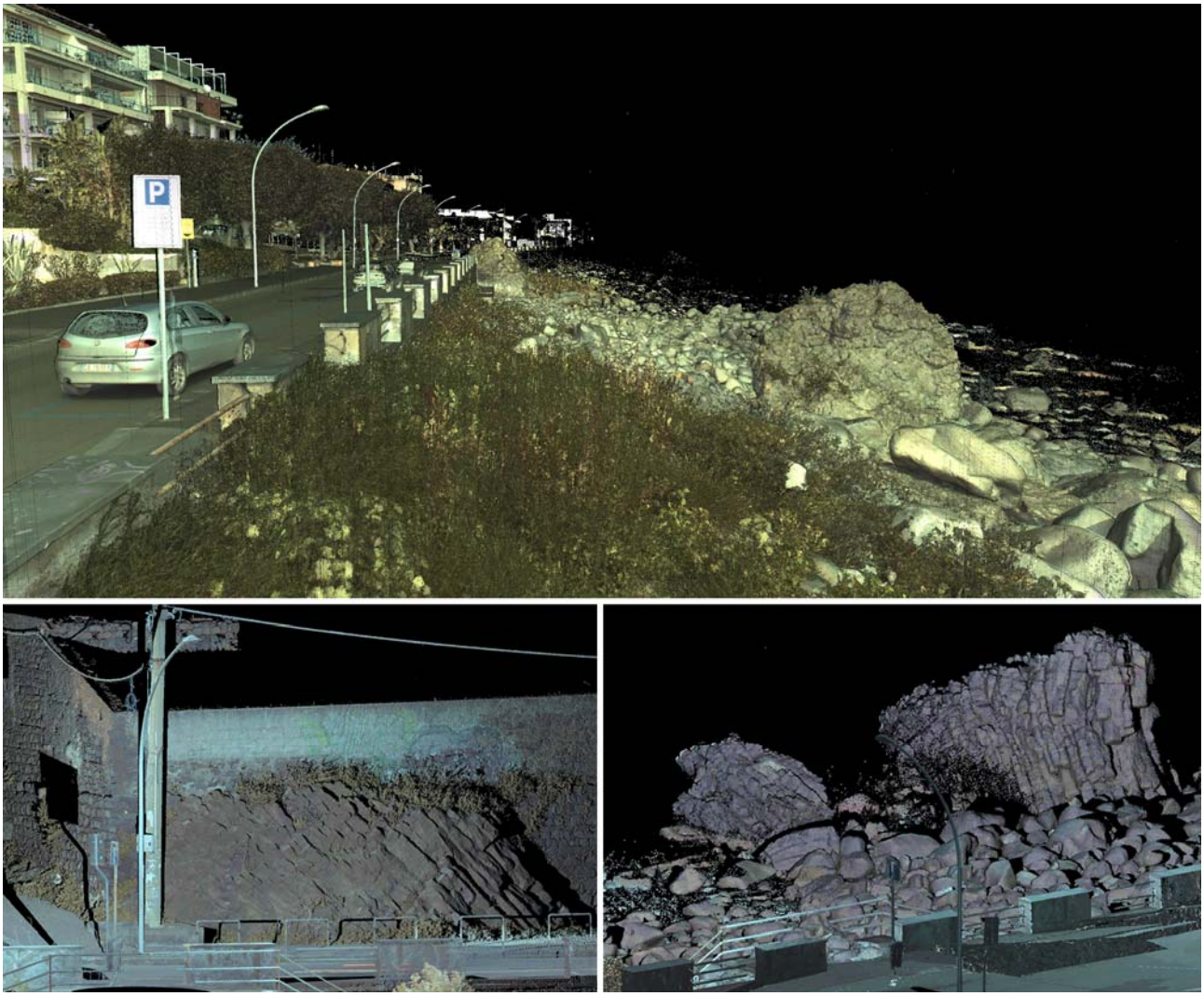

Fig. 6: Aci Castello (CT). A linear system to be redefined.
(Survey carried out by M. Liuzzo, S. Giuliano, S. Savarino, "Laboratory of Survey and Representation of the Territory and of the Environment" of the University of Enna Kore).

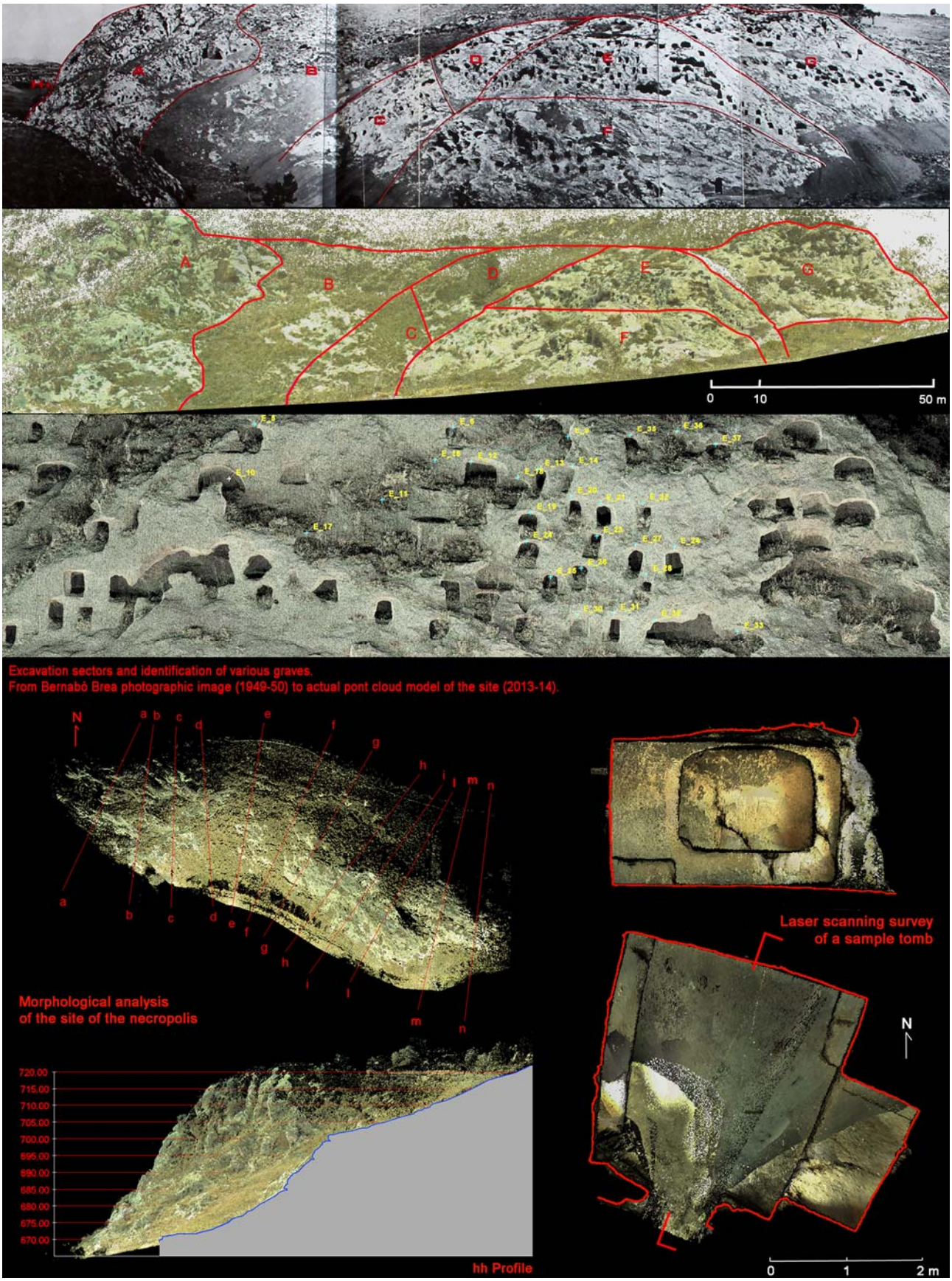

Fig. 7: Necropolis of Realmese, Calascibetta (EN). Diagrammatic evolutions for the reading of the place.
From the photographic documentation by Bernabò Brea (1949-50) to the 3d laser scanning model (2013-14). (cfr. ODDO *et alii*, 2013)

It is undeniable that still nowadays, a lot of areas, even those characterised by a significant cultural richness or a complex natural-anthropic stratification, lack a complete, reliable survey.
Sometimes the existing representations show a clear dichotomy between the analytical, representative methods and codes of the anthropic elements - often traceable to a reassuring Euclidean logic - and those of the natural element - characterised by a topological, fractal complexity - which is often the main cause of this “renunciation in representation” or of a not less risky "schematic abstraction".
As a result, some dated photos were the only documents available up to a few years ago, able to restore, at least in qualitative terms, the history of the small or large changes undergone by these areas over time, by human and natural events. These were able to grasp the whole together with all the material, formal and chromatic details, but without any “morphological discrimination”.
The same possibility is offered nowadays by modern technology, which, making use of numerical models (point clouds and textured mesh), gives three-dimensional images that give multiple levels of information. These are persuasive images that give immediate information, but risk to simply replace the existing photos, if considered the end point of the cognitive process.
Therefore, being able to deal with natural-anthropic matters that have never been studied before, because of their undeniable problematic in geometric-spatial control of complex morphologies, is only the first step of a challenge aiming at higher goals.
It is of fundamental importance to deal with the survey of morphologies both geometrical - man-made interventions - and natural - irregular and changing- not only with the same metric precision, but also with the same analytical and representative efficiency.
The definition of common, flexible but rigorous, graphic codes, which have to be the result of a subjective reading and never of technological automatisms, is necessary to control the signs - sometimes strong and incisive, sometimes uncertain, interrupted, just mentioned or erased by time - made by men or nature, to underline their intermingling, their balance and imbalance.
The possibility of manipulating, dissecting, dynamically visualizing virtual models, scientifically obtained, allows us to found on solid reliable basis the hypothesis regarding the reasons and the timelines of the changes, through the logic of overlapping, annexation and matter subtracting, made by men or nature.
The aim is to be able to transform the survey and representation tools into a powerful, cognitive, interpretative way to recognize and report effectively the elements of value and frailty. This is the first fundamental step towards the creation of the right strategies to re-establish the lost balance of several areas that might be irreversibly ruined but are an invaluable resource to hand over future generations.

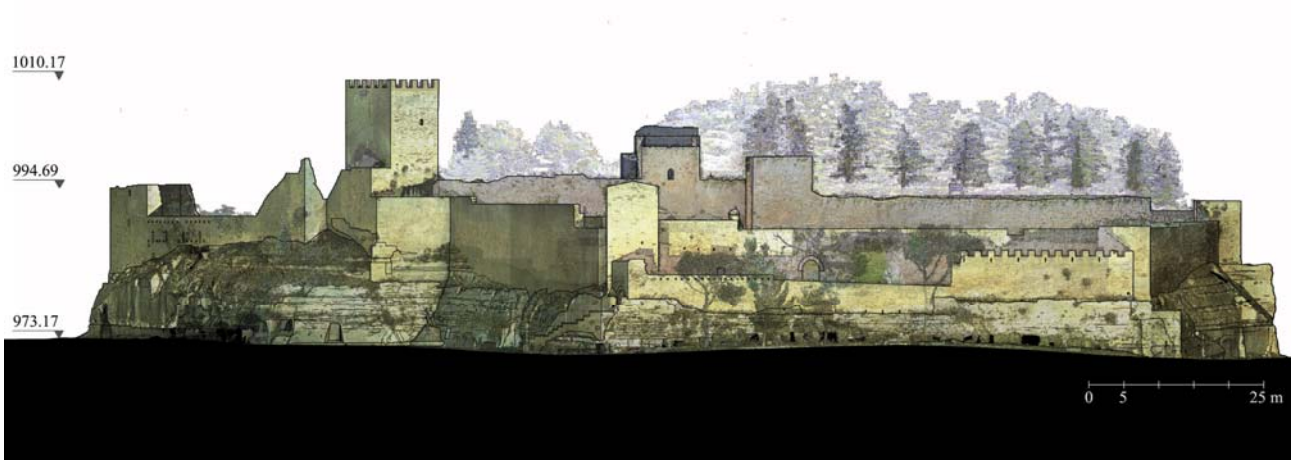

Fig. 8: The Lombardy Castle, Enna.
A criterion for the graphic transcription of congruence between natural and towered elements. (cfr. CARDACI, LIUZZO, VERSACI, 2015)

Bibliographical References

[1] CARDACI, Alessio, LIUZZO, Mariangela, VERSACI, Antonella. *Sul ruolo del disegno nel progetto di conservazione: il caso studio del Castello di Lombardia ad Enna*. In *DISEGNARECON.* CARBONARA, Giovanni, CENTOFANTI, Mario, MINGUCCI, Roberto (a cura di). Vol. 14/2015, p. 8.1 - 8.13. ISSN 1828-5961.

[2] CIANCI, Maria Grazia. *Metafore. Rappresentazioni e interpretazioni di paesaggi.* Firenze: Alinea Editrice, 2008. 171 p.. ISBN 978-88-6055-218-1.

[3] DE SETA, Cesare (a cura di). *Il paesaggio.* Torino: Einaudi, 1982. 827 p.. ISBN 88-06-05417-1.

[4] DUFOUR, Liliane. *Siracusa città e fortificazioni.* Palermo: Sellerio editore, 1987. ISBN-13 978-8876810336.

[5] ODDO, Maurizio, LIUZZO, Mariangela, VERSACI, Antonella, ALBANESE, Alice, BARRACCO, Alessandro, INDELICATO, Davide, SAVARINO, Salvatore. SINAPSIS- Sistema Nazionale Protezione Siti Sensibili. Rappresentazione, tecniche e tecnologie per la tutela, valorizzazione e fruizione della necropoli di Calascibetta. In CONTE, Antonino, FILIPPA, Monica (a cura di). *Patrimoni e siti UNESCO. Memorie, misura e armonia.* Atti 35 Convegno Internazionale U.I.D., Matera 25-26 ottobre 2013. Roma: Gangemi, 2013. p.729-738. ISBN 978-88-492-2728-4.

[6] SETTIS, Salvatore. *Paesaggio, costituzione, cemento. La battaglia per l'ambiente contro il degrado civile.* Torino: Einaudi, 2010. 326 p..ISBN 978-88-06-21037-3.

[7] TAIBI, Giacinto, GIULIANO, Sebastiano. The epistemological measure of the quality of the natural landscape. In GAMBARDELLA, Carmine (a cura di). *Best practice in heritage conservation management. From the world to Pompeii.* XII International Forum Le vie dei Mercanti, Aversa-Capri 12-14 June 2014. Napoli: La scuola di Pitagora Editrice, p. 494-502. ISBN 978-88-6542-347-9.

[8] TAIBI, Giacinto, VALENTI, Rita, LIUZZO, Mariangela. Le cromie del costruito storico di Ortigia . In AA.VV. *Il colore nel costruito storico. Innovazione, sperimentazione, applicazione*. Lerici -Villa Marigola, 13,14,15 ottobre 2011 Roma: Aracne, 2011, p. 1-11, ISBN 978-88-548-4317-2.

[9] VALENTI, Rita, GIULIANO, Sebastiano. *Un percorso diacronico: il restauro virtuale delle mura spagnole in Ortigia*. In *DISEGNARECON.* CARBONARA, Giovanni, CENTOFANTI, Mario, MINGUCCI, Roberto (a cura di). Vol. 14/2015, p. 21.1 - 21.12. ISSN 1828-5961.

[10] VALENTI, Rita. *Dal rilievo alla rappresentazione. I dettagli e i frammenti di Ortigia.* Ed. digitale. Siracusa: LetteraVentidue, 2012. ISBN 978-88-6242-071-6.

[11] VON MEISS, Pierre. *Dalla forma al luogo. Un'introduzione allo studio dell'architettura.* (Translated by DE BENEDETTI, Mario). 1ª ed. Milano: Hoepli, 1992. ISBN 88-203-1928-4.

[1] PIANO, Renzo. *Che cos'è l'architettura.* Roma: Luca Sosella edition, 2007, ISBN 978-88-89829-27-1.
[2] Siracusa State Archive, file 1280, case n.1432, Dufour, Liliane, Siracusa città e fortificazioni. Palermo: Sellerio edition, 1987, p.58.
[3] SETTIS, Salvatore. *Paesaggio Costituzione Cemento. La battaglia per l'ambiente contro il degrado civile*, Torino: Einaudi, 2010, p. 3, ISBN 978-88-06-21037-3.
[4] *Ibidem*, p. 10.

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Architecture and subtraction: Ostiense square in Rome.

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Abstract
The reordering of the urban spaces must be rooted in an act of subtraction. The part of Rome that goes from the Coliseum to the Pyramid and to the Ostiense square is one of the areas in which can still perceive the fragmented nature of urban development. The knot of archaeological melts suddenly. This zone must have seemed so remote from the "Urbe" that, with town plane of 1873, had been decided an industrial future. On the contrary, the plan of 1883 introduced important changes, according to a new order of evaluation of this area, which is now completely inserted in the circuit of monumental Rome. The present state of deterioration damages the urban image and liveability. Obstacles to pedestrian crossings, vehicular high sleep, high noise level, unregulated parkings, discontinous paving, inappropriated placed urban, poor lightings and invasive advertising billboards tarnish the architectural and urban quality. The project want to re-create a connection between the square and the context. Main pourpose is therefore to improve the environmental image and, above all, with a not addition, but a subtraction process, re-discover the previous share of the archaeological pre-existings.
Keywords: urban space_ subtraction_ Pyramid_ cleanup.

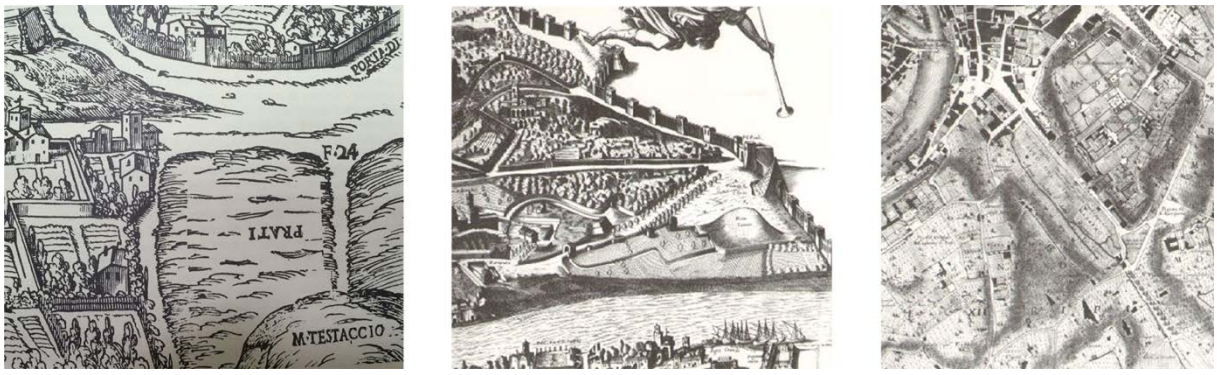

Fig. 1: A) Plan of Maggi, 1689_ B) Isometric of Tempesta, 1693_ C) Plan of Nolli, 1748.

1. The subtraction in the Architecture
"Draw the subtraction poetically, shape, size, ability to sense [...] select the existing and make room for the new, indemnify harmony" [1]. These guiding principles into the project of re-generation of one of the most important joint of the Eternal City, stayed too long a victim of time and indifference. Subtract operation is no longer antithetical to that of preserving, on the contrary, now become a historical necessity, as affirmed by Choay [2]. According to the thought of Quaroni, all modern capitals were made by transforming the ancient city not only through additions and renovations, but also by decreases and demolition [3]. So, today, subtraction may be the only tool capable of restoring the places and make their way back to read the identity of the centers and historical territories. A process

of razing that will generate an empty space that is not the *Aristotelian vacuum*, but the act of incorporation of a new renaissance [4] and that will in turn bring to light the original layers. In the deeper meaning, the target to snatch the antiquity to its theoretical space and return it to the real space, not as a static image, but as a living organism.

1.1 The context

One of the most beautiful archaeological walks starts from the Coliseum and leads us to Ostiense square, through the Circus Maximus and the Baths of Caracalla. It is one of the most significant pieces

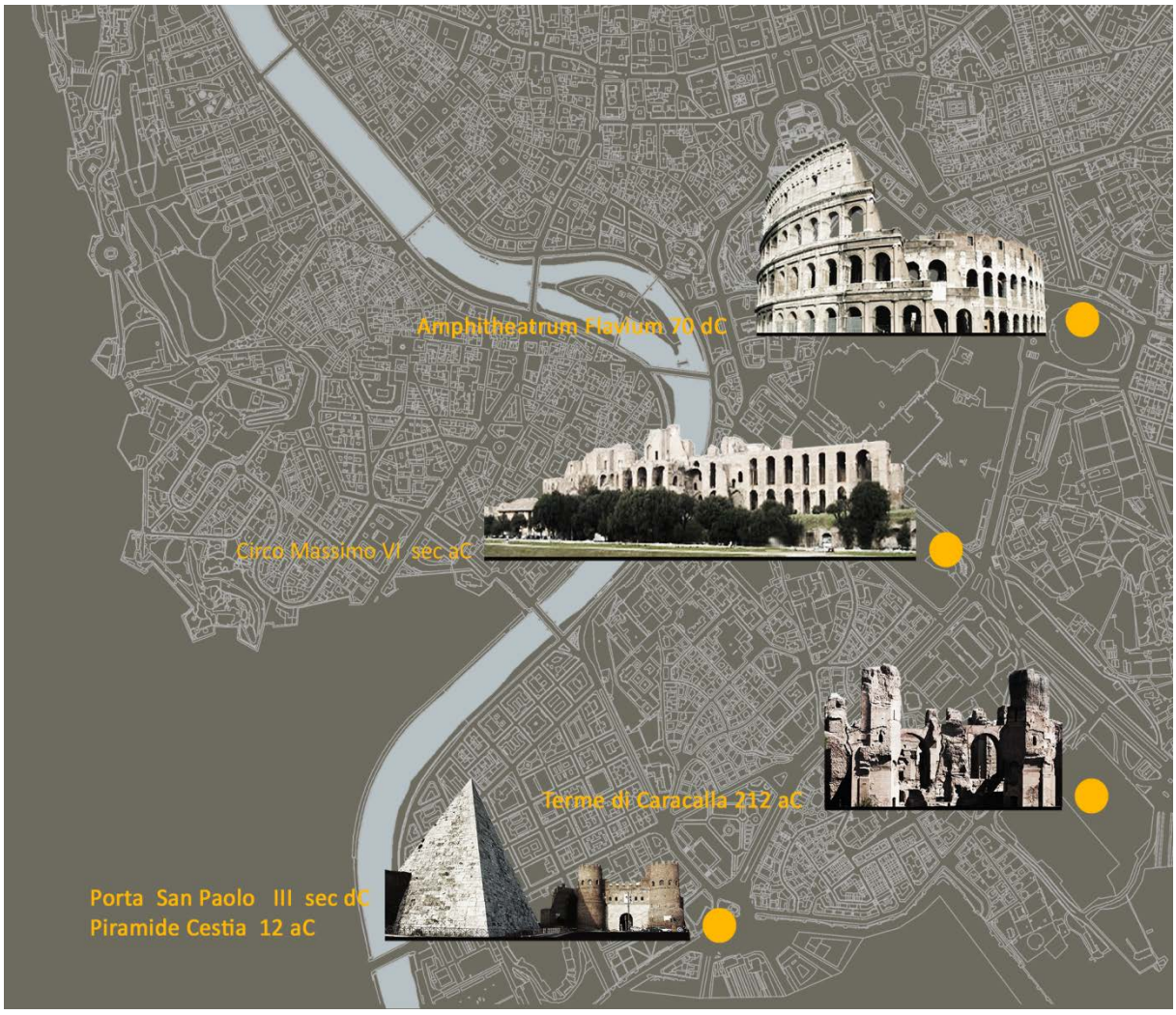

Fig. 2: Territorial framework and archaeological walk.

of monumental Rome, but the current poor conditions are such as to impair its recognizability and liveability. We are faced with a very significant and conditioning context. In fact, the Ostiense square is surrounded by buildings of great architectural value, such as the headquarters of ACEA, designed by Enrico Maria Lugli, the Post Office Building of Adalberto Libera, made between 1933 and 1935 with a strong rationalist aspect, Ostia Lido Station designed by Marcello Piacentini and finally Meter Pyramid awarded the Artemetro Rome price, thanks to the works of Castellani and Pepper; there is the Protestant Cemetery, better known as the Graveyard of artists and poets, in which are buried celebrities the likes of Keats, Shelley, Gramsci and Labriola; there is also the Resistance Park, designed by De Vico, place linked precisely to the memory of the Resistance in September 1943 against the German army; via Marmorata, so named because it was here that the Romans stored in warehouses marble imported from all over the Mediterranean sea [5]; the context is also characterized by historical and archaeological preexistences of great importance [6] such as the Aurelian Walls, Ostiensis gate, now called San Paolo' s gate, because necessary step of the journey to the

homonymous Church [7]. From Cartographies of Frutaz [8], and from the present stratigraphy, highlighted also by restorations that have occurred over time, emerges on the Walls which have been implemented and modified in four fundamental orders: by King Servius Tullius first, Emperor Aurelian after, by Maxentius in the fourth century, and finally by Honorius. Instead, in order to gate, it is found that in Roman times, the intensity of traffic at the Republican port, two doors were opened in the walls, one in the east and the other in the west, and the eastern one then took the upper hand, despite the other opened towards the vast granaries along the sea route. Finally, particular attention has given to the Pyramid of Cestius of the first century b.C, first because it's the only pyramid preserved in Rome thanks to its incorporation in the walls, unlike her twin, the Meta Romuli, which was completely demolished, and also because the textual and iconographic deepening, in particular the study of archaeological maps and of the beautiful designs of Giuseppe Lugli, showed the existence of a previous archaeological lower share over four meters than at present one.

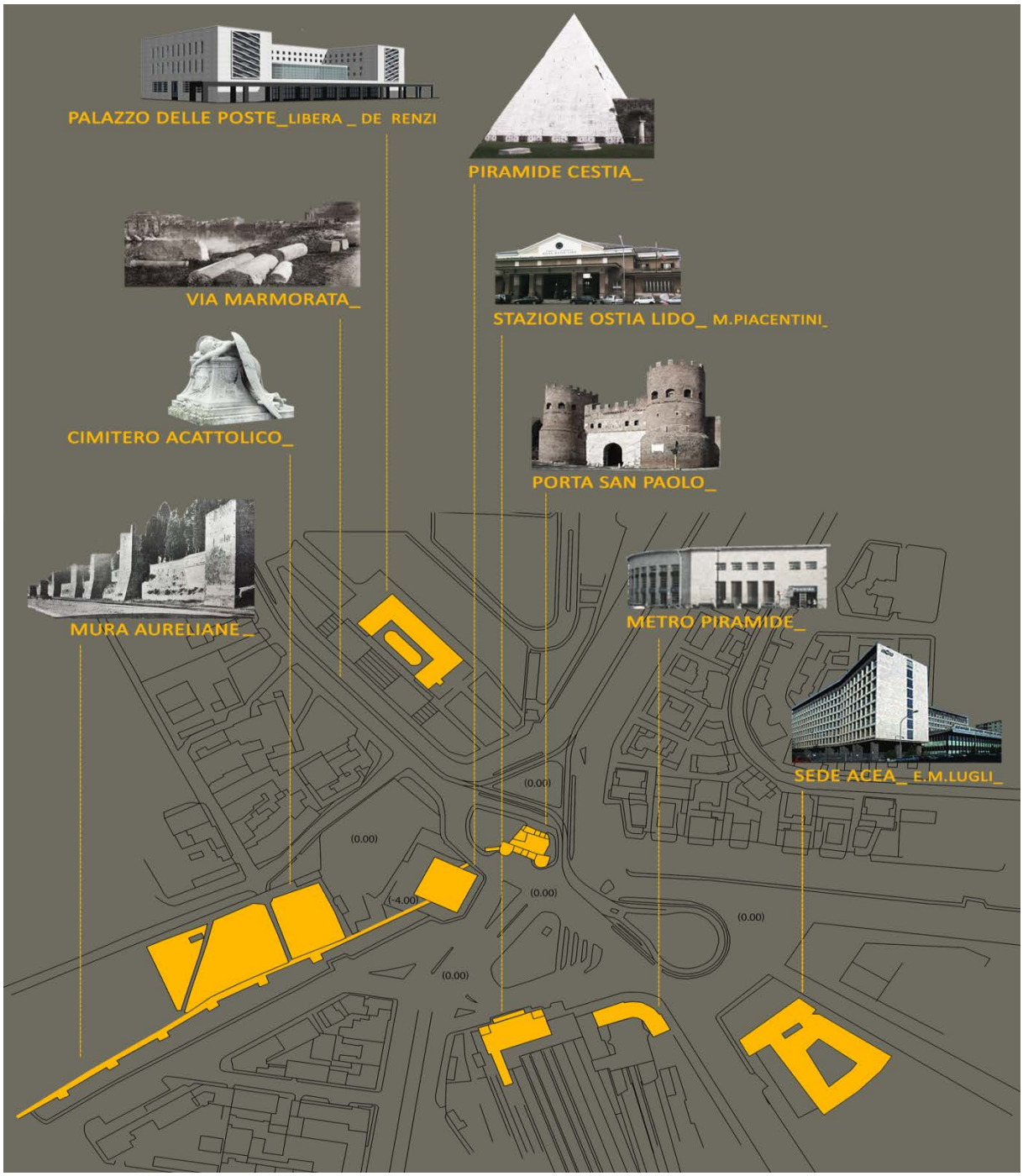

Fig. 3: The most significant elements of the context.



Fig. 4: The analysis of traffic and pedestrian flow, and of green areas.

1.2 The project

We proceeded to a total redesign of the area, starting with the suggestion of the existence of four other pyramids and imagining their rotation in the square. They came out sharp petals, in each of which is enclosed a strength and a function. In fact in the south a small area has been used to infopoints and ticketing for its close proximity to the train and the metro station; in the east we have a larger area such as to be able to devote a part to a flea market organized by the Rom and Indians, who currently besiege the area in complete disarray and without any kind of regulation. In the north it's created a space for rest and refreshment enjoyed by all those who live the square and by visitors to the Ostiense Museum.



Fig. 5: The general redesign of the square in plan.

Finally in the west has made a small exhibition area in which to place the artifacts that came to light during the excavation, the ancient texts and the wonderful images of the Pyramid borrowed from the collection "Vanished Rome", today virtually inaccessible. In the first three cases has fallen by 2.50 meters, in the other by 4.00 meters for rediscovering the existing share and thus for being able to admire the Egyptian tomb in all its height of some 37 meters. The genesis of design also comes from the study of contemporary projects, because the system of tiers is inspired to the *Ocellets Park* by

Battle i Roig, while the flooring is inspired by the Cemetery of Igualada by Miralles and Carme Pinos. In the first case have been provided bleachers of natural stone that may function as seating, interspersed with white stone stairs, to create a color separation by the general system and make them visible at a glance. The main access is guaranteed by the four big ramps, which are located in a strategic position to the direction from which the pedestrian flows are more [9]. In the case of the paving, however, the signs on the ground are in some cases simple textural variations, in other cases they are real cuts that function as gutters for rainwater. Archaeological findings are left outdoors for immediate visibility and a need for naturalness that permeates the entire project. The internal volumes are very small entities, basements so that their height does not exceed the current share of the square and do not change the skyline of the environment [10].

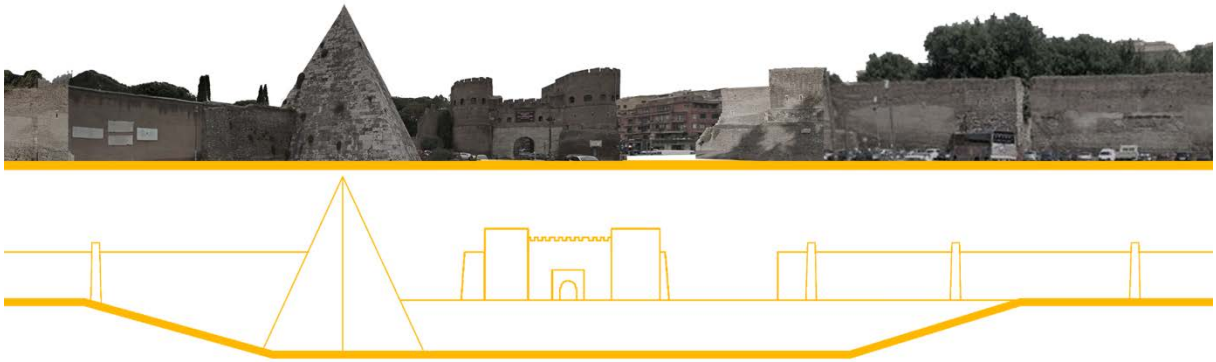

Fig. 6: The current share and the pre-existing one.



Fig. 7: Section 1_ looking toward Saint Paul getaway.

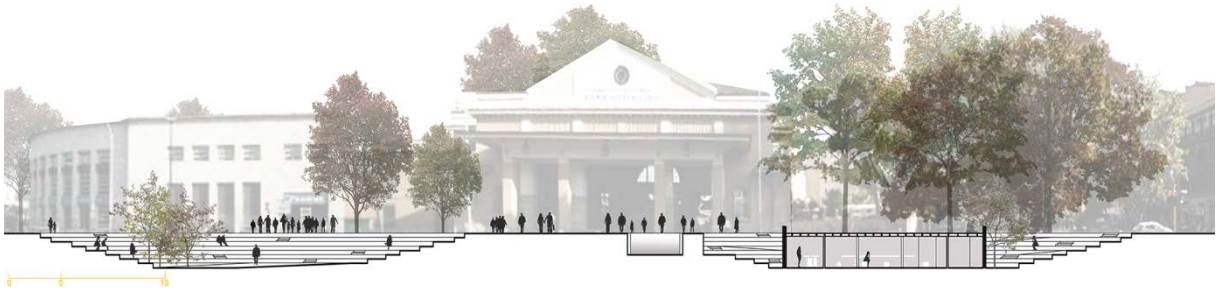

Fig. 8: Section 2_ towards Piacentini's station and Ostiense Avenue.

In the area closest to the pyramid were designed by one side of the steps as seats of a small outdoor theater and the other has been relocated the monument dedicated to the victims of war, since it is well-established tradition, on the occasion of September 8 each year, the visit of the Head of State to honor the victims and to attend the screening on the same pyramid of the scenes of the partisan resistance. Finally the study of vegetation, both in the case of the shrubs that in the case of the essences, has suggested the choice of local species and varieties that do not require excessive care and frequent irrigations.



Fig. 9: Perspective view with archaeological finds in foreground.

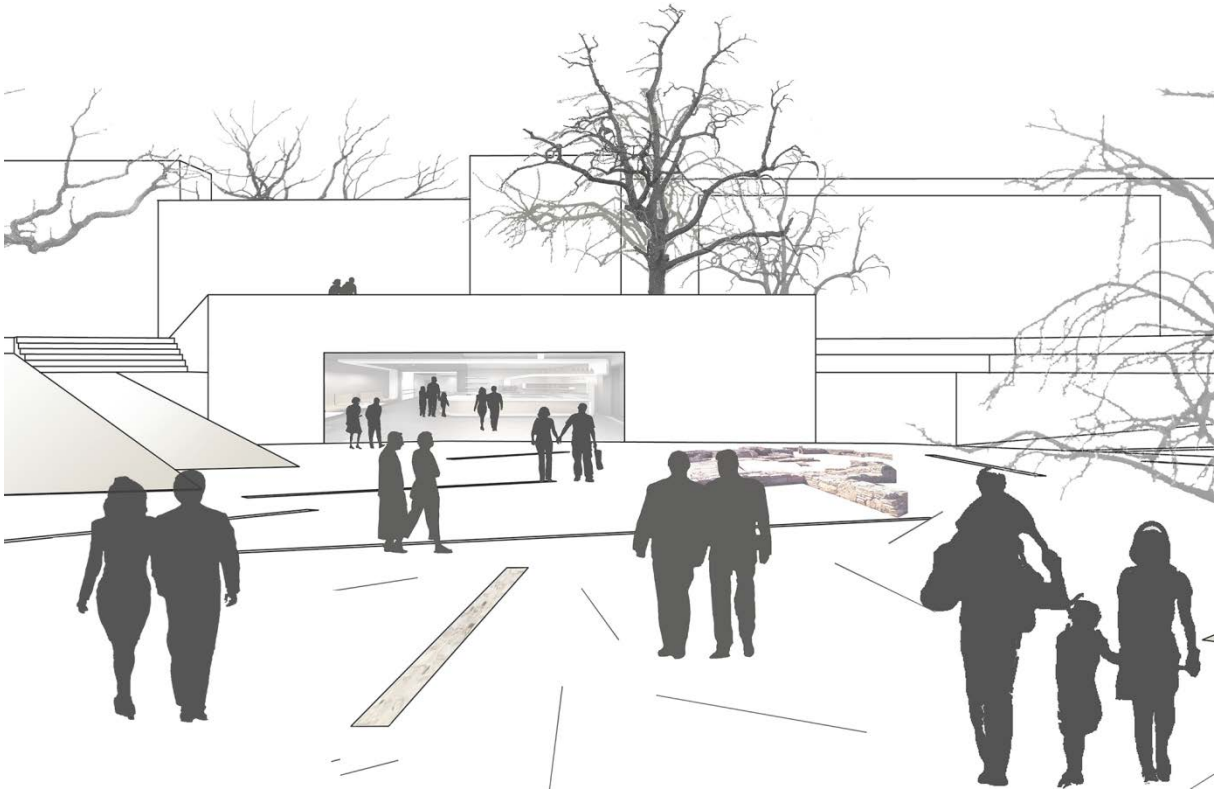

Fig. 10: Walk to the infopoint and a particular of paving.



Fig. 11: Sector where the official celebrations take place in memory of the Italian Resistance.



Fig. 12: View of the bleachers of open air theater.



Fig. 13: Alternation of steps and terraces.

2. Conclusions

The purpose of the project is to encourage the use of the area trying to awaken a new cultural interest in the visitors. We will want to return to Ostiense square its role attractor, being meaningful testimony of Italian cultural heritage, no longer only crossing place, but fundamental issue in a society of flows [11]. In a world like the present characterized by fragmentation of settlements and the resulting sense of disorientation, it's a primary need the reconstruction and the physical and functional reorganization of the territory and above all of the common spaces [12]. The "Agorà" will resume its role as a fundamental place of the meeting and of interpersonal exchange, as the stage of daily life in the open air [13], and thus becomes the emblem of the social reconstruction of a city, in terms of livability, centrality and especially of accessibility, for example through a more adequate redistribution of vehicular and pedestrian flows [14]. But when the project of re-generation of a square binds to the memory historical and archaeological lost, everything becomes more complex, because the architecture needs to interact on the one hand with the excavation and the other with the needs of contemporary living. And then we must proceed with a light, non-invasive, subtractive rather than additive work, making it possible to read all the existing stratigraphy without overwriting or cancellations, and we have to use reversible techniques and materials able to adapt perfectly to the context. Only with such an attitude can make an archaeological site "habitable place", and we can

successfully overcome the contradiction between the Architecture conceived as an art of transformation and the Archeology considered as an object of conservation.



Fig. 14: General view of the square.

Bibliographical References

[1] TERRANOVA, Antonino. *Il Progetto della Sottrazione.* 1ª ed. Roma, Groma Quaderni, 1997. ISBN 88-7621-892-0

[2] NIGRELLI, Fausto C. *Il senso del vuoto. Demolizioni nella città contemporanea.* Roma, Manifestolibri Ed., 2005, ISBN 88-7285-457-1.

[3] BENEVOLO, Leonardo. *La Conservazione dell'abitato antico di Roma* in *Problemi Urbanistici di Roma,* a cura di PICCINATO L., Vol I, Milano, Sperling e Kupfer,1960.

[4] PITZALIS, Efisio, *Per un'etica dell'esenzione,* in *Il Progetto della Sottrazione,* a cura di TERRANOVA A., Roma, Groma Quaderni, 1997.

[5] CASTAGNOLI, F., *Topografia e urbanistica di Roma antica..* Bologna, Cappelli Ed.,1969.

[6] LUGLI, Giuseppe, *Per La zona archeologica.* Roma, 1930.

[7] LUGLI, Giuseppe, *Quaderni Augustei, Aspetti monumentali della Roma Augustea.* Roma, 1938.

[8] FRUTAZ, A. P., *Le Piante di Roma.* Istituto di Studi Romani, Roma, 1962.

[9] BRANDOLINI,S. CROSET, P.A., *Strategie della modificazione.* Casabella 498-499, 1994.

[10] AYMONINO, C., *Progettare Roma capitale.* Roma, Laterza Ed. 1990.

[11] PERUZZI, C., *Progettare Roma capitale.* Roma, Laterza Ed. 1990.

[12] DI GIOVANNI, A., *Spazi comuni – progetto urbanistico e vita in pubblico nella città contemporanea.* Roma, Carocci, I Ed. 2010, ISBN 978-88-430-5424-4.

[13] AMENDOLA, G., *L'Agora' efficiente. L'impresa e la città creativa.* Roma, CLEAR Ed., 1995.

[14] Le Vie dei Mercanti Web Page: http://www.leviedeimercanti.it

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Surveying for documentation and management of the Renaissance building Royal Hospital in Granada (Spain)

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Abstract
Surveying an historical building for documentation and management is a complex task because usually it concerns more than a unique technique. We have surveyed and modeled the Royal Hospital from Granada, Spain (1511-1526). In our case, the main tool for data capture was a Laser-Scanner. Nevertheless, unavoidable shadows appeared in every Scanner station, and some of them had to be covered by photogrammetry in order to avoid holes in the subsequent modeling task. Photogrammetry was also used in order to increase the points cloud in some areas where more detailed surfaces were needed, e.g. entrance front, arms, impaired columns... The accuracy, achieved in areas where photogrammetry was applied, was similar to the Laser-based one.
Two precise traverses were necessary in order to get a precise alignment from the different Scanner stations, if we hadn't use two traverses it would be impossible to get a precise alignment because the existence of inner Scanner stations.
In the modeling and texture stages, special attention had to be paid to the dome, arcs, columns and wood frames because details and corners needed additional edition processing.

Keywords: Documentation, Surveying, Laser-Scanner, Photogrammetry.

1. Introduction
In 1504 the Catholic King and Queen declared their intentions to built a Hospital for the shelter and care of the poor by means of a decree. Nevertheless the works didn´t started until 1511 when King Ferdinand asked the city council to allocate an appropriate site for the building, which signed out an old Muslim cemetery outside the city (near the Elvira gate). The person in charge to carry out the works was Don Pedro de Atienza (Head Chaplin of the Royal Chapel). The works were slow developed until 1519, when the Emperor Charles V (Charles I of Spain), Ferdinand and Isabel´s grandson showed interest and accelerated its finalization. In 1526 during his stay in Granada, Charles V presided the official opening in December, and patients from the Hospital of the Alhambra were moved to the new building.
Several architectonic styles are present in the Royal Hospital going from Gothic, to Renascence, including some Mudejar arms. The first architect addressing the works was Enrique Egas, who was the chief exponent of the purest Gothic style at the height of the XVI century, nevertheless the Royal Hospital is built in the shape of a cross formed by two large naves intersecting at right angles, which are framed by a square building, so that the area is divided in four symmetrical coutyards (Fig. 1). The cross shape implies a Renascence style based in the General Hospital in Milan, designed by Filarete; Enrique Egas opted this Renascence inspiration because the Catholics Queen and King wanted modernize their Kingdom and buildings were suitable objects where show it [4].

Upon the ground plan were imposed several elements of the late Gothic: the external walls and the naves forming the cross, together with the central tower presiding over the whole decorated with elaborated pinacles; the vestibule which gives access to some interior rooms, particularly the central nave which is entered through an arched doorway. A remarkable feature is the separation between two floors even at the intersection of the naves; such a feature is not present in other hospitals commissioned by the Catholic Monarchs.

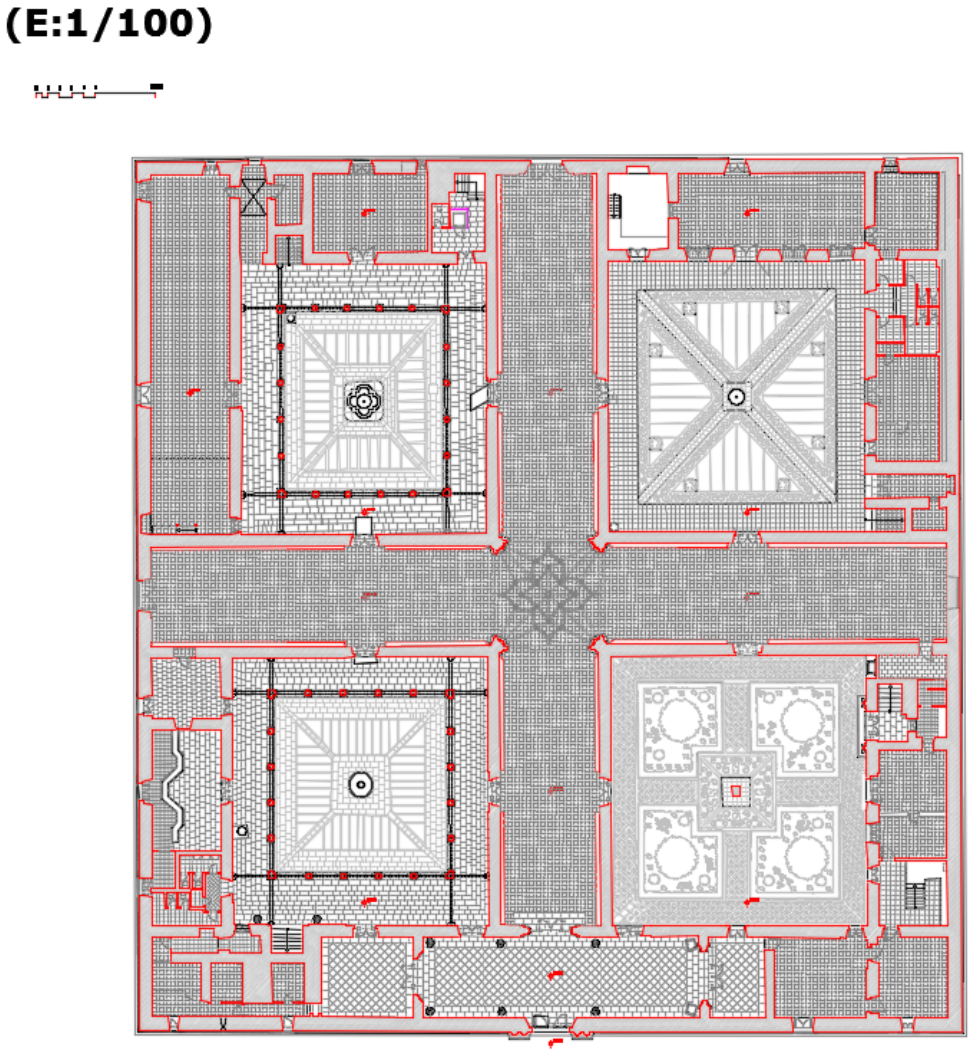

Fig. 1: Ground floor. Symmetry is the main feature.

The Renaissance is presented in the building through two courtyards named “marbles” and “chapel” respectively, being its better symbol the “marble” one. Both courtyards are porticos composed by two floors. The “marble courtyard” is considered uncompleted because the second floor does not have arches and it has different stones than marbles used in the ground floor. The chapel courtyard is composed by two floors of arches, which are similar to those designed by Diego de Siloé. The influence of Diego de Siloé is evident through his disciples: Martín Bolívar who built most of the “marble courtyard” and Melchor Arroyo who built the impressive wooden dome above the intersection of the second floor.

The great ceilings are also remarkable works in the building structure, which are crafted by Juan de Plasencia and the mentioned above Melchor Arroyo. Both carpenters provided impressive timber beams supporting the sloping ceiling that are studded with intrincate, wooden, pendant knots and adorned with ribbon-work.

The last important project concerning the Royal Hospital was the main doorway, designed by Alonso de Mena, who built and finished it in 1640. The portal is in the classical tradition, with its columns crowned by pyramids. In the centre, flanked by the statues of Ferdinand and Isabel there is a marble figure of the Virgin.

Because the importance of the Royal Hospital as a historical building we have surveyed it in order to get the base for documentation and management. Three techniques have been developed in the surveying task: classical topography, laser scanner and photogrammetry. In areas where the size is determined by a building, classical topography is enough to create a general reference system, which supports laser scanner and photogrammetry. Nowadays laser scanner has proved get suitable accuracy in order to document

cultural heritage [3]. Similarly, photogrammetry has been used as an easy technique [1], which is available for more and more users since the advances formulated by Hartley and Zisserman [5], and the appearing of the SIFT [7] algorithm. In our study, we has to combine both techniques, particularly when shadows areas appear in the scene; such a combination has been studied previously [2] and informed about its capabilities. The geometrical result from the surveying task is useful for controlling deformation (roof, ceiling, ..) and also in order to create semantic objects and incorporate to BIM, building information modeling, systems [6], [8]. The digital nature of the surveyed model, like presented here, facilitates its virtual diffusion and study [9].

2. Methodology

Laser scanner is the main source of data we used in our study because the geometry is better detailed with this technology than other ones are. Nevertheless we consider that a main traverse was useful in order to keep oriented each scanner station, so that, every scanner station was established over a known coordinates point; such a point is a station observed, computed and compensated from the main traverse. The main traverse is shown in Fig. 2 symbolized by red lines. The same reason brings us to observe a inner traverse symbolized by blue lines; this inner traverse is even more important than the main one because the scanner stations situated in the courtyard from the Royal Hospital are more difficult to align to the exterior ones, because small portion of cloud points appear in overlaid stations, so that ICP (Iterative Closest Point) alignment does not produce a suitable result. Fig. 2 shows a secondary traverse (green color) and the rest of scanner stations; the total number of stations was 31.



Fig. 2: Traverses for establishing the global reference system.

The total station used in the traverses observation was a Leica TS02 with an angular accuracy of 3¨and the distance accuracy go from 1.5 mm +2 ppm with reflector case and 2 mm + 2 ppm without reflector. The closing error for the main traverse was 2.3 cm and the corresponding error to the inner traverse was 1.2 cm. Because each scanner station was performed over known coordinates points (traverse stations) and oriented to target positioned also over known coordinates points (traverse stations), each point cloud coming from each scanner station was in the same reference system, i.e. the global reference system for the entire project. Nevertheless, after all the scanner stations were put together a final ICP alignment was run in order to reduce the error between overlaid point clouds. A set of isolated scanner stations, along with the global composed building, are shown in Fig. 3. The laser scanner we used was a Leica C-10, which is a fly time scanner with range distance of 300 m and a mean precision of 6 mm in position, 4 mm in distance and 2 mm in modeled surface.

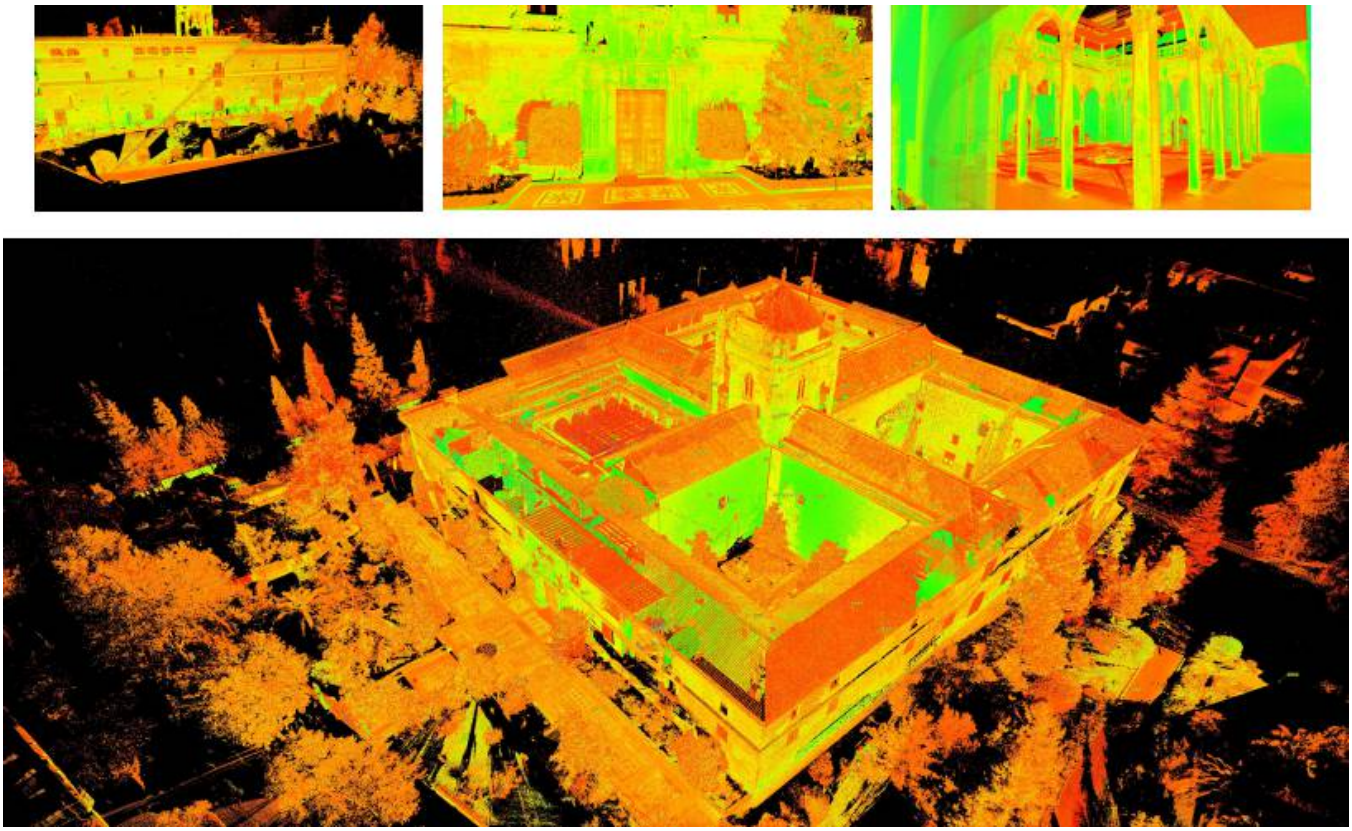

Fig. 3: Global points cloud alignment from isolated scanner stations

Some obstacles shadow the objects behind them when scanned by stationed laser, so that the computed mesh produce a hole which has to be registered and modeled by a different technique. In our study we covered the shadow areas using photogrammetry and stitch the corresponding patch to the main points cloud using ICP algorithms. Fig. 4 shows a fountain in the Carlos V courtyard where a hole is observed in the base because the front side shadows it. The solution we adopted was take pictures around the fountain and complete the mesh after computing the structure from motion.

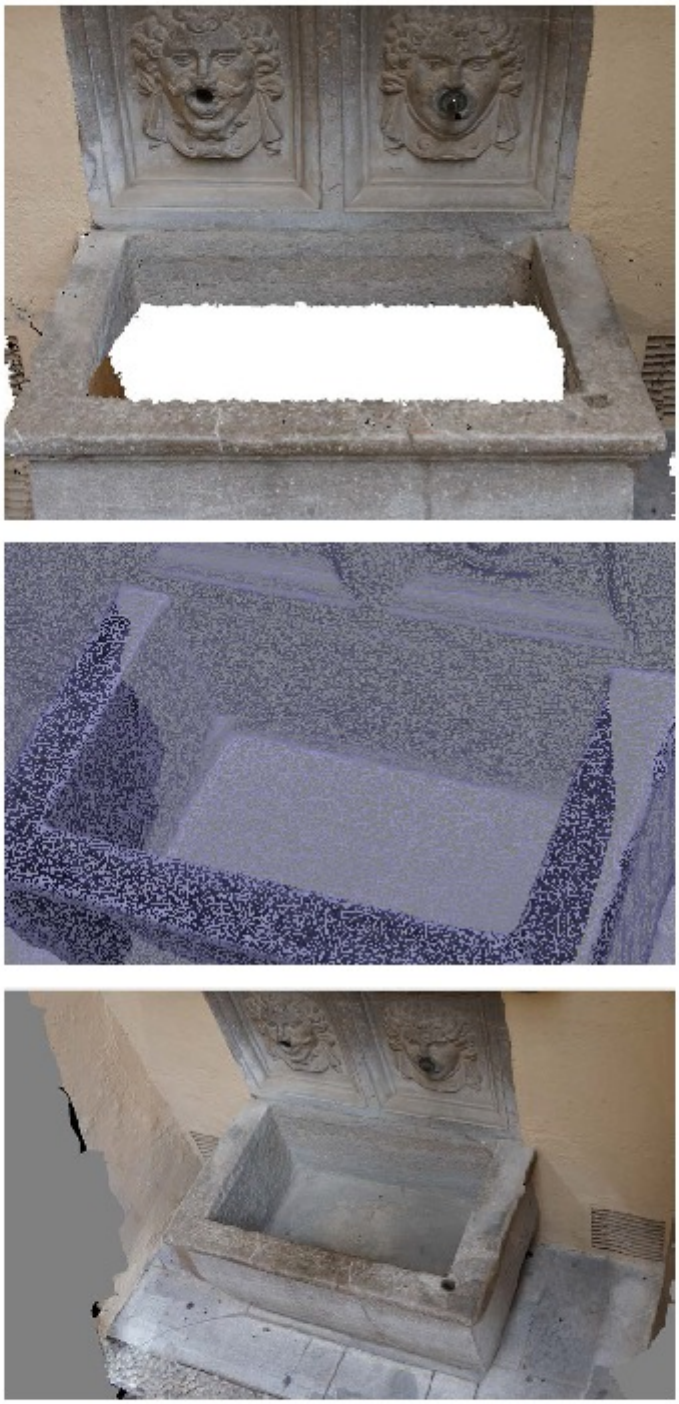

Fig. 4: Fountain with hole (upper) because shadow generated by scanner. The center image shows the mesh from photogrammetry and the bottom image shows the center 3D model textured

3. Conclusions

Laser Scanner and photogrammetry are complementary techniques suitable for surveying heritage buildings. The geometrical accuracy is its main feature, which is fundamental in order to get suitable plans at the same time it is the base for analyzing pathologies such as unleveled floors, deformations on ceilings, roofs or

walls. This kind of information can reveal the necessity of early intervention, in order to fix the problem before the problem to be increased. In our study we observed some deformations in a piece of the roof at the second floor nave.
A building surveyed by laser scanner and photogrammetry is a valuable product for deriving objects to be included in BIM structures. Tools from reverse engineering are more and more numerous, so that modeling automatically semantic objects is easier and easier.
Nowadays the main problem for building surveyed from point cloud is the files size, which can become so large than computer are not able to manage them, or be impractical to use. But such a problem it is expected to be decreased in a few years.

4. Acknowledgement

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5. References

[1] Almagro A. Simple methods of photogrammetry easy and fast. International Archives of Photogrammetry and Remote Sensing; 34(5/C7):32–8. 2001.

[2] Balletti, C., Guerra, F., Vernier, P., Studnicka, N., Riegl, J., Orlandini, S. Practical comparative evaluation of an integrated hybrid sensor based on Photogrammetry and Laser Scanning for Architectural Representation, in ISPRS, International Archives of Photogrammetry and Remote Sensing, Commission V, ISPRS XX Congress, Istanbul, Turkey. 2004.

[3] Barber, D., Mills, J., Bryan, P. Towards a standard specification for terrestrial laser scanning of cultural heritage - one year on, in ISPRS, International Archives of Photogrammetry and Remote Sensing, Commission V, ISPRS XX Congress, Istanbul, Turkey. 2004.

[4] Félez, C. The Royal Hospital. Granada: Editorial Universidad de Granada, 2012.

[5] Hartley, R., Zisserman, A. Multiple View Geometry in Computer Vision. 2nd ed. Cambridge: Cambridge University Press, 2003.

[6] Liu, X., Akinci, B., Requirements and Evaluation of Standards for Integration of Sensor Data with Building Information Models, in proceedings of the 2009 ASCE International Workshop on Computing in Civil Engineering: Austin, Amer Society of Civil Engineers, 2009, p. 24-27.

[7] Lowe, D.G. Distinctive image features from scale-invariant keypoints. International Journal of Computer Vision 60, 91. 2004.

[8] Murphy, M., McGoverna, E., Pavia, S., Historical Building Information Modeling - Adding Intelligence to Laser and Image based surveys, 4th ISPRS International Workshop "3D-ARCH" 2011, Trento, Italy.

[9] Pauwels, P., Verstaeten, R., De Meyer, R., Van Campenhout, J. Architectural Information Modeling for Virtual Heritage Application, 14th International Conference on Virtual Systems and Multimedia, Limassol, Cyprus, 2008, pp.18-23..

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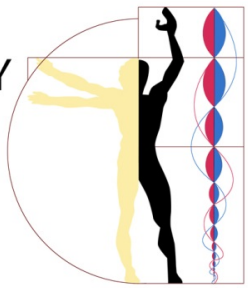

DATA QUALITY ELEMENTS FOR BIM APPLIED TO HERITAGE MONUMENTS

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Abstract

The Building Information Models are digital data sets organized as data models that represent physical and functional characteristics of places. BIM are used for decision making and management of infrastructures and for this reason data quality is a key factor.
In this paper we analyze the possible data quality elements to be considered in BIM applications and we propose a set of such data quality elements of specific interest for BIM applied to heritage monuments.
For this analysis we review some existing international standards related with the quality of data. In this way we analyze the international standard [1] (Geographic information. Data quality) and some of the Technical Specifications of ISO/TS 8000 (Data quality) (e.g. parts 120, 130, etc.).

1. Introduction

In architecture is currently taking place the BIM revolution. As [9] indicates this is a major mental transition when one comes from the CAD world. The main difference highlighted by various authors regarding CAD is the perspective provided by the I:<<BIM is building information modeling, with emphasis on the "I", which is what differentiates the both technologies. CAD can be defined as both computer aided design and computer aided drafting, but both cases emphasize the "computer aided" aspect of the proposition. BIM can be defined as both building information modeling and building information management, and, similarly the building information is emphasized. The real value proposition of building information modeling lies in the ability to analyze data.>>
However, this transition is not so when one comes from the GIS world. GIS have always been tools of analysis. GIS are tools to analyze the real world through modeling with spatial data (geographic information). The reality that is modeled and analyzed in a GIS is usually much more complex (e.g. territorial aspects, climatic aspect hydraulic aspects, etc.) than that reality modeled and managed in a BIM.
This approach of the construction management tools (BIM) towards spatial management tools (GIS) also means an approach in many other areas, including the data handling and management. Thus, since GIS is being applied from several decades, it is logical that experiences of the GIS field can be transferred to the BIM field.
This paper proposed a perspective for evaluating the quality of BIM data. This perspective is an adaptation of the experiences that exist in the field of GI regarding the quality of spatial data.
The backbone of BIM is the understanding of materials, objects, assemblies and projects [11]. All of them are managed by BIM as objects, in a programming sense. That means that materials, objects, assemblies and projects have properties, methods, events and relations. In a BIM objects carry information about: identity, appearance, performance, operation, usage, age, location, components, restrictions or rules, etc. Some of these properties actuate as base parameters (e.g. length, high and wide) for a parametric creation of a specific instance of an object type. All

this information is managed by the BIM tool as a database; actually a BIM tool is little more than a database management system with a graphic user interface [11].
The materials (concrete, wood, steel, glass, etc.) are the basic elements of construction. Have physical, chemical, visual, tactile, etc. properties, which are fully or partially transferred to the objects that compose aggregation.

The objects and assemblies differ in how they are created, implemented and managed in a project, but really are very similar. Objects are separate components, such as a door, a window; and assemblies are groups of objects that work together to create a more complex component at a given level of detail can be managed as an object. Examples of component are: walls, floors, roofs, etc. But a window (frame + glass + blind) can also be considered as an assembly, and this depends on the level of detail with which we work.
The projects are the BIM models. It would be better to use "project" to refer to how models are managed in a software package and use "model" to refer strictly to the assembly of assemblies that make sense buildings.
Each of these elements (materials, objects, assembled and projects) requires data (attributes) to specify it. For example, for an object or assembly:

- Identification: which product is
- Process: information on the lineage
- Performance: what is good, efficient, etc.?
- Limitations and rules: indication of constraints or rules.
- Installation: how is it installed?
- Appearance: what it looks like?
- Lifecycle / sustainability: how maintenance is done?
- Etc.

Moreover, the elements of a BIM own behavior and some associations that can be defined in the base model or applied specifically on a project in which they are indicated as specifications.
Everything mentioned so far has an overall resemblance to what happens in the field of spatial data, and therefore in this paper we analyze the applicability of the aspects of quality that are considered in the case of geographic information on the case BIM. In this sense the quality of the data from the perspective of the international standard [1] will be presented.
Moreover, much of the information (e.g. windows, steel sections, pipes, electrical elements, motors, etc.) incorporated into a BIM data can be considered as product data: a representation of information about a product in a suitable formal manner for communication, interpretation, or processing by human beings or by computers. With product data we mean information, including, among others, computer-aided design, data, models, parts information, manufacturing instructions, requirements, notes, documents, etc. In this sense the quality of the data from the perspective of the international standard [2] will be presented.
The proposal of a general model or framework for the data quality,(independent of any specific domain, means:

- Definition of data quality
- Dimensions /categories of data quality
- Attributes in each dimension
- How to measure these attributes
- How to control and improve data quality

But our proposal is related only with the definitions of the dimensions or categories of data quality.
This paper is organized as follows, first introduced in [1]. We present the definition of each of the components of the quality of the IG is performed. [2] will be presented later, its quality scheme and definitions. From the above discussion it will be decided whether to use these components in the case of BIM. The paper ends with some conclusions.

2. Data quality from the perspective of "[1]: Geographic information. Data quality"

The International Standard [1] establishes the principles for describing the quality of geographic data. It

- defines components for describing data quality;
- specifies components and content structure of a register for data quality measures;
- describes general procedures for evaluating the quality of geographic data;
- establishes principles for reporting data quality.

The conceptual model proposed by the standard is shown in Fig. 1. This embraces the four actions that have been indicated above. The key element is the data quality that must be reported and

related to specific scope. For this, data quality is expressed by elements of quality described by measures, quality evaluation process, results and metaquality.

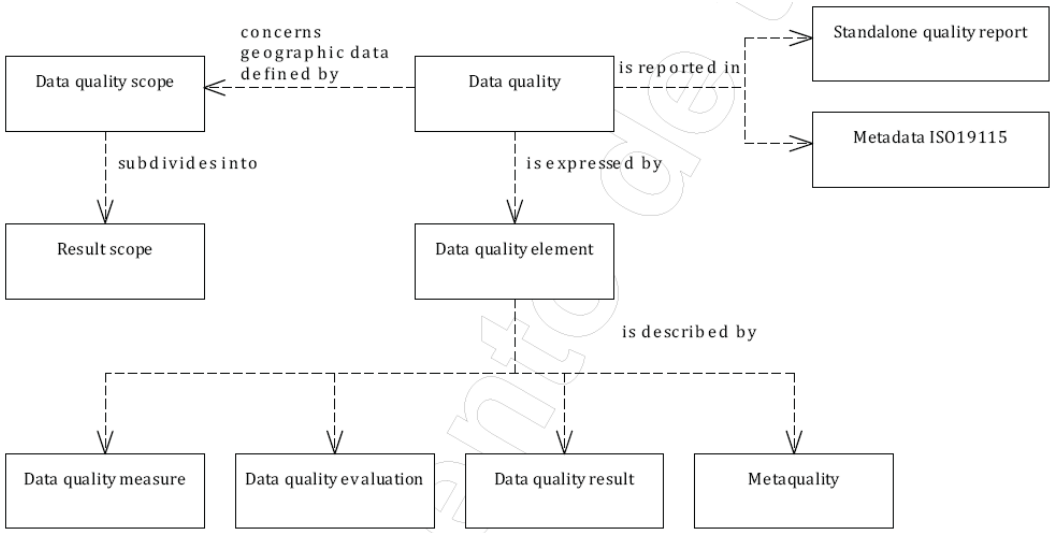

Fig. 1: Conceptual model of [1] (source: [1])

For [1] a data quality element is a component describing a certain aspect of the quality of geographic data. The elements have been organized into different categories. The Fig. 2 shows an UML diagram with categories and relations. Here follows a brief description of such categories and elements:

- Completeness. Completeness is defined as the presence and absence of features, their attributes and relationships. It consists of two data quality elements:
  - Commission. Excess data present in a dataset.
  - Omission. Data absent from a dataset.
- Logical consistency. Logical consistency is defined as the degree of adherence to logical rules of data structure, attribution and relationships (data structure can be conceptual, logical or physical). If these logical rules are documented elsewhere (for example in a data product specification) then the source should be referenced (for example in the data quality evaluation). It consists of four data quality elements:
  - Conceptual consistency. Adherence to rules of the conceptual schema.
  - Domain consistency. Adherence of values to the value domains.
  - Format consistency. Degree to which data is stored in accordance with the physical structure of the dataset.
  - Topological consistency. Correctness of the explicitly encoded topological characteristics of a dataset.
- Positional accuracy. Positional accuracy is defined as the accuracy of the position of features within a spatial reference system. It consists of three data quality elements:
  - Absolute or external accuracy. Closeness of reported coordinate values to values accepted as or being true.
  - Relative or internal accuracy. Closeness of the relative, positions of features in a dataset to their respective relative, positions accepted as or being true.
  - Gridded data position accuracy. Closeness of gridded data spatial position values to values accepted as or being true.
- Thematic accuracy. Thematic accuracy is defined as the accuracy of quantitative attributes and the correctness of non-quantitative attributes and of the classifications of features and their relationships. It consists of three data quality elements:
  - Classification correctness. Comparison of the classes assigned to features or their attributes to a universe of discourse (e.g. ground truth or reference data).

- Non-quantitative attribute correctness. Measure of whether a non-quantitative attribute is correct or incorrect.
- Quantitative attribute accuracy. Closeness of the value of a quantitative attribute to a value accepted as or known to be true.

- Temporal quality. Temporal quality is defined as the quality of the temporal attributes and temporal relationships of features. It consists of three data quality elements:
  - Accuracy of a time measurement. Closeness of reported time measurements to values accepted as or known to be true.
  - Temporal consistency. Correctness of the order of events.
  - Temporal validity. Validity of data with respect to time.
- Usability element. Usability is based on user requirements. All quality elements may be used to evaluate usability. Usability evaluation may be based on specific user requirements that cannot be described using the quality elements described above.

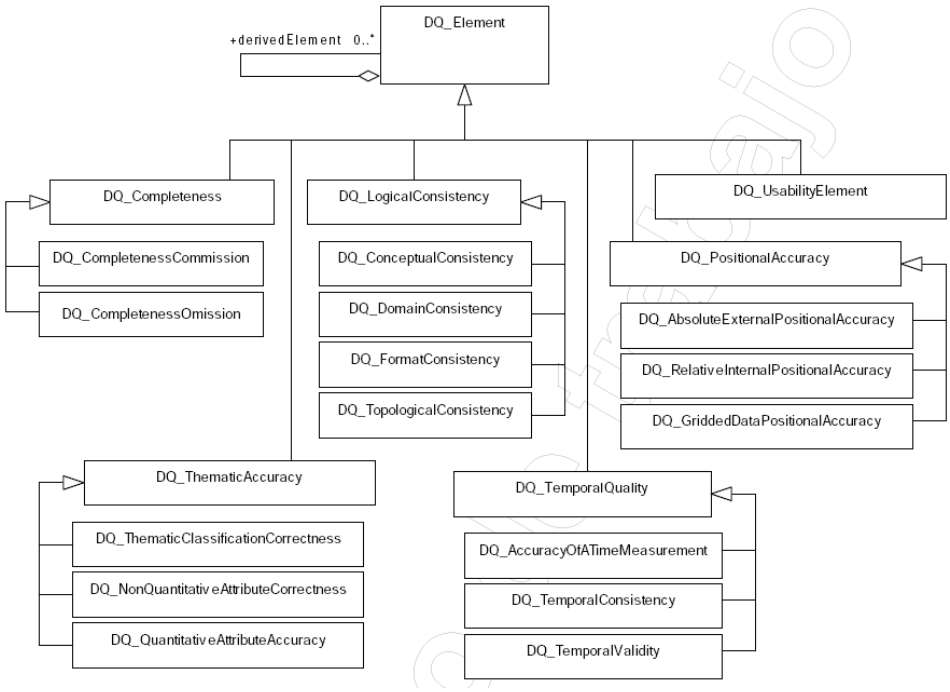

Fig. 2: Data quality elements in [1] (Source [1])

3. Data quality from the perspective of "ISO/TS 8000-1:2011. Data quality"

[2] is focused on the ability to create, collect, store, maintain, transfer, process and present data to support business processes in a timely and cost effective manner. This purpose requires both an understanding of the characteristics of the data that determine its quality, and the ability to measure, manage and report on data quality. [2] covers industrial data quality characteristics throughout the product life cycle from conception to disposal. [2] addresses specific kinds of data including, but not limited to, master data, transaction data, and product data (Fig. 3). [2] is organized as a series of parts:

- parts 1 to 99: General data quality [3];
- parts 100 to 199: Master data quality [7];
- parts 200 to 299: Transaction data quality[4], [5], [6];
- parts 300 to 399: Product data quality [8].

Each of the above series addresses communication within an organization and between two or more organizations.

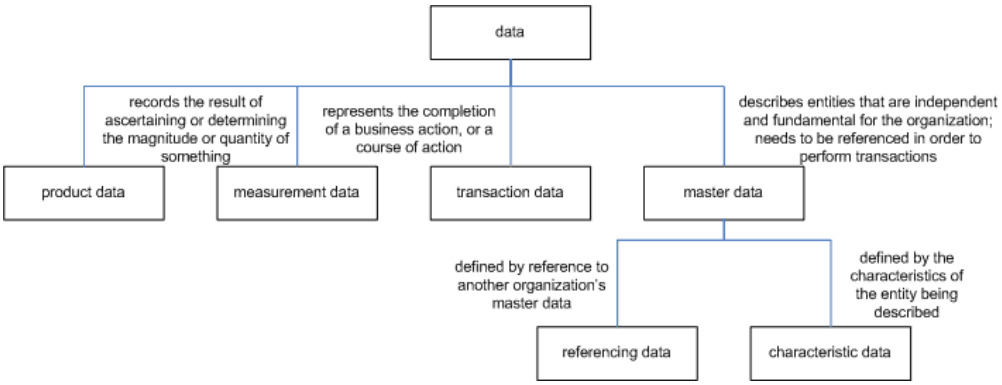

Fig. 3: General vision of the scope of [2] (Source [2])

Fig. 4 shows a general view of the data architecture proposed by [2]. This architecture is applicable to the scope of the parts of [2] that have been published until now. The relations stablished between data and other elements (data dictionary, data specifications, formal syntax and identification scheme) also can be considered valid for GI. From the point of view of our interest, the focus must be applied to the proposed accompanying quality elements for data: data provenance, data accuracy, and data completeness.

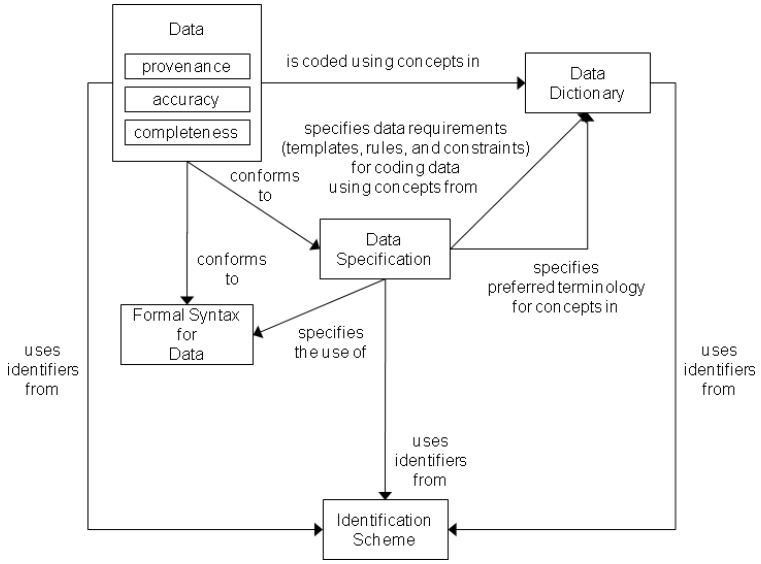

Fig. 4: general view of the data architecture proposed by [2] (Source [2])

The definitions offered by this rule are:

- Data accuracy: closeness of agreement between a property value and the true value.
- Data accuracy record: record of the information provided about the accuracy of a piece of data.
- Data completeness: quality of having all data that existed in the possession of the sender at time the data message was created.
- Data completeness record: record of the information provided about the completeness of a piece of data.

- Data provenance: This definition is not included in the rule. Provenance refers to the ability to trace and verify the creation of data, how it has been used or moved among different databases, as well as altered throughout its lifecycle.
- Data provenance record: record of the ultimate derivation and passage of a piece of data through its various owners or custodians. A data provenance record can include information about creation, update, transcription, abstraction, validation, and transferring ownership of data.

4. Discussion and proposal of Heritage BIM data quality elements

All the standards developed by ISO, and under development, focus on some specific domains, e.g. manufacturing, intelligent transportation, geography, and so on. There is still not a general model/framework of data quality independent of any particular domain or application and the existing domain models of data quality differ on dimensions, attributes, measurements, evaluations and so on. A justification is the great diversity of themes that work the very many technical committees of ISO, and the miscommunication and absence of partnerships between the technical committees that develop standards.

The two standards ([1] and [2]) that have been discussed have two different perspectives on data quality, and both are of interest in the BIM field. Besides presenting different perspectives, the definitions that they provide and how they manage these elements in their models is different. Also, there are other standards related to data quality (e.g. ISO / TR 21707-2008, ISO / IEC 25012: 2008), but the situation is similar. This circumstance is usual in ISO standards.

As stated previously, we are not going to propose a general framework for data quality, even a complete framework for the quality of BIM data in the heritage field. Our aim in this paper is more modest: we only propose a set of categories or dimensions of quality applicable to heritage BIM. This proposal focuses only on the intrinsic quality (accuracy, objectivity, believability, reputation). In later works these categories will be used to develop a UML model and to define measures, control methods and improvement, etc., but now it is out the scope of this paper.

The quality aspects are organized into elements and sub-elements of quality, here we use these terms with the same sense that were used in ISO 19113. The elements are logical groupings of quality sub-elements. The sub-elements relate to specific aspects of quality that can be measured and evaluated by means of different measures and methods.

The elements and sub-elements are:

- Provenance or lineage. This element appears in [2], as provenance, and in ISO 19113 (the predecessor of the [1]), as lineage. We believe that the inclusion is important because it provides information relevant to the credibility and reputation. For example, in the case of heritage BIM will allow authorship or featured processes. In the area of GI this element is treated by ISO 19115, and includes references to dated processes and sources. Both elements seem appropriate for consideration for heritage BIMs.
- Completeness. Completeness. Completeness appears in both [2] and [1]. The completeness's defects or errors are important when working with data, both when they occur in running BIM projects and when managing BIM related to existing buildings. In this case can be considered two sub-elements:
  - Omission. It is the absence of elements. This means that something is not on the BIM model but that really does exist in real world. In heritage BIM this may mean no consideration (omission) of any relevant element of the real world.
  - Commission. It is the presence of excess items. This means that something appears in the BIM model, but that does not exist in real world. An example in a heritage BIM project may be the inclusion of an item that really should not appear, the inclusion may involve the purchase of the good with the consequent extra cost.
- Metric accuracy. This element does not appear in [2] or [1]. However, the definition given to accuracy in [2] is fully applicable to this proposal. In this case we consider the following sub-elements:
  - Absolute positional accuracy. This sub-element does not appear in [2], since its scope is not geographical. But the position is the most significant aspect of the GI and therefore relevant in [1]. Under our consideration BIMs should be understood fully integrated with the GI and Geoservices (e.g. SDI services, virtual globes, etc.). This means that the positional accuracy, relative to a reference coordinate system and a projection system, is a critical requirement. For example, the absolute positional accuracy will be a requirement to adequately integrate a BIM model with its cadastral parcel, and place it properly on geographic viewers and virtual globes.
  - Relative positional accuracy. This sub-element does not appear in [2] since its scope is not geographical. But the position is the most significant aspect of the IG and therefore relevant in [1]. This sub-element means that heritage BIMs should pick accurately the relative positions of objects of the real world. For example, the distance between a door D and a window W must be

accurate, or the distance between wall M1 and another wall M2 must have an appropriate degree of accuracy.
  - Shape accuracy. This sub-element is directly related to the proposal of accuracy that is done in [2]. Moreover, in some applications of ISO 19113 (the [1] predecessor) it was defined the geometric fidelity sub-element, and it approximates well what we propose here. This sub-element is proposed to consider all geometrical aspects relating to the element itself, as opposed to the positional relationships between the element and its environment (e.g. absolute or relative positional accuracy). Shape accuracy includes, among others, manufacturing tolerances. Thus, depending on the aspect (roughness, roundness, height, width, etc.) we can define different measures
- Thematic accuracy. This element does not appear, as such, in [2], although interpretations of accuracy can cover this field properly. The thematic accuracy does appear in [1]. We propose to include this element in order to incorporate all aspects of the accuracy that are thematic type (not metric aspects). The following sub-elements are proposed:
  - Classification correctness. It refers to the correct classification of elements by its assigned categories.
  - Non-quantitative attributes correctness. It refers to the correctness of the registered values of object attributes.
  - Accuracy of quantitative attributes. Objects may have quantitative attributes, for example, a heat or light transmission values. This sub-element means that values are accurately registered.
- Temporal accuracy. This sub-element does not appear, as such, in [2], although interpretations of accuracy can cover this field properly. The temporal accuracy does appear in [1]. We consider the temporal aspect in BIMs is very important, although not much is highlighted in the BIMs manual. In the case of BIM applied to heritage this aspect is particularly relevant.
  - Date accuracy. It means that the dates are accurately recorded.
- Logical consistency. This sub-element does not appear, as such, in [2], although interpretations of accuracy can cover this field properly. Also, the proposed architecture by [2] for the quality does consider. Logical consistency does appear in [1]. The following sub-elements are proposed:
  - Format consistency. It means that the records are coded following the rules of the formats set in the specifications.
  - Conceptual Consistency. It refers to that elements recorded in a BIM must follow some conceptual rules that are proper of a construction (e.g. constructions rules).
  - Domain Consistency. It refers to that recorded values for any given characteristic (e.g. an attribute, category, etc.) must be within the logical domain (e.g. interval for numerical values, or an enumerated list for classes) of values for that feature. For example, an enumerated list may be relative to the material forming a gate: {wood, PVC, iron, glass}. In this case you can only use one of the items on the list; the use of any other material is a consistency error.

5. Conclusions

This work has focused on the quality of BIM data. The data that make up a BIM have a great similarity with spatial data managed by GIS, and also with product data managed by product data management systems. For this reason we have presented both, the [1] and [2] standards, covering each of the two perspectives mentioned above. It is observed that in the ISO organization there is no a general or common framework for defining the quality of data, in each application domain standards are proposed.

This paper has made a proposal of quality elements and sub-elements for heritage BIMs. This is a very basic proposal; it is not exhaustive, so that in the future it is possible to add more elements and sub-elements. This design is the first part of a more comprehensive design that should include measures, assessment methods and reporting, but these issues are beyond the scope of this work. The proposal combines aspects from the [1] and [2] standards, with the perspective of intrinsic quality. For each of the proposed elements and sub-elements it was performed a justification and included an example.

Suggestions welcome, please send an e-mail to the corresponding author.

6. Acknowledgement

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7. Referencias

[1] ISO 19157:2013. Geographic information. Data quality.

[2] ISO 8000-2:2012. Data quality. Part 2: Vocabulary.

[3] ISO/TS 8000-1:2011. Data quality. Part 1: Overview.

[4] ISO/TS 8000-120:2009. Data quality. Part 120: Master data: Exchange of characteristic data: Provenance.

[5] ISO/TS 8000-130:2009. Data quality. Part 130: Master data: Exchange of characteristic data: Accuracy.

[6] ISO/TS 8000-140:2009. Data quality. Part 140: Master data: Exchange of characteristic data: Completeness.

[7] ISO/TS 8000-150:2011. Data quality. Part 150: Master data: Quality management framework.

[8] ISO/TS 8000-311:2012. Data quality. Part 311: Guidance for the application of product data quality for shape.

[9] Weygant, R. BIM Content Development: Standards, Strategies and Best Practices. NJ: John Wiley and Sons, 2011.

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San Francisco Schools, 1839. Virtual reconstruction of the Franciscan convent of Betanzos and its transformations, in the XIX Century (Galicia, Spain).

A disappeared architecture in the English Way of Santiago de Compostela.

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Abstract
The Franciscan Schools of Betanzos were placed in the west wing of the former Franciscan convent since 1839 to 1924. The Gothic convent of San Francisco no longer exists. It disappeared after 1835 with the Confiscation of Mendizábal. The remain parts of the building that survived are the church and a fragment of the west pavilion. The research starts analyzing the vestiges of the former convent. The aim of this work is the 3D virtual reconstruction of the convent and its urban space in the nineteenth century. A historical and graphical analysis of the evolution of the disappeared convent has been carried out. Physical transformations and changes of use have been also studied. It has been considered that the historical importance of the convent justified a detailed analysis which claims the leading role it had in the history. Betanzos was one of the seven Galician main cities until the mid-nineteenth century. At the same time the changes in the city and those in the convent have been analyzed, because they are closely linked.
More than 1500 historical documents belonging to local, regional or national archives have been examined and over 242 unpublished documents have been digitized. The final result has meant the virtual recovery of a missing, unknown Franciscan architecture.

Keywords: Franciscan Order; English Way of Santiago de Compostela; Betanzos; Franciscan Schools; Confiscation of Mendizabal.

1. The Franciscan settlement and the former convent.
The convent was born outside of the city walls [1], occupying an extensive area in the northwest corner of the village (Fig. 1). The population was established in the Castro de Untia in 1219 [2], owned by the monastery of Sobrado de los Monjes [3]. The village had since the beginnings Royal privileges.
The convent was founded in the thirteenth century, being the promoter Fernán Pérez de Andrade "O Boo" and the Church became the Pantheon of nobility [4]. Its location between two rivers [5] and in a Templar settlement [6] was strategic.
Its construction began with the apse of the church (Fig. 2), following the guidelines of poverty of the Franciscan Order, Scholastic philosophy and Gothic style introduced by Franciscans in Galicia. The initial draft made a building type that was continually repeated in Galicia [7], using local materials as granite, slate or chestnut wood, with sizes and similar distributions. The convent in a first phase was finished with a one level building. Until the fifteenth century monk´s cells were community.

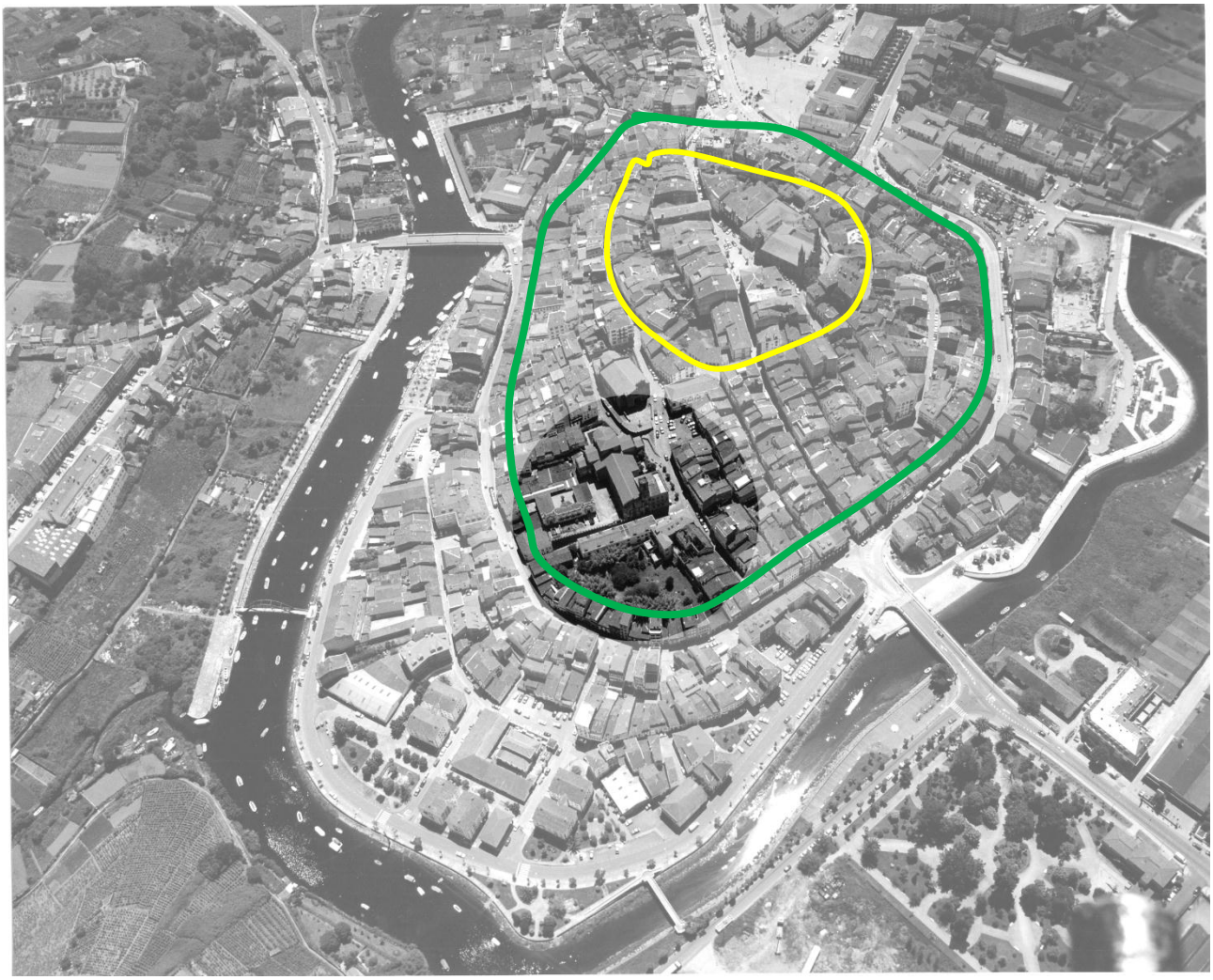

Fig. 1: Aerial view of Betanzos in the first half of the XX century, standing out the Franciscan enclosure. In yellow color the XIII city walls and in green color the XV city walls. AMB. Archive of Betanzos City Council.

The construction of a new defensive city walls, during the XV century [8], with towers [9] and gates, modified the location of the convent passing to be placed inside them (Fig. 3). In the early sixteenth century, the convent expanded outside the city walls, including a part of them in the new building (Fig. 4). The monastery became a fortress. Between the north wing of the convent and the city walls, there was a four meters way and it was impossible to build a new cloister for lack of space [10].The solution was to add the new pavilion to the north wing of the convent and continued outside the city walls. Moreover, the Church suffered some extensions motivated by the foundation of funeral chapels [11]. The convent last enlargement with historical documentation took place in the seventeenth century: the upper cloister [12]. Gothic style sizes and relationships were not randomly determined. In the XVIII century, the Franciscan convent appeared completely reconstructed after the fire that destroyed a part of it in the first third of the century.
Beauty was a consequence of the Divine proportion, golden relationship and harmony of shapes. Mathematical relationships marked the Medieval philosophy [13]. Franciscans were at the forefront of new thinking joining faith and reason, always subordinating reason to faith. The meaning of the numbers were significant in religious buildings.

2. The destruction of the convent. XIX century.

The Confiscation of Mendizábal in 1835 caused the abandonment of the convent and the beginning of its destruction [14]. Once the Franciscan property was owned by the government, the following changes occurred: a division of the land, use changes and development of infrastructure in the resulting urban space. In 1839 the City Council asked the Queen to use the west wing of the convent for First Education School Children [15] (Fig. 6).



Fig. 2: The Church of San Francisco in the XIX century. AMB. Archive of Betanzos City Council.

In 1837, the western orchard´s convent [16] and in 1839 the eastern one [17] were sold, in public sale. These orchards exist today (Fig. 5).
In 1872 the architect of Lugo, Eutasio Rodriguez, drafted the public Prison Project in the north wing of the convent [18]. Though it was never executed, it was an extremely valuable document to rebuild the former convent. Their original plans have provided the dimensions of the destroyed parts of the convent and cloister.
In the nineteenth century, many city walls did not allow the growth of Spanish cities. The same thing happened in Betanzos. In 1873 the cloister of the convent was destroyed to open the street of San Francisco [19] (Fig. 6) to communicate the interior with the exterior of the city. In this way, both, scheme uses and circulations were modified since the convent disappeared.

3. The Schools of San Francisco in the west wing of the former convent and other uses.

The convent of San Francisco hosted in the cell called "Baquero" the first Public School for children in1839 [20]. In 1872 security works were taken during the demolition of the cloister [21] and in 1873 the cloister was completely dismantled. After opening the street of San Francisco in 1873, it became necessary to carry out renovations in the Schools of San Francisco. As a result of the disappearance of the cloister was necessary to build a new facade to that street.
Important changes in education took place in Spain in the mid nineteenth century. Schools become public and the City Council Corporation decided to locate girls' school in the same building than the boys to save money. Since 1839 in the ground floor, was located the school for boys, joining from 1874 the school for girls [22] and on the upper floor were located the teachers´ home.
In 1918 a new school building was inaugurated. The philanthropist Jesús García Naveira, born in Betanzos, financed the construction of the new school located in the old cloister of the former convent. By the will of the founder the location of the building should be just in the middle courtyard of it. The children become to study in the new building. In 1924 a part of the west wing become a Military Headquarter [23].
The City Council Archive was located in the main floor of that building until 1981. All the historical documents were in a neglected state and moved to its current location in 1982. At the same time, the City Council carpenter was located in a room downstairs.
In 1990 it was absolutely necessary to carry out rehabilitation works in the west wing. The new project transformed it into a workshop school of the National Employment Agency (INEM). The project made no reference to the former convent and the solution that finally took place did not consider the constructive typology and the original materials. The structure of wood, masonry wall slate, coatings lime mortar and arrangement of the roofs were replaced by reinforced concrete in all its levels, mortar lining waterproof cement with plastic paint in external parameters and supplement walls with brick. During excavation were found pieces dating from the fourteenth century by the experts of the “As Mariñas” Museum, like “Santiago Peregrino”. There also were found bases and chapitels of columns that belonged to the Gothic cloister.

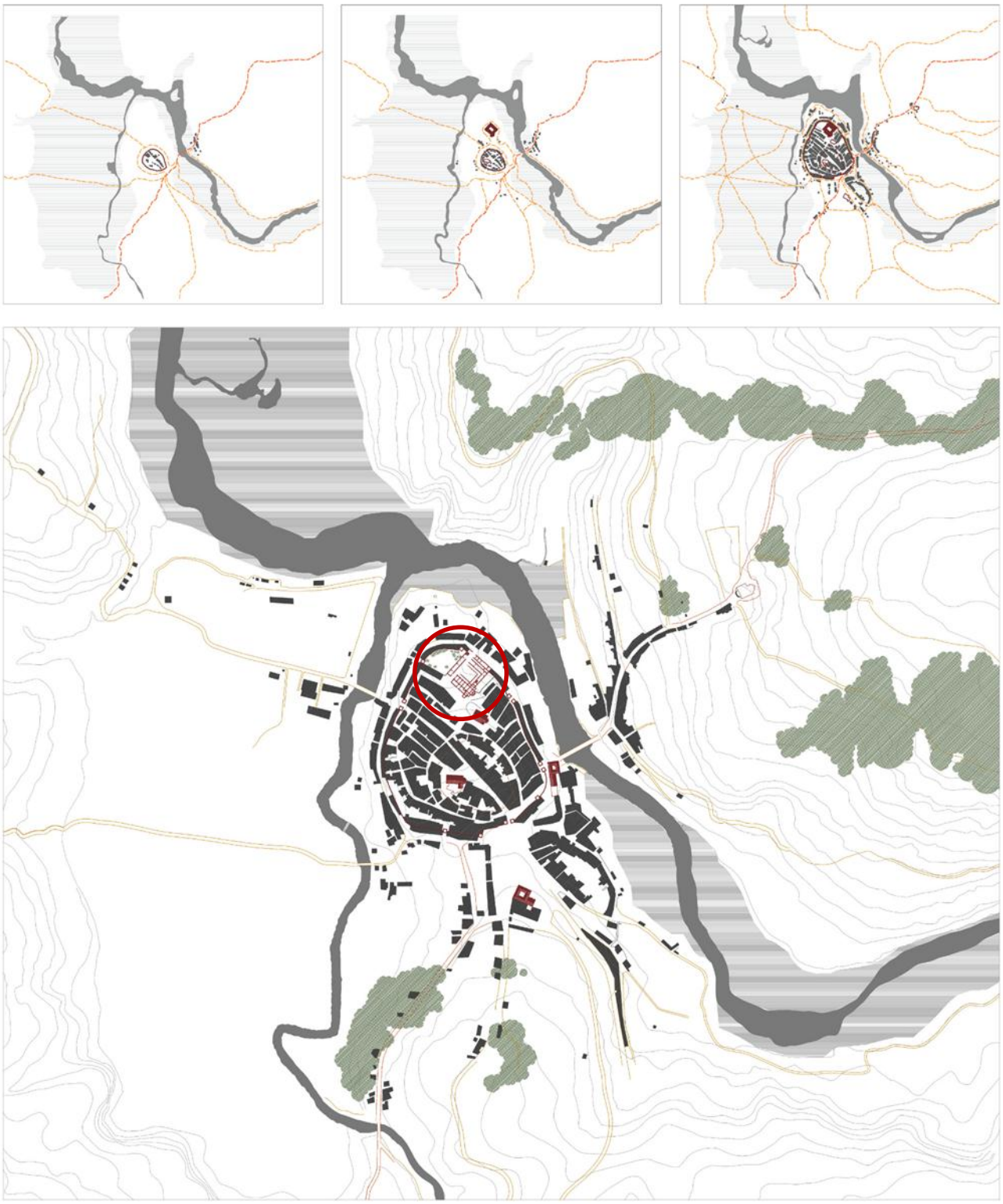

Fig. 3: Evolution of Betanzos.
Above left to right:
-Betanzos in the **XIII** century with the first city wall.
-The village in the **XIV** century with the initial Franciscan convent (in red color) constructed outskirt the first city wall.
-The city in the **XVIII** century with the convent in its final dimension and with the second city wall built in the fifteenth century.
Below, map of the village in the nineteenth century, where the destruction of the convent (rounded in red) is appreciated. The convent and town grew together until the eighteenth century. MC. Marta Colón.

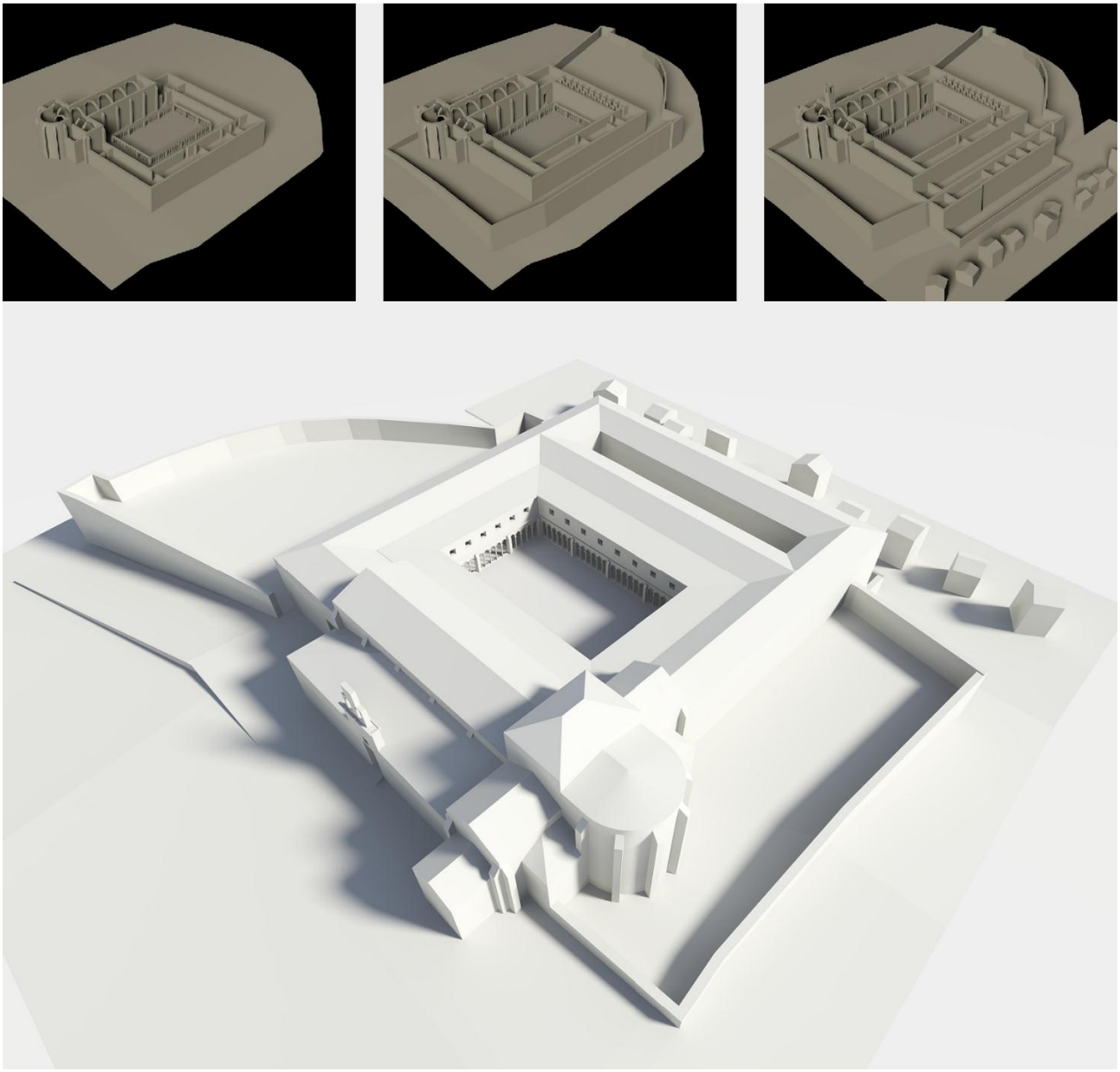

Fig. 4: Evolution of the convent.
Above from left to right:
-The friary in the **XIV** century with one level. Along the arm of the transept was the sacristy and next to it the community bedroom was placed in order to provide an instant access to the Church for morning prayers. That was the reason why the Chapter hall in Galician convents were moved to the north wing. The refectory was located in the west wing as were indicated in the documents of restoration works of San Francisco schools. The small cellar was placed between the kitchen and the Chapter hall. The refectory had a direct access door to the orchard. There were also library, classrooms and a covered access, as it was related in the Conception Brotherhood Book founded in the Archive of Betanzos. In the convent there was a division into public, semi-public and private spaces. The public space was formed by the church; the semipublic was the cloister and the rest of dependences were for exclusive use for the monks. The communication with the cloister was done through the Library in order to maintain the privacy. The rest of the spaces of the convent were interconnected.
-The convent in the **XV** century with the second city walls and two levels. From the fifteenth century, some Franciscan cloisters had a second floor. In the previous two centuries the bedrooms were located on the ground floor, near the Church to simplify the access to the temple. The Chapter Hall moved to the opposite wing of the Church as in the convents of Orense, Lugo and Vivero. When barns of convents disappeared were left free spaces to place the refectory, kitchen and other areas such as teaching classrooms and library. Galician mendicant´s temple is, volumetrically, very clear with few decorative resources. The sacristy was located in the northern arm of the transept. In this century the four zones were perfectly articulated and organized according to their functions and availability to the community or areas shared by the laity. As in the previous century the space of the convent was divided into public – Church-, semi-public - cloister and atrium-, and private for monks use. The convent had two levels. There were two kinds of communication with the second floor, the first one for friars and the second for the Royalty. The Royal bedroom was placed above the sacristy.
-Last enlargement of the convent in the **XVI** century outside the city walls. In the early sixteenth century, the convent expanded outside the city walls including a part of it in the new building. The monastery became a fortress. Between the

north wing of the convent and the city wall, there was a four meters way, as has been shown in the plan of the Public Prison Project of 1872 by Eutasio Rodriguez. It was impossible to build a new cloister for lack of space. The solution was to add the new pavilion to the north wing of the convent and continued outside the city walls. In the new convent basement floor there was an access from the Rivera Street to the friary cellars covered with a barrel vault
Below, the convent in the **XVIII** century with the upper-cloister. MC. Marta Colón.

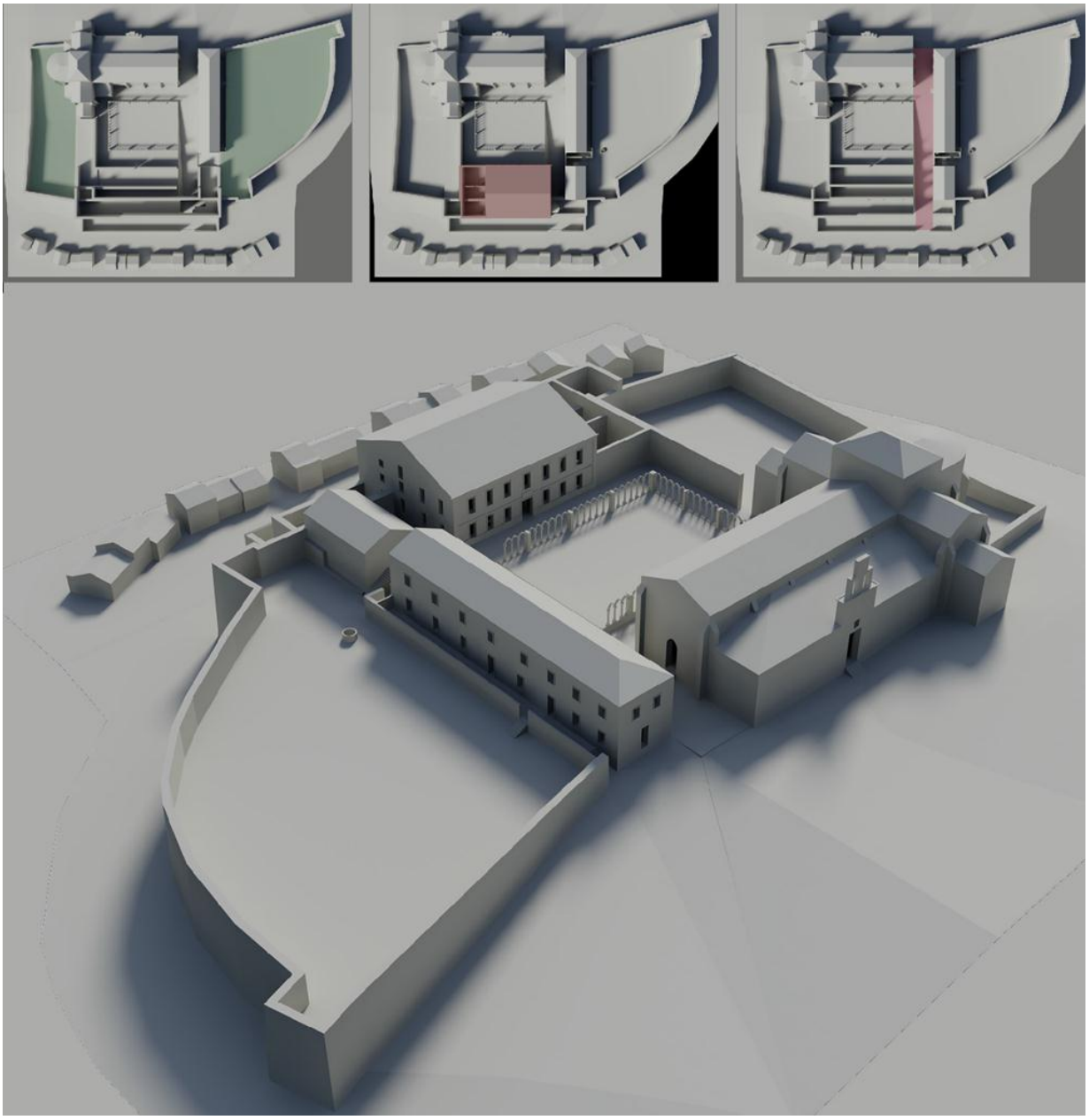

Fig. 5: Changes of use in the Franciscan enclosure in the **XIX** century.
Above from left to right:
-The orchards of the convent (in green colour) were sold in public sale between 1837 and 1839.
-The public Prison Project in the north wing of the convent (in red colour) was drafted by the architect of Lugo Eutasio Rodriguez in 1872 but it was never constructed.
-In 1873 the west wing of the cloister was destroyed to open San Francisco Street (in red colour).
Below, infographic view of the Franciscan enclosure with the schools of San Francisco, the public Prison, the Church and the new opened San Francisco Street. MC. Marta Colón.

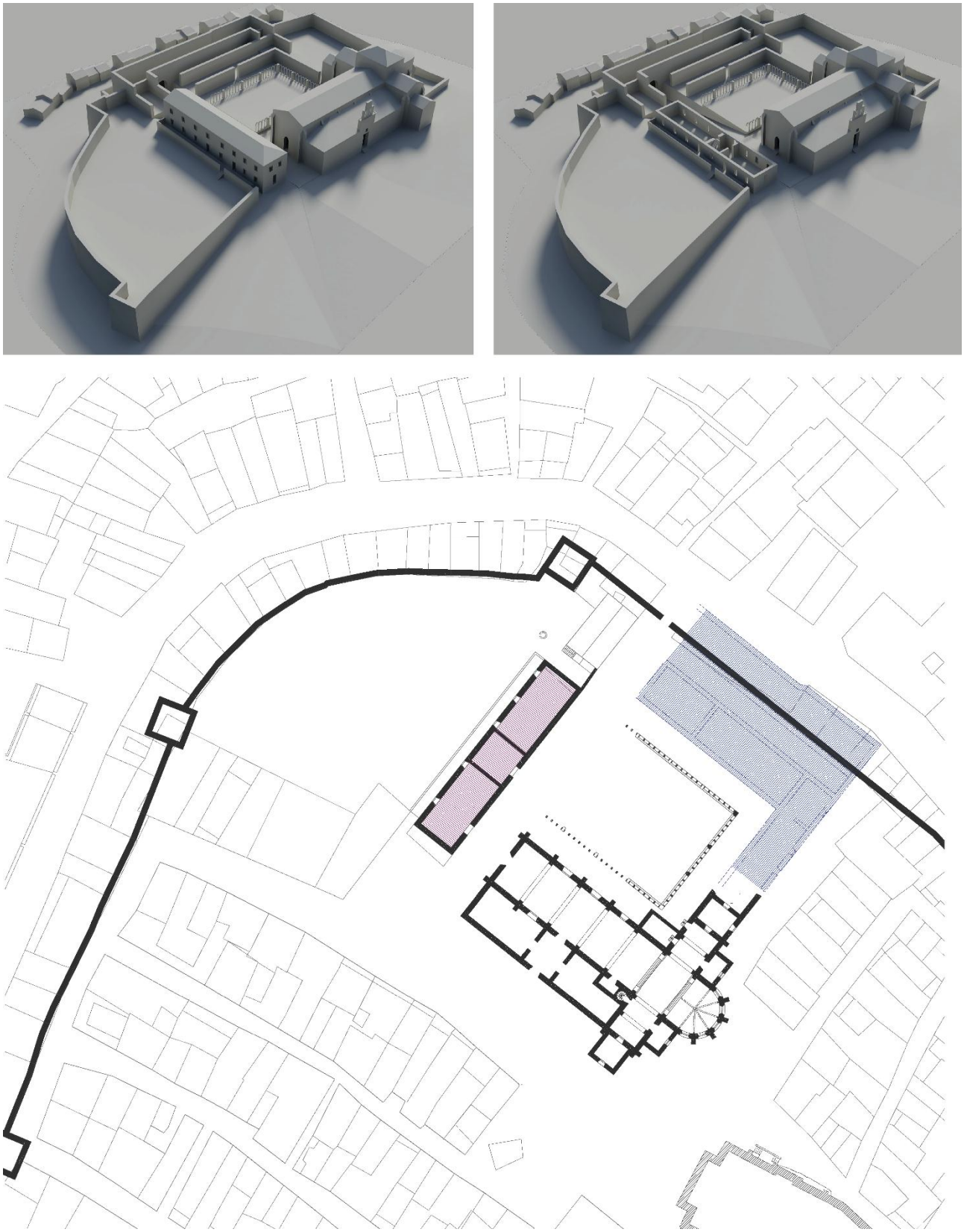

Fig. 6: Schools of San Francisco, 1839.
Above from left to right:
-Infographic view of the schools building located perpendicularly to the church.
-Infographic view of the interior distribution of the building with a classroom for boys and separated for girls.
Below, map of the city from the late nineteenth century with the church, the schools (in pink color) and the destroyed north and east wings (in blue color), the city walls (in black color) and the new opened San Francisco Street. MC. Marta Colón.

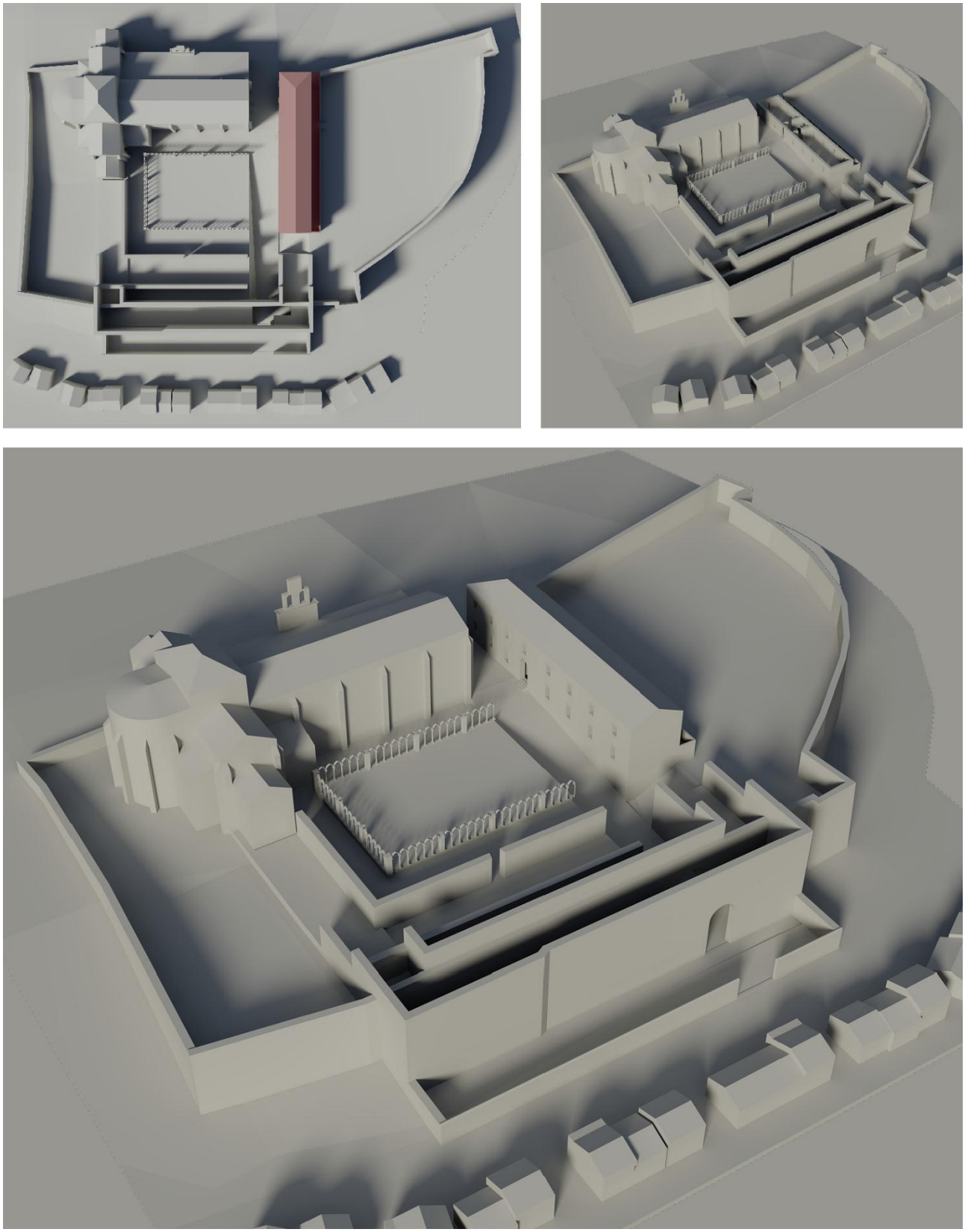

Fig. 7: Schools of San Francisco, 1839.
Above from left to right:
-Infographic view of the schools building (in red color);
-Infographic view of the interior distribution of the building with a classroom for boys and separated for girls.
Below, infographic view of the Franciscan enclosure in the late nineteenth century with the church, the schools and the destroyed north and east wings, the city walls and the new opened San Francisco Street. MC. Marta Colón.

4. Conclusions.

The friary of San Francisco of Betanzos was one of Galician major ones. It was located in a privileged location in the English Way of Santiago de Compostela and in the route of the oldest Primitive way too.
The Friars, following the spirit of the founder, chose strategic locations to carry out their spiritual work. Villages and convents grew together sharing their histories. The educational work of the Franciscans survived in the schools of San Francisco during the nineteenth century.
The designs of the Franciscan convents were based on the Scholastic philosophy. The sober and elegant Churches were built looking for divinity in their height and lighting although the poverty was always present, as the foundation rule. These constructions have given rise to a unique and unequalled architecture in Europe.
The tradition of the Pilgrimage of the Saint of Assisi to Santiago de Compostela in 1214 has left an indelible mark printed on Galician geography and soul. The birth of a young architecture along the pilgrimage routes with Divine forms and looking for eternity was the beginning of a cultural and social tradition of universal scope.
Franciscan friaries offered hospitality to pilgrims from all over the world and nowadays are silent witnesses of thousands of pilgrims´ stories who still wish "good way" to their fellow travellers in the time being.
Studying all the unpublished projects carried out in the convent enclosure throughout the history, the Franciscan architecture can be valued. Helpfully results can be obtained studying all these documents in order to get guidelines to safeguard the great Franciscan cultural heritage.

Bibliographical References and Archives consulted.

[1] GARCÍA ROS, Vicente. *Los franciscanos y la arquitectura*. 1ª ed. Valencia: Asís, 2000. 93-94 pp. ISBN 84-85461-32-0.

[2] NÚÑEZ-VARELA LENDOIRO, José Raimundo; RIBADULLA PORTA, José Enrique. *Historia Documentada de Betanzos de los Caballeros, siglos XV y XVI.* 1ª ed. A Coruña: Caja de ahorros de Galicia, 1984. 34 p. ISBN 84-241-4475-9.

[3] DEL HOYO, Jerónimo, *Memorias del arzobispado de Santiago.* Transcription of original book of 1607 by Ángel Rodríguez González y Benito Varela Jácome. Santiago de Compostela: Porto y Cía, Editores, 1976. 282 p.

[4] GARCÍA ORO, José, *Galicia en los siglos XIV y XV, Vol II, Betanzos la ciudad de los caballeros.* 1ª ed. A Coruña: Fundación Pedro Barrié de la Maza, 1987. 238 p. ISBN 84-85728-59-9.

[5] MADOZ, Pascual, *Diccionario geográfico-estadístico-histórico de España y sus posesiones.* 1ª ed. Madrid: Breogán, 1845. 145 p.

[6] MARTÍNEZ SANTISO, Manuel, *Historia de la Ciudad de Betanzos.* Facsimile edition of the original of 1892. 1ª ed. A Coruña: Diputación Provincial, 1987. 244-245 p.

[7] LAMPÉREZ y ROMERA, Vicente, *Historia de La Arquitectura Cristiana Española en la Edad Media según el estudio de los elementos y los monumentos.* 2ª ed. Barcelona: Espasa-Calpe, 1930. 456 p.

[8] MARTÍNEZ SANTISO, Manuel, *Historia de la Ciudad de Betanzos.* Facsimile edition of the original of 1892. 1ª ed. A Coruña: Diputación Provincial, 1987. 288 p.

[9] SORALUCE BLOND, José Ramón, 1982, “Feliciano Mínguez y los Ingenieros militares en Betanzos”, *Anuario Brigantino nº 5.* 1ª ed. Betanzos: Ayuntamiento de Betanzos, 1982, p. 101. ISSN: 1130-7625.

[10] AMB-C-536. ARCHIVE OF BETANZOS CITY COUNCIL. Box nº 536.

[11] MARTÍNEZ SANTISO, Manuel, *Historia de la Ciudad de Betanzos.* Facsimile edition of the original of 1892. 1ª ed. A Coruña: Diputación Provincial, 1987. 253-259 p.

[12] GARCÍA, Ramón Antonio, *Betanzos apuntes históricos de esa ciudad, que en un manuscrito envió al Ayuntamiento el licenciado en leyes D. Ramón Antonio García en 1880.* 1ª ed. Betanzos: Ayuntamiento de Betanzos, 2009, p. 266-267.

[13] PANOFSKY, Erwin, *La arquitectura gótica y la escolástica.* 1ª ed. Madrid: Siruela, 2007, p. 28. ISBN: 9788498411058.

[14] GARCÍA, Ramón Antonio, *Betanzos apuntes históricos de esa ciudad, que en un manuscrito envió al Ayuntamiento el licenciado en leyes D. Ramón Antonio García en 1880.* 1ª ed. Betanzos: Ayuntamiento de Betanzos, 2009, p. 270-271.

[15] AMB-C-23. ARCHIVE OF BETANZOS CITY COUNCIL. Box nº 23.

[16] ARG. Leg.229. Nº 7. ARCHIVE OF THE KINGDOM OF GALICIA. Document 229. Nº 7.

[17] ARG. Leg.229. Nº 6. ARCHIVE OF THE KINGDOM OF GALICIA. Document 229. Nº 6.

[18] AMB-C-536. ARCHIVE OF BETANZOS CITY COUNCIL. Box nº 536.

[19] ARG. Leg.229. Nº 7. ARCHIVE OF THE KINGDOM OF GALICIA. Document 229. Nº 7.

[20] AMB-C-23. ARCHIVE OF BETANZOS CITY COUNCIL. Box nº 23.

[21] AMB-C-28. ARCHIVE OF BETANZOS CITY COUNCIL. Box nº 28.

[22] AMB-C-539. ARCHIVE OF BETANZOS CITY COUNCIL. Box nº 539.

[23] AMB-C-542. ARCHIVE OF BETANZOS CITY COUNCIL. Box nº 542.

HERITAGE and TECHNOLOGY
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XIII International Forum Le Vie dei Mercanti
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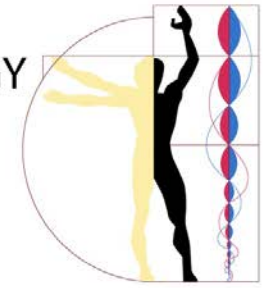

Wandering Experience in Napoli

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Abstract
The technological evolution has created in the last decade a profound change in our lifestyle, introducing epochal and irreversible changes for the society. Communication, above all, experienced tremendous revolution; the common cellular phone is already an old story.
Today, we commonly use mobile devices, so small while exploiting huge computing capabilities, that can be easily stored in our pockets, keeping us always connected with family members, friends and with the entire world.
The influence of such devices, on the young generations, is just natural.
In this scene of an evolving change, the most evident demonstration of the digital revolution is the invention of the social network. One of the best examples is Facebook that, within eleven years of life, can be proud of milliard users, out of them more than five million are kids under the age of ten years, despite the prohibition of registration for kids under thirteen.
These significantly extended phenomena should raise a flag to parents but also for instructors, schools and universities.
We need, in fact, to take advantage of what such a fertile ground offers, transforming the wish of communication and socialization that arises from the diffusion of those tools, and leverage it into an opportunity for teaching, learning, educating, feeding the human natural curiosity, thus maintaining the world heritage.

Keywords: technology, learning, experience, heritage, location.

1. Location based service
In a technological and a socially dynamic growing environment, where people are no longer building up their knowledge, experiences and keeping heritage only in an individual, passive way, but sharing information, knowledge, activities and experiences, there is a growing need for location based services, which will gather information and concentrate it in a unique platform. A citizen, tourist or a student, who is living /touring a place full of attractions and activities of all kinds, is able today to explore a location mainly in a passive way: getting information about the location from the Internet, books or a guide. This information is static and limited. Developing a dynamic virtual environment, by mapping a specific city or any defined site, will connect all standalone locations that were not having any physical or virtual connection. This enables to dynamically experience from a very personal and creative point of view a city based on a collection of locations. The experience and study is based on getting and updating all kind of information about a location from a specific and different user's point of view, and can maintain the place and local people heritage. The application that will be presented is dynamic, shared and breathing.

2. What is wandering?

Wandering is a technology knowledge platform, generating engaging activities for learning, training, team building, research and fun. Users can practice, comment, create, share, rate, organize and certify experiences generated by others. Activity related content is the core essence of the platform that brings people back to the community as active players and builds a vibrant community over the platform.

Knowledge is created around physical locations called “stations” - points of interest, social hubs, historical sites, public attractions - and is retrievable and usable all over the world. Station based content is where people can meet to create and share experiences over the Wandering platform.

The platform leverages advanced mobile cloud technologies and network applications to connect individuals, groups and communities in collaborative and productive experience.

With more members participating and creating on the platform over time, a universal repository of knowledge, experiences and relations grows in the virtual space for current and future use by individuals and communities.

3. What is Experiencity?

Experiencity (EC) is a virtual environment where citizens, tourists, offices, schools, museums and other institutions of an existing city can break the barriers of the physical world and connect between themselves sharing information, playing interactive games, learning the history of the city and its habitants and maintaining its heritage.

EC is a location based learning environment based on the atomic concept of “experience”.

An experience is a new way of exploring a place (station) consuming a virtual activity in the Wandering world.

For example, a route of Quick Response Codes (QR) distributed along a museum can attract a visitor. Scanning one of those QR with his smart phone, the visitor is projected inside the virtual environment where he will be proposed a game consisting of answering a question related to the content of the specific hall he’s visiting now.

By correctly answering the question, the visitor has consumed the activity proposed at the specific station and can get connected to others that were/are running the same activity and share experience as this would be done on a traditional social network.

In such way, the museum transforms itself from a static environment where people visit inanimate content, to a social and dynamic environment where people are being stimulated to pay attention to the content, as this is part of a game or another activity. The ultimate goal is to enhance the learning experience, while mapping a site and maintaining its heritage.

With more locations dynamically added and developed to EC, the city becomes a mapped network of location-based information, activities and people, connected between themselves.

4. Implementation: building an experience

Implementation is achieved in an easy step-by-step process.

1. Choosing and defining a site: a site is a physical location provided with sufficient atomic content that can be realized through stations.
2. Selecting stations in the site: a station is a small (atomic) component included in the site; a collection of stations creates a site.
3. Building the stations: activity done on the platform by the “site staff” or by any predefined population or community.

Example no 1: Integrate Tourism and Education into an interactive Fabric that will benefit both. Selected site is a museum,

a. Process:
    a. Museum curator will choose the stations;
    b. Museum staff creates the chosen stations using the platform;
    c. Visitors (tourist, students, others) experience the stations and populate them with content.
b. From a different perspective:
    a. To develop imagination and stimulate the creativity of students around a specific content/topic, student themselves can create stations in a museum;
    b. The created stations are reviewed by the curator, acting as moderator of the community, before publishing them;
    c. Visitors experience the stations and populate them with content.

Example no 2: Relate sites with people’s heritage that makes a city a personal and intimate place - Selected site is a street

a. Street habitants choose and create the stations;
b. Content and experience can be filled by street habitants, students, tourists.

Example no 3: Harness the social capital of universities to create a cultural and economical value – Selected site is any location in a city.

a. Stations creators are students from a specific faculty (putting their personal and professional view).
b. City habitants, students, tourists experience the stations and populate them with their content

To make the whole experience more joyful and attractive, a subset of stations in one site or more can be gathered to create a game. Different games can be defined and adapted to answer the requirement of a targeted population (students in different ages, students from different fields, civilians, tourists, employees etc.)

5. Example: consuming an experience

Here are some screenshots that were taken from the example site prepared for the city of Herculaneum.
On the left side a dashboard contains the site name and the surfing menu.
On the right side, the upper part contains the list of tags (disciplines) to which the stations relate to, the bottom part contains the link to the stations; in the specific example six stations were created. The number of stations that can be created within a site is virtually unlimited.
In order to drill down we choose to click the sixth station: Herculaneum – The Time Tunnel:

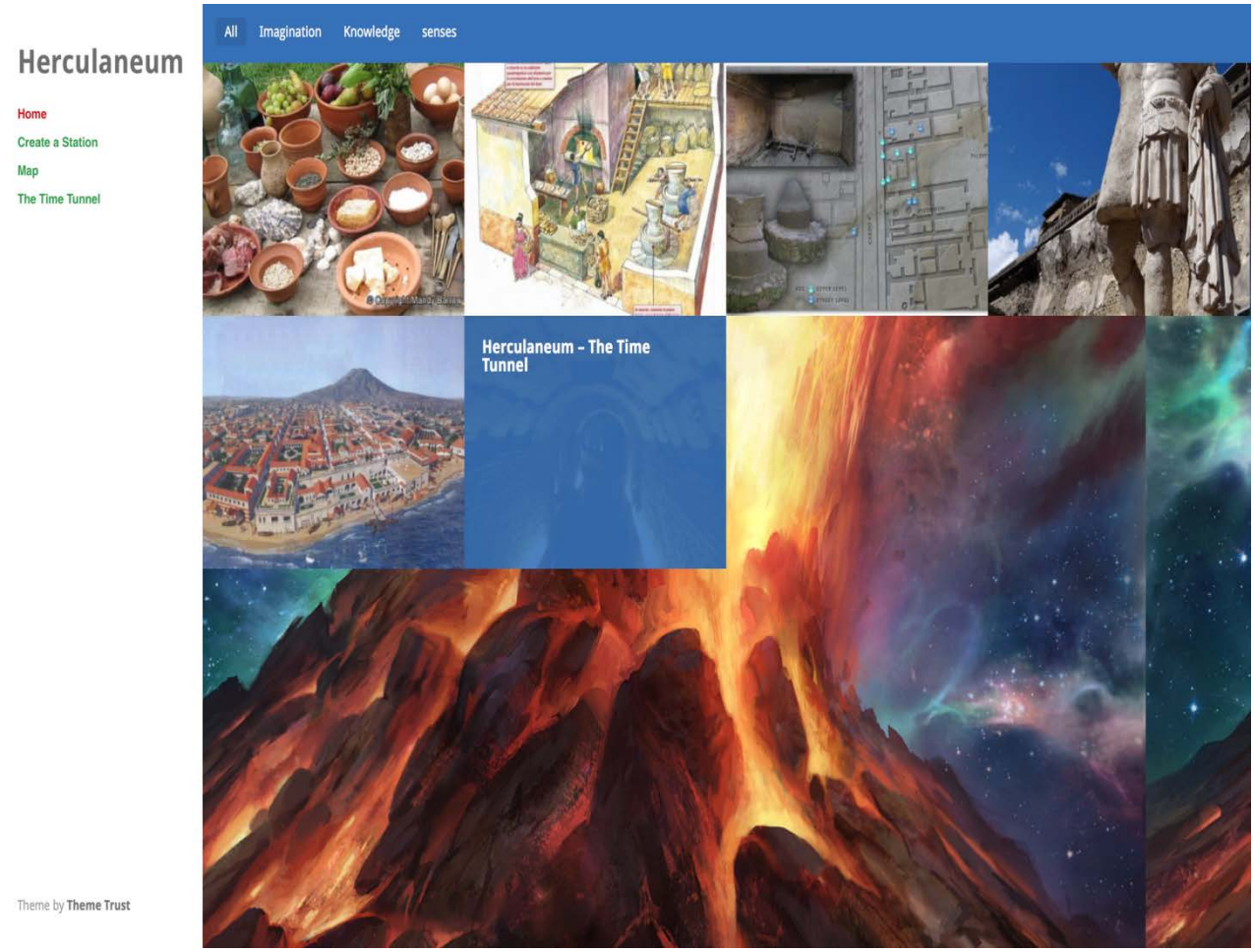

Fig. 1: Herculaneum experience site - Home page

The Time Tunnel station – main page
To experience a station the user should pass through four sub folders:
GO – explaining where physically the station is located and how to reach it;
DO – the activity that should take place in the specific station, accompanied with a short quiz related to the subject of the station;
DISCUSS – leaves the user the ability to write comments, add information in a text format, photo or video in order to expand the stations content and to share it with the other users, building, in this way, the site heritage;
INFORMATION – about the station, created by the station administrator.

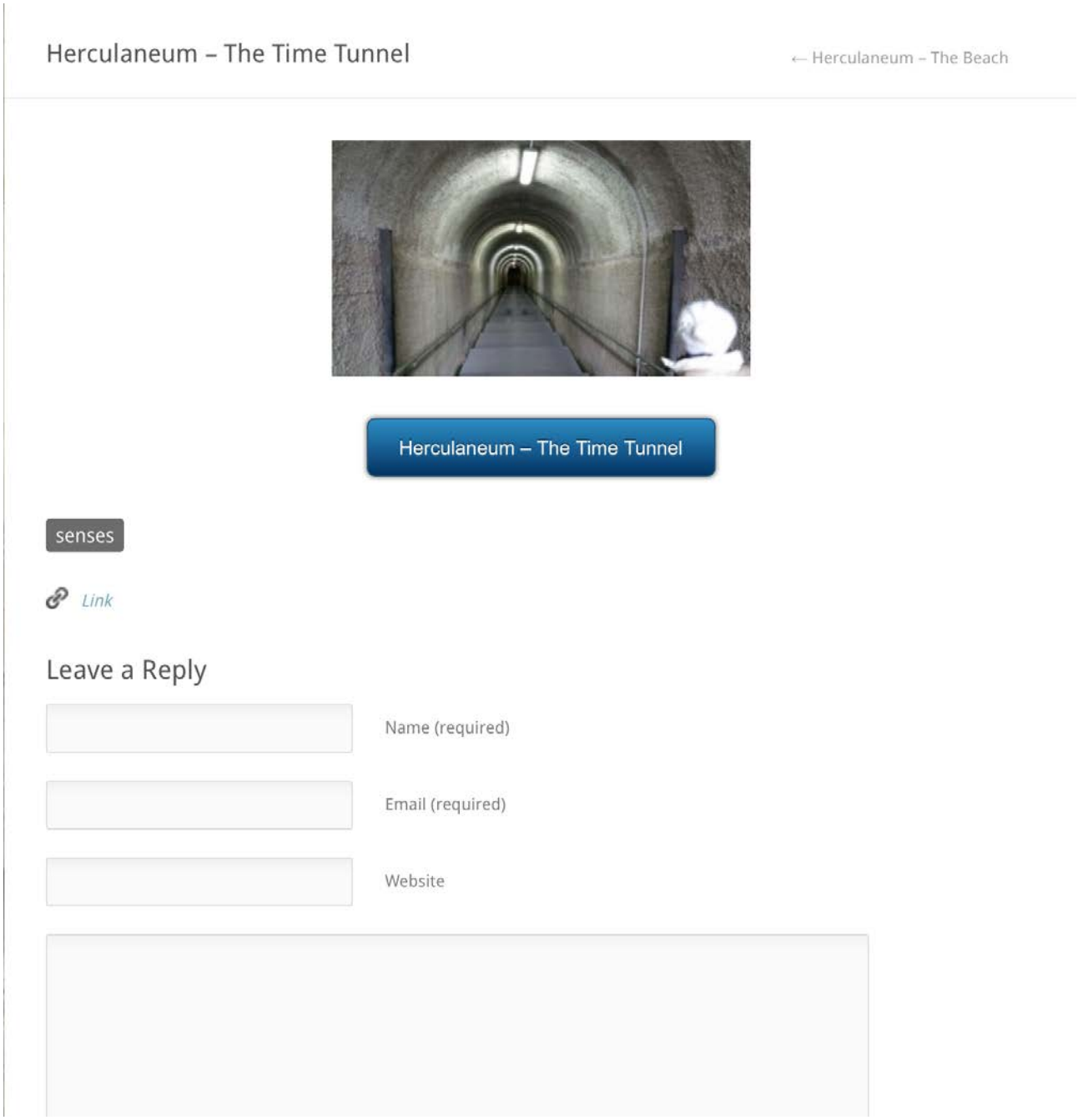

Fig. 2: The Time Tunnel Station - Main page

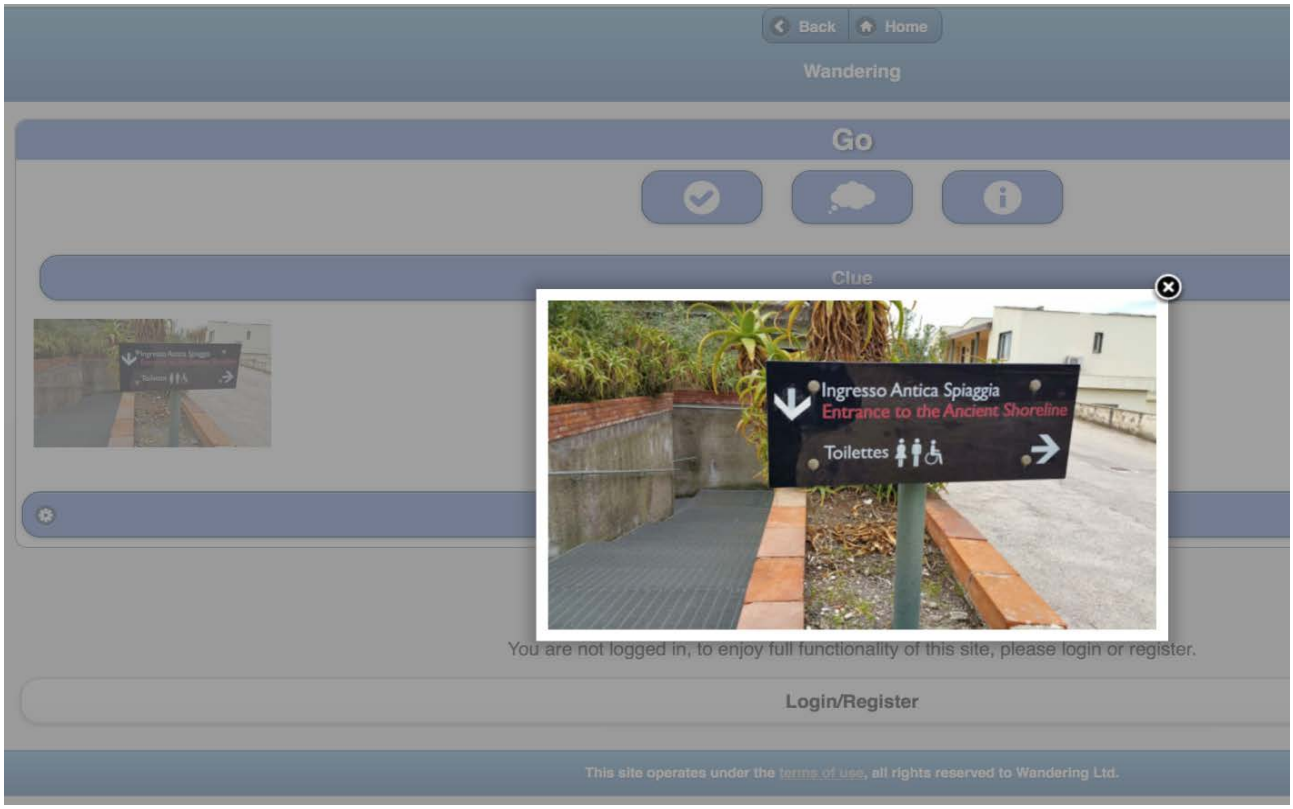

Fig. 3: The Time Tunnel Station – GO

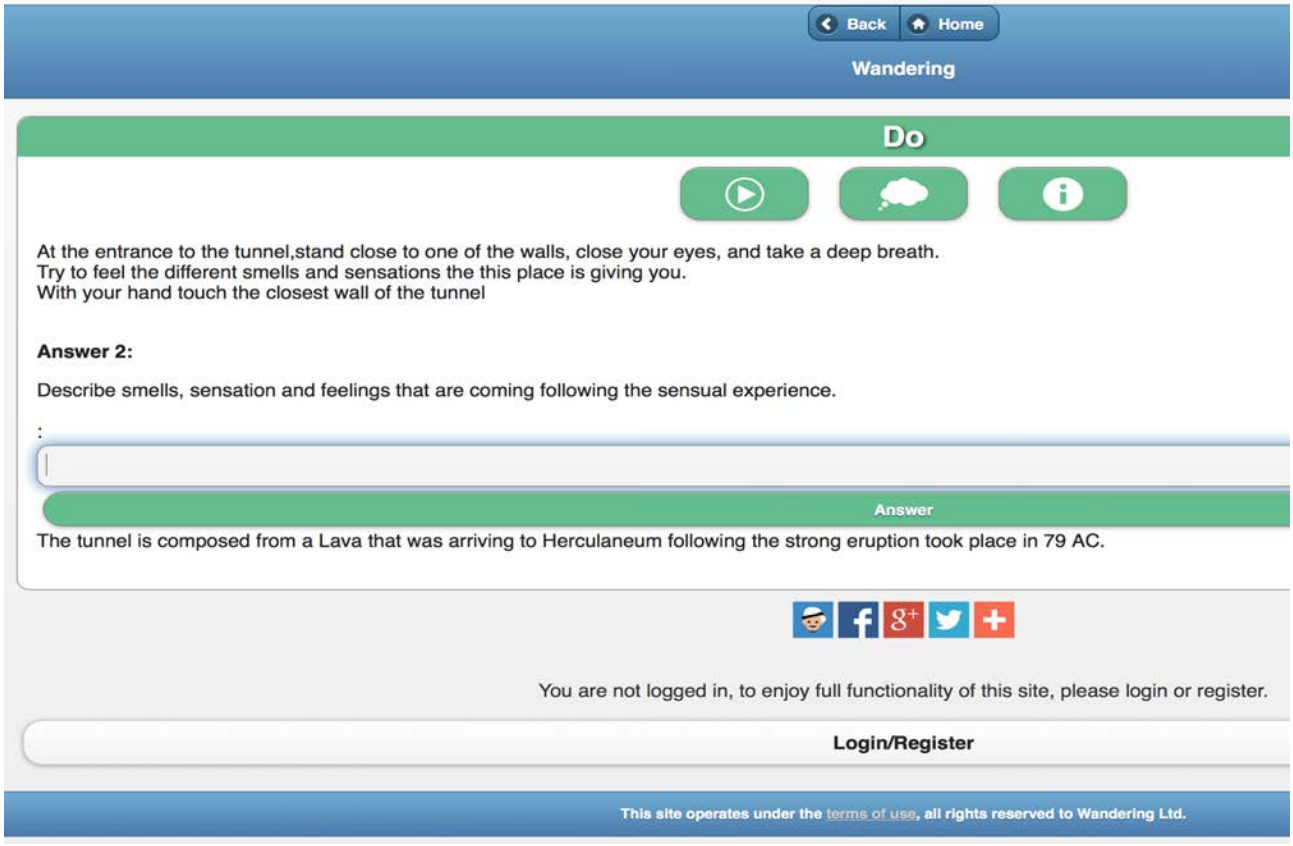

Fig. 4: The Time Tunnel Station - DO

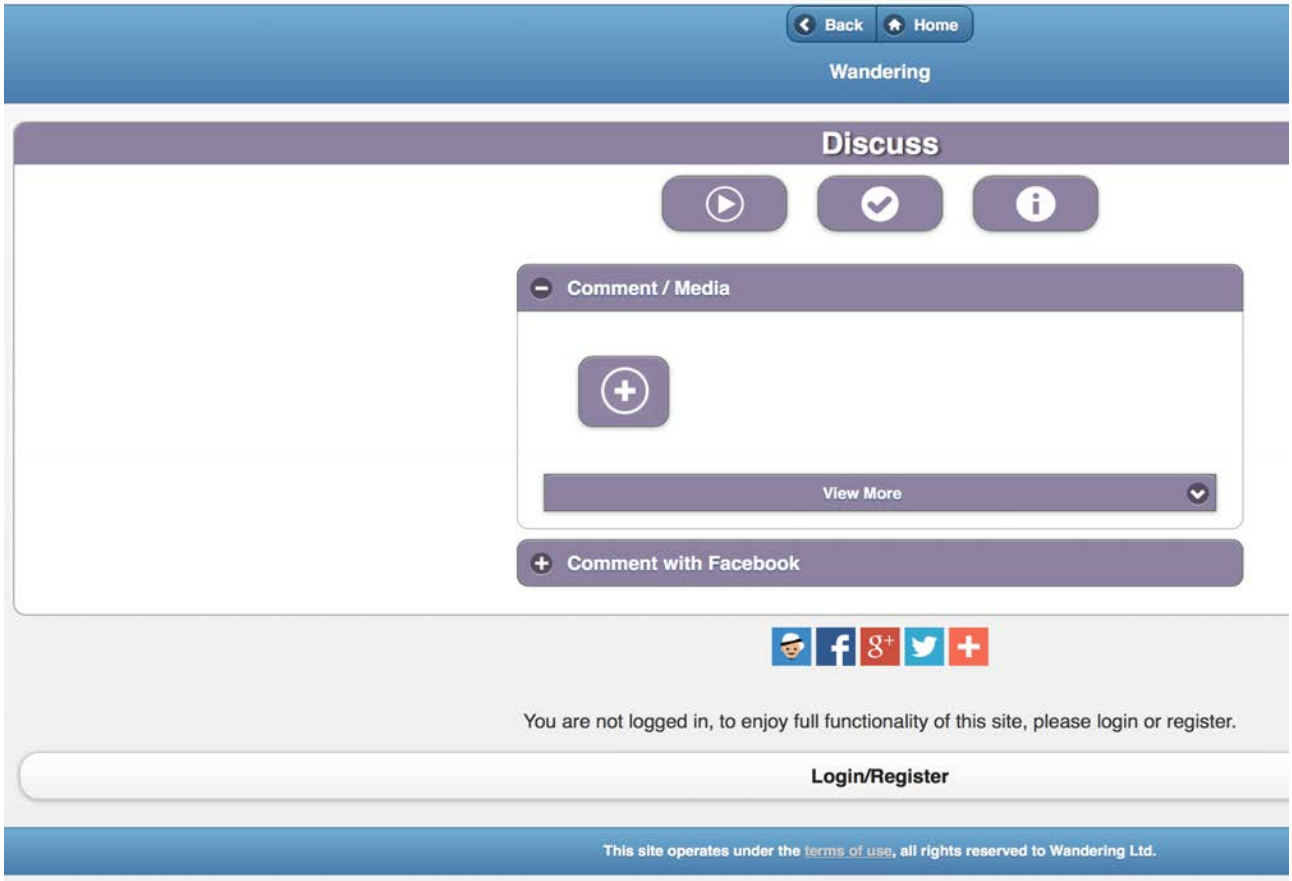

Fig. 5: The Time Tunnel Station - DISCUSS

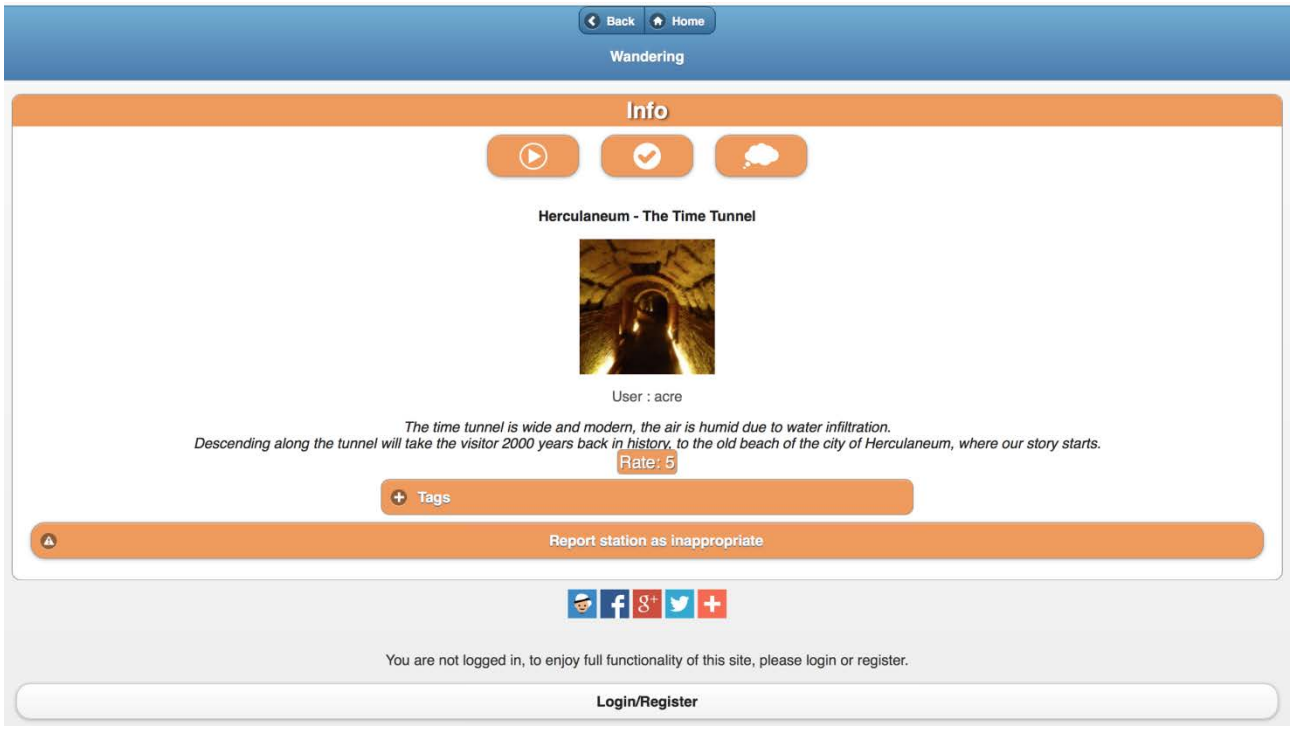

Fig. 6: The Time Tunnel Station - INFO

The entire Herculaneum experience is consumable at the link below:
http://thewandering.net/sites/corp/napol1/

6. Benefits

One of the most attracting things in the presented idea is its immediate benefit from the moment of its creation for all actors: the creators, the users and the site itself; in fact:

- Students and Pupils will gain personal exposure and experience a new methodology of learning based on social networks;
- School and Universities will upgrade the level of education to meet up to date technologies, methodologies and international standards;
- Tourists will experience and enjoy a new, alternative, social way of site exploration
- Sites will upgrade their level of service and interest proposed to the visitors
- Municipalities will upgrade the level of services provided to their citizens; increase the interaction with them thanks to the creation of a direct communication channel.

7. Examples of Wandering implementation cases and usage

Our projects are organized according to the following models, and arranged according to their complexity (top down):

- Comprehensive municipal solution (municipalities, museums, schools activities):
  - Tel Aviv – Israel (500,000 habitants);
  - Rishon le Zion – Israel (more than 250,000 habitants);
- Municipal infrastructure – a municipal signposting project of students:
  - Ramat Gan – Israel (200,000 habitants);
  - Petach Tikva – Israel (250,000 habitants);
  - Jerusalem – Israel (750,000 habitants);
- Infrastructure for curriculum – art, science etc in hundreds of Schools in Tel Aviv;
- Institutional tool – The department of education in the “Eretz Israel” museum (biggest museum in Israel);
- Educational tool – School sites for experimental learning were deployed in hundreds of schools all over Israel;
- Open Platforms for Games.

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The representation of the memory: the analogic-digital survey of two funeral monuments in the Verano cemetery of Rome

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Abstract
Visited by tourists and citizens, attracted both by the beauty of the funeral monuments and both by the stories of the personalities that there are buried, the Verano has become an outdoor museum, unique for the quantity and characteristics of the testimonies: a site about the art and expression of Italian cultural Nineteenth and Twentieth century, where painters, sculptors and architects have expressed, with styles of their language of their era, works in glass, mosaic, ceramics and architecture. In the portico, designed by Virginio Vespignani, focuses an exhibition of sculptures, architectural facades and frescos (high in the lunettes of the spans), expressions of the Nineteenth academic architectural Roman school language. The Quadriportico was designed on a series of spans covered with vaults. The inner sides rhythmed by columns with Doric capital of travertine, and on the outer sides by a wall structure, for the first half, and punctual for the second. An architectural system ultimately, with a large number of tombs with stylistic references to classic models, Byzantine, Renaissance and Gothic united in two distinct types: close-fitting and free by the wall. With the intention of documenting, also to safeguard the Verano's heritage, was formed in 2013 at the Department of History, Design and Architectural Restoration of the Sapienza University of Rome, a research group. As an example of the studies conducted to date are reported in this paper two examples of investigation one for each of the two types just defined.

Keywords: Survey, Virtual Museum, Verano, Heritage

1. The tombs of the archway XII and XLIII*
L 'Edict of Sain Cloud "issued by Napoleon in June of 1804 that gathered in a systematic previous regulations on cemeteries and prohibited in all states French burial in churches and urban centers, was based substantially on two principles: one of type of sanitation, in order to prevent the spread of epidemics, and one of a political-social that responded to Enlightenment ideals, so that the burial place not constituted as a hallmark of social class which had belonged to the deceased during his earthly life.
In 1809 Rome occupied by French troops was annexed to the Napoleonic and under the Edict of Saint Cloud -which stated that the burial areas were located outside the city, in the open and sunny, in a fence without excessive monuments - he spotted the place for the construction of the Cemetery of the Eternal City, along the consular Tiburtina.
The project of "Municipal Cemetery monumental Campo Verano" was given to the architect Giuseppe Valadier and later work continued under the direction of Virgil Vespignani; its construction proceeded even after the advent of Roma Capitale expanding and incorporating additional neighboring areas such as the Mound "Pincetto" originally ancient villa of the Capuchins.
The Verano has a distinctive style identity, a strong recognition as opposed to the depersonalization of his death. And 'this character identity, the son of a company and an urbanization now modified and superseded by the passage of time makes this place not replicable.
It is a city subdued, which was established with the discovery of the first areas, extends annexing neighboring land, acquiring as shape, texture, and identity cannot be in any way modified, altered, stratified.
Frozen in time, the "Municipal Cemetery monumental Campo Verano" preserves and watches silently, along with the memories of the dead, a number of different pieces of art. Funerary monuments, by eminent masters as Virgil Vespignani, Andrea Busiri Vici, Vincenzo Fasolo, marble sculptures from the Renaissance

style of Joseph Blasetti, Francesco Fabi Altini, Stefano Galletti, the craftsmanship of the iron works that represent religious symbols, engravings, image of the deceased painted on slate by Philip Severati etc., testify to a historical memory of our past that has been gradually disappearing.
In this contribution we reported the survey of two tombs located inside the quadriportico of the Verano cemetery, which represent two different types that characterize the relative sectors to which they belong.
The monument of the archway XII (Fig.1), by the sculptor Rinaldo Rinaldi, is on the wall, in the neoclassical style, and has a bas-relief in which it is represented the greeting farewell of the deceased to her relatives, husband and children, that assist her. The scene is realistic in form and content and the presence of the angel expresses its purely religious character.
As for the tomb of the archway XLIII (Fig.1), the monument is on the wall, built by Lubrani, carved in white marble and its classical architectural style harks back to that of temples and aedicules: two columns with Ionic capitals, topped by an trabeation with a tympanum roof, frame the sarcophagus at the center; on the front of this stand the three portraits of the family members, performed on enamel on lava by Filippo Severati (1890), whose yield is almost similar to that of a photograph.
Shooting operations and also those of data processing with regard to the above mentioned architectural episodes were facilitated by some favorable aspects: the morphological structure of the two monuments that are constituted of architectural elements traceable to known geometric forms, except for the bas-relief with human figures of the of the archway XII, the ease of access and their small size.



Fig. 1: Verano. Quadriportico. The tombs of the archway XII (left) and of XLIII (right).

2. The acquisition, management and use of points clouds of architectural and monumental heritage: lights and cautions**

The architectural specificities of the single components the site plant, the heterogeneity and the peculiarities proper of the single artistic episode as well as the dimensions of the Monumental Cemetery of the Verano, have represented the key points for the formulation of the hypotheses of the operational strategies and the methodologies of search, based on a perspective of surveing imprinted on the integration of different measurement techniques.
Of all the activity so far, this paper reports the results of a sample grafic example, but at the same time representative, of two memorials sites of the covered area of Quadriportico.
As regards the scope related to the electronic acquisition and the to consequent processing of the data, it is useful to summarize, albeit briefly, the method used (listed by phases) highlighting the critical issues inherent in a process of philological transposition of physical reality in virtual model.
A model for recording, monitoring and disclosure, in scientific contest but not only, of the artistic and monumental heritage.
First phase: from the individual point clouds produced by the laser scanner acquisitions -the density (DSM Density Surface Model) of which we remember, is dependent on the level of investigation planned- to the union (alignment) in automatic or manual mode, however aimed to the definition of an entire points clouds that is consistent to the original and, as far as possible free from gaps.
In this regard, we believe, as further set out below, it is more appropriate to work for single acquisitions postponing the union to the phase of modelling among the parts. As regards the mechanical aspect of the acquisition, it should be noted that takes place by means of a density of constant pitch established by the operator. The "grid" of coverage, as far as can be established with high density values, can never ensure a

match of the points acquired with architectural references trustees such as the edges. To this corresponds a certain level of uncertainty of the model.
With regard to the alignment step, it should be noted that the association between points clouds is still performed by the software which as governable by the operator using the parameters, however, will end up producing a model produced by algorithms with overlapping areas, often not free of inconsistency between individual parts.
Second phase: processing of data already associated (clouds aligned) or, in the alternative treatment of individual points clouds by examination and elimination by specific software of possible disturbances (noise) common procured by foreign elements or even from the same surfaces. After making any necessary corrections, data is transferred on software for the development of the surfaces (mesh).
We could define this moment as the heart of the whole process. The choices made in relation to the density of the acquisition, as well as the operations to reduce the "noise" in this phase will highlight any errors, omissions or weaknesses. Moving on to the stage of conversion of points in the mesh is necessary to appraise besides the computer weight of the files, also the configuration and the dimensions of the investigated element.
Made the due considerations it appears obvious that the level of quality of the produced surfaces, will result only conceptually in direct dependence of the number of available points. In operational circle we can very often define as necessary routine to the good result of the generation the decimation, or in other words the easing of the clouds, an operation which unfortunately can be performed exclusively according to filters not completely discriminating.

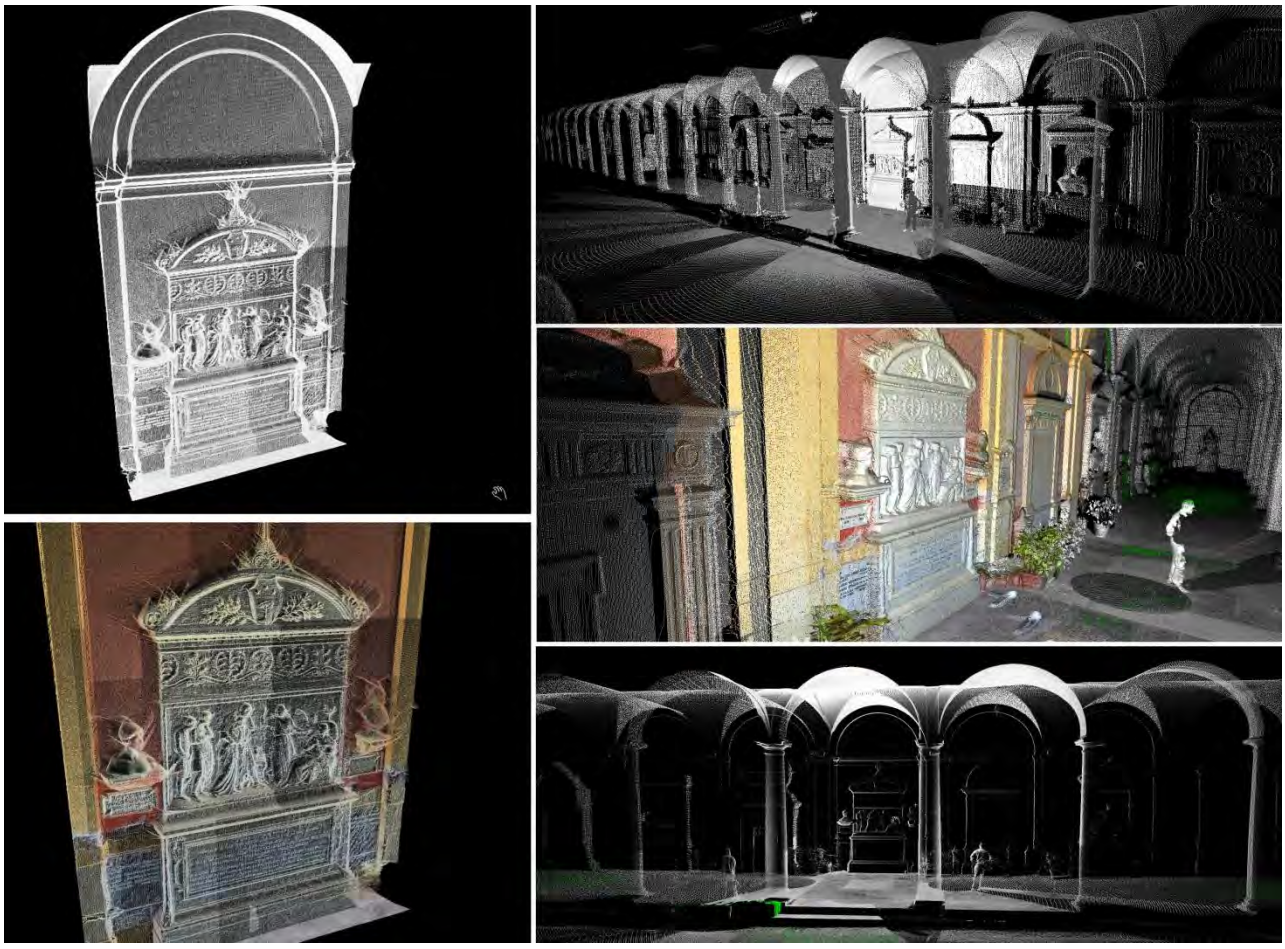

Fig. 2: Verano. Quadriportico. The tomb of the archway XII. Some views of the scanworld.

The high density of points, for example, necessary for the translation of any decorative apparatus, is redundant for flat surfaces or in any case with a lower level of articulation. Unfortunately, by means of the decimation of the data, it acts indiscriminately depleting the same way, in percentage terms, any simple surface as well as a capital, it is possible to remedy implement a number of subdivisions of the whole, through a careful operation of decomposition followed by recombining. An effective operating mode can reduce the issues of the weight information and the complexity of the surfaces to be treated, is based on modeling for discrete parts. However this mode, flying over the problems implicit in the time spent in the

search for the right compromise between the end and the means to obtain it, has shown, in the course of research, the need to define an operational methodology with relevant procedures with relevant and valid scientific objectives of time to time pursued. Once completed the phase of meshing it is appropriate to fill the resulting model in any areas of discontinuity.
Third stage: to the elaboration of data processed with the software conversion follows the phase of transformation products raster vectorial o/o through software of modelling dedicated. The final act by which it's finally possible to "materialize", by printing two-dimensional or even three-dimensional computer model of the original. The level of reliability of the results is certainly commensurate to the capabilities of the surveyor, but we have seen, unquestionably even the instrumentation hardware and software used.
The 3D model will finally be implemented with the RGB values from acquisitions cameras (mapping). The coloring and formal compliance of the model obtained will be much closer to the original than you may have valid photographic material with high resolution and of its model with a high degree of reliability. It should in any case be considered that, even if the shape and color of the product obtained may be regarded as satisfactory, the product obtained will be valid for a single level, or to be more explicit, for a unique scale of representation. We therefore believe that the model should not and can not be considered as a valid product ever, from the 3D model obtained by processing, the unique opportunity of possible operations, for example for a two-dimensional use of the same, are those relating to the operations as only the reduction of scale, in other words, it is possible can operate only personally and in a manner that will allow to obtain more synthetic representations. We do not think to share the view that considers possible, once developed a 3D digital model, the opportunity to produce drawings and printed, in scale or nature, of any view and projection type. Considering the possibility of obtaining a perfectly consistent with the original model, the same model made, will certainly not be defined as a product reduced in scale, but just as easily viewable 3D model in reduced size compared to the real.

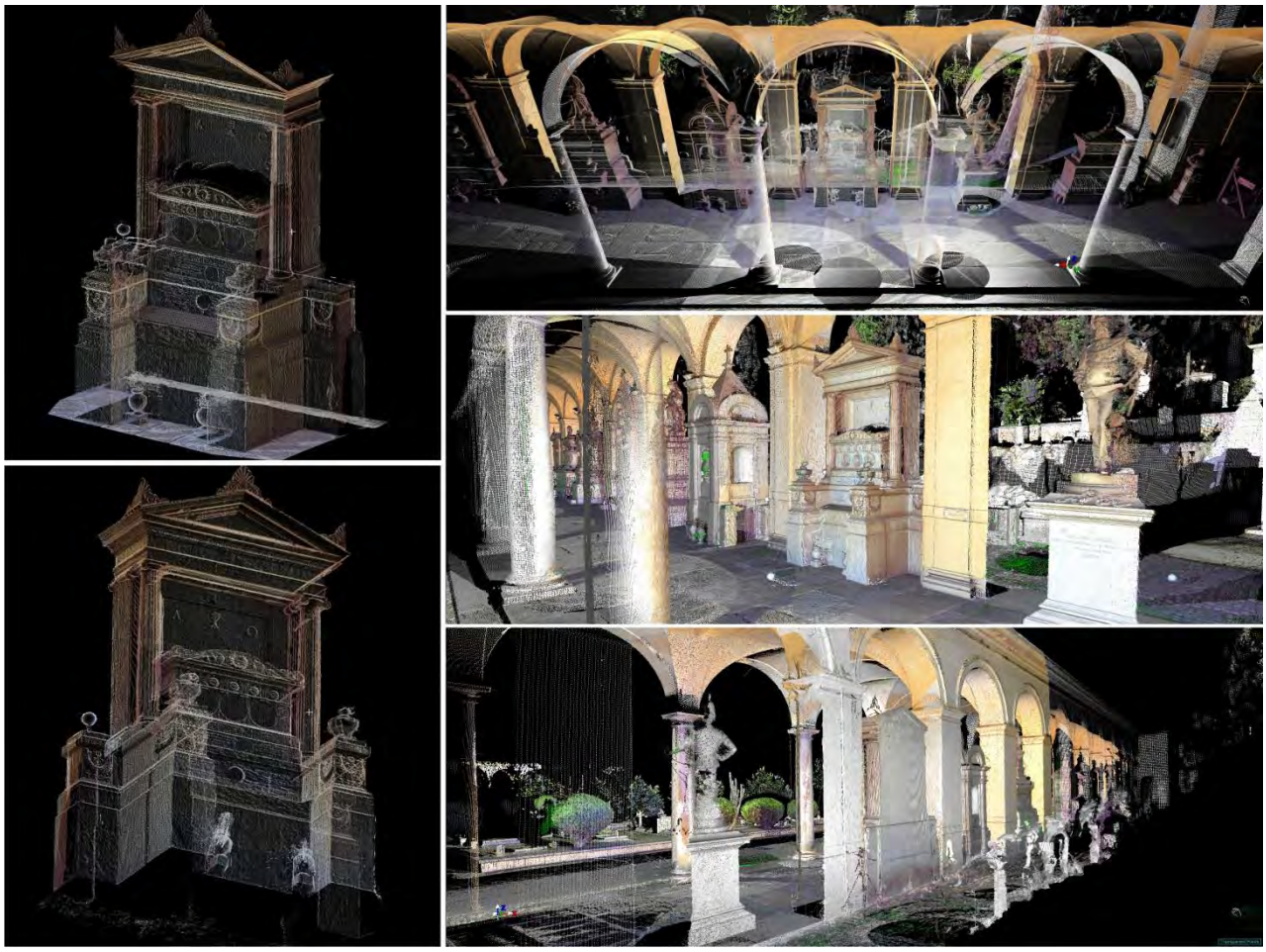

Fig. 3: Verano. Quadriportico. The tomb of the archway XLIII. Some views of the scanworld.

The considerations we reported, we believe that summarize operating methods well known to those who normally work on electronic data related to survey. As is known, as it appears often extremely expensive in terms of time resources, and therefore economic, the results related to the processing of point clouds in favor of surfaces, represent a single piece of the complex mosaic that define survey, a consideration that as

obvious, however was taken as a basis for the address of the work, the latent danger of falling in data processing in favor of some sort of formal style of writing in spite of the actual contents, we do not think it is so remote. The advent of the techniques of massive acquisition of data using laser scanners, as we know, has misled and continues in some cases unfortunately today to give the impression that the survey, not to be understood as an act of knowledge, is implicitly defined in same points clouds. Just as we can not be defined as a valid result in absolute -in just above accennate- the result from operations, as rigorous treatment of points clouds. The laser scans are an essential and irreplaceable "reservoir pocket" supply data that until 20 years ago was unimaginable. Aspects in terms of usefulness are undoubtedly countless, to the computing processes just set out, especially in conditions of volumetric complexity, alongside the ability to browse and extract, even avoiding mediations transformation: site plan, measurements, architectural profiles, etc.
During the studies conducted on the Monumental Cemetery of Verano has made, for comparative purposes, the restitution of architectural elements through the exclusive use of the data resulting from the clouds only with the help of photographs. It is performed in other words, the direct survey conducted by the numerical model comparing the results with work made by collecting data in conventional mode. We limit at the time, pending further investigation, to affirm that the results obtained have proved interesting than expected.

3. Considerations about the procedures and criteria for processing and representation from the metric data detected with range-based method. ***

In the scientific field of survey and, within it, of the representation of the acquired data, the integration between different methods and techniques of architectural survey confronts us with the problem of different types of acquired data, each requiring specific, complex and articulated operations of pre- and post-processing. Such activities must be designed to meet three key requirements: the reliability of the results, the repeatability of the processing operations, the quality of restitution.
Considering the vast panorama of survey experiences matured over the past twenty years, the increasing use of new digital technologies, represented symbolically by the laser scanner and photogrammetric digital multi-image processing techniques, raises the need for a reflection on the possibility of identifying operating protocols, procedures and criteria for interpretation, coding and digital modeling that can guarantee interoperability between the products and the necessary consistency in the behavior of both operators and final users. The common denominator of these processes must be the complete intellectual control of the operations of digital data management / manipulation phase. The research of rules for processing the data acquired by these systems stems from the desire to clarify within a sector still little explored, in which the experiments were often conducted in a free and autonomous mode, and which is characterized by works conducted on isolated incidents which have unique features. In the absence of general studies of the sector, the selections of the processing methods to be used occur in fact mostly on the basis of criteria like availability, knowledge and word of mouth, and not in consideration of the specific activity that is taking place.
This is also due to the variety of the possible post-processing procedures for this type of data, which are available in virtually unlimited quantity as the offer of software (open-source and not) addressed to the operators is extremely wide and varied.
Although this variety is definitely the one hand a determining factor for the development itself of the acquisition / processing technologies, on the other hand, in the face of multiple and diverse opportunities offered to the industry, it introduces considerable difficulties in data management and processing, since there are no reference parameters universally recognized as valid to define the "quality" of graphic products and / or multimedia products: in other words, it is extremely difficult, if not impossible, to assess in advance the reliability and accuracy of the reconstructed models and then to choose the most appropriate means to achieve the expected results.
In this context, taking a cue from the early results of a broader research, still in progress, in the following are proposed some useful criteria for the definition of processing procedures the can be the most pertinent and applicable during the pre- and post- processing phases of point clouds acquired with range-based method. The attention was mainly focused on the graphic restitutions obtained from the processing of data acquired with range-based method, for which some stages of processing were analyzed with the goal of identifying a standardized approach that is replicable and provides qualitative reference values for an “exact” representation of the episode.

3.1 Definition of pre- and post-processing operations and analysis of the related problems***

With the expression "processing of data coming from the laser scanner" we mean the set of operations that allows to obtain, from one or more previously acquired point clouds, a final product that can be useful to a user for extracting information of interest (3D color model, solid image, precision orthophotos, etc.); such operations of processing the point clouds belong to two different stages: the pre-processing, which is the primary moment of detection, that is, the acquisition and first processing of the metric data (point cloud), and the post-processing, in which there is the transformation of the metric data in a given two-dimensional and / or three-dimensional graphic product.

This series of operations is called in the literature "3D Model Acquisition Pipeline[1]" and is characterized by its specific features, and by the degree of automation of each operation.
To identify and understand the stages where there is manual intervention means to have the ability to exert a guidance skill, where possible, on the operations. If the intrinsic characteristics of the equipment used often do not allow an adequate "control" in the acquisition phase, it becomes all the more necessary to intervene, where possible, in the stages of data processing with the full knowledge of how the setting of different parameters affects the result.
The operations belonging to the stage of pre-processing are those that take place at first internally to the acquisition hardware and then externally via its specific management / exploration software (in the detection of the two tombs in question it has been used a Leica laser scanner with the Cyclone software).
At a theoretical level, the completion of the various stages presents solutions easy to apply since they always refer to ideal and "standardized" episodes; actually, the survey case histories are almost always unique and singular, for which the user has to address a number of operational issues that are going to add up themselves to those typical of the execution.



Fig. 4: Verano. Quadriportico. The tomb of the archway XLIII. At the top, the Scanworld of the tomb before the manual selection of the portion of the involved point cloud; at the bottom left corner, the polygon used for selection, at the bottom right the final result of the *data selection* phase.

Such problems arise, therefore, mainly from situations or episodes that do not provide ideal conditions (difficult access and shooting, reflective surfaces, forms of complex morphological-style character, etc.). In addition to these factors, we must also consider the operational discretion of the user, who has to act guided

[1] "… Although there are many physical techniques for acquiring 3D data—including laser scanners, structured light and time-of-flight—there is a basic pipeline of operations for taking the acquired data and producing a usable numerical model.." Fausto Bernardini and Holly Rushmeier *The 3D Model Acquisition Pipeline*, IBM Thomas J. Watson Research Center, Yorktown Heights, New York, USA. Volume 21 (2002), number 2 pp. 149–172 COMPUTER GRAPHICS forum

by a subjective interpretation of data and still linked to the use of software products about which just a list of instructions is available, completely lacking any kind of information which addresses the choice of the more effective and appropriate production process to obtain a product that meets the needs of the project.
Such a discretion is found in the manual or semiautomatic phases, such as: the *data selection* phase (that is not the spatial resampling of the points), that is, the choice of the portion of the point cloud concerned (fig.4); the phase of *filtering the point cloud / segmentation (data cleaning)*, consisting in the elimination of acquisition errors (*outliers* and *gross-errors*) and noise (those points not contextually related to the object as background or foreground points, obstacle
es, etc.), in which the operator's correct interpretation of the elements to be deleted and not (Figure 5) becomes fundamental. Most software (JRC 3DReconstructor, Geomagic, Cyclone, Scene 3D, Rhinoceros) is equipped with a set of hand tools for selecting points by tracing a polyline or a rectangle directly on the point cloud or on the 2D image (fig.5);

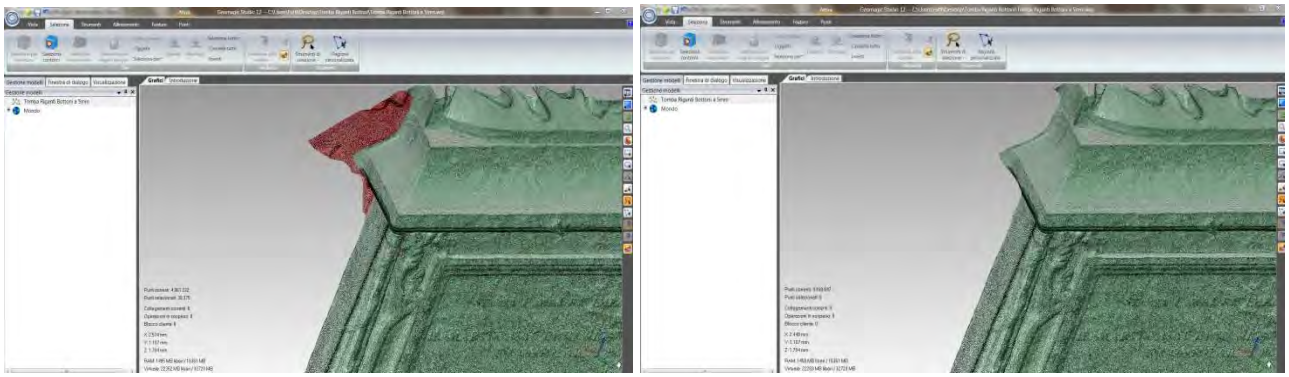

Fig. 5: Verano. Quadriportico. The tomb of the archway XII. On the left, in red the error points selected by the tracking of a polyline; on the right the final result of the *filtering / segmentation* phase.

in JRC 3DReconstructor there is also the possibility to operate a not definitive selection for which the selected points are not actually deleted, but simply identified as invalid. In the case of the archway XII tomb we used the Geomagic software, whose filtering procedure includes two guided modes: one that is based on the setting of the "Field Sensitivity" value, which is the lower limit selection value for the farthest points, for which setting high values implies the inclusion of a wider range of outliers; and another that evaluates the closeness of the points and then selects groups of points that are far apart from other groups. According to this mode, an island separated from other islands of points of the same object is a disconnected element, which can be selected for deletion or for further processing (fig.6).

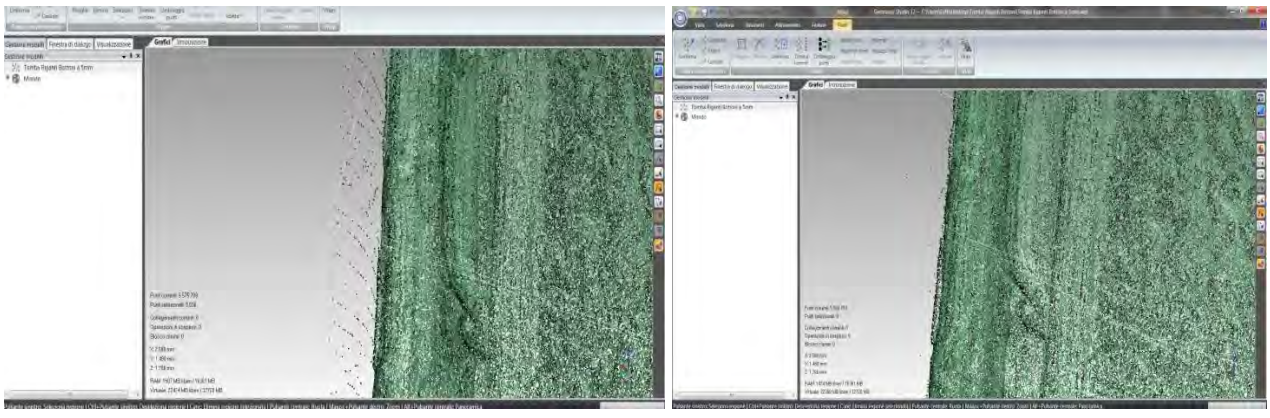

Fig. 6: Verano. Quadriportico. The tomb of the of the archway XII. The setting of parameters for filtering the error points.

Another completely manual phase is that of *decimation (resampling)*, in which there is the reduction of the spatial density of the points to make it homogeneous and congruent with respect to the nominal scale of the survey to be performed (fig.7).
Even here the selection of the most appropriate values of the sampling pitch is for the majority of cases determined following an empirical iterative process in which several attempts are made to define a range map to be considered at the same time sufficiently simplified and adequately detailed. The evaluation criteria are dictated by the purpose of the model and by the scale of representation. Most of the *software* provides the ability to perform a selective resampling that differentiates the treatment of planar areas from those

curved. Even for the post-processing phases there are stages in which the level of operational discretion determines the greater or lesser quality of the final restitution.
The *segmentation of the point cloud model*, that is the subdivision of the point cloud in portions belonging to uniform entities (fig.8), in which each entity is then modeled separately, while the overall model is generated by the union of the individual modeled entities, is one of these. This phase, theoretically related only to cases of meshing elements whose morphological-geometric composition is sufficiently complex to require the division of the point cloud into portions belonging to uniform entities to be modeled each in single mode, it is actually also used for the meshing of individual parts of architectural scale episodes since the meshing of the whole requires a computational power often not available. As there is no *software* that provides automatic recognition of these parts, the operation is completely manual and is guided by the more or less correct operator's interpretation of the elements to divide. The subdivision must, however, be conducted in such a way that there is always an area of overlap between the single parts, in order to correctly execute the next phase of mesh aligning (fig.8).

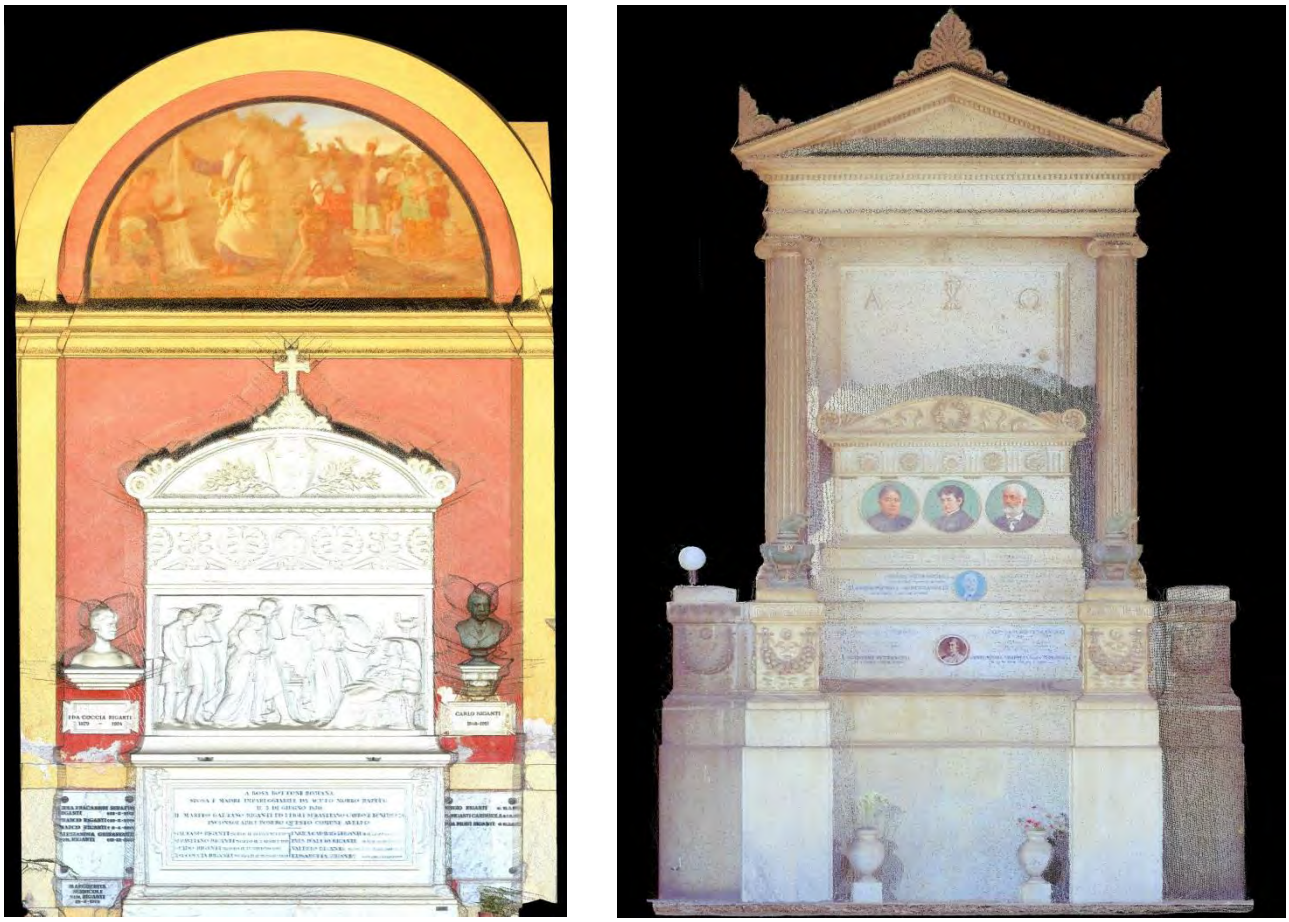

Fig. 7: Verano. Quadriportico. The tombs of the archway XII (left) and of the of the archway XLIII (right). The relating scanworlds have been decimated with a pitch of 10 mm.

A separate discussion is needed for the *meshing (fusion)* of the point cloud model, or better the transformation of the *point cloud* in a network of connected polygons[2] (Fig.9). This is the first proper stage of modeling (polygon model) of the point cloud in which the qualitative values of the outcome depend on algorithms inside the used software. It is hard to get to give a clear definition of quality of a mesh[3] as this

[2] It is the operation to connect neighboring points with lines, so that the entire surface becomes a set of triangles. A triangular two-dimensional network consists of a set of non-overlapping triangles, where no point in the network is enclosed by the circle which circumscribes any triangle.
[3] "Building a mesh does not simply mean to find any overlap in the domain that interests us, but it means finding a good quality mesh. In general we can give the following definition: QK is the measure of quality of the element K in the mesh T. The quality of a mesh is the amount: QM = max QK (K∈T). There are also other suitable values to evaluate the quality of a mesh, for example, the average of the quality of the elements, the distribution of the elements based on their quality, etc. In any case, given the way we have defined the quality of an element, it is clear that a mesh is of better quality as the QM value gets close to 1. However it is also to consider that, for practical purposes, it is important to take into account the number of items or vertices of a mesh. For example, to minimize the computational cost in the numerical simulation,

depends primarily upon the causes that led to its generation as well as its possible future applications. In any case, since the most commonly used software do not allow the operator to choose among a list of different meshing algorithms, and, moreover, these algorithms are, however, of the incremental type, derived from the triangulation method of the French mathematician Delaunay[4], it is clear that the only way to intervene on the quality of the produced mesh is to appropriately set the parameters that from time to time the various software allow to customize. For example, Geomagic allows to choose between the meshing of surfaces[5] (default), recommended in cases where the data is sufficient with a uniform sampling and in the absence of data representing inner surfaces, and volume meshing, to be applied in cases where the point cloud object has critical curves or contains data representing internal surfaces that are not visible to the eye (in this mode, each point is connected). In our case the latter mode was used.

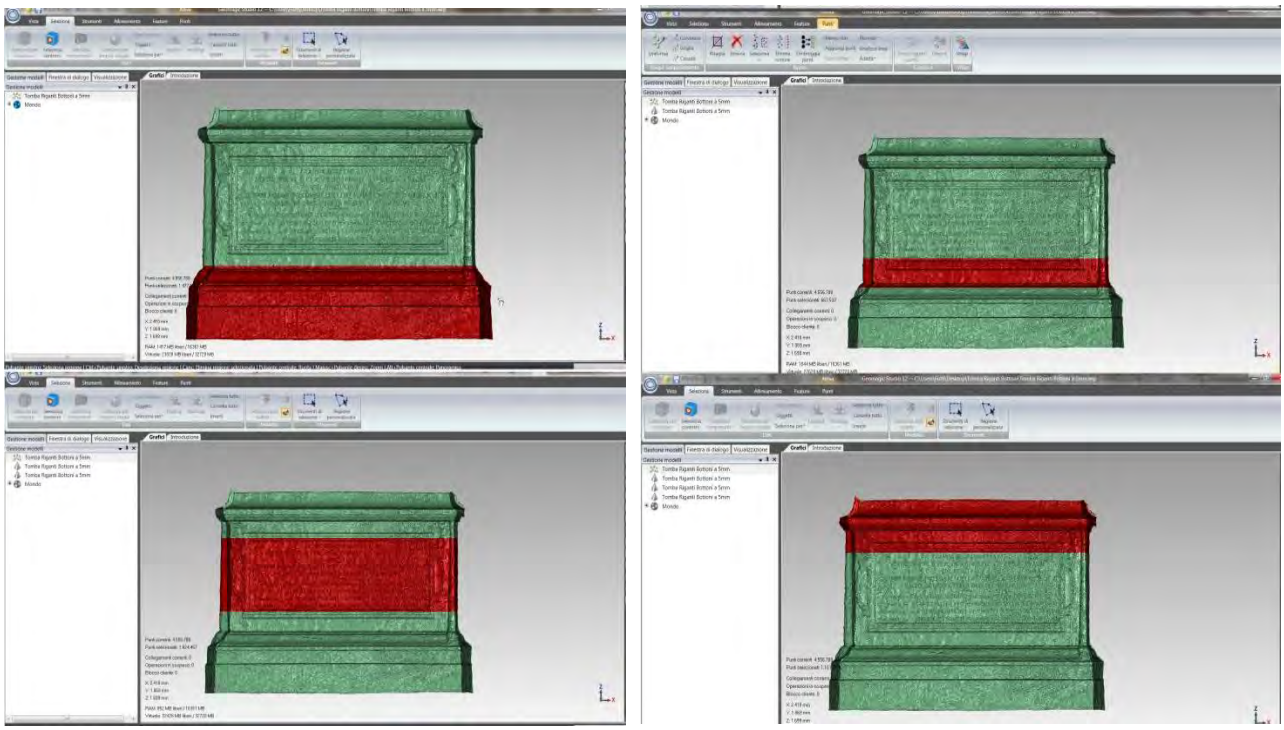

Fig. 8: Verano. Quadriportico. The tomb of the archway XII. The *segmentation of the point cloud model*, that is the subdivision of the point cloud in portions belonging to the base section.

Of course these are just some of the phases to be taken into consideration. Others are *mesh editing* or *mesh fusion* (the set of operations required for topological troubleshooting, reconstruction of the gaps and smoothing), the *mesh optimization* (all the operations concerning the simplification or decimation of the number of mesh vertices, as well as spatial organization of the mesh that consists of a redistribution of polygons according to a ordinate grid and application of texture to the mesh, phase in which the color images are mapped on the 3D geometric surface), the *mesh export* that sees the conversion of 3D data in the format required by the management software of the model and by the particular application; this choice is conditioned by the future application of the realized 3D model, which results in the choice of the format required by the software.
Overall, the reported case studies highlight some of the problems encountered in the various stages of processing and representation from the metric data detected with range-based method, mainly attributable to the following:
- Operational discretion
- Restrictions caused by external factors, such as availability of instrumentation, financial budget, technical specifications of the used software, limited computer knowledge, etc ..
- Purpose of the survey, or rather the very definition of the documents to be produced
- Gap between theoretical and practical / real dimensions.

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it is important that the number of elements of a mesh is minimized. It can therefore be concluded that a mesh is optimal if it gives an adequate compromise between quality of the elements and the number of elements." (Federica Benigni, *Delaunay triangulations*, Degree Thesis in Numerical Analysis, University of Camerino, Faculty of Mathematical, Physical and Natural Sciences).
[4] The algorithm of Delaunay is also called 2.5D meaning a 2D algorithm with the indication of the height.
[5] From the tab options/Wrap/General/ uncheck the option "Hide type of winding".

The lack of reference standards in this field, in conjunction with the high discretion of editing operations, leads to a limited control of the outcome derived by the steps of processing, and consequently to results the quality of which is difficult to evaluate.

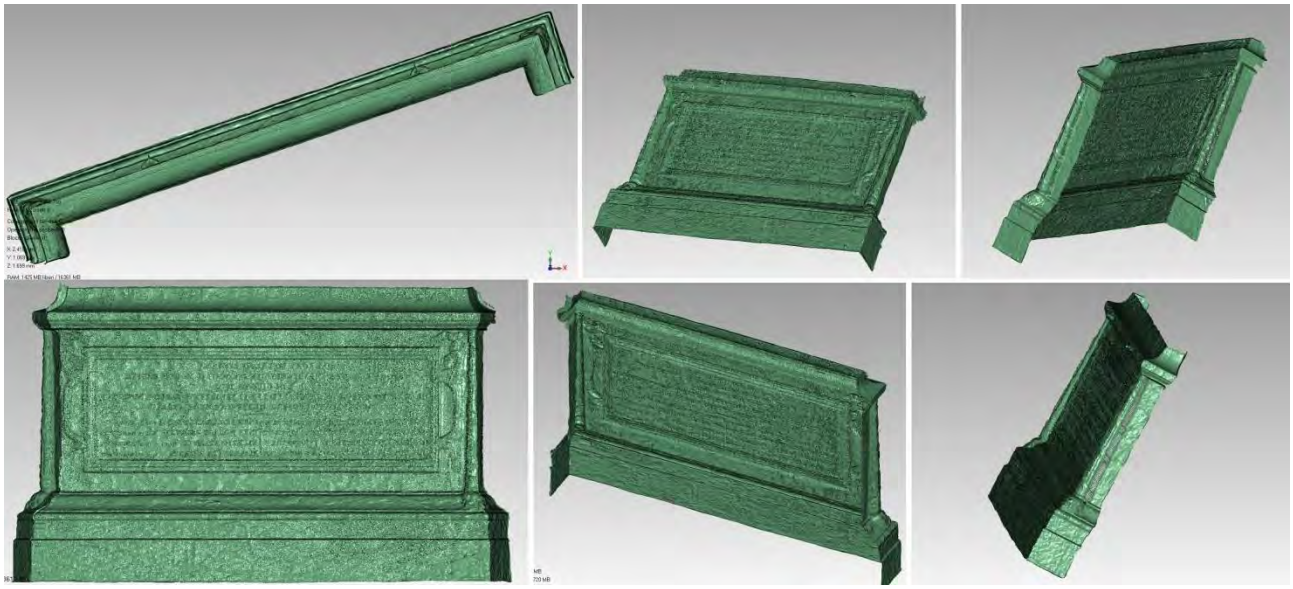

Fig. 9: Verano. Quadriportico. The tomb of the archway XII. Some views of the mesh generated with Geomagic software relating to the base section

This contribution comes from organic collaboration of both authors agree that attributed respectively to paragraphs marked by asterisks (*Laura Carnevali, **Fabio Lanfranchi ***Mariella La Mantia).

Bibliographical References

[1] Cundari Cesare, Bagordo Giovanni Maria, La Mantia Mariella, Lanfranchi Fabio. 2013. *S. Lorenzo fuori le Mura,* Roma: Aracne Editrice S.r.l., 2013, vol. 5, p.1-324 ISBN:.

[2] Docci Mario, Maestri Diego, 1999. *Manuale di rilevamento architettonico e urbano*. Bari: Laterza, 1999, 343 p. ISBN: 8842043419.

[3] Lingua A., Piumatti P., Rinaudo F. (2003) Digital photogrammetry: a standard approach to cultural heritage survey. In:
INTERNATIONAL ARCHIVES OF THE PHOTOGRAMMETRY, REMOTE SENSING AND SPATIAL INFORMATION SCIENCES, vol. XXXIV n. Part 5, pp. 210-215.

[4] Angelini, A. and Gabrielli, R. (2013) *Laser scanning e photo scanning. Tecniche di rilevamento per la documentazione 3D di beni architettonici ed archeologici.* Archeologia e Calcolatori, 24. pp. 379-394.

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Archaeology and Architectural Design
New studies and projects for the Acropolis of Athens

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Abstract
The topic chosen concerns architectural design studies related to archaeology in the Acropolis of Athens. Rather than be an obstacle, archaeological remains provide an excellent opportunity for developing a coherent project design.
The aim is to restore depth of experience to the project linking it to the wealth of ancient artefacts, adopting them as material for study: the shape of a place is in itself a precision instrument and measure.
The Acropolis has been organized in a single line from the Pnyx hill to Mount Lycabettus, in which everything is linked by an extraordinary sequence of viewpoints, and where the architecture (of the past, present and future) has to be the protagonist of the mechanism. The Architect D. Pikionis identified many "critical points" around the Acropolis; he only developed two of them and leaved the others unfinished.
Today some of these "critical points" could, in the light of more recent archaeological discoveries which involve unknown and archaic places of the Acropolis, become the basis for new reflections on building techniques and projects.
New constructions in such an archaeological area (worksite structures and services of excavation, exposition areas, infopoints, even the *custodian's lodging*) they become part of the landscape and can't be considered temporary buildings.
The new constructions to be introduced are for southern and the north slopes of the sacred hill of the Acropolis and inside the sacred enclosure.

Keywords: Archaeology&Architecture – Athens – Acropolis – Attico Museum

1. Architectural design and urban archaeology [1].

Rather than be an obstacle, archaeological remains provide an excellent opportunity for developing a coherent project design, especially in urban contexts. The project is conceived in its relation to stratification, in its search for hidden underlying forms; the shape of a place is in itself a precision instrument and measure.
The archaeological site of the Acropolis of Athens (with his slopes), object of a massive restoration and replacement for the three main monumental buildings (the Parthenon, the Propylaea with the Temple of Athena Nike and Erechtheion), today presents several problems and points unresolved.
First there are accessibility issues, adaptation and enhancement of new excavation areas, less known but very important for the knowledge of the ancient *Forma Urbis*: for example, the

area of the old Acropolis Museum, the area on the southern slopes of the Theatres of Dyonisos and Erode Atticus with the discovery of the oldest *Stadium*.
Among the more complex problems there is the access of the northern slopes for the handicapped and archaeologists (now a temporary rack) and the arrangement of internal routes that are unsafe and dangerous.
Secondly, it is urgent an appropriate solution for workspaces of the archaeologists and the buildings of the yard, now consisting of container and roofing improvised with jobs that are held by nearly one hundred years and will last much longer.
It is therefore to think not of temporary structures but definitive for the archaeological area, also providing services for tourists and the custodian's lodgers.
Finally, there is, especially in this area built partly overlapping, a kind of sediments deposited layers consisting of new archaeological finds and other hidden, forgotten characters of the architectural scene: the old Acropolis museum abandoned, fragments of megalithic walls Mycenaean Acropolis, the fortified wall of Themistocles and Cimon, the ruins of the ancient hidden Pandion, votive temple of the eponymous hero.
The project areas presented here relate to the places of the Acropolis and its slopes belonging to the deeper layers of memory and often obscure, because next to the events of the mythical origins.
Through projects the archive of legendary memory is dig. Moreover the Muses sing the past starting from the beginning *ex-Arches*. So the past is much more than the antecedent of this, is the source of this. And the lifts in time does not for a moment abandon the contemporary.

2. The Myth. Acropolis before the Acropolis

Time stands still and the Acropolis, stripped of the chronological data, is wrapped in solitude revealing architectural spaces.
In ancient Greece the crossings, wells, springs were inhabited by goddesses, gods and *daimones*. Men had to know the spirit that comes from places, the imagination that is knotted in those areas and to know how to respond it. If you did not pay attention to figures that populated the place it ran great danger of being possessed.
The project evokes in a contemporary key the ancient feel within the urban landscape and the archaeological area where everything speaks to us: a curved road, a staircase, a point of view to the landscape.
And where the empty space is not a space to be filled, but the point in which the spirit of the place is revealed. Architectures, porches, stairways contain the cultural traits of their inhabitants and together, through the geometry and proportions, make explicit the imagination of those who built them, of those who have paths, expressing what the substrate of the places.
Unleashing the demons means knowing the spatial dimension of things and reinvent the places, revealing hidden traces adapting to contemporary culture devoted to fruition fast architectural space.
In the Greek myths many things were implicit and for us are lost. Yet reduced to stories, continue to appear to us in all variations, connected, as if we knew why are connected. But we do not know.
Even the architecture, the randomness of the surviving fragments. Ancient architecture its sensual, magical and illusionist essence is hid. We have taken only fragments and skeletons of architectures: measures, types, structures, but not the vitality of the shapes, colours and marbles that were alive and seductive.
Yet in that cloth to shreds, in those stories and in those ruins we can still wrap. And in the world, as in our imagination, that cloth continues to weave itself.
The Acropolis before the Acropolis, there rests the oldest secret. In the solitude of the early days, the divine events were held on an uninhabited scene. Here originates mythical story that makes the impossible plausible instead the possible not believable. Athena was the goddess who loved the Attica more than any other.
There were Apollo and Dionysus, sovereign of possession, that reigned along opposite sides of the sacred rock. Apollo is a double: not only are essential Apollo and Dionysus, but Apollo is itself a part harmony, beauty, serenity and other ecstasy, flash, prophecy.


Fig. 1 The Acropolis from the north slopes with new projects - LuisaFerro®

Apollo lived in a dark cave to the north slopes of the Acropolis, because perfection, any kind of perfection always requires some concealment. Hiding with light, Greek peculiarities. Apollo hides with light. Dionysus is orgiastic collective experience, does not lead to rational knowledge, but brings in the world of the psyche. It is the weakness of human nature but also interpersonal relationship. The enclosure of the temple of Dionysus is a Theatre and is linked to the city through a winding road, the *Tripodon*. Dionysus is the god of awakening. The awakening of nature. His is the time of reproduction and initiation. He lived on the bright and warm side of the sacred slopes.

It is not easy, because as soon as you catch the myth expands. Here the variation is the origin. And in each of the stories that tell you reflect all the others, all we touch like flaps of the same cloth.

Then, at some point reaches a golden dust of figures. Here come the kings and heroes. They build architectures.

Erichthonios, random son of Hephaestus alone cosmic creator and of Gea. was adopted by Athena, more than a mother. Her first gesture towards the child was to girding the neck with a gold chain, which held two drops of blood of Medusa: one killed, the other healed.

Then the goddess deposed Erichthonios in a wicker basket and closed it. She handed the basket to the daughters of Cecrops, king of Athens (half man half snake) with order to never be opened for any reason. The three daughters of Cecrops were called Aglauros, Pandrosus, Herse. Two of them opened the basket and saw out a baby half snake. They knew that they had performed the act the more serious for the Greeks: open the arcane basket at the wrong time.

Terrified by the punishment that awaited them the Cecropides ran towards the deepest Acropolis rocks and threw themselves into the void. Pandrosus obeyed the goddess and she was erected a shrine on the Acropolis near the sanctuary of Athena Polias. Erichthonios was grown up by Athena in a fence in the Acropolis and became king of Athens. Instituted the Panathenaic festival and wanted to be buried in the compound where Athena reared him now lives a snake. The spirit of the city was a snake who lives in the Erectaion.

Every year ,near the shrine of Pandrosus, two baby-girls between seven and eleven were chosen by the king among the oldest families of Athens. They had as a fence where to play.

They were called Arrefore (bearers of unspeakable things or bearers of dew). One night, the priestess of Athena appeare to girls, “they carry on their heads what the priestess of Athena gives them to take, and what she gives not know what gives and the girls who bring don’t know what are bringing”. Then the two girls advance into an underground passage, down the steep north side of the Acropolis. Reached the bottom of the tunnel they lay what they bring and take another thing, that bring back. After the ceremony the baby-girls were brought home. This means making a mystery.


Fig. 2 The Attic Museum. The Myth through some sketches named “Attikà” by Pikionis (1940-50) – LuisaFerro®

From hand to hand is transmitted the chain of Erichthonios, augusta relic of the ruling house of Athens. When Erechtheus gave it to Creusa, his daughter surrounded it on her wrist like a bracelet. On his wrists tightened the grip of Apollo who dragged her into the cave of Pan, a day that Creusa caught the crocuses alone deep in thought on the northern slopes of the Acropolis. It was her more violent and faster love.

3. Mouseion

The aim of the projects would be to recreate a hidden compositional unity, following open-air museum itineraries, restore significance to single finds severed, until now, from an earlier and more complex context to which they once belonged.
Further, the chosen places constitute key points of the urban plan worked out on a metropolitan multi-disciplinary museum-school itinerary able to express the structural features of Attica, called Attic Museum.
It will be recalled that the cult of the Muses in the Pythagorean tradition, in Plato and in Aristotle assumed a particular character: their schools in Athens were to some extent organised as associations devoted to that particular cult. A project for a museum implies a number of related questions: first of all the idea to include, within the assigned space, potentially important matters such as collecting, cataloguing, placement, decisions on new destinations for items of information and knowledge.
Another question concerns coincidence, continuity and differentiation among institution, function and localisation. For that matter the origin of coexistence of different disciplines is inherent in the very etymon of *mouseion* (Temple of the Muses), as is the passage between the inside and outside of a museum where the culture and typology of architecture and of the settlement itself are necessarily and more specifically involved. The metropolitan museum

extends in the built environment and outwards to its surroundings where an epical viewpoint of the city may be obtained. The Museum must be a seat of learning and, in the case of Athens as well as for all these reasons, the great museum as designed in the project (the name chosen is the Attic Museum) stands where new roadways weave over traces of ancient paths. Here are the excavations, the ruins, the archaeological finds but also the trial pieces in gypsum with all they have generated. Finally, there are fragments of townscape, theories of art and ideas for architecture, modern contemporary projects.
At this point further attention may be given to a process that views the conception of the project in relation to archaeological stratification, to other layers of the present day, revealing concrete design possibilities surviving in forgotten fragments, in neglected openings, bearing in mind that absolutely no conflict can exist between the works of yesterday and of today.
The great works of the past move us when new ones appear increasing the value of the antique, this because the best are those which brighten things shedding a new light. This idea has its complexities in that one finds oneself “neck and neck” with the work itself,
discovering its innermost secrets, challenging it with its own weapons. The Acropolis was built, taken down and rebuilt for centuries. But reutilization damages ancient objects while at the same time ensuring their preservation. There is no such thing as “respect” for antiquities in the abstract, but there are various ways of living together with antiquity.
On the other hand the restoration of the Acropolis is the final stage of a battle fostered by neoclassical architects, by Leo von Klenze. The studies and excavations were aimed at destroying everything that was not classical Greek; not only the Turkish mosque and vestiges but even the tower of the Acciaiuoli (visible in the earliest photographs), the Venetian remains in the Propylaea. The Acropolis, a symbol that today seems eternal, was built at different stages over a long period of time, parts of it reutilized, others removed from what was the ancient castle of Satines. No less true than the Periclean image is that of the Parthenon crowded with Madonnas and saints and fought over by Greek and Latin priests, or that with the minaret, and even that of Schinkel (though never realized) who wanted it as a castle for the new Bavarian dynasty. Each of these roles for the Acropolis represents an age, an idea, a project.

4. Following Pikionis lesson

Some recent and on-going experiences carried out in prominent archaeological places of Athens following a huge and unfinished work of the architect Dimitris Pikionis (1887-1968).
Pikionis’ work considers the Acropolis as organized in a single line from the Pnyx hill to Mount Lycabettus, in which everything is linked by an extraordinary sequence of viewpoints, and where the architecture has to be the protagonist of the mechanism.
Pikionis identifies many “critical points” around the Acropolis; they direct visual perception towards different perspective sequences. Nevertheless, he only develops two of them in greater detail: at the rest area of St. Dimitris Loumbardiaris and at the viewing terrace on the Filopappou Hill. He leaves the others unfinished.
Some of these “critical points” could, in the light of more recent archaeological discoveries [2], become the basis for new reflections and new projects.
The same can be said of his considerations regarding new constructions in archaeological areas: today, more than ever, it is no longer possible to think about worksite structures and buildings at the service of excavation areas as temporary works of architecture, because that is just not the case. They also become part of the landscape, so they should be built with this in mind.
While the work written in 1928 is a defense of the Greek landscape, the famous text *Sentimental Topography* is a poetic statement, developing a procedure that meets with implementation in the project around the Acropolis. The paths of Pikionis rest on ancient ruins, and construct a rhythmical sequence of images, fragments of a film that involves the monuments and the landscape, a film whose protagonist is the Acropolis. Critical points, rhythm, pace, steps, lingering are determined by the composition, evoking the progress of the procession of the ancient Panathenaic festivals, bringing out what Pikionis called “the spirit of the place”, its innermost essence.



Fig. 3 New projects and architectural itineraries around the Acropolis – LuisaFerro®

The visitor follows this outline, first walking, then stopping to admire the surroundings. The project has the task of triggering controlled perception of the landscape (theory of harmonic trails). This ancient theory places the viewer at the centre of a harmonious track and determines the arrangement of elements in space. The pertinent places of the trail are those “critical points” of the route the visitor will follow (unconsciously) to approach the monuments.

5. The projects

Southern slopes of the hill of the Acropolis.

The Steps for access to the Odeon of Herodes Atticus form the ascent rises along the border Fig. 2wall (like a sort of harbinger) of a possible future excavation area, known as that of the Stadium of Eumenes (a very recent and important hypothesis of the archaeologists).

The terrace envisioned by Pikionis along the steps reveals the vantage point (now completely blocked by plants) for viewing the Temple of Asclepius (and its mythical spring), looking towards the Theatre of Dionysus. The terrace overlooks the new excavation area, taking on a new role in the reorganization of the new archaeological zone.

The project, through the construction of a Gallery (new Centre for Research) and a new exhibition space and staging (House Museum Proclus), has as its objective the development of a new access to the Theatre of Herodes Atticus and the new excavation area at the Stadium of Eumenes, through the staircase designed by Pikionis with terraces staging points and related visuals.

The new museum at the house called Proclus also builds a route alternative to the existing north-south pedestrian street that connects Dionisiou Aeropagitou and southern parts of the ancient city.

In the area of the Theatre of Dionysus the project aims to define new access to the current archaeological park. A new gallery *lapidarium* for ancient remains underline the enhancement of the ancient entrance to the enclosure of the Theatre of Dionysus across the street called the tripods (in ancient important part of urban life). Besides the project redraw the perimeter of the excavation of the Odeion of Pericles and dispose new services and exposition spaces.

Northern slopes of the hill of the Acropolis.

In place of a lack for access of disabled people and archaeologists, the project will construct a new access to the Acropolis from the north slopes near the Erechtheion and redefine the terraces of the building's original holy place of the original myth of Cecrops.

An unusual itinerary through the body of the ancient city connects the Plaka (the Turkish city), also through perspective shots, and the Erechtheion. The project takes shape and geometry from the lion Gate near the medieval church of St. Nikolaos at the foot of the north slopes of the Acropolis.

The walk is marked by a sequence of curbs and ramps that gradually climb towards the Peripatos (the ancient road that encircle the Acropolis from the bottom and the sacred rocks). Along this road shrines of the origins are in the caves (the Temples of Apollo, Pan, Afrodite and Eros), the Klepsidra (stage of the Panathenaic festival procession) with the Mycenaean Source, that becomes practicable with a new terrace opening of the most important caves.

From there a rack drive on top of the rock near the Erechtheion. Here is evokated the myth and morphology of the oldest Acropolis. The sacred space of the olive, the Pandroseion basement, the Arrefores *archaios Naos*. So the project through new terraces and new fences on the grounds of the old ones become a place of memory and of the origins of the foundation of Athens.

The east area of the Acropoli.

The project proposes the demolition of the Old Acropolis Museum, today abandoned following the opening of the New Acropolis Museum designed by Bernard Tschumi down of the hill inside the lower ancient town.

Here the remains of the Acropolis Mycenaean, Archaic and Classical are concealed.

Two large objects that evoke fragments of archaic and ancient parts of buildings become new workspaces for archaeologists. Besides an exhibition area extends in a downward spiral square, which follows the traces of the ancient Sanctuary of Pandion, the Eponym Hero of Athens. Down into deep the Aglauro cave.

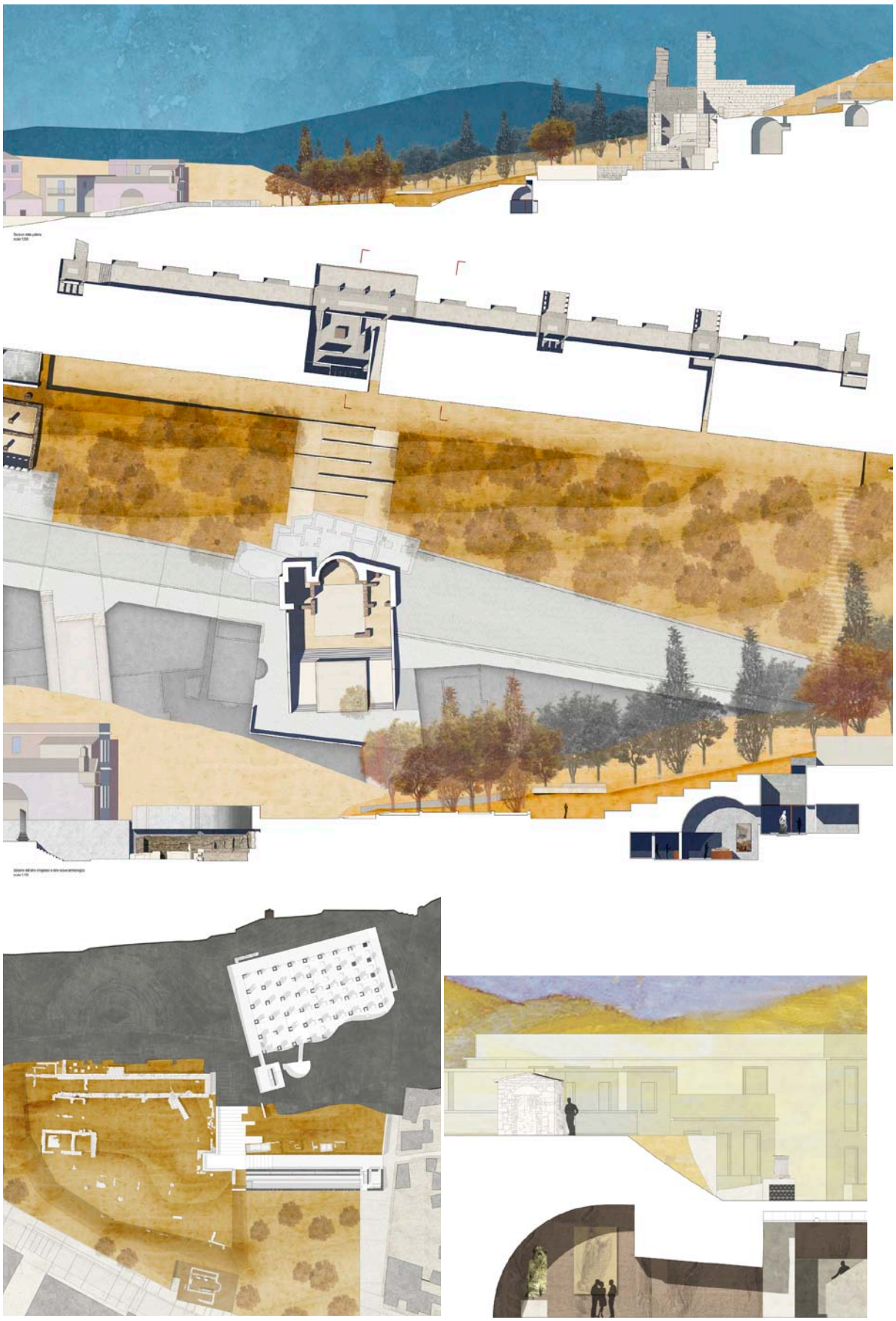

Fig. 4 Project for the area of Erode Atticus Theatre and of Dynoisos enclosure - LuisaFerro®

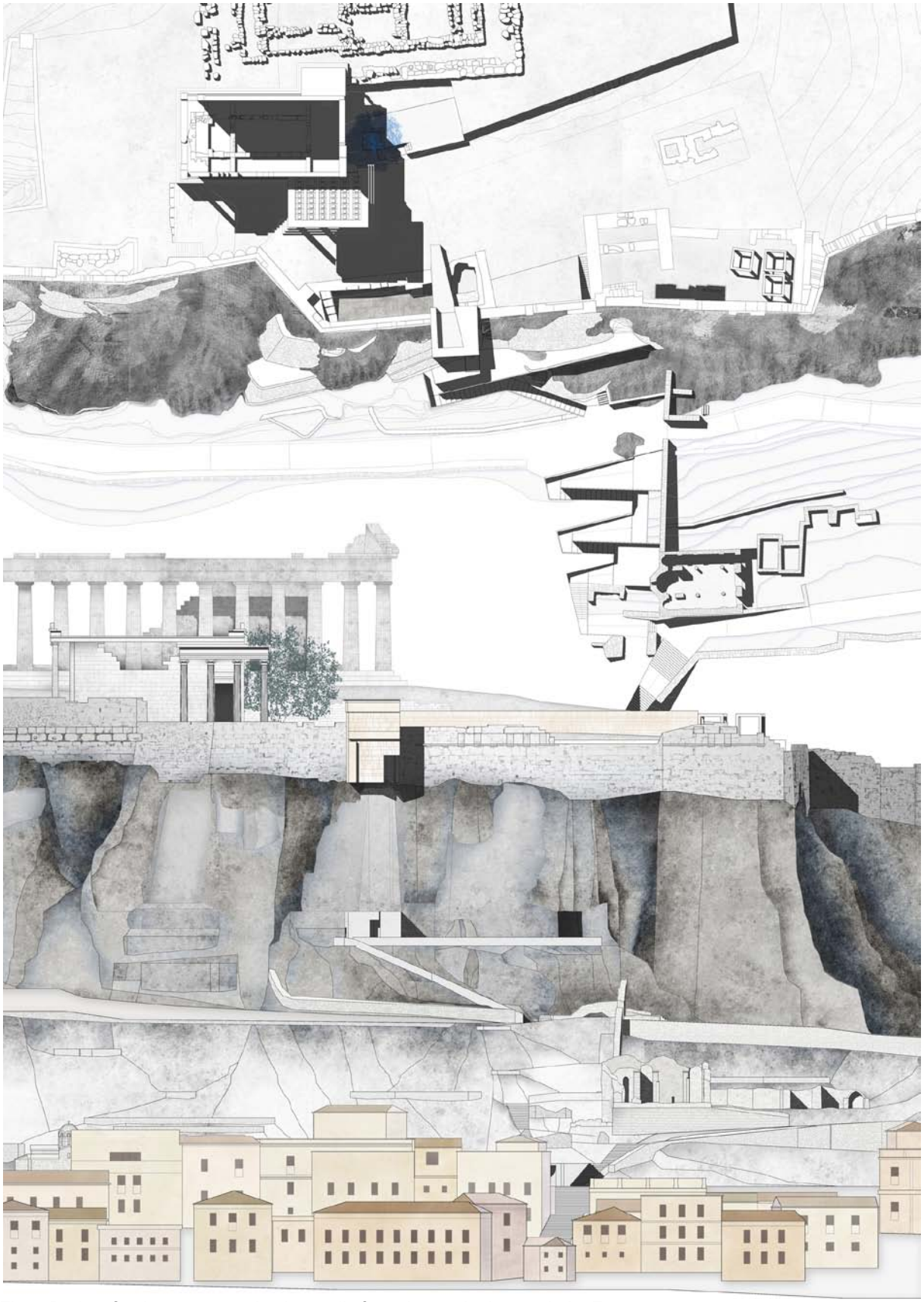

Fig. 6 Project for the access to the Acropolis from the north slopes - LuisaFerro®

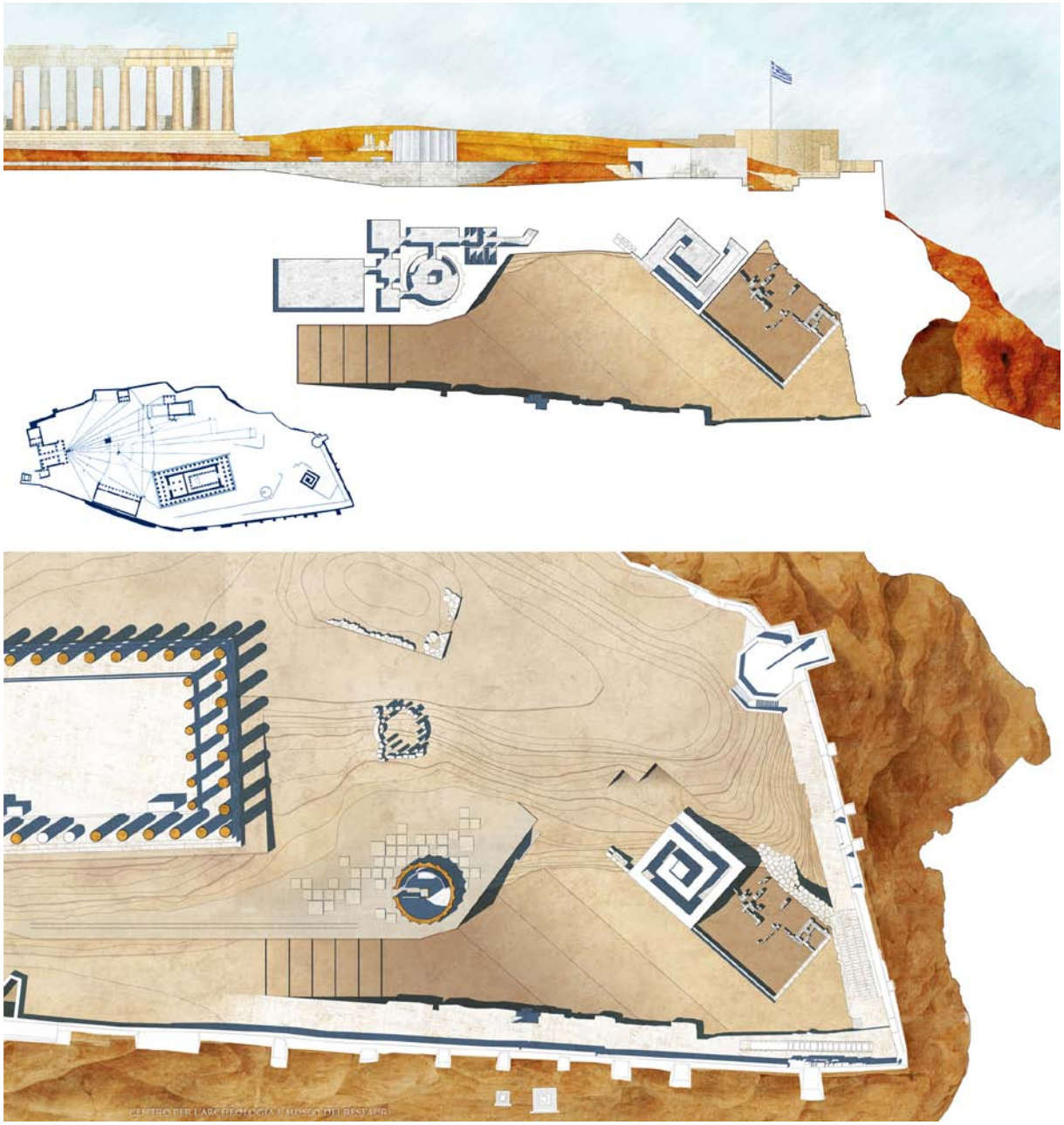

Fig. 7 Project for the east area of the Acropolis at Pandion enclosure - LuisaFerro®

Captions

1. This research project (title *Archaeology and Architectural design*) is part of a long-standing tradition of study and design in which theory and practice are productively combined.
Research Team group for the case study of the Acropolis of Athens: proff. A.Torricelli, L. Ferro (coordinators of the projects), Department ABC, Politecnico di Milano. Team group project: architects V. Bertini, E. Ciapparelli, M. Montanari and architects G. Cappellini, D. Galli, M. Guffanti, G. Cella, F. Fiorentino, S. Mullisi, A. Tettamanti, F. Ungaro, E. Volontè, L. Carrabs, E. Gerosa.
The production and scientific research is closely connected to teaching knowledge and methodology in its intentions, also finding time processing in the Scuola di Architettura Civile del Politecnico di Milano; in practice activities of ABC and in the Ph.D research (Milano, Venezia). Subjects and case studies (Atene, Campi flegrei, Milano, Mantua, Villa Adriana Tivoli, Alessandria Egypt, Alexandria in Aria and Kabul Afghanistan) have been introduced in several international seminars, workshops and publications.

2. Regarding the new archaeological discoveries, I would like to thank the architect M. Lefantzis and O. Voyatzolgou, 1st Ephorate of Prehistoric and Classical Antiquities of Athens.

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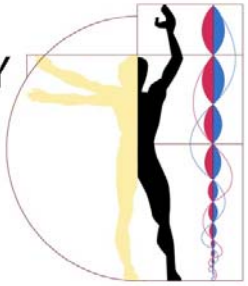

Multilevel planning regional management
A GIS Platform Structure

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Abstract

A major difficulty currently experienced by the Italian regions is the simultaneous action of many planning tools that are not very coordinated.
A single region can have up to 10-15 regional plans, as well as dozens of plans to protect special areas, and hundreds of municipal master plans. For each of these levels there are different rules, different spatial scales and different offices, but also different forms of financing for projects that each plan provides.
A functional hierarchy is added to the plans they have, and each planning tool has several validity periods and actions that overlap each other.
This condition too often causes important problems of redundancy of the rules and constraints, their poor coordination and, in some cases, also partial contradiction.
Current GIS technologies certainly help overcome these problems, but currently do not have very suitable protocols that can cross several tools to communicate in continuity. Through appropriate design, it would be possible to create technology platforms on a regional scale with which to manage any type of spatial plan and urban planning at any scale.
The objective of this work is to implement a technical GIS protocol for regions that allows synchronic dialogue between the planning and programming instruments in force, at any operation level and any relative administrative sector.
A strategic point is the mosaicking and monitoring of municipal planning instruments and their updates, whereas in Italy it is the tools at higher decision-making capacity for territorial changes and land take.

Keywords: GIS, Planning tools, cogency

1. Introduction

An important difficulty that Italian regions are currently facing is the contemporaneous presence of many planning instruments with little coordination between them.
A single region can have dozens of plans relative to both the whole regional area and areas under special protection, in addition to hundreds of municipal regulatory plans. Each of these plans is governed by different regulations, different territorial scales and different offices, but also different forms of financing for the projects necessary for each plan.
The plans also have a functional hierarchy, different levels of cogency, and each project has different validity and activation periods that overlap each other.
This condition often causes great problems with superabundance and scarce coordination of the regulations and, in some cases, even their partial contradiction.

Current GIS technology would certainly make it possible to solve these problems (Graci et alii, 2009; Murgante et alii, 2009, Murgante 2008), but there are only a few suitable transversal protocols active today that allow different instruments to dialogue continuously over time.
Suitable planning would make it possible to create technological platforms on a regional scale, which could be used to manage each type of territorial and urbanistic plan at any territorial level (from regional to municipal).
The aim of this study is to propose a technical protocol for the regions that would permit synchronic dialogue between current planning and programming instruments, at any operation level and in whichever administrative sector they belong to.
A central but very critical sector is public distribution of the information, in particular regarding its technical and professional use. Plans are made using different software instruments, with datasets that often have no metadata and correct georeferences, and with scarce web visibility. These problems, in a lesser way, involve regional plans which can normally be consulted on institutional geoportals, for example WMS/WFS services, but there are many more municipal plans with Web visibility that do not follow approved criteria and are left to the initiative of the administrations.
A strategic point, in fact, is the mosaicking and monitoring of the municipal town planning instruments and their updates, considering that in Italy they are the tools with the highest decision-making capacity for territorial transformations. On the basis of what has just been declared, an essential step is a unified key for the municipal town planning schemes (PRG) with accepted tool deposit and public distribution formats; this would factually resolve the various problems both of an ontological and a technical nature using a GIS system. The following points of the study present some examples of the mentioned themes relative to the Region of Umbria.

2. The planning framework of the Umbria Region

The survey on the general and sector planning that persists in the Region of Umbria gives a consistent profile of plans, 145 in all. The 103 Management Plans of the Natura 2000 Network (SIC and ZPS) must be removed from this profile however, because they can be correctly interpreted as a single plan with a regional geographical distribution. In spite of this elucidation, we are facing a high number of articulated planning tools that cover territorial authority in 11 supra-regional plans, 28 regional plans and 4 provincial plans, for a total of 43 plans.

AUTHORITY	PLANS	STATUS OF ACTUALIZATION
supra-regional authority	Piano del Parco Nazionale dei Monti Sibillini	approved 2002
	Piano di Bacino del Fiume Tevere	approved 1999/2013
	Piano Stralcio di Assetto Idrogeologico (PAI) ABTevere	approved 2012
	Piano Stralcio per il Lago Trasimeno (PS2)	approved 2002
	Piano Stralcio per il risanamento delle acque superficiali del Lago Piediluco (PS3)	approved 2006
	Piano Stralcio del bacino dell'Alto Tevere (PS4)	in itinere
	Piano Stralcio per gli aspetti ambientali (PS10)	in itinere
	Piano Forestale del Bacino Trasimeno (PFT)	not edited
	Piano Stralcio di Assetto Idrogeologico (PAI) AB Fiume Arno	approved 2005
	Piano di Rischio Idraulico AB Arno (PRI) AB Fiume Arno	approved 1999
	Piani di gestione del Distretto Appennino centrale AB Fiume Tevere	approved 2013
regional authority	Piano Urbanistico Territoriale (PUT)	approved 2000/2013
	Disegno Strategico Territoriale (DST)	approved 2008
	Piano Urbanistico Strategico Territoriale (PUST)	in itinere
	Piano Paesaggistico Regionale (PPR)	in itinere
	Piano Regionale di Tutela delle Acque (PTA)	approved 2009
	Piano Forestale Regionale 2008-2017 (PFR)	approved 1999
	Piano Faunistico Venatorio della Regione Umbria	approved 2009
	Piano Zootecnico Regionale (PZR)	approved 2014
	Piano Regionale Coordinato di Prevenzione Multirischio	approved 2014
	Piano Regionale della Qualità dell'aria	approved 2013
	Piano Regolatore Regionale degli Acquedotti (PRGA)	approved 2007
	Piano Regionale per l'irrigazione-	cartography and documents not online
	Piano Regionale Trasporti (PRT) -	Adopt 2014
	Piano Regionale di Gestione dei Rifiuti (PRGR)	approved 2009
	Piano Regionale di Bonifica delle Aree Inquinate	approved 2009
	Piano Emergenza Idrica	approved 2012
	Piano Energetico Regionale (PER)	approved 2004
	Piano Antincendio Locale (PAL)	plan proposal
	Piano Regionale delle Attività Estrattive (PRAE)	approved 2005
	Piano del parco regionale di Colfiorito	approved
	Piano del parco regionale del Monte Cucco	approved
	Piano del parco regionale Fluviale del Nera	approved 2012
	Piano del parco regionale del Monte Peglia e Selva di Meana (STINA)	in itinere
	Piano del parco regionale del Monte Subasio	approved 2001,update 2008
	Piano del parco regionale Fluviale Tevere	in itinere
	Piano del parco regionale del Lago Trasimeno	approved
	Piano di gestione SIC(tot.142)	approved 2012/2013
provincial authority	Piano di coordinamento della provincia di Terni-	approved 2000,update 2010
	Piano di coordinamento della provincia di Perugia -	approved 2000, update 2002
	Piano Faunistico Venatorio 2014-2018 della Provincia di Perugia -	approved 2014
	Piano Faunistico Venatorio 2014-2018 della Provincia di Terni	in itinere

Table 1. The plans and their procedural condition.

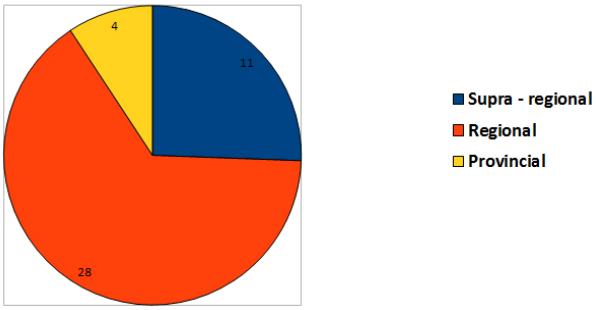

Figure 1. Plan division according to territorial management

An initial observation involves the presence of a consistent number, around 30%, of plans being created or required by the reference standard but not yet drawn up, of which the majority (9 plans) are of regional concern. We cannot, however, exclude the possibility that this number also contains tools with documentation that is not available on the institutional Web pages, but it remains symptomatic proof of the difficulty in complying easily with the planning request expressed by both national and regional regulations. In this sense the case of the Regional Landscape Plan seems exemplary; the regional profile was applied beforehand (implementation 2012), with the request to adapt it to Italian Legislative Decree no. 42 of 2004 within 4 years from when the Code came into force. Similar tendencies were found at a supra-regional planning level, where various actualized interim emergency plans of the Tevere Basin Plan have still not been applied.
Another interesting aspect that emerges from the municipal area planning analysis is the hierarchic-functional relationship between the plans, which in some situations, even though answering legal criteria, seems to be very abundant. In this sense the case of the regional and provincial faunal-hunting plans seems important, with an analysis of the results of the previous plan and the indication of a series of drafting criteria of the provincial plans converging in the former. This dualism can be overcome even simply by drafting combined plans between the two provinces, which would bring undoubted economic advantages and would greatly simplify procedures.
A consideration which transversally regards all the instruments and higher level planning levels concerns the effectiveness of the indications expressed by the plans. The convergence of different interests in the same category of resources or the need to manage the same resource under different profiles – think for example about the requirements regarding fauna protection and those tied to hunting - but often even the difficulty of transferring the planning contents from the structured regulations that are hierarchically of a higher level to the subsequent profiles tends to make plan application rather difficult. An important example is given by acceptance of the Regional Ecological Network (Romano, 2009) within the PUT regulations which, even though having created the juridical requirements for its application, found them difficult to apply to the territory, because of the movement of the categories to be preserved over the municipal territory and also the requirements tied to the number of participants, companies and holders of local interests.

3. The level of cogency

The concept of cogency, mutated by juridical regulations, implies reference to the obligatory energy of each plan and, using suitable parameters, is used to measure the ability to influence the transformation of territorial structures (Paolillo et alii, 2012).
When suitable data (digital, georeferenced and normalized) is fully available, applying the *cogency* index to zoning of the higher level plans would make it possible to prepare, using simple overlay, the geography of the obligation gradient to which a specific territory is subject.
In the particular case of Umbria, on the one hand this would make it possible to check the coherence of the protection levels expressed by the regional area plans with articulation of the perimeters and areas of each lower level plan, highlighting synergies and possible planning gaps, and also supplying direction lines that could then be integrated in the plans or used to elaborate/update new plans.
On the other hand, the application of a compulsory index with purposes similar to those indicated above was experimented during the formation of the Territorial Management Plan in the municipality of Como, where the territorial classification on the basis of cogency index , expressed by the sum of the obligations, the planning evidence and the settlement limits, was used to verify the quantity and localization of the land available for Plan purposes.
This study gives a possible elaboration of the cogency index expressed by the formula:

$$CI = (1*\alpha1 + 2*\alpha2 + 3*\alpha3)*\beta$$

Where:
values 1, 2 and 3 represent the three different levels of incisiveness that the instruments can express:
1. Direction and coordination
2. Prescriptive in comparison with other institutions
3. Conforming.

In the case of plans that contain different restrictions, αi represents the percentage of land subjected to the regulations of each zone. Therefore, if the plan establishes a single type of obligation for the whole territory, the sum will contain only one component, 1, 2 or 3 multiplied by 1 (100%).
β is the percentage of regional territory involved in the considered plan.
The value of Ic can naturally reach a maximum limit of 3.

Authority	Supra -regional Plans	Status of actualization	Date	Cogency
Park authority	Piano del Parco Nazionale dei Monti Sibillini	approved	2002	conforming
Tevere basin's authority	Piano di Bacino del Fiume Tevere	approved	2013	prescriptive plan for other institutes
Tevere basin's authority	Piano Stralcio di Assetto Idrogeologico (PAI) ABTevere	approved	2012	conforming
Tevere basin's authority	Piano Stralcio per il Lago Trasimeno (PS2)	approved	2002	conforming
Tevere basin's authority	Piano Stralcio per il risanamento delle acque superficiali del Lago Piediluco (PS3)	approved	2006	conforming
Tevere basin's authority	Piano Stralcio del bacino dell'Alto Tevere (PS4)	not edited		not edited
Tevere basin's authority	Piano Stralcio per gli aspetti ambientali (PS10)	not edited		not edited
Tevere basin's authority	Piano Forestale del Bacino Trasimeno (PFT)	not edited		not edited
Arno basin's authority	Piano Stralcio di Assetto Idrogeologico (PAI) AB Arno	approved	2005	conforming
Arno basin's authority	Piano di Rischio Idraulico (PRI) AB Arno	approved	1999	conforming
Tevere basin's authority	Piano di gestione del Distretto Appennino centrale -AB Tevere	approved	2013	guidance and coordination

Table 2. List of the supra-regional planning instruments.

In the case of Umbria, an applicatory simplification of the cogency analysis carried out was elaborated, evaluating the juridical nature of the plan, namely how its contents are put into effect in the territory according to the power given to them by reference laws and expressed in the Technical Implementation Rules (TIR).
The plans that were to be a programmatic reference for the management and use of the territory or specific resources, or an outline of criteria and lines of direction deriving from reference standards or monitoring of the effects of previous plans, were therefore classified by direction and coordination.
The prescriptive plans for other institutes are those in which compulsory contents for the formation of hierarchically subordinate plans, but which do not have a direct effect on the transformations of the territory, prevail. The term conforming refers to the direct action of the plan indications on the transformability of the territory. The conforming power is used with the prescriptions and bonds that create legal limitations to the property and which subject the asset to a specific juridical regime of affinity. Traditionally, the use of conforming power by the administration is connected to the placing of urban obligations that limit or completely impede the right to build that is connected with the property. The plans were classified, in the cases in which the reference law does not contain indications on the nature of the plan, in one of the three classes indicated based on the presence of the level of greater incisiveness (conforming); in other words, if the Technical Standards contain even a minority of directly compulsory indications for territorial transformation, the plan is classed as conforming. An additional evaluation criterion was given by the procedural status of the plan. Against a consistent number of instruments during the formation phase, it is clear that a conforming plan with its approval procedure still incomplete, does not currently affect the territorial configurations because its prescriptions are not current. The subsequent plan classification with attribution of a numeric parameter associated with the different nature of the plan, has made it possible to outline an important profile of the current compulsory level of metropolitan area planning. From the quantitative analyses carried out, it emerges that the majority of the regional plans has no current cogency because still being formed (36%), 18% have a conforming value on the territorial asset, such as to influence directly on the transformations; 25% have a strategy or coordination direction value, creating a reference profile for the sector policies and a connecting tool between various institutional levels, while 21% of the plans contain prescriptive measures towards other institutes or instruments (Fig. 3). The full profile highlights how the majority of the planning instruments has a high nominal cogency level (49% maximum cogency), a theoretical supposition for effective management of the territorial resources, which however tends to halve operatively (28% current maximum cogency) because of the numerous plans that have not been drafted. “Nominal cogency level” indicates the conforming power of the plan tied to its juridical nature, while “current cogency level” indicates the conditioning power tied to the procedure status, and as such ideal for supplying an indication on the planning profile currently in force in the Region (Fig. 2)

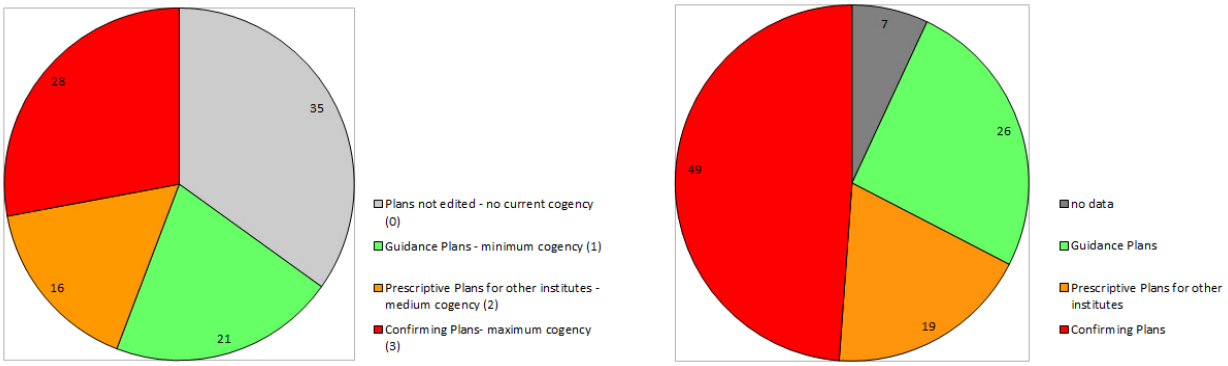

Figure 2. Current (at left) and nominal (at right) cogency levels of the plans.

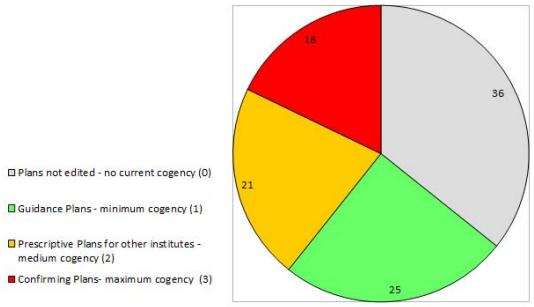

Figure 3. Percentage division of the regional plans at different current cogency levels.

4. Differences in municipal planning

As already anticipated in the introduction, a nerve sector for understanding the true prospects of territorial transformation is that of municipal planning. In Italy there are more than 8,000 municipalities, with 92 in region of Umbria that cover an area of 8,456 km^2 (average size of each municipality about 90 km^2, equivalent to a square with sides of 3 km). When carrying out its territorial planning (town planning scheme) each municipality is autonomous and only rarely are spontaneous inter-municipal aggregations recorded to elaborate plans that give greater strategic freedom (there are some cases in Umbria).
The operative contents of the plan are expressed by zoning, which attributes to the territorial parts the programmed transformation possibilities (residential, production, services, general equipment, agriculture,…) and the TIR which specify the methods and activity size inside the areas. Very important problems regarding regional plan interpretation are tied to the lack of standardization of the area names in relation to their meaning and the expressive complexity of the regulations that often make it difficult to understand the true transformation possibilities (Gruber, 1993; Borst, 1997; Chandrasekaran et al., 1999, Fonseca et al.2002).
An emblematic example is the following Municipal Plan of 2002.
The Plan includes a key for rural space and one for urban space, together with one part called “Systemic components” that provides indications on the mobility system (roads, railways, parking areas) the green system and public services (instruction, health, public order equipment…) together with systems and technological infrastructures.
Among the entries used in the key to describe plan zoning, together with the elements of environmental and cultural quality, the phrase “Green for the environmental, ecological-landscape characterization of the settlement” is used. In one part of the TIR for the Structural Plan, these areas are part of areas E (agricultural). In another section of the same TIR, their discipline considers:
“In the Green Area for the environmental, ecological-landscape characterization of the settlement not covered by woods, the soil can be used, in addition to agricultural farming, as an urban vegetable garden and a garden with the possibility of placing, in plots of no smaller than 500 m^2, a precarious wooden structure for holding agricultural equipment of maximum size 6.00 m^2 and gutter height 2.00 m. For the existing products interventions for residential use only are permitted, subordinated to maintenance of the landscape-environmental function of the surrounding areas. The areas that fall within the Green Area for the environmental, ecological-landscape characterization of the settlement can be used for primary and secondary urbanization works relative to adjacent Ambits of indirect realization; in this case they are given freely to the Municipality”. Some of the possible interventions are construction restructuring with an increase in the surface area referred to a regional law that indicates “…for buildings that already exist on 13 November 1997, expansion for a maximum increase of one hundred square meters of covered usable surface, as long as the total covered usable surface of the individual building being intervened on, including the expansion, is no larger than four hundred and fifty square meters. In cases of expansion, the maximum height of the expanded part can exceed the limit of six and fifty linear meters, until the maximum height of the existing building is reached”.
As can be seen, there is an evident difference between the classification of areas tied to the environmental and ecological-landscape values and the activities that are effectively permitted, substantially construction and urbanistic for each type of enlargement (Figure 4).



Figure 4. Extract from the key of the town planning scheme

This is a problem that can be found in many municipal plans that objectively tend to encrypt the forecasts of construction expansion to avoid or minimize the strong opposition coming from the purchase of elevated real estate values that these areas obtain once identified as being transformable. On the one hand the administrations declare their intention to improve the environmental quality of the territories, while on the other the administrations themselves are subject to strong economic pressure to guarantee areas where building can be carried out. It is, at this point, a historical phenomenon in Italy which, even in the current moment of crisis with building, still seems to assert itself and condition local policies.
The current nomenclature for defining area types is always recalled in the one introduced in 1968 by Italian Ministerial Decree no. 1444, which introduced the following “homogeneous areas”:

> Zone “A” – the parts of the territory involved with urban agglomerates with a historical or artistic character, or with a particular environmental quality, or portions of the urban agglomerates, including the surrounding areas, that can be considered as an integral part of the agglomerates themselves because of these characteristics;
> Zone “B” – the parts of the territory that are totally or partially developed, differently from those indicated in Zone “A”; partially developed is intended as being those areas in which no less than 12.5% (one-eighth) of the lands surface of the area is covered by existing buildings, and where the territorial density is above 1.5 m^3/m^2;
> Zone “C” – the parts of the territory destined for new settlement complexes, which have not yet been built or in which the pre-existing buildings do not reach the surface and density limits given in “B” above;
> Zone “D” – the parts of the territory destined for new settlements for industrial plants or related to them;
> Zone “E” – the parts of the territory destined for agricultural use, excluding those in which – in spite of their agricultural character – the division of the properties requires settlements to be considered as those in zone “C”;
> Zone “F” – the parts of the territory destined for equipment and plants of general interest.

Table 3. Homogeneous territorial areas introduced by Italian Ministerial Decree no. 1444 of 1968.

What has changed with regard to the more immediate communication structure of the ‘70s is the complexity of the regulations which today often tend, as shown above, to insert forecasts of urban growth within synoptic items which are deceptive and more captivating for today’s social environmental sensitivity.

5. Conclusions

In the presence of planning profiles like those shown, it is very difficult for a company to trace the effective paths of its transformation future, but also to manage the obligatory environmental procedures (VIA, VAS and VINCA). In the case of the metropolitan area, some of the region profiles overlapped, even if different because of classification or acquisition scales, which could be rationally surpassed by coordination between companies or departments of the same institute and the availability of common datasets for public and private use. This would give a range of advantages; in addition to the obvious reduction of data production costs, there would also be a single reference archive which could be easily updated and revised using geographic computer systems, and consequently the possibility of using homogeneous data that could be compared. These procedures are now being used partially, at least on some specific projects, but are factually not yet generalized and coded, in the same way as the keys of the municipal urbanistic instruments which are not standardized, making them difficult to interpret.

In addition, these same urban instruments are not always available on municipal geoportals. When available, only in some cases are they released in a format that can be suitably managed by a GIS. Very often the printouts of the municipal urbanistic instruments are issued in PDF format (Portable Document File which can then be converted into raster), in DWG (drawing) and DXF (Drawing eXchange Format) format, or even in a common raster format (.jpeg, .tif for example). This requires the use of pre-processing phases, which are long and laborious, in order to obtain the necessary formats that are compatible with the data elaboration procedures in a GIS environment. All this is then returned to the de facto standard of geographic information (shp format), therefore the techniques to use are different according to the original format. With raster formats, plan zoning must be georeferenced using a series of conforming GCPs (Ground Control Point), which must be easy to identify both on the plan and also on the georeference maps used (orthophoto or even Google Earth), but with understandable topographic imprecisions. Returning systematically to the various maps, at least the planimetry coordinates of the 4 vertexes in the reference system used would make the georeference much easier and more precise. The tools released in vectorial CAD-type format (.dwg or .dxf), are already produced using a reference system therefore, from this point of view, they must be transformed and converted between systems. From the georeferenced raster bases it is possible to digitalize plan zoning using common editing techniques, creating the vectorial layer ex novo. In the case of CAD files, a series of problems appear that must be solved. A computer drawing system, as is CAD, does not have a topological structure of the datum and very often, during file creation, contiguous polygons having one or more sides in common are not anchored to each other, causing a series of errors caused by spaces and overlaps. Eliminating errors of this type requires a lot of time and technical resources. The number of these errors depends naturally on the territorial extension to which the datum refers, in addition to the knowledge and technical skills of the operator who has to digitalize the geographic information. The other problem to face, partly described previously, is connected to alphanumeric information and its approval within the database. It was described how different municipalities use different descriptions, very often articulate and cryptic, to describe the various territorial transformation ambits. During the PRGs of the municipalities of Umbria, an attempt was made to class everything according to the areas identified by Italian Ministerial Decree no. 1444/1968, trying to interpret the NTAs of each plan in this key. This caused a certain discretion in attributing the areas to one or another category sensu 1444/1968 (Tab. 3), a choice that was reversible because the original caption of each area of each plan was indicated in a suitable field while creating the database (Table 4). We have already supported the usefulness of using a single key at least regionally, which all municipalities should use when zoning. Together with this, the application of GIS technical protocols common to all plans (standard shp format), would make it possible to obtain different advantages in effective territorial management. In the first place the randomness of the instruments (Figs. 5, 6) could be updated continually, supplying an ever-current profile of the transformation tendencies. The effects on the strategic vision of the territory to modulate at best the direction lines and development are evident. The easy implementation of scenarios would notably support programming, territorial planning and evaluation procedures. In conclusion, the creation of a technical protocol regarding the format to be used to draft plans, the implementation of a single standard area key for the relative database, together with greater computer diffusion of these public governmental instruments (with the use of OGC services or webgis) would make available a detailed instrument that is useful and updated, and which could be used in territorial development policies.

FID	Shape *	Zoning	Descrizion	Comune	A_P	AA	Tipologia	Area
0	Polygon ZM	S	Attrezzature per l'istruzione	Fabro	STINA	2000	Piano Operativo Comunale	12654,498521
1	Polygon ZM	F	Impianti tecnologici	Fabro	STINA	2000	Piano Operativo Comunale	3130,150447
2	Polygon ZM	S	Attrezzature per lo sport	Fabro	STINA	2000	Piano Operativo Comunale	18864,008638
3	Polygon ZM	S	Attrezzature per lo sport	Fabro	STINA	2000	Piano Operativo Comunale	20975,980817
4	Polygon ZM	S	Parcheggi	Fabro	STINA	2000	Piano Operativo Comunale	4022,408608
5	Polygon ZM	S	Parcheggi	Fabro	STINA	2000	Piano Operativo Comunale	1234,421172
6	Polygon ZM	S	Attrezzature per lo sport	Fabro	STINA	2000	Piano Operativo Comunale	37953,780918
7	Polygon ZM	D	Artigianale, industriale, commerciale (1a)	Fabro	STINA	2000	Piano Operativo Comunale	11336,056583
8	Polygon ZM	S	Zone a verde privato_Vp	Fabro	STINA	2000	Piano Operativo Comunale	5354,303702
9	Polygon ZM	S	Verde pubblico di quartiere	Fabro	STINA	2000	Piano Operativo Comunale	192,235816
10	Polygon ZM	S	Verde pubblico di quartiere	Fabro	STINA	2000	Piano Operativo Comunale	299,995082
11	Polygon ZM	S	Verde pubblico di quartiere	Fabro	STINA	2000	Piano Operativo Comunale	123,511373
12	Polygon ZM	B	Completamento estensiva	Fabro	STINA	2000	Piano Operativo Comunale	1073,507164
13	Polygon ZM	S	Zone a verde privato_Vp	Fabro	STINA	2000	Piano Operativo Comunale	698,856601
14	Polygon ZM	B	Completamento estensiva	Fabro	STINA	2000	Piano Operativo Comunale	3606,747529
15	Polygon ZM	S	Zone a verde privato_Vp	Fabro	STINA	2000	Piano Operativo Comunale	6632,854511
16	Polygon ZM	B	Completamento estensiva	Fabro	STINA	2000	Piano Operativo Comunale	1975,950099
17	Polygon ZM	B	Completamento estensiva	Fabro	STINA	2000	Piano Operativo Comunale	2277,491562
18	Polygon ZM	B	Completamento semiestensiva	Fabro	STINA	2000	Piano Operativo Comunale	1179,204655
19	Polygon ZM	B	Completamento semiestensiva	Fabro	STINA	2000	Piano Operativo Comunale	810,714345
20	Polygon ZM	B	Completamento semiestensiva	Fabro	STINA	2000	Piano Operativo Comunale	6991,063963
21	Polygon ZM	B	Completamento intensiva	Fabro	STINA	2000	Piano Operativo Comunale	516,126213
22	Polygon ZM	B	Completamento intensiva	Fabro	STINA	2000	Piano Operativo Comunale	1157,385639
23	Polygon ZM	B	Completamento intensiva	Fabro	STINA	2000	Piano Operativo Comunale	2820,731871
24	Polygon ZM	S	Parcheggi	Fabro	STINA	2000	Piano Operativo Comunale	472,330072
25	Polygon ZM	B	Completamento intensiva	Fabro	STINA	2000	Piano Operativo Comunale	17434,452268

Table 4. Extract from the database of PRG mosaicking

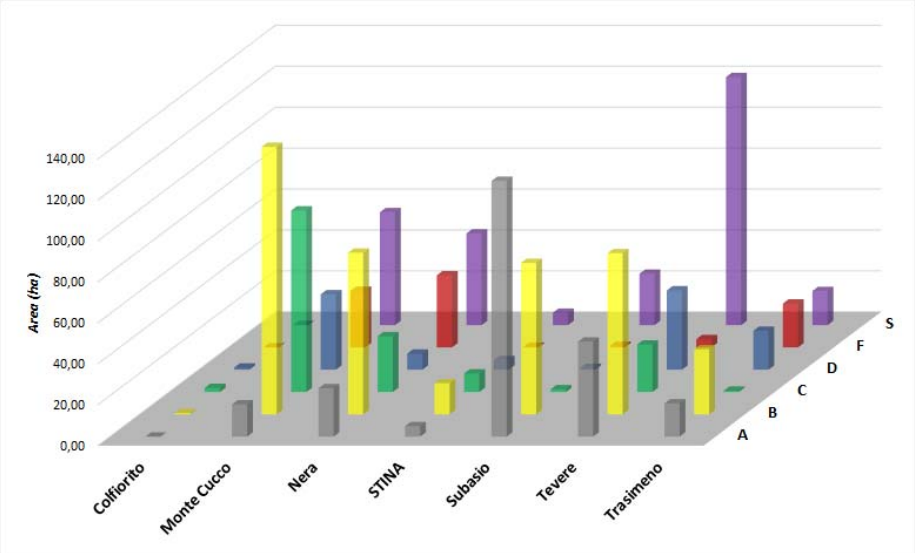

Figure 5. Bar chart showing the range of territorial transformations in the protected areas of Umbria.

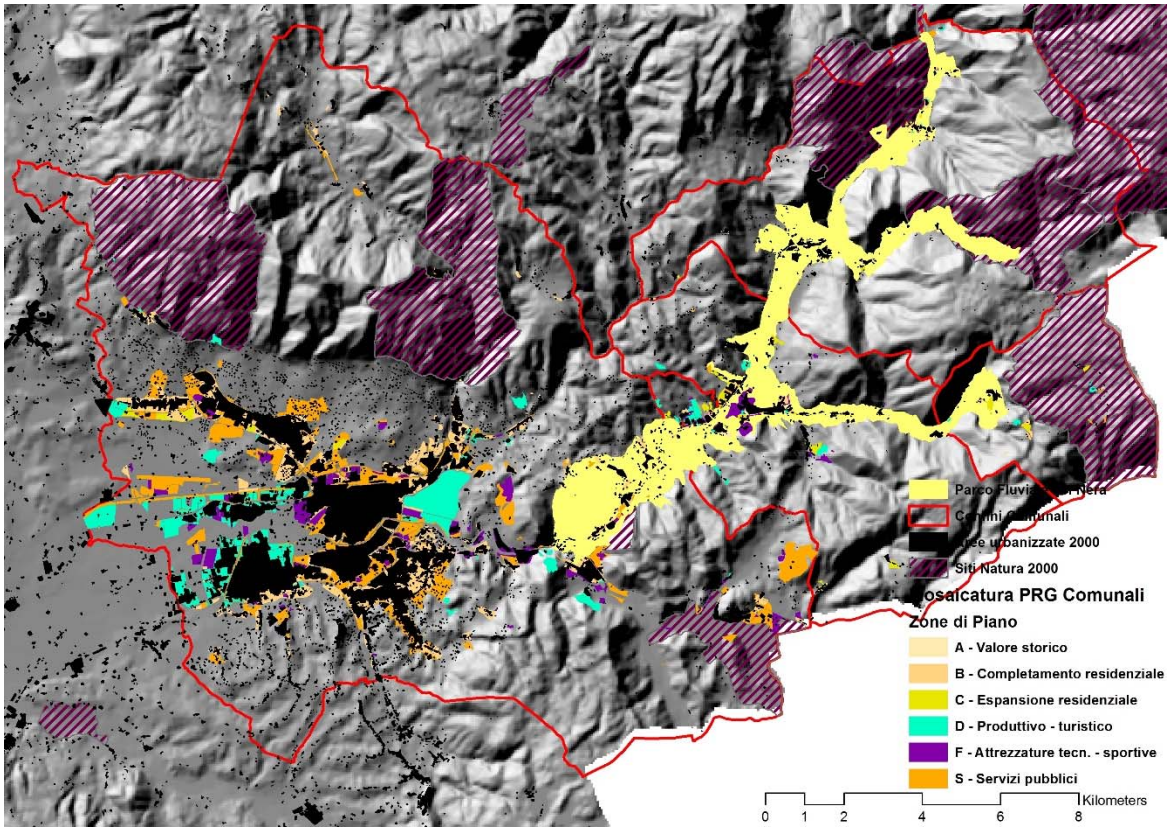

Figure 6. The Fluvial park of the river Nera and articulation of the urbanistic forecasts elaborated using current PRG mosaicking.

References

[1] BORST W.N.. Construction of engineering ontologies. University of Tweety. 1997. Enschede, Centre for telematica and information Technology.
[2] Paolillo P.L., Benedetti A., Graj G., Terlizzi L., Bisceglie R.. *The decisions support scenarios in the first phases of the strategic environmental evaluation: the Barzio territory government plan experience*, in Campagna M. et al., Planning Support Tools: Policy Analysis, Implementation and Evaluation Proceedings of the Seventh International Conference on Informatics and Urban and Regional Planning INPUT 2012. 2012. Angeli, Milano, pp. 2009-2010.
[3] Chandrasekaran B., Johnson T.R., Benjamins V.R.. Ontologies: what are they? Why do we need them?. 1999. IEEE Intelligent Systems and their application, Springer-Verlag, New York.
[4] Fonseca F., Egenhofer M., Davis C., Camara G.. Semantic granularity in ontology-driven Geographic Information Systems. 2002. Annals of mathematics and artificial intelligence.
[5] Graci G., Pileri P., Sedazzari M.. Gis e ambiente. Flaccovio 2009, pp. 270
[6 Gruber T.R.. Towards principles for the design of ontologies used for knowledge sharing. Formal ontology in conceptual analysis and knowledge representation. 1993. Kluwer Academic Publisher.
[7] Romano B.. La rete ecologica della Regione Umbria e linee guida Umbria Greenways, Atti del Convegno Internazionale "Verso una politica del paesaggio: temi e buone pratiche a confronto", Orvieto 19 - 20 Marzo 2009, *Architettura del Paesaggio*, Overview, 21:1-15.
[8] Murgante B., Borruso G., Lapucci A.. Geocomputation and Urban Planning. Studies in Computational Intelligence. Vol. 176. Springer-Verlag 2010, Berlin. doi:10.1007/978-3-540-89930-3
[9] Murgante B.. L'informatica, I Sistemi Informativi Geografici e la Pianificazione del Territorio. In: Murgante (A cura di) *L'informazione geografica a supporto della pianificazione territoriale*. Franco Angeli Editore, 2008.

HERITAGE and TECHNOLOGY
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"COL CERVIELLO ET NON CON LE MANI" New hypotheses on the Michelangelo plaster works of the Fine Arts Academy of Perugia

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Abstract
The Michelangelo plaster works of the Fine Arts Academy of Perugia represent an unsolved enigma of art history. Formally they echo the sculptures *Day*, *Night*, *Dawn* and *Dusk*, molded by the Italian Renaissance genius for the Medici tombs of the Sagrestia Nuova of the Basilica of San Lorenzo in Florence, but, at the same time, they don't follow exactly the lineament of the Florence sculptures, and they express an original poetic due to the autonomous dimensional and expressive characteristics. In the past centuries and up to the contemporary, the scholars have proposed interpretative hypotheses on the origin and historical events of the plaster works, so as to making the famous architect and historian Ugo Tarchi exclaim: "if it was possible to transport the Perugian casts close to the statues of the Medici Chapel"!
The proposed paper aims to investigate the relationship between the Perugia plaster works (donated in 1573 by Vincenzo Danti) and the Florence marble sculptures (carved around 1530 by Michelangelo Buonarroti) through historical research (knowledge), investigative survey (mind) and new technologies (experience), to definitely shine a light on Michelangelo alleged authorship and on original collocation of the plaster works of the Academy of Perugia: as Michelangelo said "*brain instead hands*" ("*col cerviello et non con le mani*"), or rather to declare the "surveyor-detective" to be a leading figure in any art-historical research.

Keywords: Michelangelo, Academy of Perugia, digital survey, photomodelling, surveyor-detective

The four Michelangelo plaster works moved to Perugia in 1573 by "Cecchino viturale" [1] on behalf of Vincenzo Danti as trusted servant for the "able crowd of painters and architects" ("vertuosa schiera di pittori et architetti") affiliated to the fledgling "Academy of Drawing" ("Academia del Dissegno") [2], currently preserved at the plaster casts gallery at the Fine Arts Academy Museum of Perugia, embody a historical-artistic enigma still unsolved. Because they, though formally echoing the Times of Day (*Day*, *Night*, *Dawn*, *Dusk*) sculpted around 1530 by Michelangelo to seal in a monumental manner the tombs pertaining to the Medici family of Giuliano, duke of Nemours, and Lorenzo, duke of Urbino, in the Sagrestia Nuova of the Florentine Basilica of San Lorenzo, don't reproduce that features faithfully: neither from the compositional point of view, nor, least of all, from the dimensional point of view. But also because their location in the first academic seat remains unknown: that church of Sant'Angelo della Pace where Orazio Alfani and Raffaello Sozi "made the Academics train making drawings" ("facevano essercitare gl'Academici in fare dissegni") [3].
The art historians interest to the Perugian plaster works, however, has always been great and has never diminished [4]. Starting from 1597, when Cesare Crispolti [5] attributes to Vincenzo Danti the donation: an hypothesis confirmed by Annibale Mariotti in 1788 [6] and by Baldassarre Orsini in 1810 [7], but invalidated by Serafino Siepi in 1822 [8], who singles out Ignazio Danti, Vincenzo's brother. The debate, still unsolved despite the accurate documentary researches carried out by Mariano Guardabassi earlier and by Iodoco del

Badia later [9], restarts in 1909, when Walter Bombe, in an interview with Giulio Loccatelli and published on the “Il Giornale d’Italia” pages, floors the art history world, maintaining that the Florentine marble aren’t Michelangelo’s work, but they are work of one of his pupils, whereas the Perugian plaster works, which are something more than just mere casts of the Florentine marble, are work of Michelangelo. It is no coincidence that their “admirable technique” (“tecnica mirabile”) discloses the “sovereign hand” (“mano sovrana”) [10]. Bombe’s declarations fuels a heated argument: on the one hand they enjoy appreciation by the academics from Perugia [11], on the other hand they direct criticism of the main historians. Which are in any event so biting as to induce Bombe to pull back his assertions, reporting the hasty divulgation of the “immature results” (“resultati immaturi”) of his researches and the inconsistencies between marbles and plaster works to a clear understanding of the trainer Vincenzo Danti [12]. Returning the originality chrism to the Florentine marbles and reversing the Perugian plaster works to copies rank.

As long as, in 1954, Ugo Tarchi overturns all stabilized certainties (stoked by the marginality of Charles De Tolnay and Ludwig Goldscheider quotes [13]), publishing a reserved piece of writing [14] in which, into the shoes of the “surveyor-detective” [15], reveals the differences between marbles and plaster works, by analytically comparing the Michelangelo study drawings with the photographic images and the direct surveys performed on the Florentine marbles and the Perugian plaster works [16]. The comparison reveals that the Perugian *Night*, *Dawn* and *Dusk* are substantially greater than the Florentine corresponding, while, conversely, the Perugian plaster work of the *Day* is smaller than the Florentine corresponding [17]. It is precisely this incongruity which drives Tarchi to rule out the Perugian plaster works like Florentine marbles casts on the one hand, and to conclude that the Perugian plaster works are casts of misplaced models on the other hand [18]: maybe shaped by Michelangelo himself starting from his study models previous to the Medicis’ marbles [19], as confirmed by the different positioning of the Perugian plaster works compared with the Florentine marbles (the former are placed on an incline plane, while the latter are laid over a volute) that can be reasonably attributed to the variability of Michelangelo’s inspiration [20].

A brave thesis, which returns dividing researchers. In fact, while Giusta Nicco Fasola supports Tarchi’s conclusions [21], John David Summers and Dimitrios Zikos contest that, restarting the allocation hypothesis to Danti’s compass, in particular to Timoteo Refati, Ignazio’s partner [22]. However not even the new documentary contributions find out by Lidia Mazzerioli solve the enigma, because, though confirming the hypothesis that Vincenzo Danti is the Perugian casts’ author, they don’t throw light on happening [23], in which it seems characteristic at least that the casts obtained from a number of original models may be partly of greatest dimension and partly of smaller dimension than the originals corresponding.

In order to throw light on this intricate historical-artistic enigma, the Department of Civil and Environmental Engineering of the University of Perugia has turned on a reserved research [24] that, recalling the comparison started by Ugo Tarchi between the Perugian plaster works and the Florentine marbles, it is proposed to perfect it using advanced survey techniques, which are able to give life, with the aid of virtual reality, to the wishes with which the Florentine architect gloomily ends his script regarding the Michelangelo’s querelle: “if it was possible to transport the Perugian casts close to the statues of the Medici Chapel” (“se fosse possibile trasportare i calchi perugini accanto alle statue della Cappella Medicea”) [25]! In this sense, the survey of the Perugian plaster works has been carried out by integrating the continuous metric data derived from the digital survey with the discontinuous metric data derived from the direct survey [26]. Which, in addition to vouch for two-dimensional and three-dimensional restitution of the architectural drawing, has confirmed the precision of the metric values published by Tarchi and it has allowed to speculate about the original plaster works collocation in the church of Sant’Angelo della Pace [27]. For this purpose, assuming as credible the hypothesis that their relative disposition in respect to the altar coincides with that of the Florentine marbles in range of the tombs pertaining to the Medicis’, a body of graphic and infographic drawings has been composed, returning the plaster works position according to the doric arcades which chant the lateral walls of the Alessi’s ecclesiastical building. Moreover, because of the presence of three lateral recesses interrupted by two pilaster strips, more suitable alternatives have been verified, even assuming the presence of two central lateral altars. That has enabled the prefiguration of a number of possible dispositions, virtually realizing the documentary knowing thanks to high-tech technologies applied to the scientific research and to the prefiguration of virtual reality [28].

But then is now verified that the survey is in itself a cognitive act which, at the same time, reinforces the obtained knowing (because it weighs the material dimensions), confirms the interpretative hypothesis (because it weighs the subtended geometries) and highlights the innovative theories (because it weighs the cultural trends). Above all in the specific case, in which the proposed contribution check on the connection between the Perugian plaster works and the Florentine marbles through the historical research (knowledge), the detective survey (mind) and the new technologies (experience): paraphrasing the Michelangelo’s famous motto “*brain instead hands*” (“*col cerviello et non con le mani*”) that is declaring the “surveyor-detective” as decisive figure in range of any historical-artistic research.

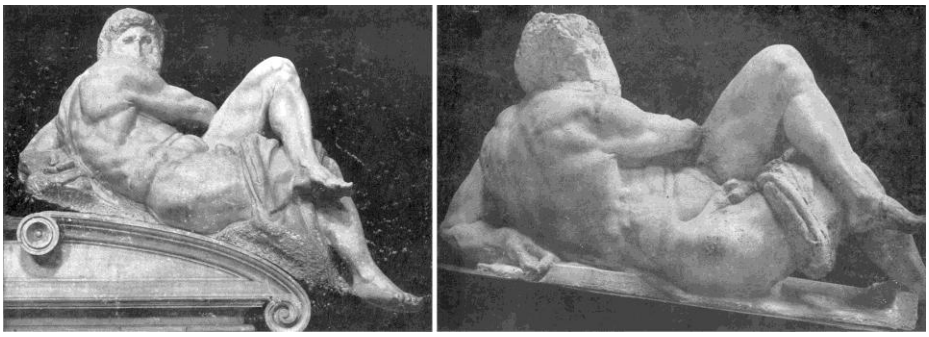

Fig. 1: Photographic views: *Day* (Florence), *Day* (Perugia) (Tarchi, 1954).

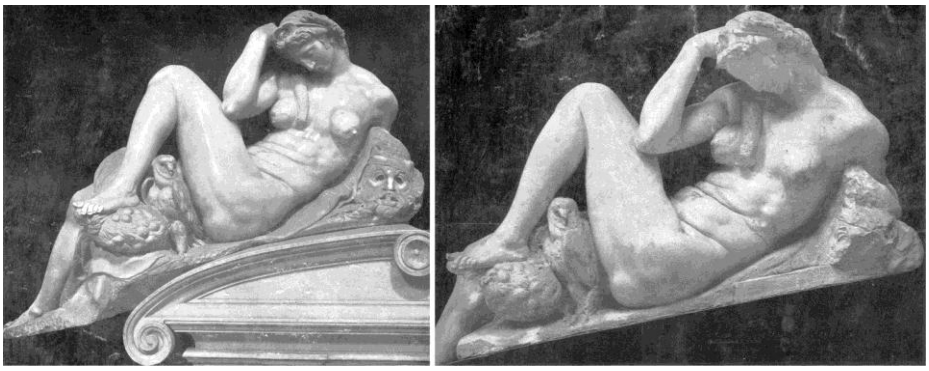

Fig. 2: Photographic views: *Night* (Florence), *Night* (Perugia) (Tarchi, 1954).

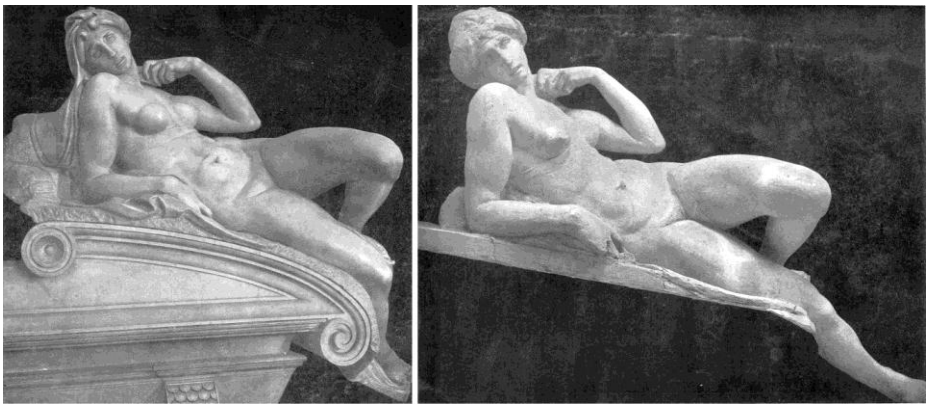

Fig. 3: Photographic views: *Dawn* (Florence), *Dawn* (Perugia) (Tarchi, 1954).

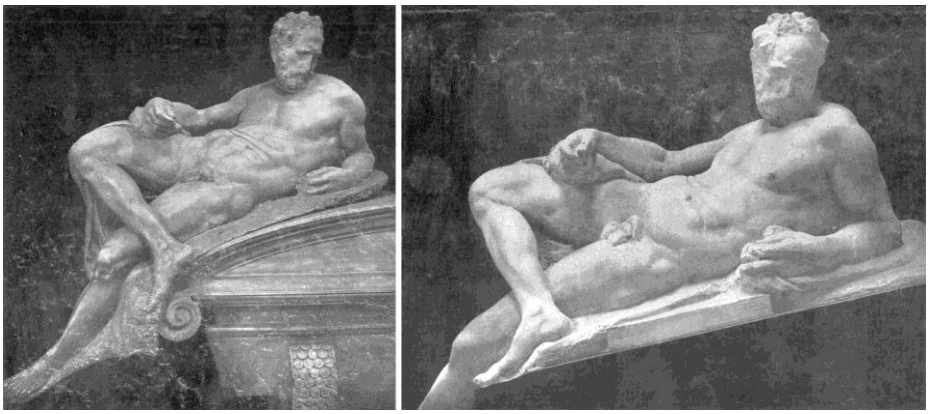

Fig. 4: Photographic views: *Dusk* (Florence), *Dusk* (Perugia) (Tarchi, 1954).

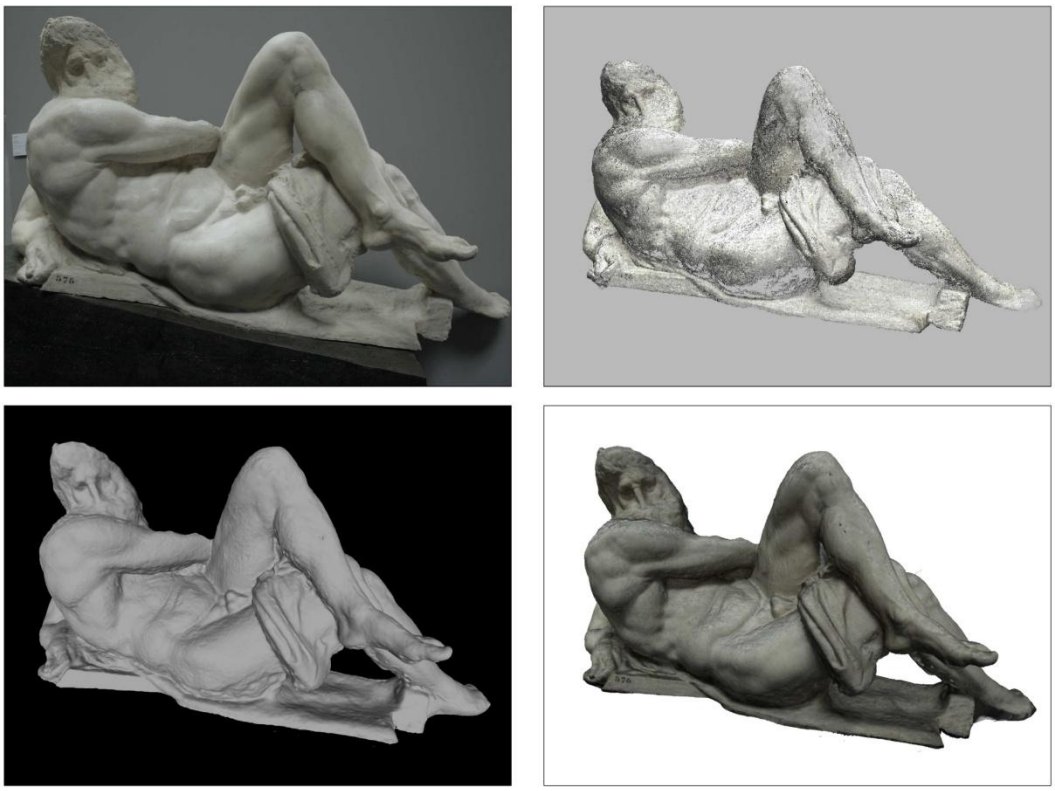

Fig. 5: Digital survey of the Michelangelo plaster works of the Fine Arts Academy of Perugia, 2015, *Day*: photographic view, point cloud, mesh, textured mesh.



Fig. 6: Digital survey of the Michelangelo plaster works of the Fine Arts Academy of Perugia, 2015, *Dawn*: photographic view, point cloud, mesh, textured mesh.

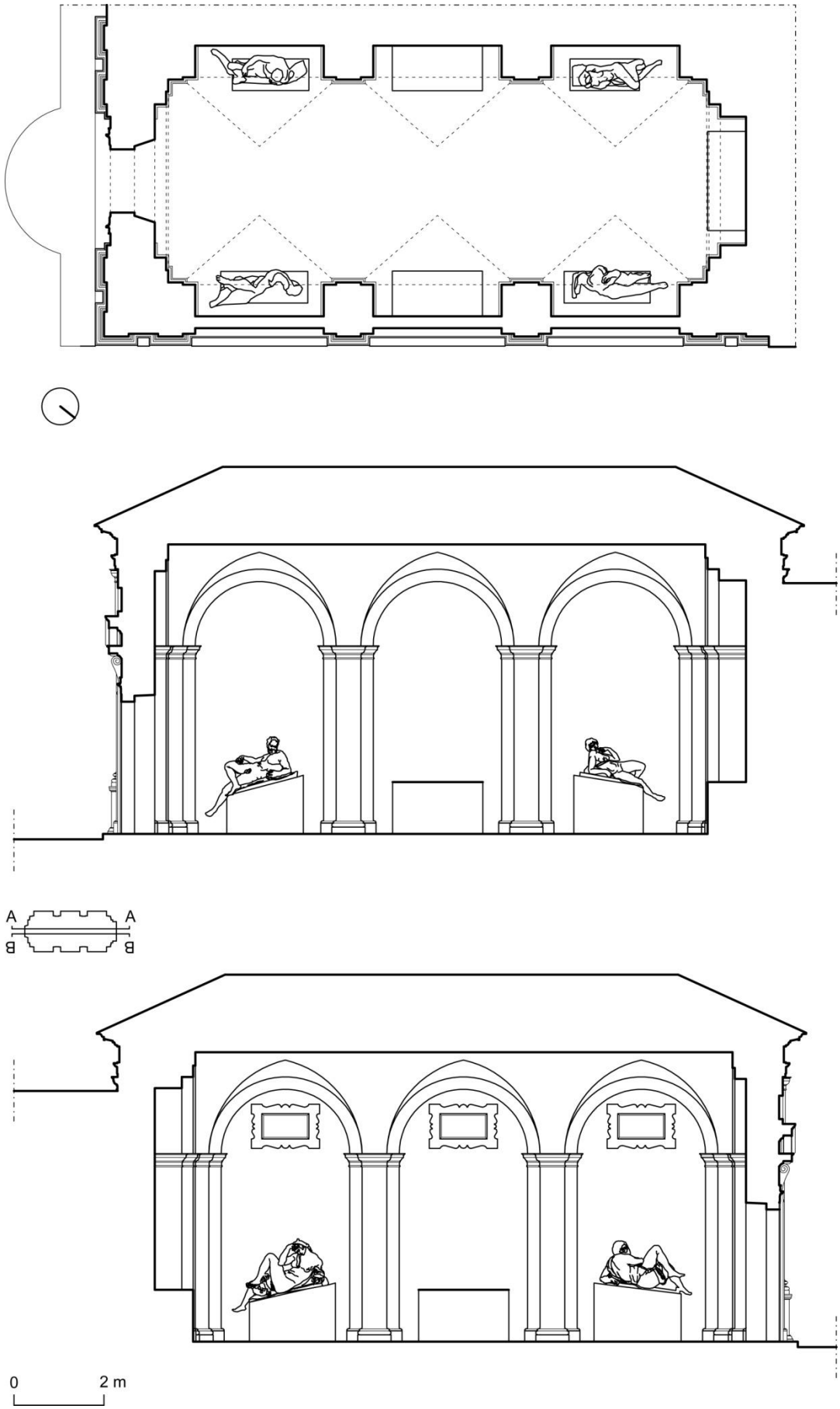

Fig. 7: Digital survey of the Michelangelo plaster works of the Fine Arts Academy of Perugia, 2015, reconstructive hypotheses of the original collocation, plan, section A-A and section B-B.

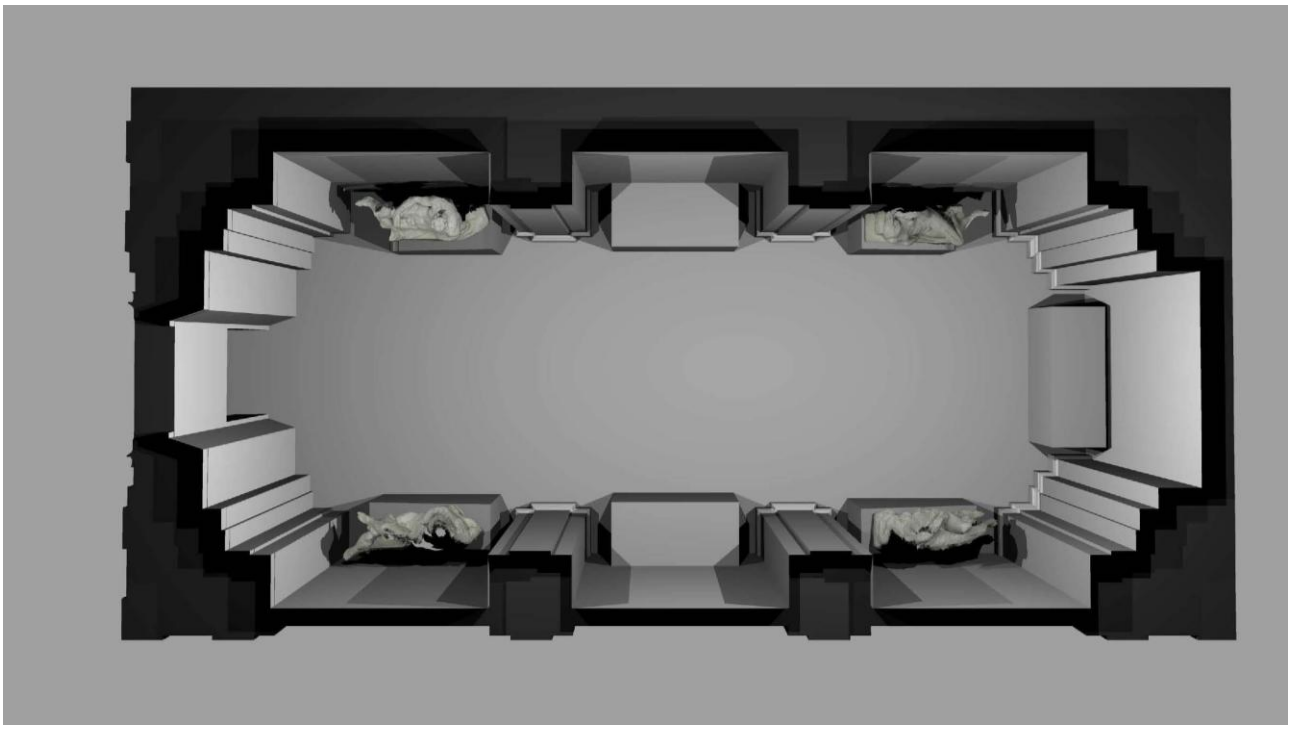

Fig. 8: Digital survey of the Michelangelo plaster works of the Fine Arts Academy of Perugia, 2015, reconstructive hypotheses of the original collocation, render view.



Fig. 9: Digital survey of the Michelangelo plaster works of the Fine Arts Academy of Perugia, 2015, reconstructive hypotheses of the original collocation, render view.

References

[1] “The magnific academics on the other hand must have had until on 1 August 1575 seven ecus 12 doughs money lent them to pay ‘Cecchino viturale’, who moved the statues from Florence, and because of other academy needs, and 15 ecus for them to mastro Giammaria Bisconti painter academy keeper *videlicet*” (“I magnifici academici di contro deveno havere sino a dì primo di agosto 1575 scudi sette baiocchi 12 di moneta prestatigli per pagare Cecchino viturale, che portò le statue da Fiorenza, e per altri bisogni de l’academia, e per loro a mastro Giammaria Bisconti pittore conservator dell’academia videlicet scudi 15”). Archivum Romanum Societatis Jesu, Fondo Gesuitico, 1490, s. 318v. The document, which reports the transport to Perugia of the four Vincenzo Danti’s plaster works inspired by the Michelangelo’s original ones, was published by Francesco Federico Mancini for the first time (cf. MANCINI, Francesco Federico. L’Accademia di Belle Arti di Perugia nel contesto storico-culturale della fine del Cinquecento e del primo Seicento. In BOCO, Fedora, PONTI, Antonio Carlo, edited by*. Proceeding of the conference L’Accademia riflette sulla sua storia. Perugia e le origini dell’Accademia del Disegno. Secoli XVI e XVII*. 1st ed. Perugia: Futura, 2011, p. 62). About Vincenzo Danti cf. FIDANZA, Giovan Battista. *Vincenzo Danti 1530-1576*. 1st ed. Firenze: L.S. Olschki, 1996. About Giovanni Maria Bisconti cf. MANCINI, Francesco Federico. La decorazione manieristica della cattedrale. In CIANINI PIEROTTI, Maria Luisa, edited by. *Proceeding of the conference Una città e la sua cattedrale. Il Duomo di Perugia*. 1st ed. Perugia: Edizioni Chiesa S. Severo a Porta Sole, 1992, p. 499.

[2] In addition to the Sozi’s handwritten (cf. SOZI, Raffaello. Principio dell’Academia del Dissegno. In SOZI, Raffaello. *Annali, memorie, et ricordi, scritte da Rafaello Sotij cominciando l’anno MDXL*. Perugia: no publisher, XVI secolo, p. 115, manuscript of Public Library “Augusta” of Perugia, 1221), about genesis of the Academy of Drawing of Perugia cf. MONTESPERELLI, Zopiro. *Brevi cenni storici sulla Accademia di Belle Arti di Perugia*. 1st ed. Perugia: Tip. Centrale G. Donnini, 1899; CECCHINI, Giovanni. *L’Accademia di Belle Arti di Perugia*. 1st ed. Firenze: Le Monnier, 1954; BOCO, Fedora. Quando la Storia entra in Accademia. In MURATORE, Giorgio, BOCO, Fedora, edited by. *Scuola e Architettura. L’evoluzione del disegno architettonico dal 1790 al 1940 nelle Raccolte dell’Accademia di Belle Arti di Perugia*. 1st ed. Perugia: Benucci, 1989, pp. 15-23; MANCINI, Francesco Federico. L’Accademia di Belle Arti di Perugia nel contesto storico-culturale della fine del Cinquecento e del primo Seicento. In BOCO, Fedora, PONTI, Antonio Carlo, edited by*. Proceeding of the conference L’Accademia riflette sulla sua storia. Perugia e le origini dell’Accademia del Disegno. Secoli XVI e XVII*. 1st ed. Perugia: Futura, 2011, pp. 61-114 and BELARDI, Paolo. Perugia MDLXXIII. “Principio della Accademia del Dissegno”. In CARLEVARIS, Laura, FILIPPA, Monica, edited by. *Proceeding of the international conference Elogio della teoria. Identità delle discipline del disegno e del rilievo*. 1st ed. Roma: Gangemi, 2012, pp. 179-188.

[3] SOZI, Raffaello. Principio dell’Academia del Dissegno. In SOZI, Raffaello. *Annali, memorie, et ricordi, scritte da Rafaello Sotij cominciando l’anno MDXL*. Perugia: no publisher, XVI secolo, p. 115 (manuscript of Public Library “Augusta” of Perugia, 1221).

[4] Enough to be subject to a real operation of “culture multiplication” (“moltiplicazione della cultura”) like *Michelangelo in Cina* iniziative, in which, over 2013, the Perugian plaster works’ bronze copies have played a leading role in an important travelling event started from Pechino achieving Shangai. Cf. BELARDI, Paolo, BIANCONI, Fabio, MENCHETELLI, Valeria, MARTINI, Luca. “Tutti siamo capaci di creare, è copiare che è difficile!”. L’opera d’arte nell’epoca della sua proliferazione iconica, in GIANDEBIAGGI, Paolo, VERNIZZI, Chiara, edited by. *Proceeding of the international conference Italian survey & international experience*. 1st ed. Roma: Gangemi, 2014, pp. 755-762.

[5] Cf. CRISPOLTI, Cesare. Santo Angelo nel Monte di Porta Sole. In CRISPOLTI, Cesare. *Raccolta delle cose segnalate*. Perugia: no publisher, 1597, s. 29r (manuscript of Public Library “Augusta” of Perugia, 1256). In TEZA, Laura, edited by. *Raccolta delle cose segnalate di Cesare Crispolti. La più antica guida di Perugia (1597)*. 1st ed. Firenze: L.S. Olschki, 2001, pp. 113-115.

[6] Cf. MARIOTTI, Annibale. *Lettere pittoriche perugine o sia Ragguaglio di alcune memorie istoriche riguardanti le arti del disegno in Perugia al signor Baldassarre Orsini pittore e architetto perugino accademico d’onore dell’Accademia Clementina di Bologna ed Etrusco di Cortona*. 1st ed. Perugia: Delle stampe Badueliane, 1788, p. 256.

[7] Cf. ORSINI, Baldassarre. *Memorie Istoriche dell’Augusta Accademia delle Belle Arti del Disegno di Perugia dall’anno 1573, a tutto il 1810. Parte I*. Perugia: no publisher, 1810 (manuscript of Academy of Fine Arts “Pietro Vannucci” Perugia Foundation library, 1GVII6), p. 3.

[8] Cf. SIEPI, Serafino. *Descrizione topologica historica della città di Perugia*. 1st ed. Perugia: Garbinesi e Santicci, 1822, I, p. 259.

[9] Cf. GUARDABASSI, Mariano. *Indice-guida dei monumenti pagani e cristiani riguardanti l'istoria e l'arte esistenti nella Provincia dell'Umbria*. 1st ed. Perugia: G. Boncompagni e C., 1872, p. 116 and DEL BADIA, Iodoco. *Ignazio Danti cosmografo e matematico e le sue opere in Firenze*. 1st ed. Firenze: Cellini, 1898, p. 15 (n. 1).

[10] Cf. LOCCATELLI, Giulio. Grande scoperta artistica di Walter Bombe? Quattro modelli di Michelangelo nell'Accademia di Perugia. *Il Giornale d'Italia*. 2 dicembre 1909. Roma: Società editrice Esedra, 1901-2014.

[11] Cf. LOCCATELLI, Giulio. La scoperta dei calchi michelangioleschi all'Accademia di Belle Arti. *Il Giornale d'Italia*. 4 dicembre 1909. Roma: Società editrice Esedra, 1901-2014.

[12] Cf. BOMBE, Walter, URBINI, Giulio. I marmi di Firenze e i gessi di Perugia (Da Michelangiolo Buonarroti a Vincenzo Danti). *Il Marzocco*. ORVIETO, Adolfo. 50, 1909. Firenze: no publisher, 1896-1932.

[13] Cf. DE TOLNAY, Charles. *Michelangelo*. 1st ed. Princeton: Princeton University Press, 1948, III, *The Medici Chapel*, p. 155 e GOLDSCHEIDER, Ludwig. *Michelangelo. Pittura, scultura, architettura*. 1st ed. Firenze: Sansoni, Londra: The Phaidon Press, 1953, p. 207.

[14] Cf. TARCHI, Ugo. I calchi michelangioleschi nell'Accademia di Perugia e i marmi nella cappella medicea. In TARCHI, Ugo. *L'arte del Rinascimento nell'Umbria e nella Sabina*. 1st ed. [Milano]: Garzanti Editore, 1954, appendix (no pages numbers).

[15] Cf. BELARDI, Paolo. *Why architects still draw*. 1st ed. Cambridge, London: The Mit Press, 2014, p. 59.

[16] Tarchi particularly highlights the scientific value of the survey method, carried out "with a single system for both of series of sculptures, by applying tape to the various stretched in the same way" ("con un unico sistema per tutte e due le serie di sculture, applicando la fettuccia alle varie tese nello stesso modo"). Cf. TARCHI, Ugo. I calchi michelangioleschi nell'Accademia di Perugia e i marmi nella cappella medicea. In TARCHI, Ugo. *L'arte del Rinascimento nell'Umbria e nella Sabina*. 1st ed. [Milano]: Garzanti Editore, 1954, appendix, in particular pics. II, II^A, VII, XII, XVII e XXII.

[17] Cf. *ibidem*, pics. VII, XII, XVII e XXII.

[18] The main differences relate to the poses (in particular the pose of the *Dawn*'s leg, elongated in Perugia and folded in Florence, and the different twisting of *Dusk*'s back and *Day*'s bust, head and limb) and some details (in the Perugian *Dawn* the bendages wrapping Florentine head are missing, in the Perugian *Dusk* the figure shakes a "fabric" with its left hand and in the Perugian *Night* the owl and the mask used to decorate the figure appear differently placed and least well defined than the Florentine corresponding). Cf. *ibidem*, in particular pics. III, IV, V, VI, IX, X, XI, XIII, XIV, XV, XVI, XVIII, XIX, XX, XXIII, XIV, XXV and XXVI.

[19] In this sense Tarchi rejects all the previous hypothesis, in which he argues that the noticed differences between marbles and plaster works don't owe to wrong restorations of the latter, because that restorations would lead into evident discontinuity in the figures pose. In addition to this he denies that Vincenzo Danti could be the author of the missing originals as marbles copies of his mentor Michelangelo, because just "see the plastic strength with which the Perugian statues have been made, strength that the gypsum moulding has failed to distort, so that the hypothesis falls down. The perugian plaster works speak for themselves to those who are able to look at them and they clearly expose the lion nail" ("osservare il vigore plastico con cui sono state eseguite le statue perugine, vigore che la formatura in gesso non è riuscita a svisare, perché tale ipotesi crolli. I gessi di Perugia parlano chiaro a chi sappia guardarli e denunciano nettamente l'unghia del leone"). In addion, in that case, Danti would have reproduced in the copies the exact shape of the originals. Cf. *ibidem*, in particular pics. XXV, XXVI e XXVII.

[20] Cf. *ibidem*, in particular pics. II e II^A.

[21] Cf. NICCO FASOLA, Giusta. Di nuovo dei gessi perugini (nota michelangiolesca*). Commentari. Rivista di critica e storia dell'arte*. SALMI, Mario, VENTURI, Lionello. III, 1955. Roma: De Luca, 1950-1978.

[22] Cf. SUMMERS, John David. *The sculpture of Vincenzo Danti. A study in the influence of Michelangelo and the ideals of the Maniera*. 1st ed. New York, London: Garland publishing, 1979, p. 431; Aurora e Crepuscolo. Egnazio Danti e Timoteo Refati (da Michelangelo). In DAVIS, Charles, PAOLOZZI STROZZI, Beatrice, edited by. *I grandi bronzi del Battistero. L'arte di Vincenzo Danti, discepolo di Michelangelo*. 1st ed. Firenze: Giunti, 2008, pp. 324-325 and ZIKOS, Dimitrios. Limina incerta. Filosofia e tecnica del "non finito" nell'opera di Vincenzo Danti. In DAVIS, Charles, PAOLOZZI STROZZI, Beatrice, edited by. *I grandi bronzi del Battistero. L'arte di Vincenzo Danti, discepolo di Michelangelo*. 1st ed. Firenze: Giunti, 2008, pp. 272-298.

[23] Cf. MANCINI, Francesco Federico. L'Accademia di Belle Arti di Perugia nel contesto storico-culturale della fine del Cinquecento e del primo Seicento. In BOCO, Fedora, PONTI, Antonio Carlo, edited by. *Proceeding of the conference L'Accademia riflette sulla sua storia. Perugia e le origini dell'Accademia del Disegno. Secoli XVI e XVII*. 1st ed. Perugia: Futura, 2011, pp. 62, 80 e 102. Cf. also BOCO, Fedora. Notte Giorno Crepuscolo Aurora. In BOCO, Fedora, edited by. *MUSA Museo dell'Accademia*. 1st ed. Perugia: EFFE, 2014, pp. 71-79.

[24] This research survey is scientifically coordinated by the professor Paolo Belardi of the Department of Civil and Environmental Engineering of the University of Perugia.

[25] Cf. TARCHI, Ugo. I calchi michelangioleschi nell'Accademia di Perugia e i marmi nella cappella medicea. In TARCHI, Ugo. *L'arte del Rinascimento nell'Umbria e nella Sabina*. 1st ed. [Milano]: Garzanti Editore, 1954, appendix (no pages numbers).

[26] The digital survey of the Michelangelo plaster works of the Fine Arts Academy of Perugia has been conducted by the Department of Civil and Environmental Engineering of the University of Perugia (science director: Paolo Belardi; survey team: Paolo Belardi, Luca Martini, Michele Martorelli). The technique used has been the digital photomodelling which makes it possible to obtain a textured cloud of points of the captured object starting from a discrete, but synergistic, series of reserved photographic images (*image-based modelling*). The approach adopted is the *structure for motion* which taking advantage of the photogrammetric basic principles automates the process for conjugate image points recognition on the photographic images set used, and starting from these it rewrites independently the gripping points position and the geometries of the photographed scene. The capturing data has been made through collection of a digital photographs set taken circling around the gypsum to survey. To acquire images a digital reflex camera (DSLR) Canon EOS 5D Mark II has been used, characterized by a 21,1 megapixel sensor CMOS, CCD 36 x 24 mm, with a 2784x1856 pixel images resolution. The photographic images has been made in diffused natural light conditions with a shutter click every 15 degree, so that each sampled point could be present in three images at least. The software that have been used are Python Photogrammetry Toolbox (in this survey campaign the "Feature Extractor" values has been set to "siftvlfeat" and "Photos Width" to "2400") for the cloud of points' construction starting from the photographic images, CloudCompare because of *cleaning* the cloud itself and MeshLab because of creating and to texturing the mesh surface. 145 photographic images have been handled for the *Dusk*, 135 for the *Dawn,* 129 for the *Day* and 128 for the *Night*, in 15, 30 and 50 cluster shots. Cf. MARTORELLI, Michele. *I gessi michelangioleschi dell'Accademia di Belle Arti di Perugia: dal rilievo alle ipotesi ricostruttive della sistemazione originaria*. Perugia: University of Perugia, 2013-2014 (academic year, Master's degree thesis in Civil Engineering, supervisor prof. Paolo Belardi); MENCONERO, Sofia. Dalle fotografie alla mesh texturizzata, sperimentazioni. *Free and Open Source Software per i Beni Culturali*. BIGLIARDI, Giulio, BEZZI, Alessandro, CAPPELLI, Sara. 1, 2013. Siena: no publisher, 2013-2014; MOULON, Pierre, BEZZI, Alessandro. Python Photogrammetry Toolbox. A free solution for Three-Dimensional Documentation. In CANTONE, Francesca, edited by. *Proceeding of the workshop Archeofoss. Open source, free software e open format nei processi di ricerca archeologica*. 1st ed. Pozzuoli: Naus editoria, 2012, pp 153-170; CIGNONI, Paolo, CALLIERI, Marco, CORSINI, Massimiliano, DELLEPIANE, Matteo, GANOVELLI, Fabio, RANZUGLIA, Guido. MeshLab: an Open-Source Mesh Processing Tool. In SCARANO, Vittorio, DE CHIARA, Rosario, ERRA, Ugo, edited by. *Proceeding of the international conference Sixth eurographics italian chapter conference*. 1st ed. Aire-la-Ville: Eurographics Association, 2008, pp.129-136; DE LUCA, Livio. *La fotomodellazione architettonica. Rilievo, modellazione, rappresentazione di edifici a partire da fotografie*. 1st ed. Palermo: Dario Flaccovio Editore, 2011. Cf. also BELARDI, Paolo, BIANCONI, Fabio, ROMANO, Carlo. Conoscere per progettare la conservazione dei beni culturali. Il rilievo con tecniche di laser scanning della statua lignea del San Rocco. In GALASSI, Cristina, edited by. *Sculture "da Vestire". Nero Alberti da Sansepolcro e la produzione di manichini lignei in una bottega del Cinquecento*. 1st ed. Perugia: Electa Editori Umbri Associati, 2005, pp. 141-145.

[27] Cf. CRISPOLTI, Cesare. Santo Angelo nel Monte di Porta Sole. In CRISPOLTI, Cesare. *Raccolta delle cose segnalate*. Perugia: no publisher, 1597, s. 29r (manuscript of Public Library "Augusta" of Perugia, 1256). In TEZA, Laura, edited by. *Raccolta delle cose segnalate di Cesare Crispolti. La più antica guida di Perugia (1597)*. 1st ed. Firenze: L.S. Olschki, 2001, pp. 113-115 and CECCHINI, Giovanni. *L'Accademia di Belle Arti di Perugia*. 1st ed. Firenze: Le Monnier, 1954, p. 100. The architectural survey of the church of Sant'Angelo della Pace in Perugia has been conducted in the framework of the educational and research activity of the ex Drawing and Architecture Interdisciplinary Section at the Department of Civil and Environmental Engineering of the University of Perugia coordinated by the professor Paolo Belardi, and in particular in the framework of the PhD course in "Civil Engineering" (XXIV cycle), activated in the academic year 2008-09 at the University of Perugia (coordinator: professor Claudio Tamagnini, tutor: professor Paolo Belardi; PhD students: Marco Armeni, Luca Martini). About the church of Sant'Angelo della Pace cf. BELARDI, Paolo. Disegnare "per profili et contorni". Il rilievo delle architetture umbre di Galeazzo Alessi.

Bollettino per i beni culturali dell'Umbria. CUTINI, Clara. 9, 2012. Viterbo: BetaGamma, 2007-2014 and MARTINI, Luca. *Alessi disegnato. Rilievo architettonico delle opere umbre di Galeazzo Alessi*. Perugia: University of Perugia, 2010-2011 (academic year, PhD thesis in Civil Engineering, coordinator prof. Claudio Tamagnini, tutor prof. Paolo Belardi), p. 41.

[28] The next stage of the research campaign will be clouds of points realization for Michelangelo's marbles by photomodelling, and in this sense the contacts with the responsables of the Museo dell Cappelle Medicee of the Polo Museale Fiorentino have already started, with the aim to define the necessary agreements to hit the mark. In order to be able to compare the digital clones in a scientific way, to prove Tarchi's consideration in metrical terms and to highlight critically the link between the Umbrian plaster works and the Tuscany marbles, in such a way as to provide additional inputs to Michelangelo's research thanks to the searching chances offered by the new technologies of the augmented reality.

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The lost imperial palace of Antioch on the Orontes (now Antakya, Turkey)

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Abstract
We know very little about Diocletian's palace completed by Constantine and Constantius II in Antioch. The excavations of the 1930s are the main source of modern studies on this subject, but they convey a general idea whereas the building plan is still unknown. Some scholars have pointed out a strict analogy with the Split Diocletian's palace modeled on a chester layout. Although ancient sources on this palace are rare, we have found some details pointing to an indirect literary tradition. From the 4th to the 13th century an idea of royal and sacred palace was developed based on examples of imperial architecture in the Tetrarchic era. The main sites were formerly Thessalonica, Nicomedia and Antioch, but this tradition started from the Latin *Passio sancti Thomae*, written in Antioch around 360 AD. Obviously, it is to the Antiochian palace, the main building of the most important city from which the eastern portion of the Empire was ruled, that the anonymous author of the *Passio* referred. Indirect literary sources, as *Passio sancti Thomae*, the gnostic *Vision of Dorotheus* and acts of other martyrs provide many important details increasing our knowledge on the lost Antiochian palace.

Keywords: Tetrarchic architecture. Imperial palaces in the 4th Century. Mediaeval tradition of ancient imperial architecture. Roman architecture under Constantine and Constantius II.

1.1 The imperial palace in the *Passio sancti Thomae*

Antioch on the Orontes was a very important town in the late Roman Empire, with many public buildings now scarcely known through archeological investigations. Among these buildings there was an important palace of late Antiquity, often used as main basis for imminent campaigns against the Persians. Ancient sources provide only an approximate picture of this imperial palace, built on the Island originated by the river Orontes in the northern quarter of the ancient town. Evagrius (*Historia Ecclesiastica*, II, 22) tells us only that the palatine complex built on the Island of the Orontes river was similar to the other imperial residences, in Sirmium, Thessalonica (Thessaloniki), Nicomedia. It's not a great help for us, because we still know very little about all these palaces.
The Antiochian imperial palace was started by Galerius and Diocletian around 300 AD, carried out by Constantine and completed by his son Constantius II before 361 AD. It was one of greatest residential complexes of the East, but despite its importance we know too little about it. The hippodrome, whose remains are still readable on the Island, was the most important Roman circus of the Empire, second only to his close model, the Circus Maximus in Rome. Ancient descriptions of the imperial palace don't consider it as an essential part of the residential complex, approximately sketched as a typical box-palace, all surrounded by towers and walls. It was conceived as a "new town" on the other side of the river, where the old town, called *pàlea* ("the ancient") was instead situated. The Latin apocryphal acts of saint Thomas (*Passio sancti Thomae*) [1] give us an important key to explain the basic layout of the lost imperial palace. In the Acts, written in Antioch in 360-361 AD, the Apostle draws a Palatine plan for the Indian king Gundaphorus, who asked for a "roman" architect, and looked for him in Roman Syria. The palace, as it is quoted, had to be built "romano opere". There are no doubts about the models chosen for this sumptuous building. Thomas's plan starts from the *prima porta publica*, situated *ad hortum solis ingressum*, that's to say that the main entrance was placed in the east, looking at the sunrise and fixing orientation and a gromatic grid of cardinal points for the whole area. This is typical of

the Tetrarchic palace planning, as still shown by the remains of Galerius's Palace in Thessaloniki. The Latin *Passio sancti Thomae* records only twelve halls or spaces, listed in sequence. We may suppose that the author's view was strongly symbolic. Mediaeval tradition, following the *Passio*, records some rooms and halls, but it's difficult to believe that this was a complete layout of the entire complex. Ancient texts don't provide a full description of the building. Since the Christian ideas of royalty and of sacred space are most relevant, only twelve rooms are mentioned. This view is based on the myth of the Sun, typical of the late Empire: twelve are indeed the *domus* of the yearly run of the sun. Thus the author emphasized the idea of power. This anonymous Christian source records some of these places, otherwise unknown. First of all, the *proaulum*, a Latin word derived from Greek sources, *pros* e *aulè*: a *proaulum* is a monumental hall, or courtyard, before the main hall (*aulè*), surrounded by columns as a peristyle, as still shown in Diocletian's palace at Split. But the *Passio* provides some other acknowledgements: the *aula* / *aulè* is a too generic term, and its layout was in reality much more articulated. There was a great greeting hall, the *salutatorium*, which was a space used for the ritual *salutatio* of the Emperor. Only after a careful selection, followed the *admissio* and distinguished visitors were admitted to a restricted area, the main hall of the imperial meetings, *consistoria*. The apocryphal Latin acts of saint Thomas apostle, written in the 4th century, bear the first literary testimony of an architectural use of this typical political term, derived from Latin *consistere*, or standing before the Emperor. This is the main public section of the palace, essential for displaying power. But there was also a more restricted area in the palace, where the Emperor met his guests: a great banqueting hall called by the anonymous author of the *Passio* as the fourth distinguished hall of the whole complex, the *trichorium*. Typical of an idea of royalty, the *trichorium* derives its name from three semicircular walls, where the *stibadia* or *klinai*, the typical seats for banqueting in ancient era, were placed. It was a *triclinium*, a distinguished dining room where business or social dinners were held. According to early Byzantine customs this was the most sacred area of the imperial residence, the hall where the protection of God on the holy person of the Emperor was the strongest. In the imperial Constantinopolitan palace, for instance, this room was called the golden *triclinium*, *krysotriklynios*. After this sumptuous banqueting hall begins the true residential section of the palace: the royal apartments, called *diaetae* and divided into summer and winter wings, *diaetae aestivales* and *diaetae hiemales* (in our source, and in its long mediaeval tradition, *diaetae* become *zetae*). Archeological excavations of 1932-1939 in the palace area of the Island of the Orontes have not identified this section of the palace. The *Passio sancti Thomae* becomes therefore a precious help for ideal reconstructions of the whole complex. The *Passio* highlights another unknown aspect of the imperial palace: the buildings which connected the box-palace to the great circus on his eastern side, otherwise unknown. There were a series of buildings standing between the imperial apartments (*zetae*) and the public terrace on the Circus (*kathysma*), probably added by Constantine and then repeated in the Circus at Constantinople. Our Latin source cites a pavillon or *fumoir*, called after the Greek manner *epicaustorium*. And it also quotes other banqueting halls, called *triclinia accubitalia*, for imperial guests watching the chariot races in the Circus. The importance of political symbolism of races of *quadrigae* (the four horses-chariots, similar to the Sunrise mythical representation with a chariot) is typical of Constantine's kingdom, while Diocletian's Palace at Split has no circus. For the anonymous author of the Latin *Passio* there were no doubts that the great therms, *thermae*, are –as the Circus nearby- an organic section of the whole imperial palace. The excavations of the Thirties of XX Century discovered the remains of five or six baths and thermal buildings on the Island area, but for the Christian anonymous writer of the 4th Century only one body or bathhouse is recognized as a main section of the imperial palace, as it can still be seen in the so-called *Kaiserthermen* (Emperor's Baths) of the imperial palace in Trier. The Great Baths on the Island were built outside the palace walls, close to the north-eastern area of the Circus. Private baths of royal apartments, or other baths of the apartments of high imperial officials also living in the palace as the *Comes Orientis*, were not considered worthy of any mention by our Christian author. Near the *Thermae* there were *palestae*, *gymnasia* and guard quarters (*contubernia*), but in the *Passio sancti Thomae* these are quoted only as *gymnasium*, a single building. Only another Christian author, Theodoret of Cyrrus (born around 393 AD), records the presence of a *gymnasium*, meant in a clearly military sense, in the imperial palace of Antioch. In his short description of the Antiochian *palatium*, Theodoret (*Hist. Eccl.*, IV, 26, 1-3) quotes the great southern two-storied porch (with a columned arcade at the top of the river wall, as it was built in the palace at Split facing the Adriatic sea) flanked by two high towers –as we may still see at Split Diocletian's Palace- and the *gymnasium*, conceived as a military building. Perhaps there was a *palaestra* near the guard lodging quarters of imperial special guards (*scholares*). This section of the palace is not meant for ceremonial or public representation, but characterized by a special water supply. There is an outstanding planning logic in the proximity of all these buildings: the *gymnasium* is close to the *thermae*, and both are close to the great kitchen, *coquina*. The link between the baths and the *gymnasium* is highlighted by the anonymous hagiographer: there were once other cases, as the complex built in Ephesus by the roman governor Publius Vedius Antoninus during the reign of Antoninus Pius (138-161 AD) or the similar one built in Sardi in the same century.

It may seem quite strange the inclusion of the kitchen in a strictly selected list of twelve "imperial halls", but the kitchen marks a great difference of scale between an ordinary rich palace and an imperial one, and also this aspect might have been considered by our anonymous author. Hagiographic literature often contains various references to public houses and *praetoria* of the persecution era, and sometimes to imperial palaces, or to the

palaces of Roman *praesides* and local governors (*proconsules*, *vicarii*). In some *Passiones* the martyrdom of many saints is set in the imperial kitchens, especially in the imperial palaces of Nicomedia, Antioch and *Sirmium.* In some cases, as saint Castulus, the martyr was a palatine official or employee, called a *zetarius palatii*, clearly linked to his service in a *zeta/diaeta* of the palace. Although the exact location of the imperial kitchen in Antioch is still unknown, our source suggests a place close to the main thermal building, in the north-eastern quarter of the Island. We agree that this positioning would be not so close to imperial apartments, in order to avoid smokes, bad smells and traffic and the vicinity of the royal chambers. There is another strong logical reason for this layout: the main kitchen body may have served different ranks and separated bodies of *triclinia* distributed in several ways in the whole complex, even close to the hippodrome. The function was evidently centralized, and the location of the main kitchen attentively weighed. Near the great kitchen, the *Passio sancti Thomae* records a *colymbus* nearby, that is to say –as our source explains- an *aquarum locus influentium*. It was probably a gardened scenographical *nymphaeum*, with a public display of the rich water supplies to baths and kitchens, as that one built under Constantius II in Ephesus. The original meaning of the Latin word *colymbus* or *colymbum* is witnessed by an inscription of the 4th Century, CIL, VI, n. 1179, as synonymous of a *balneum* (bath). As a basin or water channel the lemma is used in the *Vita Elagabali* by Elius Lampridius (XXIII, 7): «Marinae aquae colymbos exhibuit [..]». Perhaps the word originally derives from a water bird (Athenaeus, *Deipnosophistae*, IX, 18), and from the Latin version of the Greek term *kolymbos* quoted by Plutarch (*Sympos. Septem Sapient*.) and in the *Panegiricus sanctae Barbarae* by John of Damascus [2]. As an idraulic Greek-like term it is also quoted in *Peristephanon* by Prudentius (348-c. 413 AD), and also in the early Christian *Hymn to saint Peter and Paul* (*Hymn. XII*): «Nunc pretiosa ruit [aqua] per marmora, lubricatque clivum donec virenti fluctuet colymbo».
The last section of the short list of palatine halls mentioned in the *Passio sancti Thomae* is the hippodrome, *In duodecimo ypodromum, et per girum arcus deambulatorios*. We meet now the twelfth (and the last one) building of the whole palatine complex. Water mains to the imperial baths (*Kaiserthermen*) and to the fountains in the middle of the circus were found in the imperial palace in Trier (*Augusta Treverorum*), dating to Constantinian era. The *circus* of the great Syrian palace was modeled on the Roman *Circus Maximus*, but in Antioch it was always called –as recorded by ancient sources- in the Greek way *hyppodromos*, and never as *circus*. The anonymous author –probably Antiochian- of saint Thomas' acts is correct using the Greek word *hyppodromus*, often altered throughout the mediaeval tradition. It was a large building erected in the middle axis of the Island, flanking the eastern side of Diocletian's palace and standing outside the towered palace walls. The hagiographer of the *Passio sancti Thomae* has no doubts: the hippodrome was the ideal conclusion of the whole imperial palace. The building was once surrounded by *porticoes* and *deambulatorii*, (enveloping ambulatories, the *arcus deambulatorii* of the anonymous author) destroyed by earthquakes in the 6th Century (strong earthquakes wrecked havoc in Antioch in 526, 528 and 588 AD).This reference is very important, because witnesses that there was a welded joint linking the circus to the palace, and this continuity between the circus and the imperial residence was noticeable to the Antiochian writer of the Fourth Century.

1.2 The imperial palace in the *Vision of Dorotheus*

.
Another source allows us to know something else about imperial palaces of the late Fourth century, filling the gap of other sections of the Antiochian complex. The *Vision of Dorotheus* is a short poem witnessed by an Egyptian miscellaneous papyrus transcribed around 400 AD [3]. The author of the poem, Dorotheus, relates a vision he had while he was sitting in the imperial palace. In this vision (*oràsis*) he finds himself in God's heavenly palace, which is evidently closely modeled on the emperor's earthly one.
Although the *Vision of saint Dorotheus* is a gnostic text known thanks to a miscellaneous Egyptian papyrus dating to 400 AD, the Greek fragmentary poem of the *Vision* may be dated, basing on internal evidences, around 360-380 AD. Dorotheus was a young member of the palatine guard, giving services in an eastern imperial palace in the age of the Constantinian dynasty, especially in the reign of Constantius II (337-361 AD). The palace he evokes is presumably the one in Antioch, or less probably in Nicomedia, because Constantius often resided or wintered in Antioch in his late reign. The *Passio sancti Thomae* and the *Vision of Dorotheus* are quite contemporary and remind of the same imperial palace, but the anonymous author of the *Passio* seems to have a more precise knowledge of the entire complex. Maybe he was a high level official, not a simple guard as Dorotheus, as he seems to have access to more distinguished places and halls of the palace. Dorotheus was indeed a recruit (*tiro*) of the chivalry guard of the palace (Constantine was the first emperor who changed the former *praetoriani* into horseguards), and we know that the *tirones* had a complex training, in part carried out in the *paedagogium*, as we can still see in the remains of the *Domus Augustana* on the Palatine Hill in Rome. Dorotheus's duty was being the *ostiarius* (doorkeeper) in the external section of the palatine complex, near the great gate of the forecourt. He doesn't use the term *proaulum* cited in the *Passio*, but it might have been the exterior gate of the same place. The young guard was punished –for duty cause- in another hall of the palace called *signa*, a probable ancient mispelling for *sigma*, a Greek word to mean *porticus semirotunda* (the capital letter of the Greek alphabet *sigma* was written in two ways: C and Σ, and a *sigma* is meaning a C featured portico). It was a monumental columned hall (Dorotheus was scourged at a column of

this arcade or colonnade, not in the interior of a jail) as in the western wing of Galerius's Palace of Thessaloniki, and in the subsequent Constantinopolitan Antiochus's Palace on the Circus. This is only one of many references to a link between Antioch and Constantinople we should have to investigate more deeply. Even the dedication of Constantinople to *Anthousia*, a fate goddess assimilable to the Antiochian *Tyche*, maybe read as a clue of following Syrian models in late Constantine's era. Since there is no evidence of a *sigma* in the *Passio sancti Thomae*, the *Vision of Dorotheus* adds here more data to the ancient imperial palace. After having expiated his guilt, Dorotheus is called to a new duty, having a new post in another section of the palace, in the *dòma* and in the *aulè*, evidently contiguous and more central than the *prothuron* (l. 167). He is clearly promoted in rank and his duty is now closer to the sovereign. There are no doubts on the identification of this hall, the *aulè*, which was introduced by the *proaulum* mentioned in the *Passio sancti Thomae*. More difficult is it to understand the real meaning of the *dòma*, a word adapted from Latin to indicate the internal hall –perhaps covered by a dome- of the imperial residence, probably the reception hall where the emperor, as a private homeowner, would receive his guests, or the *triclinia* or –less probably- the *diaetae/zetae*. Now Dorotheus is close to God in heaven as to the emperor in the earthly palace. The hall of the throne, the *aula Dei*, is called in Homeric style *mègaron*, and is clearly distinguished from the *aulè* meant for enlarged meetings (l. 178). There are definitely no doubts that the *mègaron* had more restricted ceremonial functions than the *aulè*. The author of the *Vision* gives us only a partial survey of the palace internal distribution, scarcely coinciding with the glossary of the palatine halls quoted by the *Passio sancti Thomae*. The image of the *Passio* is evidently more complete, but doesn't include satellite bodies. There is no mention of the *paedagogium*, of the *sigma*, of the *contubernia* or military apartments (lodgings for the guards), of the *xystus*, from which a palatine specific official (*xystarcha*: Ammianus Marcellinus, *Res gestae*, XXI, 1, 4) derives. All those rooms, we suppose, were not considered to express the whole idea of royalty proposed by the saint architect Thomas to the Indian king Gundaphorus. The architectural terms quoted remind us that the official language of the palatine administration was Latin. The *Passio* is the most important source of this lost technical glossary, essential to understand the use and distribution of palatine spaces in the late Tetrarchic era. Unfortunately it's only an incomplete image, but some elements are added by the coeval *Vision of Dorotheus*, despite a quite different level of confidence in the subject matter and the different speech *medium*, in this case modeled on an archaistic imitation of Homer.

Evagrius the Scholar (*Historia Ecclesiastica*, I, 12, 55-57) describes the hard effects of the earthquake of 458 (and damages of another one, in 588 AD, are mentioned in VI, 8). According to his testimony, the first and second *aedificium* of the palatine complex collapsed: probably he quoted the *proaulium* (or *proaulum*) and the *salutatorium*, but the other bodies of the palace survived without bad damages, and the *thermae* still remained in function. This is a clear evidence that they were independent buildings, and that the whole palatine structure was much more open and articulated as shown by the Diocletian's palace at Split. Evagrius cites the bathhouse as a building close to the first two ones, that means he was thinking about the *thermae aestivales*, built near the branch of the Orontes river. He adds that the baths were not used before, and we may suppose that during the Fourth century their function was provided by the largest *thermae hiemales* situated near the hippodrome (the only baths quoted in the *Passio sancti Thomae* are close to the *gymnasium* and to the hippodrome). We have to consider that the Antiochian palace, under the rule of Constantius II, was mainly a winter residence: the remark of the Church historian Evagrius seems therefore believable. Even the hippodrome was damaged, but, as he says, not so heavily. Our source describes also collapses of porticoes situated "on the front of the palaces", maybe of the colonnade or arcade passageways reaching the imperial palace, which were cross-featured and had a *tetrapylon* (a monumental double-faced arch) in the middle, as even the rhetorician Libanius (314-393 AD) in his oration (*Oration XI*) for the town (*Antiokikòs*) [5] of 360 AD reports. This building was badly damaged, and also heavily damaged were the *deambulatorii* built around the hippodrome, where vaults collapsed in the entrance ways to the circus. So we may draw out a more precise picture of the environmental quarter situated outside the palace, to be considered in this case as the first precincted area of Galerius's and Diocletian's palace. The colonnades of the outside quarter and the peristyles of the palace were much more vulnerable to the earthquake shocks and suffered great damages indeed. This monumental access to the Island was focused on the great gate in the middle axis of the southern side of this box-palace, in a similar way reminiscent of the Thessaloniki palace, where the well-known Galerius's Arch was probably a model for the lost Antiochian *tetrapylon*. If we consider this portico-axis, in the north-southern orientation (the same as the hippodrome), as the exterior prosecution of the *cardo* of the chester-shaped old palace, we may detect a basic difference between this layout and that of the Split palace, a rotation of 180°. The *Porta Aurea* or main gate (Golden Gate) in this last case is situated in the northern side, but in the Antiochian palace on the Island it towered in the middle of the southern side, and the great columnated way outside crossed the ancient branch of the Orontes river with a triumphal bridge. We can underline in this case a greater emphasis given to the ceremonial exhibition of imperial power than in the Split palace, which was accordingly the residence of a retired sovereign, a *privatus paterfamilias* no more in full function as a ruling emperor, *auctor* or *pater tetrarchiae*, but not *augustus* anymore. This different *status* was clearly underlined in these palaces trough their architectural differences. Indirect sources allow us to rectify a usual academic misunderstanding [4]: the

Antiochian palace was not an accurate copy of the Diocletian's one at Split, because its plan was much wider, more articulated and richer than the well-known Adriatic residence of the old father of the first Tetrarchy.

Bibliographical References

[1] AMORE, Orsola, *De Palatio in Passione Thomae. Miti e leggende tra immanenza e trascendenza in occidente e in oriente*, Milano, Monduzzi Editoriale, 2011, pp. 137-153.

[2] LUPI, Antonmaria, *Dissertazioni, lettere e altre operette […]*, I, Faenza, nella stamperia di Gioseffantonio Archi, 1785, p. 87, diss. I, CLXXXVI.

[3] KESSELS, Antonius H. M.- VAN DER HORST, *The Vision of Dorotheus (Pap. Bodmer 29) edited with introduction, translation and notes*, *Vigiliae Christianae*, 41, 1987, pp. 313-359.

[4] DOWNEY, Glanville, *The Palace of Diocletian at Antioch*, *Les Annales de Syrie*, 3, 1953, p. 111 n. 2: the palace is read as the Split one, a *castrum* with a middle *tetrapylon*. That the Antiochian Palace had the same plan of the Diocletian's palace at Split was advanced before by WEILBACH, Frederick, *Zur Rekonstruktion des Diokletians-palastes*, *Strena Buliciana*, Zagreb-Split, w. n., 1924, pp. 119-125. Also SMITH, Earl Baldwin, *Architectural Symbolism of Imperial Rome and the Middle Ages*, Princeton NJ, Princeton University Press, 1956, pp. 141-142, considered Split a *castrum cum palatium* derived from the Antiochian Palace layout.

[5] DOWNEY, Glanville, *Libanius' Oration in Praise of Antioch (Oration XI), Proceedings of the American Philosophical Society*, 103, Philadelphia, APS, 1959, 5, pp. 652-686; NORMAN, Andrew F., *Antioch as Center of Hellenic Culture as observed by Libanius*, Liverpool, Liverpool University Press, 2000, pp. 7-65.

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New technologies for knowledge and the physical space of the museum

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Abstract
Within the complex relationship between technological innovation and cultural heritage, the aim of the paper is to investigate how the multimodality, the sensory faculty and the aesthetic dimension, which are peculiar to the kind of knowledge possible through the experience of exhibitions and museums, are modified by the most current technologies.
The digital technologies expand the exhibition area temporally and physically, allowing the comparison between what is present and what is elsewhere or does not exist anymore. Moreover, they allow to anticipate the experience of the visit, preparing it, and to rebuild it, thanks to memory.
Particularly, they contribute to increase the availability of the museum, or the exhibition, to follow the different interests and cultural backgrounds of the public who comes in contact with these material and immaterial goods, which these institutions aim to preserve and transmit.
Since their entry, the communication technologies have changed the sensitivity and the modes of perception, leading the aesthetic theories to considerate their impact on the production and the fruition of the cultural heritage.
The infinite space of the information compares itself with the concrete architecture of the museum space, where we recover the value of haptic experience in the processes of knowledge as well as in the conception of architectural space. The new technologies, combined with the traditional instruments of the architecture, strengthen and enrich the sense of experience which is possible inside the museum, thanks to the active role of the user.

Keywords: Museums, Experience, Exhibit, ICT, Aesthetic

1. Peculiarity of the museum space
The museum space meets both the need of preserving and passing on material (documents and artworks) and non-material (cultural values and knowledge) heritage, but also the need of promoting the transmission of those values through its exhibition spaces and means. All this occurs in a quite particular way that cannot be compared to precisely other communication media. The main museum communication strategies and means are, well beyond the simple exhibition of documents, those typical of architecture: space, size, distance, light, and colour, all combined with means taken from other fields, such as sound and graphics, that nowadays are increasingly made available by the most innovative technologies. The space set up embraces the visitor and the objects exhibited, thus influencing their mutual relationship and contributing with its non neutral feature to the selection of the values these objects contain and their efficient transmission. The path has a key function. It is the physical translation of the logical structure of an exposition, and, even in the most traditional exhibition settings, it is freely used and lived by the visitor who, establishing the manner and timing of the visit and moving in this space, builds his/her own schedule. The physical presence of the visitor inside the space set up, that is an architectural space designed to make this experience of knowledge real, takes an especially connotative meaning, becoming itself a main reference element for designing this space. E. N. Rogers has effectively stated that "an exposition should not be a tattered book

along the walls and the showcases of several rooms" [1], referring to the mainly spatial and architectural feature of its equipments and means, to the importance of the physical presence of both visitors and objects and to the high influence of the aesthetic and sensory dimension in this particular communication experience that takes place in the exhibition space.
Because of all these aspects, the latter takes on the characteristics of immediacy, synthesis, and participation, gratifying the senses, and involving emotions. All these transform the setup area in a place of communication that is closely connected to the needs of contemporary society, so as to become a privileged place of care and experimentation through which it is possible to engage a wide and different audience [2].

2.The impact of new technologies on the museum space

Thanks to the mainly multimodal nature of museum communication, more interesting scenarios can surely be opened in connection with the technological innovation that provides more and more advanced tools to improve its efficacy and the way in which it is designed and enjoyed. There are two different field where technology can be found in the museum setting: within the instrumentation and in the process of becoming itself the aim of communication. In both cases, modern technologies have contributed to the creation of new forms of expression and sensitivity. These, precisely in the museum space where sensory perception and the aesthetic dimension have a leading role, produce very interesting scenarios, thus confirming a main feature of the contemporary condition in our culture that can be defined as based on technology but with a strong aesthetic tendency. The technology itself fascinates and draws the attention of visitors on the content transmitted by the media it provides. For example, you can easily notice how the audience, that quickly passes by an information panel without reading it especially if this contains lots of information, stops and pauses in front of a touch screen. The use of advanced technologies in the setting is fundamental when the playful dimension is being included in the knowledge acquisition processes. This process allows us to define museums and exhibitions like places where the best edutainment is performed; thanks to this fusion cultural places are more and more like the place of choice where to spend your free time.
Digital technologies cause a temporal and physical expansion of the museum space. The online access to content and, virtually, to the museum spaces expands potential access to its cultural values, draws the attention of new visitors, enables those who are motivated by well-defined interests to plan their path visit and to acquire all the means useful to make the visit more worthwhile. For example, during the recent renovations just completed at the Rijksmuseum in Amsterdam, the physical structure of the museum and its virtual platform have also been affected; this operation produced an expansion of the physical space of the museum and its means of exposition.



Fig. 1: Image from Street Museum, an App created by Museum of London.



Fig. 2: FImage from Street Museum App.

During the visit, ICTs (Information Communication Technologies) help accessing a wider content that can be referred to the artworks themselves. For example, special applications connected to RFID and GPS recognize the position of the visitor along the visit path and provide him/her with additional information on the smart phone or tablet provided at the beginning of the museum tour, that in turn guides the visitors in understanding the documents and artworks they are looking at. Thanks to these systems, access to multimedia content becomes even more simple and immediate if compared to the already known and widespread stations located along the path, since these systems help people, who are less familiar with these technologies (i.e. children and the elderly) to its proper use. Compared to the traditional museum audio guides, these systems also allow an increased interactivity and customization of the degrees of detail. Finally, such systems even allow to provide you with a retrospective reconstruction of the visit tour performed and of its memory. This can be very useful just for those who visit museums for study and research purposes, rather than simply for pleasure.

An example of physical space implemented as a virtual space can be found in the London Science Museum's Dana Centre. Since 2003 it has been a location for study and discussion, intended for an adult, although unskilled audience, witness to the growing role of museums as places where culture is produced and not only keepers of established knowledge. The Dana Centre has been both a physical place, where seminars and conferences have been held, and a virtual forum where everyone, who was interested in subjects addressed by the foundation, could express opinions or ask questions.

Thanks to ICTs, the physical limits of the museum space can also be extended by comparing what is physically available in the museum with what is accessible elsewhere, in other museums, or in the places of origin of artworks, which generally have suffered displacement, or which no longer exist, opportunities which can be very useful in the case of archaeological expositions.

It also means being able to turn the most heterogeneous spaces into a museum, creating a museum out of the street as can be seen by the application Street Museum, designed by the Museum of London, which allows you to access historical information relative to important places of the city, displaying particularly important transformations or events that have occurred there. An Italian experiment using similar

technologies is the Looking for Achille Castiglioni project by the Politecnico di Milano in collaboration with the Studio Museo Achille Castiglioni. It allows you to identify and recognize the places where interventions have been made by the artist and to connect them with the artworks inside the museum.
In order to sum up the changes introduced by the most advanced technologies in the museum set-up, we can say that, while the traditional system corresponded to a "one to all" scheme, the one offered by contemporary means corresponds to a "many to many" scheme.
The traditional space set up results in a defined structure, where the exhibition project carries out its role of selecting and interpreting the objects exposed, suggesting to the visitor the proper approach and reading. This approach, depending on the historical periods and the different underlying and planning cultural attitudes, is more or less contemplative or narrative, rather than engaging and participatory. Certainly the active role of the visitor in the physical and cultural exhibition space has always allowed to modulate the experience based on his/her personal feelings and interests.
Thanks to the use of technologies, the museum space is much more able to reflect the interests and the needs of visitors and somehow becomes more flexible and versatile, even though on the other hand there is the risk that the playful aspect and a certain cultural reductionism, often associated to spectacular and captivating methods of communication, become predominant.

3.Modes of perception and new sensibilities in the use of the museum space

The museum space, because of its architectural nature, was never just a visual space, but also an haptic one. The remarkable importance of the aesthetic dimension in the knowledge communication and transmission processes that take place in the museum space, regardless of the object exhibited, can be noticed through the complexity of the sensory perception levels and its peculiarity is given by the physical



Fig. 3: Van Gogh's bedroom, from "Touch Van Gogh: woat paintings can reveal", an app that allows to explore the wealth of information about Van Gogh's masterpieces.



Fig. 4: “Step into Van Gogh’s world”, new settings in Van Gogh Museum, Amsterdam, by Marcel Schmalgemejer, 2014.



Fig. 5: Van Gogh Museum, Amsterdam, new presentation of permanent collection, by Marcel Schmalgemejer, 2014.

presence of visitors and artworks or documents in a specifically designed space. Since the beginning, communication technologies have changed sensibility and modes of perception, causing the aesthetic theories to take into consideration their impact on production and on the use of cultural heritage. The connection between the evolution of media and the implications of the medium chosen on the communication content [3] has been widely discussed. The question which perhaps we should think about is how much ICTs and the use of virtuality may improve or rather make the use of a museum meaningless.
The aesthetic theories have different positions about the results produced by the communication and production technologies in the world of art These different considerations can be applied to the museum sphere, not only because it is a place along with others where artworks are enjoyed, but also because it is where the aesthetic dimension, the fascination, the communication through images, are also essential for the communication of apparently faraway content, such as museums or exhibitions in the field of technology, natural sciences or ethno-anthropology.
According to Paul Levy, the use of virtualization does not give less importance to the real, although it allows to get out of the "here" and "now", peculiar of the real itself [4]. In this way it goes against the present, not the real, and stimulates new speeds and the changing space-time dimensions. Just like the difference between text and hypertext (the first is a continuous narrative flow, offered to the reader in its entirety, while the second is a system made up of nodes and links that guide the reader from one link to another), the new media used for artistic purposes have their own efficacy and are the natural result of the process of "hominization", that is to say the evolutionary processes that have transformed the human species into what it is today. On the other hand, Ives Michaud believes that digital technologies and the use of virtualization have vaporized art into a sort of "aesthetic ether", where beauty like gas pervades the world without assuming the concrete form of a piece of artwork. [5] This view denies the traditional status of the artwork, that is close to worlds such as fashion or advertising because of its self-referentiality and ephemerality This contemporary art aims at producing unique and intense experiences: it is no coincidence that painting has almost disappeared, unlike photography, interactive works or performances.



Fig. 6: RPBW, MuSe, Trento, Italy, 2014, stuffed animals suspended in the central void.

In this scenario, the set-up itself, that builds areas planned for a knowledge experience where the aesthetic dimension plays a fundamental role, seems particularly appropriate for the needs of contemporary cultural experiences.
Far more sharp is the scenario suggested by Paul Virilio, who not only attributes to digital technologies the transition of art from a substantial to an accidental state, but also ascribes to them the passive state of the audience, indifferent to the condition of reality and physical proximity to the object that it is enjoying. [6]
According to Virilio, current communication techniques have got the human eye used to a sort of "tele-objectivity", typical of the videos format, which makes the *de visu* (direct) and *in situ* (local) perception less important, that has been at the base of the museum institution for centuries. The physical aspect of the artwork disappears in the continuous stream of images that, through the screen, involve the audience everywhere, reducing the impact of the real and sensitive contact with the artwork, which in turn has dematerialized. The optical and haptic space suffer a toposcopic catastrophe: the world seems to be locked into a screen and we experience it as a landscape seen from the window of a train, and we have the wrong perception of being still while images are moving around us. The dulling of senses related to this catastrophe leads to a never-ending search of the "sensational", able to replace the "sensitive", that could be seen as a reason for the increasing use of the museum architecture as a media, as redundant as the information overload that at times is transferred to visitors in an uncritical or trivialized manner thanks to multimedia. The same dulling of the senses could be seen as the reason for an exaggerated tendency towards spectacularization in the set-up of exhibitions and museums.



Fig. 7: RPBW, MuSe, Trento, Italy, 2014, view of the great central space.

The importance of protecting "the integrity and clarity of our senses - our sensory experience - from the endless attacks by multimedia in the age of cyberspace" [7] demands to highlight the characteristic features of the museum space where architecture helps building a place where one could enjoy the objects exhibited along with the values, the intentions of the exhibition designers and the feelings of the audience, that is not in front of, but inside the space set up, where it moves around freely, taking part in the construction of this experience with its body and soul. The museum is a physical and social space where the direct (*de visu*) perception goes on for a long time and where objects are simultaneously exhibited to the view of the audience, but that is enjoyed with individual feelings.

The way senses and body are involved in the aesthetic enjoyment is the subject of interesting research in neuroscience [8], which allows you to trace the bases of an experimental aesthetics, considered as a multimodal perception of the world through the body. Based on the theory of mirror neurons, Vittorio Gallese restates that the brain performs its function just because it is connected to a body located in a particular physical place and interacts with objects and people. This approach is particularly interesting when applied to architecture, especially an architectural space, such as the museum space, aimed at an aesthetic and knowledge experience. It is very interesting to connect these comments with the definition of *shintai* provided by Tadao Ando, taken from the traditional Japanese culture as an inseparable synthesis of body and mind that experiences the architectural space [9]. Gallese shows that, although the enjoyment of artworks is always mediated by knowledge, you can not minimize the role played in the aesthetic experience by body involvement, which builds a synaesthetic and multimodal relationship with objects, whose perception is called "haptic vision". This interpretation, that agrees with the phenomenological thought about the role of the tactile dimension in the use of architecture, is interesting to understand the implications of the impact due to digital communication tools. These mean that we are constantly surrounded by a representation of reality, which seems today the main tool for evaluating reality: things exist because they are represented by mass media and the shared truth is the weighted average of truth spread by these. All this weakens our sense of reality: we live in an unstable existential condition which blurs that line between reality and fiction.

As illustrated by Gallese, through new digital technologies the main vehicle in experiencing reality is no longer spoken or written language, but rather a new physical visualization. The *Erfarhung* (the experience of the world through the reflection on words) gives way to *Erlebnis* (embodied experience). Therefore, the body is central in the relationship that can be established with reality through the digital interactive visual representation: the technological impact provides our experience with a bodily dimension. Through mimetic bodily action we adapt to technology. The body becomes a producer of new realities: interacting with digital tools, therefore producing new cultural *performances*.

This phenomenon has far-off roots: Walter Benjamin already stated that, with respect to the still image, movies, introducing motion in the representation of reality, have transformed vision, making it haptic and multimodal.

The new media, therefore, lead us to perceive in a different way the knowledge of reality, made possible through them. This form of "embodied cognition" cannot be explained only through neural mechanisms, but through the connection of brain, body, and cultural environment. Science essentially confirms that the processing of tactile sensitivity is not dependent on nor separated from other senses, such as sight and hearing. It seems to me the contribution of these considerations to the museum communication is very valuable, where inherently converging multimodality, sensorial perception, movement, proprioception, aspects that can be enhanced by the sensitive and cultured use of the means made available by technology.

It is important to note that the sensory aspect and the importance of physical interaction in understanding contents are increasingly the focus of attention for those who are involved in the project management and in the critical and anthropological reading of the museum [10].

The endless space of information is compared with the architectural concreteness of the museum space, where the haptic experience value is retrieved in the knowledge processes as well as in the architectural space design. The new technologies, along with the traditional instruments of museum architecture, increase and enhance the sense of experience that it is made possible on its internal part, thanks to the active role of the audience and the characteristic of the museum space. This, even in its various forms, is an architectural space inhabited by objects and people, aimed at communication, with respect to which the statement by Steven Holl is absolutely valid: “only the body moving through space can connect space, body, eyes and mind” [11].

Thanks to new technologies, the museum not only maintains its unique role and the characteristics of the kind of experience that it is possible to live in, but it also continues its evolution process: from a casket intended for the protection and preservation of artworks and documents to a place of production and exchange of the values related to them [12]. The new languages introduced by the digital visual culture respond to the need of multilayering the communication model proper to museums or exhibitions. The use of modern technologies contributes to the transformation process of the museum typological identity, induced by the change of its social function and the complexity of the mechanisms of cultural enjoyment. A possible contribution of ICTs to the contemporary museum can be summarized in the contribution of making it a sensitive organism, able to flexibly interact with visitors at different levels, going beyond its traditional physical limits and involving the audience not only in enjoying, but also in taking part in the exhibition designers action, allowing it to modulate the content according to its needs. These potentialities assume a peculiar value within the physical space of the museum, inhabited at the same time by visitors and things exhibited, both characterized by their physicality.

Bibliographical References

[1] *Casabella Continuità.* ROGERS, Ernesto Nathan. N.261, 1961. Milano: Editoriale Domus, 1954-1965.

[2] CAFIERO, Gioconda. *Il progetto di allestimento. Esposizione e comunicazione.* 1ª ed. Naples: B. di M., 199. 140 p. ISBN 9788890797408.

[3] McLUHAN, Marshall, FIORE, Quentin. *Il medium è messaggio*. (Translated by PETRILLO, R.), 1ª ed. Milano: Feltrinelli. 160 p. Universale Economica v. 557. Translation of: The medium is the message. ISBN 880780557X.

[4] LEVY, Paul. *Il virtuale.* (Translated by COLÒ, M., DI SOPRA, M.), 1ª ed. Milano: Raffaello Cortina Editore, 1997. 148 p. Scienza e idee v.28. Translation of: Qu'est-ce que le virtuel?. ISBN 8870784460.

[5] MICHAUD, Yves. *L'arte allo stato gassoso.* (Translated by SCHETTINO, Lucia), 1ª ed. Roma: Idea, 2007. 148 p. Translation of L'art à l'état gazeux. Essai sur le triomphe de l'estétique. ISBN 9788890302206.

[6] VIRILIO, Paul. *L'arte dell'accecamento*. (Translated by PREZZO, Rosella), 1ª ed. Milano: Raffaello Cortina Editore, 2007. 96 p. Translation of L'Art à perte de vue. ISBN 9788860300997.

[7] ILLICH, Ivan. La perdita dei sensi. (Translated by PUCCI, Giannozzo), 1ª ed. Firenze: Libreria Editrice Fiorentina, 2009. 352 p. Translation of La perte des senses. ISBN 9788895421407.

[8] *Micromega.* GALLESE, Vittorio. 2014/2. Milano: Gruppo Editoriale L'Espresso, 1986. 46-67 p.

[9] ANDO, Tadao. Shintai and space. In MARBLE, Scott. et al. *Architecture and body*. New York: Rizzoli International, 1989. ISBN 9780847809479.

[10] LEVENT, NINA, PASCUAL LEONE, Alvar. *The Multisensory Museum: CrossDisciplinary Perspectives on Touch, Sound, Smell, Memory, and Space.* Lanham (MD): Rowman & Littlefield Publishers, 2014. 410 p. ISBN 9780759123540.

[11] HOLL, Steven, *Parallax. Architettura e percezione.* (Translated by BERGAMIN, Antonella), 1ª ed. Milano: Postmedia Srl, 2004. 160 p. Translation of Parallax. ISBN 9788874900139.

[12] CAFIERO, Gioconda. *Museografia. Riflessioni sulla metodologia e l'identità disciplinare*. Napoli: Edizioni Scientifiche Italiane, 2012. 144 p. ISBN 9788849522907.

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A pyramidal kitchen vault in a Gothic-Renaissance palace. Oliva, Valencia, Spain

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Abstract
The splendid Gothic-Renaissance palace is almost completely in ruin, except for a few remains. However, thanks to the Hispanic Society of America important graphic and photographic documentation has been preserved, making it possible to evoke its architecture. This was drawn up by Danish architect Egil Fischer and collaborators in the form of survey drawings from the 1918 deconstruction process. The plan of the main floor shows the situation of the kitchen. Moreover, one of Fischer's notebooks includes a complete sketch of this room with the plan, elevation, section, and dimensions. It shows the interesting quadrangular vault, squinches and wide pyramidal chimney, as they were in the early 20th century. This space has disappeared completely following the complete destruction of the main floor. Research based on the drawings makes it possible to virtually reconstruct the vault in its original condition, dating back to the late Gothic period. To do so, an architectural methodology is developed to further examine constructive aspects. This methodology is applied to the few similar cases which still remain as an original type which is both undervalued and under-researched.

Keywords: Pyramid vault, lantern, chimney, octagon, squinch, virtual reconstruction, architectural heritage

1. Introduction

The Oliva Palace of The Centelles is a paradigm of the Valencian architecture of its period, combining a flamboyant late Gothic style which incorporates *Mudejar* elements, with added Italian Renaissance decoration. It has dominated the Mediterranean coastal town of Oliva for over five centuries [1].
Although the exact date of construction is not known, the early stages of the palace can be dated to the 14th and 15th centuries, and it was possibly built on an earlier fortress. Major extensions and improvements were added in the 16th century [2], immediately followed by the start of a period of decline which culminated in its devastation in the 19th century. In the 1910s, the Danish architect Egil Fischer became interested in the building. Practicing *elginism* [3], he initiated a process of dismantling the palace for transport and reassembly in Copenhagen, although for various reasons this reconstruction was never completed. The data collection phase of this process resulted in sketches, drawings and photographs that are currently of great interest for our understanding of the palace [4].

Unfortunately the splendid palace completely lost its main floor due to the continued process of destruction. Nowadays only some parts of the lower floors remain, embedded in new buildings.

The palace is of great interest and complexity, and there are different kinds of studies to be carried out on its architecture. The aim of this article is the virtual reconstruction of one of its demolished rooms, the kitchen, covered by an unusual octagonal *pyramidal* chimney.

2. Data analysis

2.1 Graphic documentation

As was mentioned earlier, the team led by Egil Fisher began measuring, drawing and photographing the palace in 1918. One of his collaborators was the important modernist architect Vilhem Lauritzen, then a student of architecture. Aiming to dismantle and transport parts of the palace, they drew up important documentation recovered by the Hispanic Society of America a few decades ago, and donated to the Council of Oliva in 2010 [5].

The graphic documentation consists of two notebooks (17x 11 cm), 74 and 69 pages long, which include notes and hand drawn sketches of details and plans. These are accompanied by 110 large architects' drawings (68 x 47 cm) which accurately record structural and decorative elements.

The survey focused on the main floor, which is well defined in the northern part of the palace with a well drawn plan showing the arrangement of spaces. A structural plan was also produced for the main floor, with a roof plan indicating the wooden beams, although not for the entire palace. Unfortunately there is no documentation on the lower floors, only partial detail.

The documentation is quite extensive and the analysis is complex. This article focuses solely on the documentation relating to the kitchen vault. No photographs of this room were found among those preserved and the exterior of the room and its roof are not clearly visible in photographs of the general exterior.

The situation of the singular kitchen- chimney can be deduced from the sketches, and was recorded by Fischer in Notebook I, where the different rooms of the main floor appear numbered. Moreover some plans with scale drawings confirm the location and its relationship to adjacent spaces (Fig. 1). The roof plan also shows the roof was not wooden, since beams are not drawn in this part [6].

However, the graphic document providing the most information to this research work is undoubtedly a sketch from Notebook II (Fig. 2), dedicated specifically to the room under study. This sketch defines a floor plan (horizontal section), a vertical section and the detail of a squinch. All these views include the measurements and some notes in Danish. Although they contain a lot of information, it is important to keep in mind that, as a freehand drawing on a small piece of paper, it may contain simplifications.

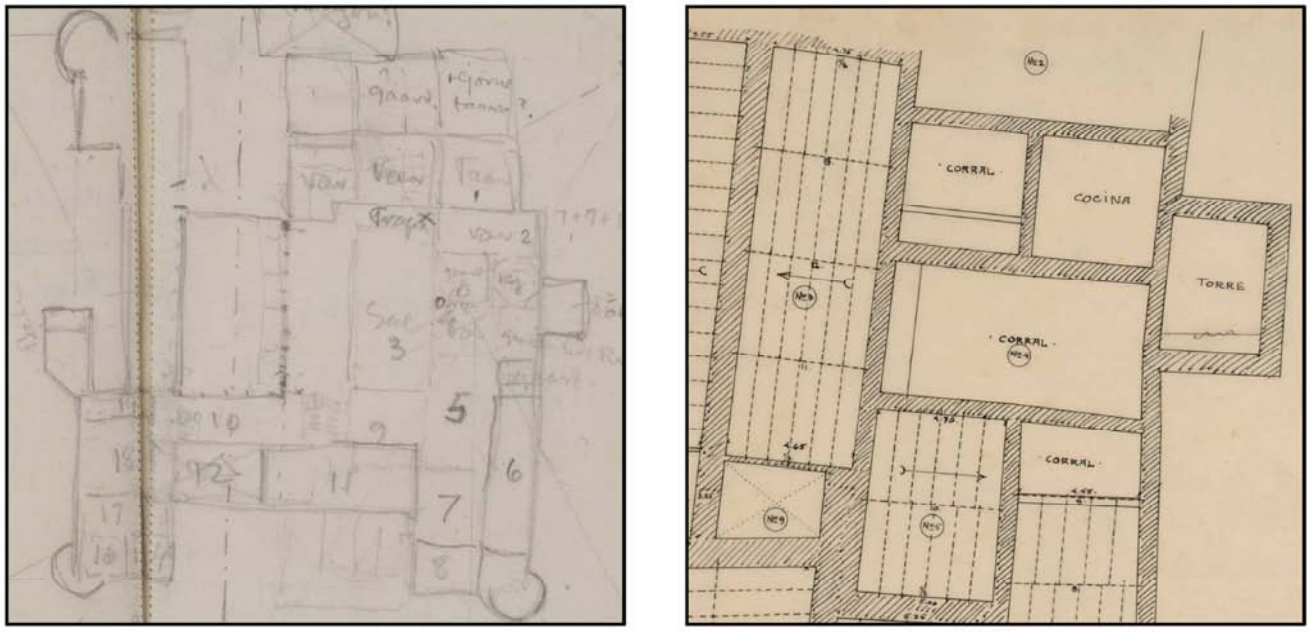

Fig. 1: Composition from the different plans in which the kitchen area appears.

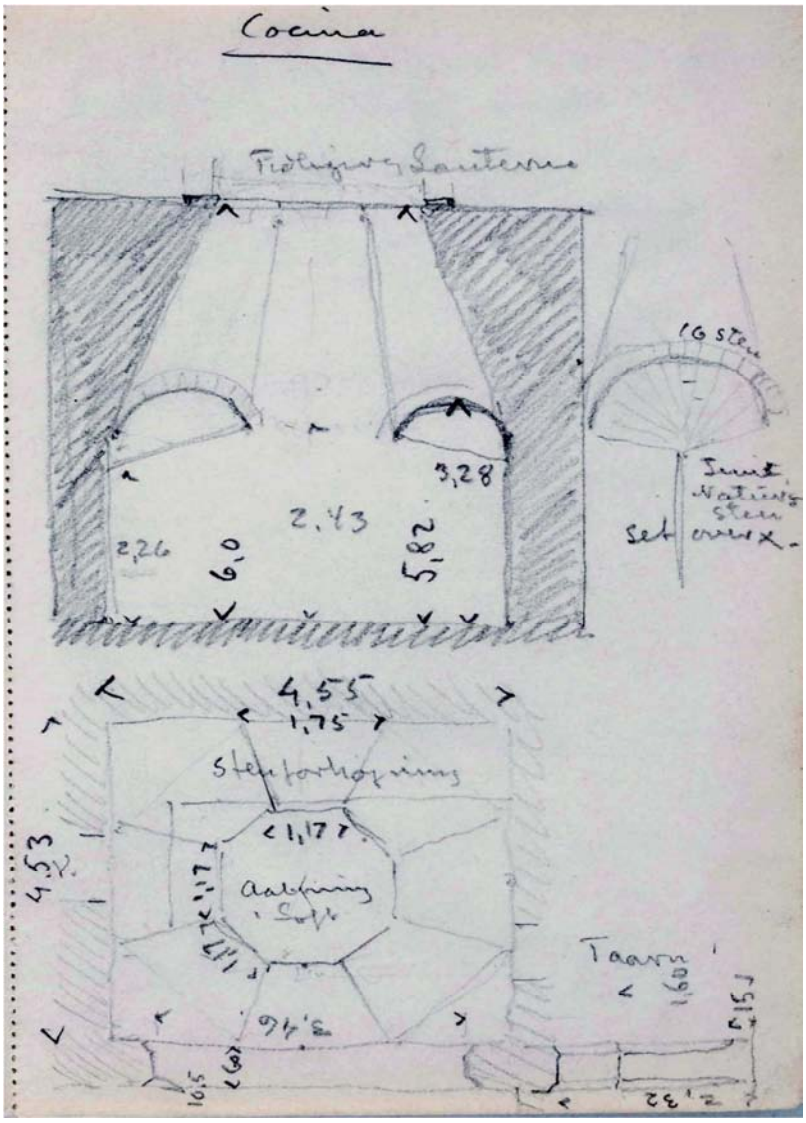

Fig. 2: Fischer's sketch in Notebook II.

2.2. *In situ* data

A block of houses has swallowed the destroyed palace, conserving some remains. In the house on Carrer Palau, 14 (the street name preserves the memory of the palace), the back of a courtyard leads to a square room with tall ceilings which corresponds to the lower level of the kitchen space.

The paving level of the disappeared kitchen is in line with the current level of the roofs of the houses, so no elements of the Gothic palace are conserved above this level. Therefore, although the walls preserved do not belong to the kitchen but to the room below, this is worth noting because it confirms the dimensions and the paving level of the main floor.

Moreover it is convenient to know about the materials and construction techniques to provide context. Several pointed arches built with large format brick (49, 17, 6 cm) are observed in the lower part of the walls. The rammed earth technique appears in the upper part, about 80cm thick, and using brick (29, 14, 3cm). At the top, traces of arches show what would have been the springing of a brick vault now in ruins (Fig. 3).

The correct interpretation of the current state is not obvious, and should be made taking into account different aspects such as the initial construction phases, the subsequent state of ruin of what would have been the kitchen room, and modern reconstructions.



Fig. 3: Remains of the palace in the current lower floor. Digital photography, coloured point cloud.

2.3. Typology

This research attempts to place the case of Oliva within a type, comparing it with other cases with common architectural and constructive features. We have observed that this is an almost extinct rare space, with very few and insufficient documentary references. For this reason it is worth highlighting that in the region of *El Maestrazgo* in the north of Castellón, similar constructions, known as "fumerals", are preserved [7]. They are located in Sanctuaries, major groups of buildings from the Gothic period with attached or superimposed Baroque or Classicist phases. Such rooms are usually found in buildings with arches and vaults built with voussoirs and keystones from the Gothic repertoire of stonemasonry.

We analyzed a sample of four representative cases of the type [8]. They are characterized by a square plan, formed by four segmental arches on which squinches are placed in the corners forming the base of an octagonal pyramidal-frustum structure (Fig. 4). These rooms are a service space for kitchen use. However, in some cases with wider dimensions, this tall central space acquires other connotations as a meeting place by the fire, or room to house pilgrims.

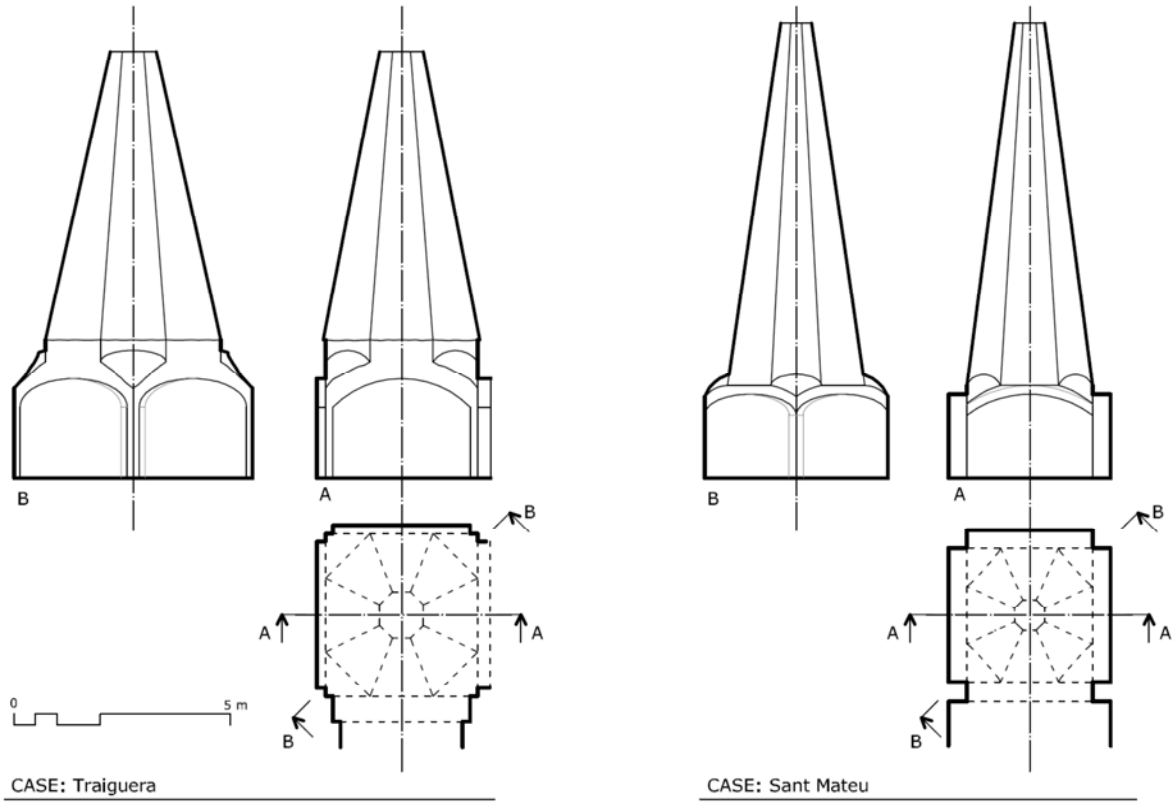

Fig. 4: The cases of Sant Mateu and Traiguera conserve the original construction.

3. Restitution of the state in the early 20th century.

Following a methodology that considers all the above data it is possible to carry out a graphic reconstruction of the lost space.

One issue to consider is the interpretation of texts or notes included in the sketch. They are handwritten, in small letters, and are sometimes not easy to read. First of all, a header appears in Castilian "cocina" (kitchen). The rest of texts are in Danish. At the top "Polygonal lantern" appears. In the detail of the squinch, "16 sten" (16 stone), and "naturlig sten" (natural stone) are indicated among other words. "Sten forhojning" (stone platform) is written on the floorplan, and "taarn" (tower) appears next to that. The large octagonal hollow in the center is listed as "Aabning Loft" (ceiling opening).

The plan can be interpreted quite clearly from the sketch (Fig. 2). The length and width of the room define an almost perfect square. Then lines are drawn from the square to the central octagonal opening. At the bottom of the sketch there is a span of access to the room, with the height indicated in vertical section. This is assumed to be a segmental arch with detailed chamfered corners.

It is essential to define the vertical measurements of the vertical section, but the interpretation is problematic, particularly as regards the meeting of the pyramidal frustum with squinches and walls. The detail of the stone squinch appears to be conical. It is interesting to consider this within the context of Spanish Renaissance stonework [9].

The interpretation of the drawing presents problems. We have established two different hypotheses to define the geometry of the squinches in transforming the square to an octagon (Fig. 5).

Hypothesis A: The geometric model is that of a conical squinch with all the stones cut in the same shape. The main arch is semicircular and joins the wall horizontally. Thus the transition is made by an octagonal vertical band with squinch arches on which sloping pyramid walls begin. This solution has been observed in some of the cases in *El Maestrazgo*, but it does not correspond completely to Fischer's sketch, and the slope obtained for the pyramid vault is very pronounced.

Hypothesis B: An accurate analysis of the sketch shows that the wall joint with the squinch is not horizontal so that the apex in the corner sits lower. Also, the arch is not vertical because it is contained within the truncated pyramid surfaces. Although this geometrical solution is more complex it has also been observed in Sant Mateu.

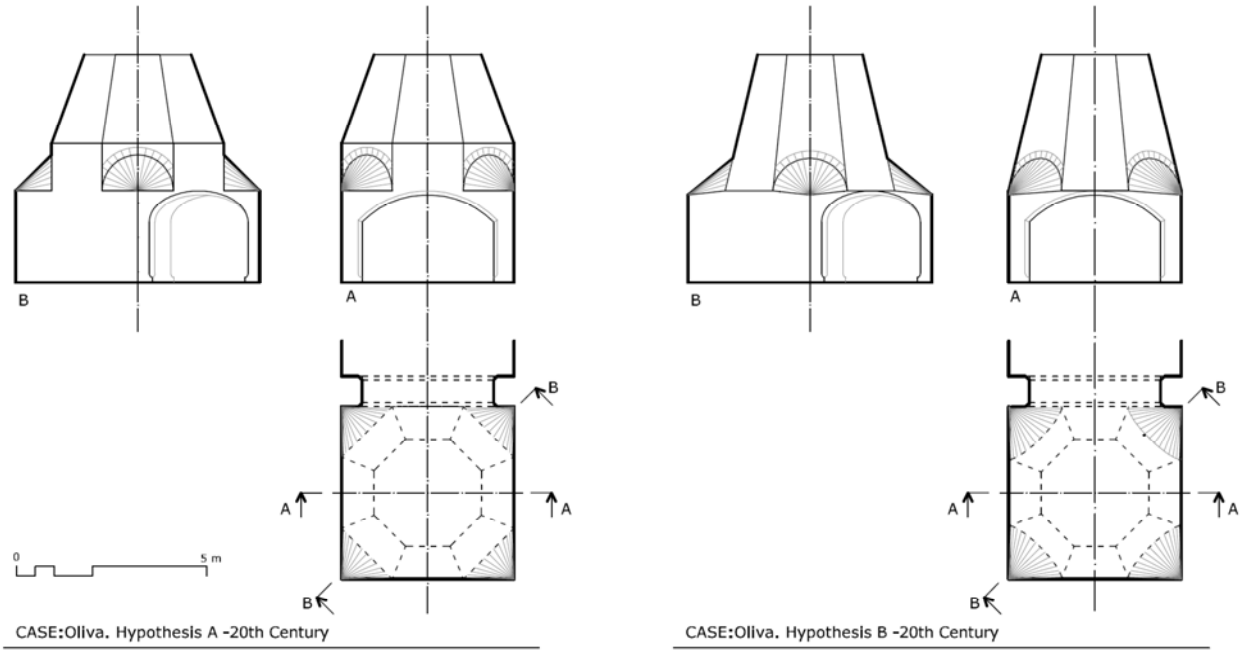

Fig. 5: Hypothetical reconstruction of the state in the early 20th century.

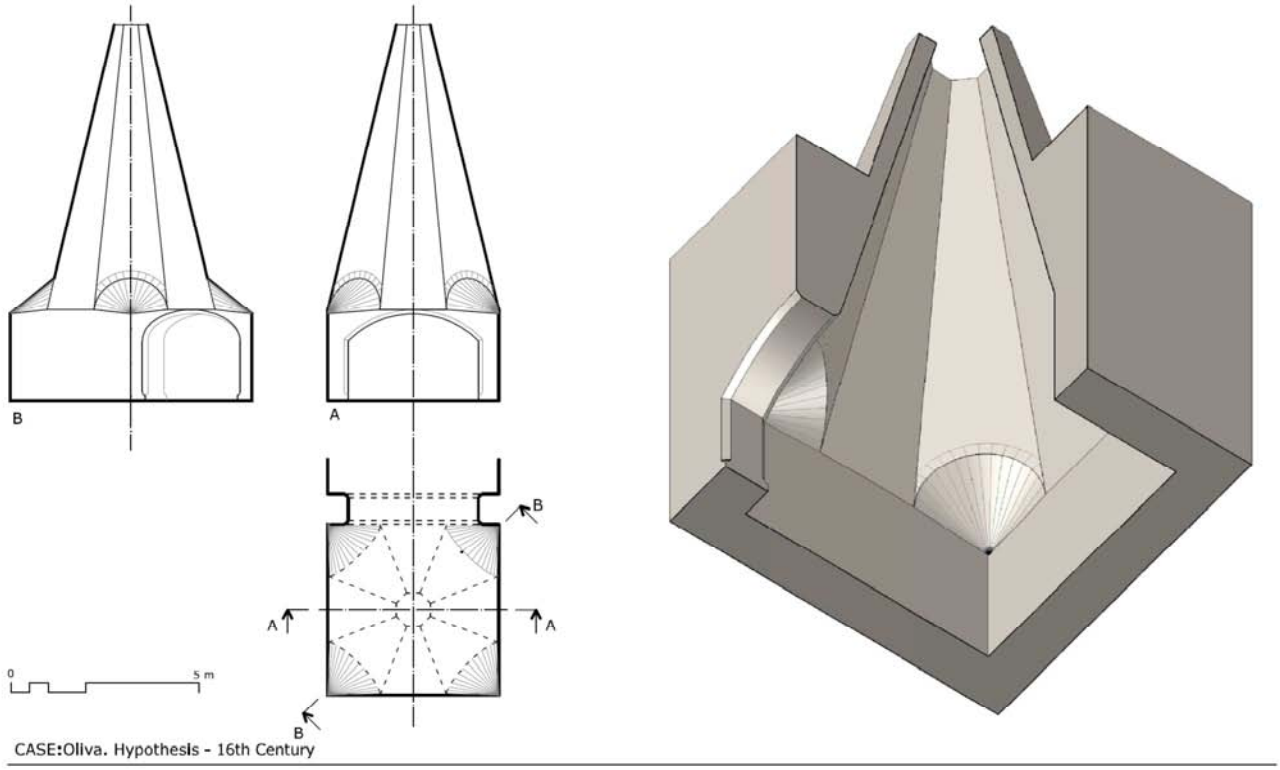

Fig. 6: Restitution to original state.

4. The original state, 16th century

The drawing represents the state in which Fischer found the kitchen in the early 20th century, when it was in partial ruin and had lost its original crown. The sketch only shows the part that was conserved. The upper hollow that he drew is an octagon set within 3m sides in a square. This large aperture raises questions as to the form of crowning and how it could protect from rain without blocking the flue.

To hypothesize the status in the 16th century, we have relied on the cases described in section 2.3. These all have high chimneys, over 10m high. From these data it can be assumed that at the time of the sketch a very high upper portion, which would have been thinner and built of brick, would have already been lost (Fig. 6).

5. Conclusions

For the complex history of the palace, which has nearly disappeared, the existence of graphic documentation is of great importance when examining its lost architecture.

The lantern-chimney undoubtedly caught Fischer’s attention for its spatial, constructive and structural interest. The sketch defines the geometry and general dimensions and contains the main information, despite being small and in freehand. This demonstrates the author's commendable precision, capacity for analysis, and graphic ability.

At a guess, the stonecutting technology shaping the access arch and squinches suggests a work in line with the most cultivated architecture of the palace, probably built in the period of splendor of the 1500s.

The geometry of the vaulting system of this wide chimney may bear some relation to cloister (or domical) vaults, in which any horizontal cross section is made up of straight lines. The drawing does not detail materials and construction techniques except for the detail of the squinch. These can only be postulated taking the context of the palace into account.

The case presented only studies one of the rooms, but the methodology proposed can be applied to the rest of the Palace. For graphic reconstructions, data should be analyzed in an orderly fashion, and taking into account cases of the same architectural type.

Different hypotheses have been proposed and analyzed, leaving an open answer. Virtual reconstructions are just one possible form of research, but can never replace the centuries-old physical architecture or reveal all its mysteries.

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To Vicent Burguera for management, classification and analysis of the documents preserved in the Archaeological Museum of Oliva, and especially for his expert advice in onsite visits and data collection.

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Quotations and Bibliographical References

[1] MULLER, Priscilla E. “The Oliva Palace of the Centelles” *Architectura* 18: Arkitekturhistorisk årsskrift 18, 1996.

[2] BÉRCHEZ GÓMEZ, Joaquín. *Arquitectura Renacentista Valenciana*. Valencia: Bancaixa, 1994.

[3] Elginism: The taking of cultural treasures, often from one country to another. The term is derived from the Earl of Elgin (1766–1841) for removing sculptures from the Parthenon and other ancient buildings in Athens and taking them to London.

[4] ESTEVE I BLAI, Antoni. Et Al. *El palau dels Centelles d'Oliva.* Oliva: Associació Cultural Centelles i Riu-Sech,1997.

[5] MULLER, Priscilla E.; GAVARA PRIOR, Joan J. *El Palacio condal de Oliva. Catálogo de planos de Egil Fischer y Vilhem Lauritzen*. Oliva: Ajuntament d'Oliva. 2013.

[6] There is also a conserved inventory of assets of 1550 describing a series of rooms.

[7] DUALDE VIÑETA, Vicente. *La estructura del territorio en la Edad Media: La Batllia de Cervera. Criterios de intervención*. PhD Thesis. Universidad Politécnica de Valencia, 2014.

[8] One case in the Sanctuary of *Mare de Déu dels Angels*. Sant Mateu, Castellón, Spain. One case in the Sanctuary of *Mare de Déu de la Misericòrdia*. Vinaròs, Castellón, Spain. Two cases in the Royal Sanctuary of *Verge de la Font de la Salut.* Traiguera*,* Castellón, Spain. The existence of the type in other geographies is also found in the case of the kitchen of Pamplona Cathedral.

[9] PALACIOS, José Carlos. *Trazas y cortes de cantería en el renacimiento español*. Madrid: Munilla-Lería, 2003.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Aversa, Capri 11-12-13 June 2015

LANDY*. LANdscape DYnamics. Survey, representation, monitoring and communication of the dynamics of the landscape and risks related to them**.

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Abstract
Representation is a fundamental tool to transfer knowledge. Through the representation and visual communication it is possible to encourage the awareness of public opinion on environmental and urban dynamics and risks related to them.
This article will present the research project "LanDy. Landscape Dynamics" finalized to the survey and to the representation of urban and environmental dynamics, whose evolutions and interactions can be the basis of risks to populations.

Keywords: representation, landscape, risks.

La Sardegna cresce con l'Europa
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1. Risk and dynamics of the landscape

The issues related to destructive phenomena that threaten the safety of property and individuals have come back at the centre of debate in the discipline following the increase of catastrophic episodes occurred in recent years in our country. The geological and geomorphological conformation of a territory pursues, no doubt, an important role in determining its level of vulnerability, as with other environmental features determines the higher or lower natural predisposition in terms of risk. However, human activity and the continuous modifications made by it on the space are no less relevant. The reasons of the increase of destructive phenomena may in fact be increasingly associated to the adopted models of territorial development. Hazardous locations, unsuitable settlement forms, organizational dysfunction, favor the vulnerability of settlements instead of reducing them. In this sense, the question of risk and that of the protection of the landscape are closely related. The contribution synthesizes the most important elements of this relationship in order to direct the choices of planning especially in situations of border between urban and rural areas.

The theme of the maintenance of the territory and risk prevention is connected indissolubly with the history of the socio-economic transformation and environmental characteristics that have crossed it, intercepting phenomena such as the abandonment of the countryside, industrialization and urbanization. These facts have generated not only changes in the structure of land use, but also the overall characteristics of the Italian landscape and the relationship between town and country. In this context the interventions for the defense of the soil which hydraulic-forest interventions, the water regulation, the works in defense of the coasts, constitute productive investment even if in the long term. In fact, it shows that the cost to realize the preventive works can be much lower to the amount of the economic damage and the investment for the works of arrangement. However, it should be noted as in addition to the problem of prevention through a conscious planning of the territory there is a pressing problem of management of the existing situations of danger. The analyzes relating to the level of danger and the complex indexes of risk assessment are undoubtedly very useful tools in guiding the choices on future use destinations of a territory as well as the planning of interventions and resource allocation. However, they are not very useful in implementing strategies to mitigate risk in existing settlements (Besio 2001).

Although by now the need to integrate natural hazard mitigation strategies especially in the policies for achieving sustainability goals is officially recognized as a priority in government processes of urban and territorial transformations (Mileti, 1999; ISDR, 2005), appears still evident the difficulty faced to concretize these principles in planning tools (Galderisi, Ceudech 2008).

Transfer in terms of planning practices current knowledge built on natural hazards (Galderisi, Menoni, 2007) cannot be limited in the simple delimitation of the existing situations.

The implementation of systems of representation and monitoring networks efficient and coordinated, the predisposition of protective actions aimed at prevention, are an essential precondition to a strategic plan of action compared to situations of risk already overt based on the definition of mitigation actions that can be handled through ordinary tools of government of urban transformations. The actions of monitoring of these phenomena are now mainly confined within the administrative limits that show their weakness on the occasion of exceptional events that threaten the security of the populations established.

The role of representation, in recent years, has profoundly changed and enriched by new meanings towards a real knowledge of the environment, the landscape and the territory. The rapid developments of technological tools are placed in a general sense of awareness about the importance of planning and management the natural and build heritage, which if properly preserved can bring development and prosperity to the community (Gambardella et al., 2014).

The platform LanDy differs from regular monitoring tools of the territory because it does not consider the phenomena that occur in the territory from a bureaucratic point of view but with a scientific approach, in the complexity of their environmental ecological, human and social characteristics. LanDy is a scientific instrument of representation and monitoring of spatial phenomena that may be useful to help the predisposition of plans, municipal and inter-municipal, for civil protection contributing to the coordination of actions and measures because of their fragmentation and inconsistency often end up not to reach their full effectiveness. LanDy also promotes innovative methods of communication and information to the public about the risks territorial contributing to the construction of the public sphere (Cicalò, 2010). Communication of territorial and environmental risks is often delegated to instruments that require specialist knowledge and skills (gis, webgis, technical representations ...) or, when entrusted to the information media, relegated to situations and moments of emergency.

A survey therefore understood as an active and open process, of acquiring and processing of knowledge aimed to draw a set of information accessible and available with different purposes, by different users, on different media (Falcidieno 2014). LanDy moves towards building a true culture of risk information, in which scientific studies, in addition to monitor continuously the territorial phenomena, are able to reach the people both in the form of indications for the institutions attendants for land management and as informational messages effective and capillary able to get to the user through a variety of different media, from the most traditional to the most technologically advanced. The platform LanDy promotes the connection between

technical knowledge and common knowledge by promoting information and public awareness on the risk factors of its territory by moving from a concept of risk as exceptional event to a concept of risk as a social and cultural awareness.

2. A representation system of territorial dynamics and of risk monitoring

The project LanDy, Landscape Dynamics, is a system of representation and monitoring of urban and environmental processes whose evolutions and interactions can be the basis of risk situations. The LanDy project is aimed at testing new survey methods, of representation and monitoring, of the processes and phenomena that, in both anthropic and environmental, - due to their complexity, their peculiarities and their being still largely unexplored in the panorama of the studies and the analysis of urban and regional - require methods, techniques and innovative tools as well as the involvement of various disciplinary sectors (Gambardella et al., 2014). The LanDy project wants to experiment the application and the combination of tools and the most advanced technologies in the context of GIS, remote sensing, the mobile app and survey to new and unusual fields of study that will require the definition of new operational concepts then applicable to other areas of investigation.

The goal of the advanced representation platform is to contributing to the security of the territory offering himself as a decision support tool, to the project of the territory and to the communication of risks to the population. Some fields in which the platform may be used include: geological risk, risk of fires, risks from environmental pollution and more generally to the risk of the ecosystem.

For this, the project LanDy, will identify an initial scope and an initial study area on which to experiment and test the application of techniques, methods and tools that can then be extended to other fields and subjects of investigation. The work focused on the transfer of knowledge and therefore on the representation as a means of building, communication and dissemination of knowledge itself, we have chosen to work on a context in which there was already a corpus of information and data available that can then implemented during the project. The system of representation LanDy allows you to put in system studies, researches that individually have been conducted in recent years on this territory to compare them with each other and make it usable and available to the territory itself.

During the eight months allowed for conducting of research, it will be possible to test the platform on a particular theme and on a particular area of study that may be subject to risks of this kind, as it can be a single river basin subject to phenomena of human potential conflict with environmental processes.

This tool can be used by agencies to land management in the preparation of urban plans, of the civil protection plans and all those measures and interventions that in various fields undergo the influence of urban and environmental processes that are often difficult to represent and therefore not easily understandable and controllable.

With the support of the platform LanDy it will be designed user friendly representations (thematic maps and infographics on paper, multimedia and mobile app) aimed at a communication to the populations established of potential risks that could affect the territories not only during exceptional events. These representations will be able to reach, and be understandable, by the broader range of the population who will thus benefit from the studies and research supported by LanDy to guide their choices and behaviors.

These objectives will be achieved through three strategies strongly related and facilitated by platform LanDy:

1. the identification, representation and monitoring by the expert knowledge of the phenomena and situations of conflict from which can arise risks for the population;
2. the transmission of the results of these studies to the governmental organizations assigned to land management that may use them as tools for decision support within the different planning processes of its territory;
3. the communication to the public of the risks through user-friendly tools, technologies, languages and representations;

The three strategies will lead to the development of:

1. a prototype of GIS platform for identifying, monitoring and representation of territorial processes;
2. a methodology for identifying the elements of crisis and risk arising from the conflict between the different phenomena that characterize a particular geographical area;
3. an integrated communication project aimed to building a greater awareness of the risk. This project will include different techniques and tools for raising public awareness and construction of the public sphere.

In the next page: Fig. 1: Poster published and awarded at the “World Soil Day 2014. Workshop Il Suolo nella Pianificazione Territoriale“. Alghero, 5-6 dicembre 2014.

Università degli Studi di Sassari
DADU - Dipartimento di Architettura, Design e Urbanistica

LANDY
LANdscape DYnamics

Strategies for the Representation, the Monitoring and the Communication of Urban and Environmental Dynamics and of Related Risks

project funded by INNOVA.RE – POR FESR 2007-2013"; CUP J85G09000350002

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Partner company:
NeMeA Sistemi
Flytop

ABSTRACT

LANDY Landscape dynamics is a research project recently funded. Its aim is the representation and the monitoring of urban and environmental dynamics, whose developments and interactions may be the basis of risks for the populations who live those territories.
LANDY is a representation system that supports decision making, landscape design and communicating risks, contributing to the safeness of settled populations.
LANDY may be applied to analyse ecosistemic risk as well as hydrological risks, fire risks, environment pollution etc.
LANDY tests the application and the combination of the most advanced technologies in landscape survey, GIS, remote sensing and mobile device apps in new research fields using new methods and strategies, eventually applicable to other areas of investigation.
Partner of the project is NeMeA Sistemi, private company specialised in development and distribution of GIS and WEBGIS platforms and mobil device apps. It has expertise in the field of geospatial informations in situations of environmental disaster (Intergraph e Hexagon Geospatial solutions).

KEYWORDS

representation, monitoring, communication, landscape, risk

OBJECTIVES

1. The identification, the representation and the monitoring of the landscape dynamics and their conflicts causing risks for inhabitants and populations.
2. The transmission of the research results to the local institutions that are involved in the territory governance.
3. The communication to the population of risks by means of tools, technologies, languages and representation user friendly.

EXPECTED RESULTS

1. A GIS model for the identification, representation and monitoring of the landscape dynamics.
2. A methodology for the identification of the risks originated by the conflicts between the different phenomena characterizing a particular geographical area.
3. An integrated communication project aimed to increase risk awareness. It includes a variety of techniques and tools aimed to the of public opinion building.

METHOD

Step 1
Preliminary activities
1.1. Individuation of case studies
1.2. Data gathering
1.3. Design and implementation of GIS platform

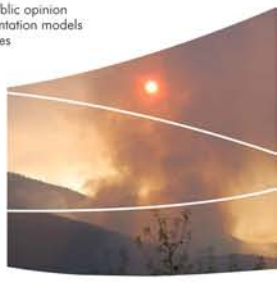
Step 2
Analysis and modelling of urban and environmental dynamics
2.1. Development of the gIS platform for the identification, analysis and representation of landscape dynamics
2.2. Identification, analysis and representation of urban dynamics
2.3. Identification, analysis and representation of environmental dynamics
2.4. Application to the case studies

Step 3
Identification of critical situation and ecosystemic risks
3.1. Development of a methodology for the identification and representation of critical situation and ecosystemic risks connected to conflicts among landscape dynamics
3.2. Identification and representation of critical situation and ecosystemic risks
3.3. Application to the case studies

Step 4
Communication and dissemination of research results
4.1. Identification of strategies for the communication to the public opinion
4.2. Study of comunication tools and technologies and representation models
4.3 Applicc n of the comunication strategies to the case studies







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FLYTOP

3. Towards the construction of the “supply chain” of the landscape representation for the decision support and the transfer knowledge.

Representing to learn, learn to design and manage, with the knowledge of what is happening today in the sphere of visual communication (Falcidieno 2014), this is the goal of the project LanDy: the representation of complexity through the graphic sign and through all the possible instruments and linked languages. This is an opportunity from which the research in the field of representation can draw new impulses that can also strongly support all disciplines who need representation. Manfredo Massironi (1982) showed how researchers of almost all disciplines reached certain limits of their knowledge expressed with the word, find with a nonverbal sign the opportunity to go further. The graphical notation becomes visible sign capable of describing and explaining the phenomena; simple but so much elastic as to allow the narration of the different ways of complexity.

The LanDy project focuses on the aspects of the representation of the landscape, giving the opportunity to explore and develop the whole supply chain of landscape representation and communication that goes from survey - through the contribution of the topography and cartography - through the issue of depicting the landscape, of visualization of phenomena sometimes invisible, of thematic maps, of graphics and visual communication, and arrives to the design of communication strategies using different strategies, tools and media. The representation, therefore, appears as a privileged instrument of transfer of knowledge, information display and data, as an indispensable tool for decision support.

Bibliographical References

BESIO, Mariolina. *Dalla carta del rischio al piano integrato della sostenibilità territoriale*. Urbanistica 117, 2001.

CICALÒ, Enrico. *Immagini di progetto. La rappresentazione del progetto e il progetto della rappresentazione*. FrancoAngeli, Milano, 2010.

FALCIDIENO Maria Linda. 1984-2014: Trent'anni di mutamento. Il caso della rappresentazione del territorio e dell'ambiente, in Giandebiaggi P., Vernizzi C. *Italian Survey & International Experience*, Gangemi, Roma, 2014.

GALDERISI Adriana, CEUDECH Andrea. Dalle tecniche per la conoscenza agli strumenti urbanistici per la mitigazione del rischio idrogeologico in ambito urbano, *XXIX Conferenza italiana di Scienze Regionali, Associazione Italiana di Scienze Regionali*, 2008.

GALDERISI Adriana, MENONI Scira. *Rischi naturali, Prevenzione e Piano*, Urbanistica 134, 2007.

GAMBARDELLA Carmine, ZERLENGA Ornella, PISACANE Nicola, ARGENZIANO Pasquale, AVELLA Alessandra, CIOFFI Gianluca, EMANUELE Gilda, "Il biodisegno per la conoscenza e la rigenererazione dei territori compromessi", in Giandebiaggi P., Vernizzi C., *Italian Survey & International Experience*, Gangemi, Roma, 2014.

MASSIRONI, Manfredo. *Vedere con il disegno. Aspetti tecnici, cognitivi e comunicativi*. Muzzio, Padova, 1982.

MILETI Dennis.S. *Disasters by design, A reassessment of natural hazards in the United States*, Joseph Henry Press, Washington DC, 1999.

HERITAGE and TECHNOLOGY
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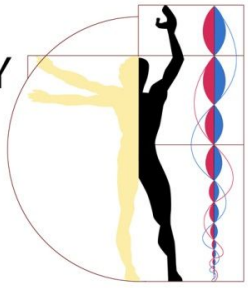

A strategic plan of investigation into the urban areas carried out together with public bodies

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Abstract
Over the time the increasing number of more and more sophisticated instruments together with the cultural awareness of operators and the scientific progress, have allowed the transmissibility and universal legibility of the results.
As far as the systematic outline of the research is concerned, the main aim of which is to study what already exists, it becomes more significant and pregnant in its contents, not only when it manages to arouse the interest of the public, but also when it succeeds in creating a synergistic relationship with public bodies and cultural associations. Local councils have to draw up and update the plans of the knowledge of the whole sector. Therefore public bodies need to get to know their territories and their dynamics and, consequently, the opportunity to make use of all the instruments offered by modern technology which make it possible to satisfy this need.
The research activity, focused on the historical centre of Ortygia, has been characterized by concreteness and credibility and has succeeded in creating a synoptic outline. Thanks to its binocular point of view, focused on the single material texture, it has been able to point out the whole distribution of building units, where the already planned implementing projects, especially the detailed plan, need a precise, dynamic basic information project.

Keywords: Urban survey, Control, Territory, Public Administration

1. Control and Intervention Function Strategy for Public Authorities *(G. Taibi)*
Nowadays, we live in tough historical and cultural times. This is the reason why it is particularly successful to identify the best position and the most suitable strategies in order to reach goals which are qualifying for the interrelation between Research centres and Public Administration.
The possibility to rule and manage in an effective way the relation between the city powers comes from a sound and robust plan of technical-linguistic communication. It is crucial to symbiotically relate intentionality, goals and strategic actions and then to put them in an organic and pragmatic frame.
The goal is directed to an innovative logic, for which the developments of the researches of the academic assemblies are the awakening and incitement engine for territorial transformation and requalification.
It is determining the geographic, territorial and socio-economic analysis of the context of reference, that is the place of intervention, in order to create a quality product of the expectation of accurate and critic users.
In this sense, administrators and technical management are culturally called to activate decisive procedures about organicity and adequacy of innovative proposal in the territory. Above mentioned procedures have to be aimed to requalify public space, to improve their own usability and to empower services in the parametric set showed by the users.
Hence the shared need to establish a strategic link of engagement and merging of interests between Public Administration and Academic Centres of Research.

The main goal is to lay the foundation of correct information, aiming to achieve the creation of a “Knowledge Factory”, by primarily establishing a hierarchy of interests and a codification of the levels of in-depth fact-finding analysis of investigation on the environment.
Pushed by this “proposal engine”, we meant to establish a cultural harmony with the Municipal Administration of Syracuse. This harmony bases on leathery synchronic relations and it has the main wish to achieve a reasoned and gradual representation of the Planning Tool, using the abundance and implementation of qualities linked to the different levels of Knowledge.
The first step can be identified in the analysis of the scenery, which can be both the highest point of the territorial landscape and also the managing ability of the Administration. With “analysis of the general context frame” we mean the set of the sector where aims to pursue and consequent policy of territorial intervention have to be located in.
The gradualness through which in-depth and details levels of this analysis will be defined in symbiotic connection with predetermined goals and the quantity of available resources.



Fig. 1: 45 degree view of urban scenery of Ortygia.

2. Methodological planning of Urban Evaluation *(R. Valenti)*

The governance of the architectural heritage works through a decision system of spatial and time relations identified in the city plans that the administration, using the designed offices, struggle in actuating, since the data of the built reality are not based on an organic and updated system.
The possibility of serenely using the law instrument, relating in a sure way with the private sector, which wants to participate in compliance with the law, hinges on the quantity of updated data and their organization and usability. They are the systematic compass guiding the Public Administration when they have to issue authorisations and concessions.
In the light of the above, it is felt as needed the arrangement of a methodological process of knowledge of the urban pattern, conveniently hierarchized, which can orient and simplify the Evaluation and, in the meanwhile, offer critical points which can help planning and territorial control.
The aim of the research is to give to the Government a tool of the Urban Space of Ortygia which is objective, flexible, expressive, easy-to read and which can also be implemented; a representative system able to

combine analytic knowledge, which comes from the thematic survey, and synthetic knowledge, needed for any effective resolution given.
The arrangement of the knowledge system occurred through a critical selection of needs expressed by public administration operators, the real direct users and final operator of the digital platform created, and also operative actors of the launching phase of the knowledge.
This part of the research is surely the most complex to manage; in this particular case, the research team, though its interface with specialized workers of the urban management, has faced particularly awkward themes, not because of the contents of the knowledge to gain, but because of the application ways and management of the current technologies in information system for the knowledge sector.
This experience carried new models of cultural approach in managing the implementing plan, through the processing of an ad hoc survey system, related to the complexity of the location.
The prepared system is the real basis of a continuous monitoring of the location and, in particular, of authorized and unauthorized transformation and it is also the guide for reorganizing and restoring processes.
In this particular case, a methodological process availing itself of traditional operation of survey at urban level has been launched. It is supported by the current technologies which allow a faster, but detailed, sample taking.
The preparation of the evaluation is traditional but, depending on the situations, it is fitted to the specific characteristics which structure and characterize the context.

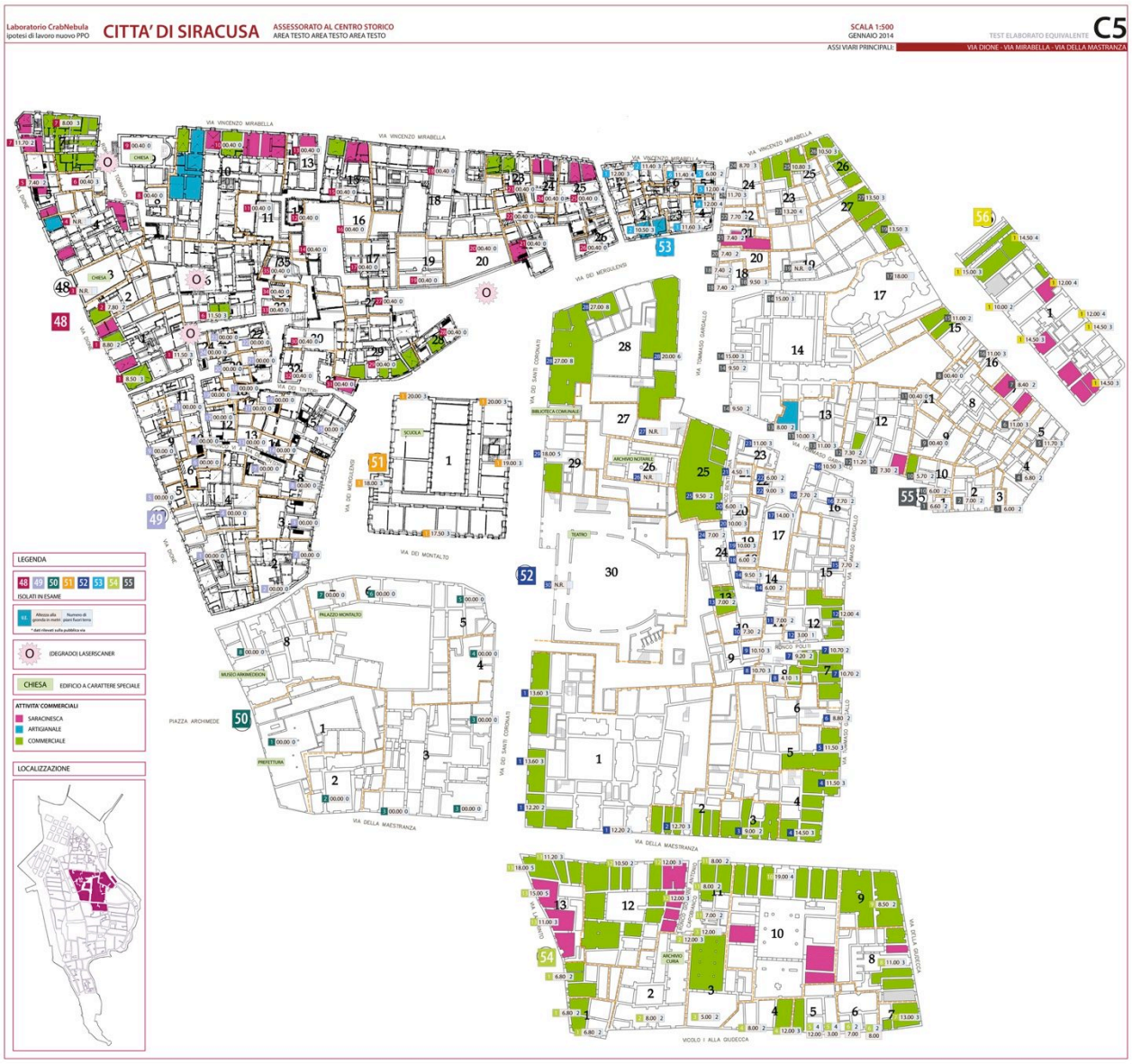

Fig. 2: Area of Spirduta. Implementation of urban data.

The theme has faced two problems; the first one is linked to the critical discernment of the "isolated samples"; the second one is linked to the modalities of data representation.
Considering the first point, the isolated characteristics which were evaluated should have been the range of all possible situations which the place of Ortygia can present under the aggregative and morphologic aspects (residential units, properties intersections, superfetation, etc) from the general viewpoint of the analysis.
The attention towards some specific themes is needed to answer to one to the development of the activities of the public administration in the field of the detailed plan tool.
The second aspect, the return of the survey, has deepen, in particular, the theme of expressiveness of the evaluation products, the immediate and easy consultation even of parts, depending on the complexity noticed in the reality. The graphic language has been improved basing on the methodological contents of the research; we tried to assemble a synthetic frame of information, interrelated with the various scale of representation, considering the particularities and contents of the urban pattern to highlight.
In operative terms, the three-dimensional representation are now associated with the traditional charts and two-dimensional representation; the three-dimensional representation gives back the formal data in a perceptive way, that is suitable also for not specialized users.
The scientific value of this systematic information set is not based on the precision of the metrical data, but on the potentiality of the methodological approach, striving to spread, in not-research structure, the procedure of a "smart" digital documents about the whole of the architectural heritage, a part from the exact historical value, able to guarantee a knowledge support detailed and complete. The aim is to give to the Public Administration of cognitive tools able to give a synthetic and hierarchized reading of the spaces which constitute the complex structure of Ortygia.

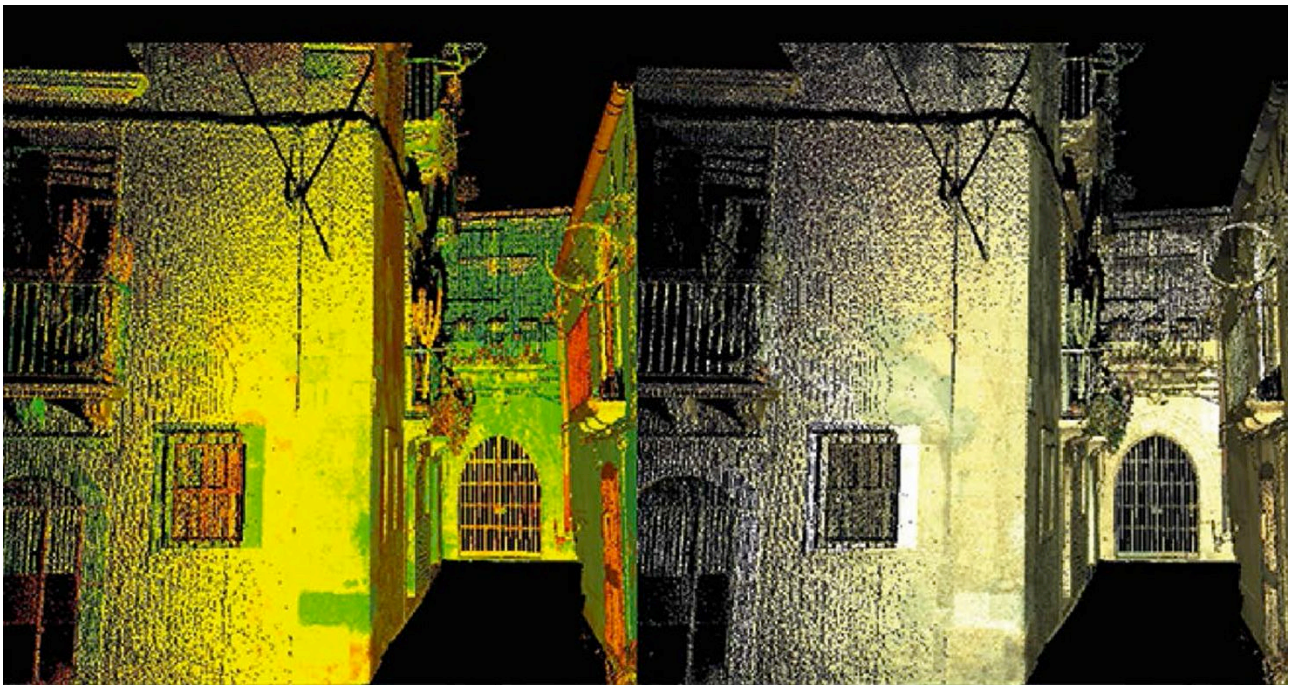

Fig. 3: Via dei Tintori. Laser Scanner survey.

3. Examining the historical context *(S. Giuliano)*

It is already established the idea that every operation of reading an historical and urban context has to be supported by a suitable process of knowledge related to the level of thematic deepening. This process is often obstructed by happenings linked with the examination itself or, even more often, by a lack of economic funds to support the examining operations.
Specifically, the Laboratory of Representation of the University of Catania has identified these critical situations during the examination of the historical location of the Ortygia Island.
The last operation of systematic evaluation of the urban centre goes back to the detailed plan of the 1988[i] – which chronology lasts ten years precisely for the complexity of the application field – in which all the ground floors and first floors of all buildings of Ortygia are detailed.
But an evaluation of an historical centre ten years old, even if systematic and accurate, results obsolete if we think about the continuous transformation of historical centres – living entity in continuous evolution – characterized by process more or less legal of fusion, above-grounding and demolition.

In this sense, the technologic innovation of the urban survey prepares a series of technologies which let to implement the data of the historical city: mobile mapping technology, laser scanner upon drones, etc.
But if, on the one hand, the technological innovation tends to simplify data collecting processes, also in high urban extension cases, on the other hand, the economic inability of the administrations deny the use of this innovations in the historical centres.
The aim of the research then, is to improve the cognitive plan of the historical centre, compared to the old Detailed Plan, with the arrangement of a unique system of data collecting, easily extensible and consultable by the Public Administration and by the Technicians who works on the territory.
A system which considers sure the information coming from the survey of the old Detailed Plan; data collected in an experimental and punctual way directly on the examination field.
Information mentioned have been inserted in an unique multidimensional form on thematic layers, which contains information about the height of the buildings up to the eaves, the house number, the number of levels out of the ground with eventual superfetations, the superimposition of the new cadastral plans – poor of information – on the old evaluation plans, the activities of the ground floors and the urban fields surveyed through the Laser Scanning technology.
In order to detective the development of the “unnoticed twenty years” of the urban patter, it is particularly important the data about the height of the buildings up to the eaves, with the relative indication of the floor up out of the ground and the eventual superfetation. In this way it was possible to identify the buildings whose double height of noble floors has been transformed (more or less legally) in different levels.
The superimposition of the new cadastral plans, together with the old plans of the Detailed Plan, in addiction to complete the cadastral cartography missing data, has given the possibility to improve the information about the diachronic pattern of the buildings plan, highlighting the process of fusion between different buildings, the demolition of small block transformed into parking and the changes of private places such as courtyard and the turned roofing of the interiors.

LOCALIZZAZIONE	ISOLATO	UNITA' EDILIZIE	ALTEZZA ALLA GRONDA	NUMERO PIANI	ATTIVITA' COMMERCIALI	COPERTURA	DATA RILEVAMENTO	DEGRADO FUNZIONALE PIANO TERRA	ACCESSO
VIA DEI TINTORI	48	36			8		30/12/2013		SI
		A	15,40 m	4	4	falde (altro)		SI	
		35	13,70 m	4	1	piana (altro)		NO	
		36	9,90 m	2 T1	1	falde (bing)		NO	
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Fig. 4: Form of urban survey

Moreover, the survey of the activities of the ground floors has not to be underestimated. The systematic evaluation of these activities has given the chance to map the areas with particular urban blight linked to the lack of use of the place itself. In fact, if we consider the building characterized by a strong state of functional

abandon, we can infer that the absence of a function can be directly link to the state of building conservation and consequently to the factor of usability of the area-neighbourhood examined, or vice versa.
An endemic analysis of these areas is so consequent. Areas which are often linked to particular historical and architectural characteristics typical of the whole island.
The survey with the Laser Scanning technology of these fields with the characterisation of clouds of points coming from the digital evaluation in RGB of photo data, in addiction to the diachronic establishment of the morphological and architectural data on the knowledge field, is a starting point for a functional recovering of single buildings that will guarantee the maintenance of the usability of the area examined.

4. The implementable knowledge as fundamental tool of the urban planning and the territorial governance *(M. Liistro)*

The urban analysis as scientific activity, aimed to the knowledge of the urban complexity and introductory to the urban decisions, was born in 1910, not thanks to architects and town planners, but thanks to a biologist, Patrick Geddes, who showed the analogies between the functioning of the human body and the urban one in his famous book “Cities in Evolution”.
The City, in fact, as entity in evolution, needs studies and analysis to read and to understand its developments process, its pathologies and to define the corrective actions; it is needed to study its past in order to understand which could be its future, as it is done for the human body.
For a long time, Geddes theories were the centre of a knowledge action aimed to guarantee the process of Urban Plan construction. This Plan allowed the Town Planning to come out of the narrow space of the daily activity of the urban regulations and to enter the more proper space of the scientific discipline.
The idea of reading and telling the Ortygia Island, the Historical Centre of Syracuse, comes from observations for which the scientific references assume different meanings.



Fig.5: Ortygia orthophotos

It is not possible to read our own city just from the top, from a plan, an aerial photography or census data: “it is also necessary to go down from the sky, to land and walk through its spaces and places step by step”.
It is necessary to halt to listen to the life, to feel the blood flowing in that reticulum of vessels and arteries.
Then the reading of the old city becomes a more demanding story, because it necessarily includes the analysis of an evolution and transformation process much more complex and, at the same time, more hidden, hardly entirely readable during the development process of the physical city.
Ortygia is an urban monument, a real urban rarity which saves, upon its rocks, all the signs of all the cultures have passed through it and, in particular, it saves the signs of the old Greek urban plan, largely preserved.

A city which passed though glorious moment but also profound crisis, due to invasions and earthquakes, especially the 1693 one, which destroyed all the Eastern Sicily. Glory and crisis have determined important transformation of its structure.
The invincible colonial City which defeated Athenians and which expanded itself by conquering important establishments and territories, was many times a conquered city, submitted, coerced in its urban area, surrounded by bastions and by an impregnable and unassailable fort, where enter passing through seven doors. For four hundred years, from the Spanish domination to the proclamation of the Kingdom of Italy, Ortygia was forced to not expand itself but to grow upon itself, occupying all the available spaces of its urban pattern.



Fig. 6: Area of Graziella: on the left thinning urban IACP; on the right urban decay

The most important renewing interventions interest the western sector of the town, which is the part of the urban pattern closer to the big port and more qualitatively important from the architectural aspect.
The renewing process, in fact, did not affect the eastern urban pattern, except marginally. In fact the areas of Graziella, Spirduta, Giudecca and Turba were greatly marginalised and separated and it contributed to progressively stress the decay process. These areas became the residence area of the poorest.
These areas depopulated after the end of the II World War, in full economic boom for the building of the petrochemical industry area of Augusta, when the major part of the population moved to the mainland.
From that moment, Ortygia started a real agony: shops, ateliers, and bar were closed, the buildings shored up, fallen down and a thunderous silence, especially at night time. In few years the city lost its identity and was left of its ancient complexity.
If you had entered the heart of these patterns, you would have seen the picture of a city invisible from streets and public spaces. The scenery was discouraging for the triumph of the “deregulation”, the result of small but innumerable daily misdeeds due to countless reasons.
In the 70s the Region, with the Special law for Ortygia, allocated funds for the recover and the relaunch of Ortygia. On that occasion it has been done a systematic evaluation of the whole Historical Centre. All the ground floors and the first floors of all Ortygia buildings were evaluated with the traditional tools and techniques then used.
With that operation, for the first time, we were conscious of scenery which showed all the complexity of the place and, moreover, what still remained of the original plan, the blockage level and the illicit above-groundings realized through times.
In the Operative Detailed Plan were planned about 50 interventions, all to activate by public enterprise through the expropriation for eminent domain.
Nowadays, the administration is preparing a new project, hopefully an alternative to the Detailed Plan and in compliance with the new regional laws, which identify the modification of Municipality General Regulation Plan as the most suitable tool for the interventions in ancient cities, especially when they are large-scale

ones as Ortygia is, referring to the Implementing Plan the cases of particular complexity.
The project identifies an alternative route, called “fil rouge” (to qualify under the functional and morphologic aspect) which crosses the heart of this eastern urban sector, from the Castello Maniace to the Talete Terrace, intercepting all the most important emergencies (spaces, monumental buildings, special buildings, places). Among this pattern a limited number of particularly degraded (Critical Areas) places shall be identified and they shall be requalified by Implementing plans or recovering programs of public/private enterprise, which will be arranged when there will be the suitable political and economic condition for operating.



Fig. 7: Area of Bottari. Thinning urban.

These areas could be regulated by specific laws (as guidelines) which will not identify the predestined particles for eventual expropriation, in order to avoid the ten years deadline of time bonds provided by Law.
The project intervention shall be forerun by a proper reading of the historical urban context and shall be supported by a suitable knowledge level, coming from a new evaluation, setting up all the possible technological innovations, extended to the whole island because the current evaluation, very dated even if systematic and detailed, it is clearly obsolete and does not include information about the transformation of the last twenty years.
The work team of the Laboratory of Representation of the University of Catania, according with the Municipality Administration of Syracuse, has already launched evaluation activities in Ortygia both of the ground floors, with notes on the carried out activities which had allowed to link the degrade situation with the lack of activities, and the complete evaluation of the structure raising from the historical building of the “Spirduta” area in order to provide a methodological reading of the complex structure of Ortygia, which can guide and help the planning and the governance of the territory.

Bibliographical References

[1] BRUSAPORCI, Stefano (a cura di). *Sistemi informativi integrati per la tutela la conservazione e la valorizzazione del patrimonio architettonico e urbano. Roma*: Gangemi Editore, 2010.

[2] CHIAVONI, Emanuela. FILIPPA, Monica (a cura di). *Metodologie integrate per il rilievo, il disegno, la modellazione dell'architettura e della città.* Roma: Gangemi, 2011.

[3] GIANDEBIAGGI, Paolo. VERNIZZI, Chiara. Rilevare le città. Rappresentare la conoscenza con i sistemi informativi. In *Le Vie dei Mercanti. Rappresentare la conoscenza*. Napoli: La Scuola di Pitagora, 2010. ISBN: 978-88-6542-014-0.

[4] MINGUCCI, Roberto. BARTOLOMEI, Cristiana. BRAVO, Luisa. GARAGNANI, Simone (a cura di). DisegnareCon, Università di Bologna, 5(10), Numero Speciale, DOCO 2012, Atti del III Seminario Internazionale Documentazione e Conservazione del Patrimonio Architettonico ed Urbano, Tomar 25-27 ottobre 2012.

[5] TAIBI, Giacinto. VALENTI, Rita. LIUZZO, Mariangela. From the complexity of architecture to the knowledge of the construction of Siracusa. In GAMBARDELLA, Carmine (a cura di*). Less More Architecture Design Landscape.* X International Forum Le vie dei Mercanti, Aversa-Capri 31 May- 2 June 2012. Napoli: La scuola di Pitagora, 2012, pp.195-205 ISBN: 978-88-6542-129-1.

[6] TAIBI, Giacinto. VALENTI, Rita. LIUZZO, Mariangela (a cura di). Trame e stratificazioni urbane. Casi studio a confronto. Atti della Giornata di Studio *IL DISEGNO DI ORTIGIA*. Siracusa 28 settembre 2012. Siracusa: LetteraVentidue, 2012 ISBN: 978-88-6242-072-3.

[7] TAIBI, Giacinto. VALENTI Rita. LIUZZO, Mariangela. D'AIELLO, Massimo. Crabnebula Digital Suite, an Algorithm of Survey and 3d Modelling for the Preservation and Management of Urban Heritage. THE INTERNATIONAL ARCHIVES OF THE PHOTOGRAMMETRY, REMOTE SENSING AND SPATIAL INFORMATION SCIENCES, vol. XL-5/W1, p. 227-234, 2013. ISSN: 1682-1777, doi: 10.5194/isprsarchives-XL-5-W1-227-2013

[1] In March 1978 he signed an agreement between the City of Syracuse and the team of engineers in charge of the preparation of the Detailed Plan of Ortigia. In 1980 the City Council approves the rough draft of the Detailed Plan of Ortygia. The November 14, 1987 takes place the delivery of this, and April 30, 1988 the Detailed Plan is adopted with favorable opinions.
Transilation by Associazione Culturale Madrelingua - Floridia (Siracusa).

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Reticular valorization model for castles in Central-Eastern Europe. The Slovak experience

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Abstract
The aim of the work was the development of a tourism system management model targeted to revamp historical and architectural capital in relation to emergencies that characterize, nowadays, Slovakia, unique in the world for its concentration of castles, that are experiencing a degraded condition. The model is designed to create a network of functions by combining structures from different tourist attractiveness. After a phase of acquisition and analysis of data, acquired in Slovakia, concerning to system-country, tourist and cultural heritage legislation (Law SCR/1962), tourism and financial statements were evaluated the characteristics of the network model, Marshallian, cultural and atopic district. The castles object of study were Bratislava, Bojnice and Devin, downstream of an historical-anthropological examination and regarding the museum collections. The environmental units model of behavior was developed on the basis of the data analysis previously evaluated and of the postulated needs. The execution of this phase involved the foreshadowing of an user profile to identify with the functions allocated in the castles (framework of needs). In relation to the framework was composed a functional program. Through the development of a financial analysis, was demonstrated as the castles, with individually losing budgets, if included in a reticular valorization project can sustain themselves.

Keywords: Valorization, Management , Communication for Cultural Heritage, Cultural landscapes

1. The system nation
The Slovak Republic it's a Central-Eastern European country founded in 1993 by the peaceful dissolution of the Federal Republic of Czechoslovakia. The country has a long history closely connected with Czech Republic where the earliest evidence of civilization belong to Lower Paleolithic. Slovakia it's one of the countries with the largest number of historical architectural emergencies in Europe, in fact, there are 425 villas, 180 castles and chateaux. Even with revenues from tourism which have exceeded 45 billion of Slovak kronor, the percentage of workers in the tourism sector is very low, in some cases below 0.9 percent, making it necessary to develop an economic model of management of the tourism system aimed at revitalization of the historic capital. There are some boundary conditions that favor the success of a valorization project in the country such as the division into "tourist regions" whose name is based on characteristics of the territory based on laws "Rajonizácia cestovného ruchu CSSR z roku 1962" and "Rajonizácia cestovného ruchu SSR z roku 1980", or the large number of visitors that in 2010 have created 1,566,174 overnight stays in the capital, Bratislava, and 3,435,188 in the Region of Stredne Povazie. Among other boundary conditions are a good knowledge of languages and good training in the tourism sector. To place an enhancement project was necessary to make a thorough research regarding regulations on tourism and cultural heritage, which in the case of study are quite stringent and complicated. There are numerous bodies responsible as the Cultural Heritage Monuments (Národná Kultúrna pamiatka), and many elements of local territorial protection. In the specific case it was necessary to detect at which protection registry belong studied areas under the law n. 49/2002 (NR SR č. 49/2002 Zz or ochraně pamiatkového fondu knows zmenil systém evidencie pamiatkového fondu) between the movable cultural heritage monuments, the immovable cultural heritage monuments (Register nehnuteľných NKP), the protected historic reserves (Register Pamiatkových rezervácií) and protected historic zones (Register Pamiatkových ZON) (Article 22). For the model were determined also the Set of Monuments (Pamiatkový fond), the value of conservation (Pamiatková hodnota) and the protection of cultural heritage (Ochrana pamiatkového fondu). Others bodies are responsible for the

process from the Ministry of Culture of the Slovak Republic (Ministerstvo kultúry Slovenskej republiky), the Monuments Office of the Slovak Republic in Bratislava (Pamiatkový úrad Slovenskej republiky v Bratislave) and the Regional Council of Monuments (Krajské pamiatkové úřady) .

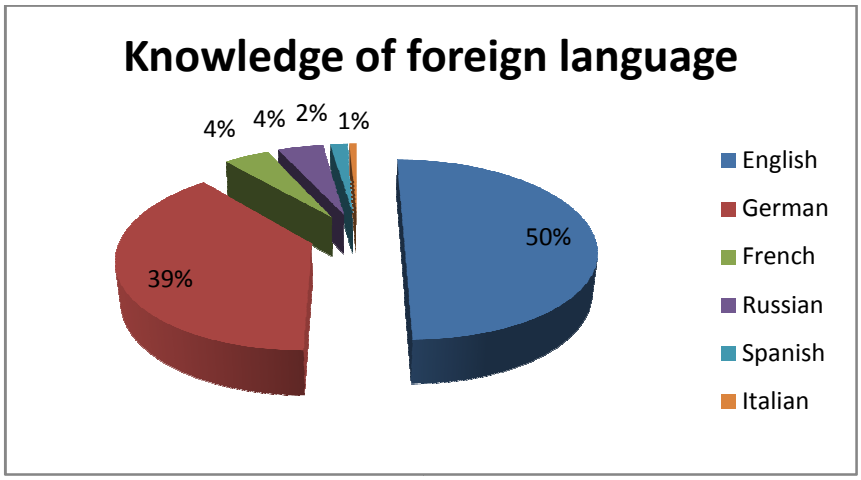

Fig 1: Knowledge of foreign language in Slovakia

2. The network as concept and project

The main goal proposed was to design a network part of a cultural district, museum type identifying an area that express, through art or traditions, a soul specific and strongly characterized capable of creating a real product territorial. It becomes, in this way, a tool for tourism policy that puts the system in large and varied opportunities offered by the considerated amplificated regions. The establishment of a cultural district, in general, it's a boost to the productivity of the area resulting and it's a birth of a real chain of activities that are connected with the protection and enhancement of cultural heritage, and it's able to characterize the whole economy. The integrated system of cultural and tourist offers will have the advantage of being able to enhance even the great heritage represented by the so-called minors museums and architectural heritage that, despite their excellence and the important role in the territorial identity, are risking to be cut off from most recall tourist paths. The project was developed from Marshallian insights about large scale, identifying a lateral district with a configuration of emergencies not all involved in a homogeneous way but included in a system of subsidiaries interdependencies. The consequence it's a designed complex, related, planned and participated district not to be a set of small accidental emergencies, but a group of historical and architectural plants located in the same area made by a community of people who share a single system values. The designed castles network it's part of a cultural district of tourist-museum type characterized by the presence of idiosyncratic local factors, the product of intellectual creativity of individuals and a cohesive local community in its cultural traditions and accumulation sediment of technological knowledge and social capital whose purpose is to create a structure of relationships to build in agreement in view of a purpose: the integrated valorization of land resources aiming at sustainable development. The physical boundary of this district was formed thinking of cultural criteria, historical criteria, geographic and physical-spatial, political and administrative criteria, social criteria, economic criteria and demographic criteria. The extrication of this concept it's in the point of intersection between two axes: a horizontal axis of the integrated production of culture and cultural services and a vertical axis on which we find the local culture, systems of urban values, the history of the city and all those elements that can be traced back to the historical and socio-cultural dimension of the district as a whole. Once drawn the cultural district border is necessary to evaluate the effects of its institution by identifying which interventions mark the limit point. The limit point it's the point beyond which the space becomes utopian and atopic. The tourist valorization creates from nothing or manipulates existing places in order to specifically sew a product that can respond to user profiles carefully selected. The basic idea that emerges is that a cultural district is developed from the idea of the fence, the fence that almost always aims to recreate a microcosm in which there is already a system of rules that is supposed to be better than the external. Crossing the limit point, to the users profile will be given a dichotomous mass needs: the desire to come into contact with diversity without losing the safety routine. In this situation, the principle for defining physical borders of the tourist district is changed and the economic

criteria gains the upper hand, tending to standardize fruition of the site and to emphasize the local identity intended as its evocative image. The rest of the tourist space, then becomes a deliberate scenography of the place with an history seen as atmosphere. The point of intersection between the two axes of need it's displaced from the original point and will create spaces with changes of scale without a functional sense in favor of dimensional relationships and scenographic type hierarchies. The community of people who share a single system of values, is surmounted by expectations tourist who often tend to respond to a contemporary compositional logic. At this point it's possibile to engage a copied model imitation process in which the original model tends to resemble its copy reworked. The final product-site should look like as much as possible to the idea of "local" that the external user projects into place. Crossing the limit point it will be possible to create spaces for tourism franchise.

3. Specific analysis of the network

Identified the cultural district, the examined network of castles for this work was realized using three manors. The first it's Bratislava Castle, part of the tourist region "Bratislava a okolie", the second it's Devin castle that still belongs to the tourist region "Bratislava a okolie" and the third castle, Bojnice castle, that belongs to the region "Stredne Povazie". To produce a valorization project was arranged an examination of the three historical-architectural manors, studying the changes that over time have led to the current configuration of the castles, but also viewing the symbolic value that they have acquired over years. Downstream of the examination the attention was focused on some historical events that can be used to create a mercantilist marketing with a expendable reputation in order to have the revitalization of the historic capital of the minor architectural heritage. Bratislava castle has a long history, thanks to its privileged position. The first references to the castle date back to 3500 BC because settlement of the population Boleráz who established on the hill to facilitate the sighting of enemy tribes. Later the castle of Bratislava is transformed from a Celtic castle to a Slavic castle because was realized a large wooden building. During the 40s of the thirteenth century, the castle of Pressburg had to restore its role as fort to defend the kingdom from the attacks of the Mongols, and the structure of the fort underwent insertion of a so big tower as to be converted, in later years, in a residential building called Tower Crown. After the concretization of the Habsburg Empire, and the ascent to the throne of Emperor Ferdinand I, Bratislava castle had a conversion in Italian Renaissance style. Many architects and artists such as Giulio Licino da Pordenone and Ulisse Maciotano da Roma, during the years 1552 to 1562, under the supervision of the architect Pietro Ferrabosco, changed the manor. The architects, without affecting the outside perimeter, completely changed both the interior of the building, both facades. Because of the strong depletion of physical Renaissance makeover, in particular the wooden elements, starting from 1610 the castle had a remodeling in Baroque style.



Fig 2: Bojnice castle, Devin castle and Bratislava castle

In 1740, when Queen Maria Theresa of Austria promised to maintain the residence both in Austria and Hungary, Bratislava castle had further modernization. The basic idea of the Queen was to create a building of representation for the Habsburg monarchy that would attract the interest of Europe. The Devin castle, it's located in the homonym area, outskirts of Bratislava, near the Austrian border. In this place it was possible to control a very important trade route along the Danube River, a branch of the Amber Road. Subsequently, both the Celts both the Romans, built fortified settlements there. The ancient name of the castle "Dowina", from the Slavic word "deva", Slovak for girl, was mentioned for the first time in a text written in 864, when

Louis the German besieged Prince Rastislav in "Dowina Castle". With the establishment of the Great Moravia, in the site of Devin was established a Christian church formed by three apses and with a long nave. This unique style is inspired by the Byzantine churches of Macedonia, where the Saints Cyril and Methodius drew for the Christianization of modern Slovakia. In 1809, after the siege of Pressburg, the troops of Napoleon I, retreating from Bratislava, burned the castle, reducing it in currently conditions. From October 1938 to April 1945, Devin was part of the German Third Reich. The most interesting part of the castle is the small tower, prospectively not much bigger than a chess piece, known today as the Maiden Tower. Separated from the main castle, welded dangerously on a lone rock, has spawned countless legends concerning an unhappy girl who throws herself into the river. Inside, the castle is full of walls and very suggestive courtyards. Bojnice Castle dominates the northern part of the basin of Prievidza. The first writings about the existence of the castle date back to 1113 in Zobor's schedule. In this register written in Latin, the king Koloman, confirms that the castle it's a Benedictine monastery dedicated to St. Hippolytus belonging to the state of Upper Nitra. The walls around the castle initially traced an asymmetrical path plan adapting to the orography of the territory. In 1637, Emperor Ferdinand III donated the castle of Bojnice to the Pàllfy family that decided to hire the Italian architect Filiberto Lucchese and his team, to rework the castle in Baroque style. Only in 1852, Count Pàffly, the last private owner of Bojnice, decided to "modernize" the castle. Palffy did make a "dress" for the outside of the castle making it in French Gothic style similar to Loire's one. The work was entrusted to Jozef Uberth, architect from Bratislava while the interiors, which were supposed to be in the Gothic Tyrolean style, were commissioned to a company from Innsbruck. The idea of the Count was to create a castle with romantic connotations. The winter garden is an part of the lounge area, and, as well as orangery, the area is the "game area" of Hungarian nobles. All the glass used for the castle contain Renaissance images that Count bought in 1902 in Paris, while the furniture of the apartment are in neo renaissance style. Another important room it's the oriental room, fully paneled with elements of the craftsmanship Turkish tradition dating back to the seventeenth century. The most prominent element of the building is the Golden Hall that takes its name thanks to the totally golden ceiling pine that Count Pàllfy decided to commission as a copy of the Academy of Fine Arts in Venice. The upper floor of the golden room it's interconnected with the chapel of the castle built as a copy of the Parisien Sainte Chapelle. The staircase of the manor, totally in travertine marble, enters directly into the base by connecting with foundations.



Fig 3: Bojnice castle. Interiors

The west area of the castle, which originally served as a granary, was rebuilt in 1900 to achieve the armory that can be admired in several film productions. The profile of the museum collections, however, has as its mission to identify those features of value that can be used in the process of enhancement. The Historical Museum of Bratislava Castle has primary mission is to acquire and protect the museum collections that document the evolution the society in Slovakia. Bojnice Castle it's a national cultural monument since 1950. Nowadays it is possible to admire the paintings of great masters such as Jacob Jordaens, Paul de Vos, Jacques d'Arthois and the Nardo di Cione's altar of Bojnice. There is inside the castle a permanent exhibition of arms of the seventeenth and eighteenth centuries. The most important part of the museum it's textile collection and the great tapestry "Joseph and His Brothers", which was woven in Brussels at the beginning of the seventeenth century.

4. The intervention project

The valorization project involves the inclusion of the manors in a emergencies network belonging to different areas of the territory. It was developed a model of behavior of environmental units on the basis of the analysis of the data previously evaluated and needs postulated. The execution of this phase involved the foreshadowing of a user profile to identify with the functions allocated in the castles (framework of needs). In relation to the framework of needs was composed functional program. As for the framework of needs was made a research on the historical financial statements from year 2003 with the identification of costs and expenses, and crossed with the data detected by suppliers and distributors. Research has conducted to an identification of the average cost for the museum sector per square meter of 700 and 550 euro in the regions of Bratislava and Trencin. The measurements were intertwined with the depreciation of goods purchased, assessing the useful life and by designing the replacement as expressed by the data collected. An important voice in the historical financial statements of the castles considered in this work were the cost of energy supplies such as water and gas whose costs were assessed on the basis of data gathered from suppliers and distributors. As for the framework of needs the goal to be reached is to match supply with customer demand, optimizing available resources and intervening with targeted actions and specific projects in those areas where customer satisfaction has been weak. Were made a series of projects of investigation based on the model Servqual and Likert scale. The customer satisfaction, were achieved through study circles, methods of analysis aimed at the development of their communities with community analysis and action planning. There were three participatory techniques in the cities of Bratislava and Prievidza with brainstorming activities, focus groups and case studies. In addition for two months were established a number of interactive tools including an online chat, discussion forums, a database containing the answers to the questions most frequently asked by users (FAQ) and an e-mail address to be contacted to report opinions, as well as questionnaires and interviews conducted in the city at the exit of the castles. The proposed themes investigated mainly about exposure, guided tour, cleaning, information materials and souvenirs, admission price and variety of services offered. The set of participatory processes are summarized in the following table. The global data were also evaluated on differences of nationality and also on the basis of the single architectural quality in order to redesign, consequently, the system service delivery. The characteristics are quite homogeneous because satisfied tourists are 64 percent of Slovak nationality and 68 percent foreigners. In terms of architectural quality most satisfied visitors are those of of Bojnice's castle (74 percent).

	Very satisfied (%)	Quite satisfied (%)	Not very satisfied (%)	Not satisfied (%)
Exhibition	66,6	28	2,7	2,7
Price of admission	41	39	17	4
Tour guided	18	3	69	10
Cleanliness	30	34	19	17
Information material	13,3	23	29	34,7
Variety of services	15,4	1,4	46	21

Fig 4: Customer satisfaction

The network that is supposed in this work has the property to make self-sustaining not only the entire network itself, but also the Devin castle, which is less known in terms of tourism. As for the functional program, the functions are mainly designed of conservation nature , in particular will be built in Bratislava Castle a museum of itself, in Devin castle still a museum of itself, while in Bojnice castle a museum of itself a film set with the possibility to rent some areas. These functions are preferred since they create a low impact on the depletion of cultural capital. The functional program requires that the management staff will be responsible for drawing up plans of sponsorship, implement the services of fund-raising and friend-raising, follow the steps for the granting of public funds, build and manage capital funds, keep relationships with past and potential donors and monitor buying opportunities, maintain relations with the associations and the world of non-profit, follow the activities of the additional services (Ticket service tours, bookshops, museum-shops), ensuring the choice parteners of technologically more reliable and more profitable ways and determine the functions of demand for cultural goods and services. Concerning the aspect of external communications the functional program also requires a constant and specific monitoring of the individual and collective culture needs through interviews, closed questionnaires, touch screen prerogative infocorner therefore also easy to be consulted by tourist that are not familiar with the computer and semestral focus groups. Will be realized also a programmed users monitors. All information collected will feed into a database through which it will be possible to build historical data series. The usefulness of monitoring user responds to the organizational needs that impact directly on service delivery. The program includes a disservice management process at the front desk and by infocorner. The management of the disservice also serves to controlling and monitoring the possible negative user reactions facing a disservice that has already occurred: sometimes an fast action can even flip the feeling of the user, transforming disservice into a positive event. In order to facilitate the entry of users is planned a reorganization of the front office, which will become a one-stop multifunctional.

Year	Golden Hall (€/day)	Clubhouse (€/day)	Apartment (€/day)	Coloumn's Hall (€/day)	Second courtyard (€/day)	Moat (€/day)	Hunyady Hall (€/day)
2015	1.000	500	650	200	1.584	1.250	1.350
2016	1.000	500	650	200	1.584	1.250	1.350
2017	1.000	500	650	200	1.584	1.250	1.350
2018	1.000	500	650	200	1.584	1.250	1.350
2019	1.200	600	700	250	1.700	1.350	1.400
2020	1.200	600	700	250	1.700	1.350	1.400
2021	1.200	600	700	250	1.700	1.350	1.400
2022	1.200	600	700	250	1.700	1.350	1.400

Fig 5: Daily cost of rents in Bojnice castle.

The multi-functionality can be understood both as sharing and dissemination of informations, both as coordinated conduct of joint delivery of services. The more specific objectives related to the establishment of a multi-purpose access in order to give the opportunity to citizens to turn to a single desk to get both the information both different types of service, eliminating the intermediary of tourists in the various stages of a process that involves more offices, such as information about train connections, making it easier and faster delivery of a service or information circulation, simplifying and reducing the time spent on the internet searching on information platforms, spreading an oriented user culture, oriented also to communication, transparency and collaboration among staff and tourists. For the cultural heritage valorisation, will be featured in the management of the network of castles a number of actors who will take care of the sector; in particular concerning the responsibility of marketing policies and communication will be implemented a policy that will see the three castles advertised as part of a single route offered as a "service to the person", that is not transferable in space, consequently, users will have to go to the "producer" to buy the service. The network will be publicized in the headquarters of the tourist offices in all the major Slovak cities, train stations, airports and in the typical special wooden advertising spaces as well as the same castles for a total of 200 stations with annual renewal. The network will be also advertised in the tourist information center in the city of Vienna, especially in the port area of Vienna Schwedenplatz, where currently there is already an information desk about Bratislava because of closeness and connection port between two capitals. Another advertising designed in the functional program, will be introduced in the local and international media, with

commercials, even on radio, and on major newspapers and magazines for a total of 60 activities with annual renewal. It will be possible in the bookstore to buy publications that contain historical and architectural information regarding the castles because it's planned a publication every year. Concerning the responsibility of policy development the staff will be responsible for implementing plans in order to developing the network every two or three years, so as to be always updated with the tourism and local citizens demands; the same staff will handle the bookshop and the museum shop considering and evaluating management decisions more profitable for the network of castles.

Year	Bratislava (€)	Devin (€)	Bojnice (€)
2015	7	3	8
2016	7	3	8
2017	7	3	8
2018	7	3	8
2019	7,5	4	8,5
2020	7,5	4	8,5
2021	7,5	4	8,5
2022	7,5	4	8,5

Fig 6: Admission fees

The management will also have an press relations officer who will administer the public relations, even about specific requests. Its main figure will be the press officer. The role of the press office will not fade into management of traditional media, but will target to online infomediary, or to all those organs digital information that can have an effect on corporate reputation. Cultural policy that will be adopted in the castles involves the construction of a network that can be accessible to everyone, and not only from the cultural elite. All actors in the community will have access to the network, both children, with dedicated routes, both parents with the opportunity to dine in special rooms; for local artists, with the realization of exhibitions or for the elderly, with the entrance to the gardens. Among the various tasks of the employees of the network there is to create a working group on the teaching activities every six months. The working group will design teaching activities, caring relationships with associations of teachers and parents, the secular and religious associations, other local cultural institutions, national and international. This organization will have functions of policy-planner, planning timing, methods and issues of educational projects. The management will have to also realize actions in terms of socio-cultural point of view; to attract more and more tourist demand will set up exhibitions of emerging local artists, will host meetings for the community free of charge in order to increase familiarity of the population towards the net. In other words, the instruction of a free exhibition could attract tourists and residents of the area, who, once in one of the manors belonging to the network, will be interested and curious to them and decide to visit the other two castles with an improved of the process of self-financing because the visitors, saving on admission, will spend in other activities offered. The designed rates are expressed in the following tables. In each castle is provided free use of the parking lot in front of the castle. Bojnice Castle can be used and rented as a film set, conference room, room for fashion shows and events. Not all castle can be rented, but only some particular areas in order to preserve the physical integrity as expressed in the following tables.

5. Conclusions and financial analysis

The production of cultural services has as a "consequence" the realization of other products and services, which can be defined secondary output like the production of social identity, because the process of managing and developing of the network generates not only services and products, but also values, which transform the physical resources in a collective good that belongs, regardless of ownership, to the community. Citizens themselves, both as individuals and as a community, become actors of the valorization process. it's also generated the production of innovation, research and knowledge and input production for other production processes that create still new input for other sectors, becoming as a strategic sector like research, training or construction. The work concerned the design of a model of behavior aimed at the development of a network of castles in which are expected the following results: democratization of access

to culture; wide portfolio of activities for the local community and the their entry in the valorization process; increasing the number of tourists; birth of a reputation expendable; constant advertising of castles; creation of conditions for the effects of secondary economic development; creation of employment; Increasing rate of education; production of innovation, research and knowledge about the castles. The planned time frame it's from 2003 to 2022. The prices for the previous years are historical prices and current prices are considered constants for the future. The prices are expressed in euro. The network of castles, being public property, will have a management policy type strongly conservative, but targeted to the revitalization of the property. This section aims to show the financial sustainability of the project. The graph detailing the expenditure incurred by the castles where are shown the following data: General expenses, which are present purchase costs, in terms of paper, printer ink, binding books, furniture, etc., service charges, that is those related to Internet , telephone, electricity etc. Under employee expenses, wages and salaries. As a last entry includes those costs incurred for the physical recovery of the castle, but also costs of advertisment. As for revenues, the entries are the following: Income from visitors, from the sale of events, books and brochures, and those relating to the state contribution. Regarding the budgets projection, the entries are: Charges understood as all expenditure previously detailed and unchanged for future years, salaries, entering those related to the recruitment of new people related to the management company, and finally the costs related to the recovery of the areas related to the project.

Bojnice - Year	Expenses (€)	Returns (€)	Profit/Loss
2015	1.157.697	1.091.394	0,94
2016	1.187.697	1.101.395	0,92
2017	1.182.697	1.225.235	1,03
2018	1.147.697	1.225.236	1,06
2019	1.147.697	1.225.237	1,06
2020	1.147.697	1.185.238	1,03
2021	1.162.697	1.185.239	1,01
2022	1.147.697	1.185.240	1,03

Fig 7: Financial analysis. Bojnice castle

Bratislava - Year	Expenses (€)	Returns (€)	Profit/Loss (€)
2015	808.239	990.414	1,22
2016	808.239	1.015.547	1,25
2017	830.239	1.058.073	1,27
2018	810.239	1.098.074	1,35
2019	810.239	1.098.075	1,35
2020	810.239	1.028.076	1,26
2021	810.239	1.028.077	1,26
2022	830.239	1.028.078	1,23

Fig 8: Financial analysis. Bratislava castle

Devin - Year	Expenses (€)	Returns (€)	Profit/Loss
2015	132.200	153.000	1,15
2016	132.200	153.000	1,15
2017	142.200	153.000	1,07
2018	132.200	293.000	1,99
2019	132.200	203.000	1,53
2020	142.200	203.000	1,42
2021	132.200	203.000	1,53
2022	132.200	203.000	1,53

Fig 9: Financial analysis. Devin castle

Net -Year	Expenses (€)	Returns (€)	Profit/Loss
2015	2.098.136	2.234.808	1,07
2016	2.128.136	2.269.942	1,07
2017	2.155.136	2.436.308	1,13
2018	2.090.136	2.616.310	1,25
2019	2.090.136	2.526.312	1,21
2020	2.100.136	2.416.314	1,15
2021	2.105.136	2.416.316	1,15
2022	2.110.136	2.416.318	1,15

Fig 10: Financial analysis. Net

Bibliographical References

[1] Beccatini G., Mercato e forze locali: il distretto industriale, Il mulino, Bologna, 1989;

[2] Camden T., The History of the Rise, Progress, and Overthrow of Napoleon Bonaparte: With a Summary Account of the Circumstances which Paved the Way to the French Revolution Together with a History of the Wars, London, J. Stratford, 1814;

[3] Chancellery of the National Council of the Slovak Republic, Bratislavsky hrad, Bratislava, CNSR, 2008;

[4] Central bank of the Slovak Republic, Národná banka Slovenska, Bratislava, 2011;

[5] De Mare G. e Garzillo C., L'analisi di redditività del recupero e nella gestione dei castelli, un modello di valutazione finanziaria e sociale complessa, CUES, 2004;

[6] Engel P., Archeologia secolare ungherese (Magyarország világi archontológiája), Budapest, MTA Történettudományi Intézete, 1996;

[7] Guerzoni G. e Santagata W., Galleria Sabauda, Organizzazione, gestione, politiche museali, Rapporto per la Compagnia di San Paolo e la Fondazione CRT, Luglio 1999;

[8] Guerzoni G. e Santagata W., Galleria Sabauda, Organizzazione, gestione, politiche museali, Rapporto per la Compagnia di San Paolo e la Fondazione CRT, Luglio 1999;

[9] Kálmán B., Cronologia storica dell'Ungheria (Magyarország történeti kronológiája),Budapest, Akadémiai Kiadó, 1981;

[10] Maleckovà K., Castello di Bojnice (Bojnice Castle), Prievidza, SNM, 2004

[11] Ministry of the Czechoslovak Socialist Republic, Ministerstvo Československá socialistická republika, law SNR 109/61, 11/10/1961;

[12] Santagata W., Distretti Culturali, Diritti di Proprietà e crescita economica sostenibile, “Rassegna Economica”, n.1, anno LXIV, gennaio-giugno 2000;

[13] Marshall A., Economia della produzione, Milano, 1975, ed. orig., The Economics of Industry, London, 1879;

[14] Ministry of the Czechoslovak Socialist Republic, Ministerstvo Československá socialistická republika, legge SNR 109/61, 11 ottobre 1961;

[15] Trillo, C., Utopia e atopia degli spazi contemporanei per il turismo, CUEN, Napoli, 2004;

[16] Valentino P.A., Le trame del territorio, politiche di sviluppo dei sistemi territoriali e distretti culturali, Sperling&Kupfer, 2003;

[17] Valentino P.A., Mossetto G., Museo contro museo, Giunti, Firenze, 2011

[18] Zammuner V. L. , Interviste e questionari. Processi psicologici e qualità dei dati, Borla, 1996;

HERITAGE and TECHNOLOGY
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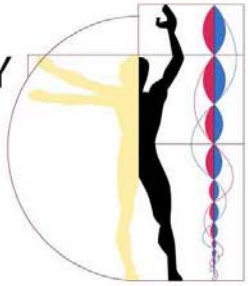

Methods and Techniques "*to work on the built*"

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The different positions on the contemporary city fate (dispersion-centralization, transience-stability, dissolution of form) open extended fields of research, starting with the need to verify models and identity in the subway system. Faced with the current problems of the city balance between the processes of expansion and those of internal transformation is changing in favor of the latter. As for the urban extension, the answer to the problems of land use and resource sees converging interests, in Europe and America, for settlement systems dense and compact with strong additions to residences and equipment.
The typological and technological adaptation, completion, *overlap*, *insert*, now accompany the modernization of peripheries of many European cities. In twentieth century isolated (from Vienna to Hamburg, Amsterdam and Berlin) are often incorporated new elements (loggias, glass elevators, roofs, etc.) that do not alter the original architectural character of the work.
Other times the image is changed by *restyling* (like *maquillage* of large blocks of the former East Berlin) or overlaps modern redesign the crowning of the block, grafting showy *high-tech* solutions.

Keywords: Insert, Overlap, Stratify

1. The cities development in Europe between the wars

The Italian cities development between the wars went through a different attitude from the one that took the various countries of Europe. Lifestyles and ways of living diverged and consequently led to the differentiation of urban space and building types made. In this scenary, particularly lively in Europe, there are two dominant approaches in the way action on architecture and city design: one was dictated by the new idea of the Modern Movement and the other from Monumentalism. The two ideas were distinguished, particularly in the urban form of the city, in the type of plot and space settlement that created, and relationship between it and existing city. The Modern Movement established itself in northern Europe on the basis of efficiency, technological development and function, and spoke with a strong utopian and a break with the nineteenth-century tradition that was unprecedented. The ideas of progress and collective interest pushed Modern Movement to identify and build an ideal city, "rational" that would create the types most likely to respond different functions of community of the time: housing, roads, services green. The new town plan would generate a plot by creating a radically new type of urban space irreconcilable with the existing: the principles of functional city represented the new benchmark of the city development. During this time, for the first time in history, there was a "sharp contrast between the new and the existing city"; a rift between "old and new" that made it impossible to impress throughout the city's new urban order. The real subject of the city project was "new city" while the historic city was enshrined the concept of "conservation".
In the rest of Europe, meanwhile, particularly in the states still dominated by authoritarian regimes, including Italy, celebrated the values of national identity and power represented, in symbolic form, in the construction of urban form, continuing the composition urban nineteenth century but accentuate the grandeur of the spaces and forms. The large volumes would have been the backdrop to the great outdoors; wide avenues and squares were replaced by screens arboreal to focus on elements that would have symbolized the monumental national power. Identical grandeur was attributed to the great monuments of antiquity as to isolate them and enter them in the focal points of the new city design. The city became essentially space of representation, symbolic model in the new expansion and upgrading of the existing city.

2. Different positions on fate of contemporary city

The different positions on the contemporary city fate (dispersion-centralization, transience-stability, dissolution of form) open extended fields of research, starting with the need to verify models and identity in the subway system. Faced with the current problems of the city balance between the processes of expansion and those of internal transformation is changing in favor of the latter. As for the urban extension, the answer to the problems of land use and resource sees converging interests, in Europe and America, for settlement systems dense and compact with strong additions to residences and equipment.

The typological and technological adaptation, completion, *overlap*, *insert*, now accompany the modernization of peripheries of many European cities. In twentieth century isolated (from Vienna to Hamburg, Amsterdam and Berlin) are often incorporated new elements (loggias, glass elevators, roofs, etc.) that do not alter the original architectural character of the work.

Other times the image is changed by r*estyling* (like *maquillage* of large blocks of the former East Berlin) or overlaps modern redesign the crowning of the block, grafting showy *high-tech* solutions.

Many *Siedlungen* '20s-'30s in Germany and Netherlands have adequate cells housing the changed social composition that sees the replacement of workers' houses with those of the middle class and new professional classes. In Rotterdam the small housing designed by Oud for the neighborhood *Kiefhoek* were united in pairs to increase the reduced surfaces of *existenz-minimun*.



Fig. 1: Spangen, Rotterdam

Large isolated *Spangen* designed by Brinkmann , who until the sixties appeared as a building of *clinker* dark, after the king's new immigration settlement was entirely painted white assuming the appearance of an eastern district. In Berlin-east the opening of *hofe* at the cultural and commercial activities has changed the way of these spaces, similar to the old disused factories converted into museums, cultural centers and malls, restaurants. Places once reserved and domestic spaces segregated labor, open to the passage, to walk, to great number. These changes alter the identity of entire urban parts that acquire composite characters.

The difference of the present condition than in the past, is that in the historic city overlay architectures occurred between compositional systems different but compatible because they belong to spatial concepts that are altered on a long time, in a substantial continuity of architectural experience. The rapid changes in the contemporary fashions, the sensitivity and compositional paradigms, accentuated by a frantic search for the new, the different, individual, fueling alienation and exclusion, eliminating the possibility of comparison and compatibility between interventions.

The need to write the architecture of urban pieces varied, often anonymous or unskilled, requires us to carefully select the significant themes that lurk between multiple and contradictory signs, on which to weave new urban stories.



Fig. 1: Hufeisensiedlung, Berlino



Fig. 2: Bad Dürrenberg, Leuna, Gross-Siedlung

3. Interventions methods "*to work on the built*"

The strategy of building built in is expressed in multiple ways. The first is to *demolish and rebuild* the buildings that have exhausted their life cycle. The replacement building allows the tissue to regenerate urban areas where it has elements of decay, as if what replaces seniority was a stem cell capable of reversing a biological cycle decadent revitalizing. The second way is identified in the *rehabilitation of buildings or groups of buildings*. In this case the recovery allows to confer a new functional content and formal building elements equipped with an architectural value which can be confirmed and strengthened. The third way is recognized in the *densification*, or to build in those residual spaces of the urban fabric, which may prove crucial in allowing, once used to house buildings, a better connection between different urban areas. The fourth way is the *mending*. It is to intervene in the interstitial spaces present in the urban fabric to create a network of new places, able to confer a better environmental quality to built. As regards the fourth mode it has more to do with the vacuum that with the full. In this case the space is the subject field that is put at the center of the operation of modification, an open space which in turn may be interpreted in different ways. It can in fact be considered as the result of the design of soil theorized by Bernardo Secchi, a term which refers to a certain extent in a bas-relief or tactile boards futuristic, but it can also be interpreted as a correlate of contextual relations produced by tilting the soil by the presence of buildings, as if the joint weight of the built planar find a match that would represent in a sense diagram.
Today with a concise analysis than has been realized according to these theories and practices we can identify three areas of action:

- interventions regardless of past and existing buildings: the case of many works entrusted, perhaps with direct appointment to the character of the moment Star System, which while leaving their indelible mark and clearly visible in the area, sometimes more tied to their image that express the true values of architecture, proposes styles and signs have already been adopted in other geographical and socio-cultural totally different;
- Interventions of relief and quality, compliance with design rules, the existing structures and a significant relationship with history: are those works that tend to fit into the existing fabric with contemporary interventions made with techniques, materials and languages of our time but discreetly and with special attention to the history of architecture;
- Finally, the last approach is Where was and How it was: anti-cultural phenomenon, remains widespread and sometimes imposed by strict regulations and grim sign of profound myopia, which impose in town centers to adopt languages that are not an expression of our times but only a copy of what had been achieved in the past.

4. From the existing modification to regeneration of industrial tissues

The city is subject to constant changes, the sites project become brownfield sites become available.
The disposal, as a practice of neglect, it grew rapidly: where industrial plants are decommissioned, remains the wound, the footprint imprinted in the urban fabric. The question posed is to build a complex of design strategies, operations on existing tissue that determine new languages for production space. A recovery process that passes by the modification of industrial fabrics existing regeneration of through consolidation

and the permanence of the track built, which memory to keep. A recent exhibition at the MAXXI in Rome was entitled *"Re-Cycle. Strategies for the architecture, the city and the planet"*, took the urgency of building a " *practice of recycling* " in front of the myriad of disused structures that dot the land.
Brownfield sites can no longer be considered as urban voids, made available by the demolition of existing structures, but as the ruins of the contemporary city. Is the building, fragment, and its relations with the context, to become an object of study.
The disposal is in recycling of parts and materials strategy of building spaces for new forms of production, where they recovered a *mixité* of uses and functions aimed at building a new relationship-house workshop. The architecture is "*recyclable material"*, history tells us this: Diocletian's Palace in Split or monuments of Rome and their endless transformations. *Stratify*, but also *overwrite* the existing new looks the way forward to restore quality to the territories abandoned in Italy and abroad, think Paris and projects for Ile Seguin in Grand Paris. Un work grafts, emptying and inclusions, so a job related to build on built in an effort to consolidate the tissues brownfield.



Fig. 3: Ile Seguin- Rives de Seine, Paris

5. Regenerate brownfield area: ASI Teverola (CE)

The Industrial Development Area in Teverola is an island of sheds between infrastructure networks in the north-east of Aversa. In Italy these urban systems are an emanation of urban zoning principle that produced built pieces between countryside and recent urban expansions. Agglomerations with independent life disconnected from city and suburbs.
Sheds stand as remains of a modern ruin invaded by nature. Vegetation appropriates buildings re-naturalizing what remained; a peaceful occupation of spaces, which has caused a disorientation and a time lag between the construction of large concrete elements and construction principles, between heavy prefabrication and vegetation's lightness, between elements' stiffness and the unpredictability of light filtering from above: only now the structural elements can be re-conceived in their function tectonics.
More than a hypothesis for the re-conversion of never built industrial buildings, we can speak about the use of large structures' pieces, as in the late Roman Empire pieces of ancient Early Christian's basilicas or parts of amphitheatres were re-used to build churches or when the columns became *spolio* architectures or when temples were incorporated into new buildings losing their initial shape to change into new buildings.

So we think that can happen in Teverola: concrete pillars, long beams, incomplete floors and stairs, excavations, nature become material for project. All is yet present, we need to remodel existing spaces and use *objets trouvé*.
To demonstrate that the system has its own importance at the landscape scale, we studied the possibility of introducing new elements allowing old alignments to come out as well as nature, spontaneously, appropriated buildings. Revealed territory's traces would re-found the place. The system of lot sin ASI, which took place in the '80s, was based on very clear internal rules: it uses a penetration axis with a perpendicular direction respect to historical road linking Aversa and Santa Maria Capua Vetere, with a thirty degrees rotation respect to Roman centurion axes who had governed urban centres growth like Carinaro, Gricignano, Teverola and Casaluce.
In particular, we are interested in arrangement of Camigliano, a small medieval village, of which only the «castle» still resists, really a big country house, a farm house built on the edge of a tufo fence near study area and cut by an old decumano.
In Caserta Provence there are several examples of mixed-use historical buildings with a large scale enclosure that had the task of collecting large portions of cultivated land for the control and management. From the walled courtyard houses, introverted, closed by blank walls and buildings on two or three sides, isolated in the countryside or aggregated making city, to large size systems, at landscape's scale, such as the Palace of Carditello, Ponti della Valle, the park of Caserta Palace which allow to introduce new rules. Then these settlement principles allow us to connect, to track directions, to overcome obstacles, to cross, to protect, to limit, to divide fulfilling needs that you may find on this land; they can be described as large metropolitan enclosures defining partially cultivated enclave, unsuitable for industrial agricultural exploitation, intended for small use or urban gardens. (*Carlo Alessandro Manzo Recinti Metropolitani' in Recinti Metropolitani. La costruzione della pianura campana a cura di C. A. Manzo, ed. Kappa, Roma 2012*).
The program provides a Music Polo divided into different subgroups of functions from production of musical instruments to sale, from education to production of CDs, from receptivity to musical experiments. To give the project a strategic breadth and a "place" that can rethink its historical past incorporating the recent infrastructural changes, there are three connection systems with adjacent areas defining a infrastructural connection network with different scales.
1 - The moving of Gricignano station on the metropolitan regional line identifies a provincial access point. At that node there are a connection with the study area, an high-rise office building, a parking area connecting new green axis with the nearby sports equipment;
2 - The realization of long inhabited wall with variable cross-section, as service volume for adjacent green areas, enhances the Centuriatio arrangement and sets a new limit to intervention area reducing fragments of cultivated areas and recovering abandoned ones. This system defines an agricultural park, crosses the study area at the outdoor arena, connects the triangular reception area and passes under the Asse di Supporto Nola / Villa Literno.
3 - The development and restoration of historical rural route cuts the two previous systems and combines the connected green areas: the park, the green urban axis, the adjacent tissue and farm house of Camigliano.
The system of existing sheds is reassembled and compacted into two compatible functional areas, through introduction of four architectural elements: a perforated slab placed at an intermediate height, a long inclined plane, a dig and a wall. There are conditions for introducing some typological variations distorting the idea of sheds as isolated objects and re-conceive them as aggregate objects in close relationship with outdoor spaces. These new elements allow us to have a ground floor covered with patios, filter green areas and light from above and the upper floor, more easily accessible, becomes a single connection terrace.
The first group of buildings, located on the west side, is the most consistent and houses at ground floor shops and exhibition halls; upstairs there are educational workshops as unique flexible spaces, with covers that are modified for technical and functional reasons. The second group of buildings, located on the east side, is connected through an excavation, an inclined plane and a glass wall. The new submitted plan identifies an intimate space, a square which if necessary can be used for outdoor performances. In these volumes there are educational workshops and workshops production of musical instruments.



Fig. 4: design intervention by group 05, Designing in Greenfield, Workshop 2013, ASI Teverola (Ce)

6. Conclusions

The topics considered are, then:
• Preservation and restoration of historic buildings
• Reuse of residual spaces and abandoned factories
• Renovation and development of urban surrounding areas.

Conservation and restoration of historic buildings
Is from comparison between the new and old that emphasizes the expressive intensity of both; both in conservation work (where the prevailing care in safeguarding the characters and matrices formal building materials, construction techniques and types compliant), or renovations (where present sincerely shapes, materials and technologies as its contemporary expression a renewed urbanity, however, in balance with the urban landscape conformed). In both cases remains determining the capacity to act, on the one hand, without forcing the performance capabilities of historic buildings and their architectural qualities; the other developing a constructive logic compatible, able to dialogue with the existing.

Re-use of residual urban spaces and abandoned factories
The closure of production activities has left abandoned spaces degradation: from factories nineteenth century, rich in history, with the residences workers still inhabited to those of more recent industrial period, the most remote and uninhabited. In any case, they represent an opportunity for new forms of urban living as well as for more solid reasons constructive architecture: productive functions of traditional and innovative, new ways of living and working in space unpublished regenerated, responding to the question of the manifold contemporary society; green spaces, squares, meeting places, leisure and culture. The opportunity to engage unexpected public functions and group in the urban marginal offers hope of aggregation and integration of the current multi-ethnic society and a foundational principle for the future city.

Renovation and development of urban surrounding areas
The issue that arises is to recover the values of the rural environment with functions appropriate to their characteristics, by encouraging the use of agricultural and forest soils. The process of recovery and development of peri-urban areas should aim to provide rural services to urban communities in terms of cultural facilities and leisure as well as products from organic farming to zero km, in a logic of network relations, in which the territories peri regain the strength to fight their occupation indiscriminate.

Bibliographical References

[1] BONELLI, R. *Il rapporto «antico-nuovo» nei suoi aspetti storici generali*, 1957, in R. BONELLI, *Architettura e restauro*, Neri Pozzi Editori, Venezia 1959.

[2] CANIGGIA, G. *Strutture dello spazio antropico*. Studi e note, Firenze 1976.

[3] CANIGGIA, G. MAFFEI, L. *Composizione architettonica e tipologia edilizia*. 1a Lettura dell'edilizia di base, Venezia 1979.

[4] DE LUNA, G. *Se questo è un monumento*, 'La Stampa' 21 gennaio 2008.

[5] PANE, Roberto. ROGERS E. N., *Dibattito sugli inserimenti nelle preesistenze ambientali*, in «CASABELLA Continuità», n. 214, febbraio-marzo 1957.

[6] PANELLA,R. *Frammenti di una città possibile: Piccolo decalogo per una città possibile*, in Community/architecture. 57 contributi di ricerca in ambito internazionale, a cura di E. Prandi, Parma 2010, pp. 20-32

[7] RIVA G., Il colore del patrimonio industriale, Atti del Convegno Il Colore nella produzione di architettura, Università Iuav di Venezia, 27-28/09/2007, Ipertesto, Verona 2007, pp. 212-220.

[8] RIVA G., STEFFINLONGO F., On two interesting industrial prestressed concrete buildings in the Alto Vicentino (1958 - 1962), Proceedings of Fourth International Conference on High Performance Structures and Materials, HPSM 2008, WIT Press, The Algarve, 13-15/05/2008.

[9] ROGERS,E.N. *Gli elementi del fenomeno architettonico*, a cura di C. De Seta, Napoli, Guida 1990, p. 113.

[10] RUFFINI,E. *Lav oro di squadra, intelligenza e fantasia: storia del Memoriale*, in 'Quaderni di Ananke' 1/2009, p. 13.

[11] SEMERANI, L. *Tecnica e civiltà moderna, in «CASABELLA», n. 238, aprile 1960*

[12] TRISCIUOGLIO M. (a cura di), Progettare per il patrimonio industriale, Celid, Torino 2008, pp. 232-239.

[13] ZEVI, B. *Linguaggi dell'architettura contemporanea*, Milano-Perugia, Etaslibri 1993; RCS 1998, scheda 46.

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Villa Cambi – an unpublished posthumous building of G. Michelucci realized by B. Sacchi

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Villa Cambi – the discovery of an unpublished posthumous building of G. Michelucci and B. Sacchi
During the course of the research related to the study of the design and construction problems of posthumous building attributed to the most important designer of the XXth century, it has been examined in depth the buildings attributed to G. Michelucci and realized after his death.
In this context, it has been found the completely unpublished archive of the architect Bruno Sacchi, a close Michelucci's collaborator, for more than 20 years, that completed many of his building after his death. This archive has been in part listed and computerized.
During this work it has been individuated a big residential building realized in Prato, near to Florence, named Villa Cambi, that, at this moment, is not present in the list of building attributed to Michelucci.
Due to the presence many typical invariants of the Michelucci's design, it has been decided to examine in depth this building, through an analysis of the document deposited at the Municipality Archive of Prato. Here it has been found a project of the house signed by G. Michelucci as well as B. Sacchi.
The analysis of the building, concluded in 1994, 4 year after Michelucci's death, underlines the many analogies between the project signed by Michelucci and the house effectively realized by Sacchi, making it an unknown building of Michelucci.

Keywords: Michelucci, Sacchi, Modern, posthumous

1. 'Cambi' Villa

Cambi Villa, a single-family building built at the turn of 1990s in the suburbs of Prato (Tuscany), can be mentioned within the research [1] field concerning the problems of design and construction of the posthumous works attributed to the masters of Modern architecture. Such buildings, built after the designer's death, represent the artistic will of the master's architectural intuition. Hence the approach to their recovery and conservation must follow meticulous principles which, in some cases, are more complex than in a modern work. This difficulty depends on the fact that the designer who follows the works until the construction of such buildings, from one hand interprets the original design (coming from the died designer), from the other hand adds his personal contributions during the construction phase or during the completion of the project.
Although this building is not numbered among the works attributed to the Arch. Giovanni Michelucci, it was possible to find a project signed by him. The documents (around 1000 between drawings and technical reports) were found both in the Arch. Bruno Sacchi's private archive, that it's now owned by the heirs, and in the historical archives of Prato. The project is co-signed by the two architects, although the building was built only after Michelucci's death.

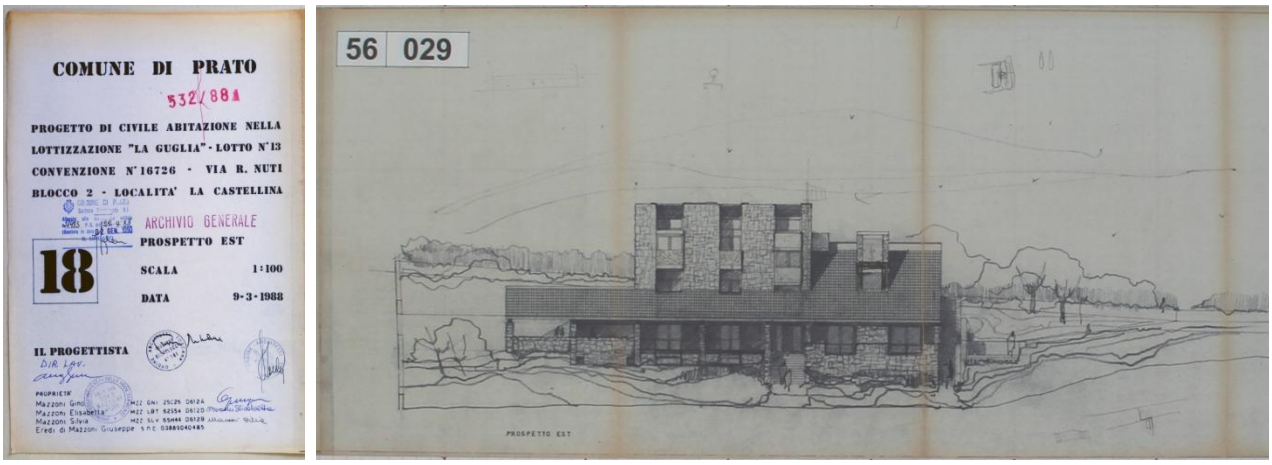

Fig. 1: One of the paper of the project signed by Arch. Giovanni Michelucci and Arch. Bruno Sacchi - 1988. Archives of Prato Municipality.

The Architect B. Sacchi, coming from Emilia Romagna and student of Adalberto Libera, fulfilled several important works in the second half of the '900, such as the buildings ISES located in *Le Torri a Cintoia* in Florence, the set-up of Marino Marini Museum in Pistoia and the restoration of S. Pancrazio Church for the realization of the same Museum in Florence [2]. Since the '70s he was a close collaborator of Michelucci with whom realized several important buildings, such as *Cassa di Risparmio di Pistoia e Pescia* located in Pistoia or the branch of *Monte dei Paschi di Siena* in Colle Val d'Elsa. After Michelucci's death, B. Sacchi also took charge of the prosecution of all those works still unfinished at the moment of master's death, such as the *Limonaia* of Villa Strozzi in Florence, the new Headquarter and the *Contrada di Valdimontone* Museum in Siena, the *Misericordia di Badia a Ripoli* in Florence and the Church and the parish *Santa Rosa* in Livorno. In these works Sacchi tried to affirm the cultural, artistic and ethical principles that are always been at the base of Michelucci work, to interpret the master will and, at the same time, he added his personal stylistic invariants into the buildings, combining them with the previous principles [3] [4].

2. Eng. Gino Mazzoni's 1987 plan

The design concerning the new realization of the area is dated back to the 1987 and is signed by the Eng. Gino Mazzoni, co-owner together with the brothers of a lot of irregular ground, with an area of 7200sqm and located in the suburbs of Prato, in an high quality residential area.
The Eng. Mazzoni realized a first preliminary project that included the construction of two single-family villas. This setting-out of the intervention will remain unchanged for all further design stages. Mazzoni built one of the two villas, instead the architects Michelucci and Sacchi received the task of designing the other one, after the sale of a land portion to the textile entrepreneur Mario Cambi.
In the Villa Cambi first design, the Eng. Mazzoni considered a distribution on four floors, including the basement and the attic, internally linked by two detached stairs blocks. At the basement there were the secondary places: garage, boiler room, laundry room and a storage room. At the ground-floor there were a living area overlooking a large semicircular loggia, made by a double eight living-room, a kitchen, besides a night area with two bedrooms, two restrooms and a studio. The first floor housed instead 4 bedrooms and three bathrooms. An uninhabitable attic was located at the second floor.
In 1987 the Eng. Mazzoni showed up the request for the building permit. The year after Cambi commissioned Michelucci and Sacchi to design the Villa, even if the acquirement of the lot would have been formalized later, on the 13th of February 1990.

3. Prof. Michelucci and Arch. Sacchi's 1988 plan

The first sketches found in Bruno Sacchi's archive are dated back to the first months of 1988; most of them are unsigned, but a comparative analysis let us confirm that the majority of them are Sacchi's work.
This is in line with the usual planning methods known for other projects carried on in team between the two architects. In fact Michelucci, during his last years, carried on his own concept of architecture as a social mean, and at the same time the innovations and brilliant intuitions coming from his lifelong career; his ideas thus were used to inspire Sacchi in developing the work, always under the supervision of the master.
Although the new plan developed by Michelucci and Sacchi may appear close to Mazzoni's work, especially for what concerns the general layout, as a matter of fact the building is strongly different.
The Villa has a gross area of 700sqm and develops on three floors above ground, plus a basement, and is surrounded by a garden which is wider than 3000sqm, and abuts on two sides with the roads and on the other sides with two lots, one of which was Mazzoni's estate.

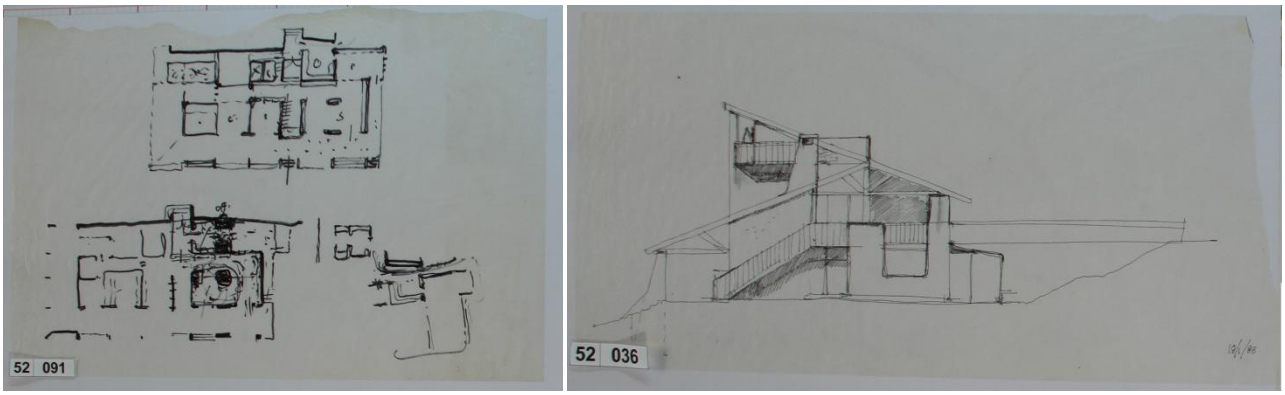

Fig. 2, 3: Sketches of the first project presumably realized by Michelucci - 1988 - Archivio Architetto Bruno Sacchi.

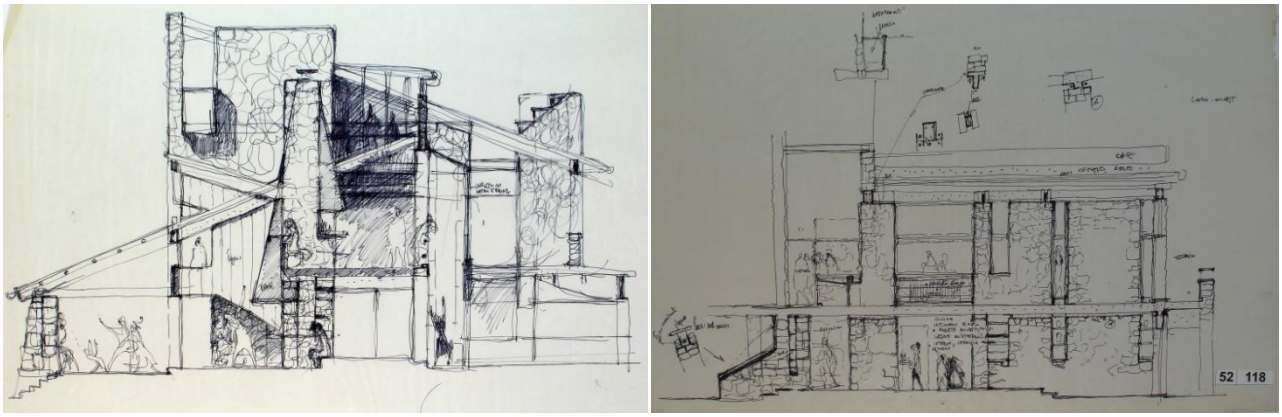

Fig. 4, 5: Sketches of the living area and of the "West house side" - prob. 1988-1990. Archivio Architetto Bruno Sacchi.

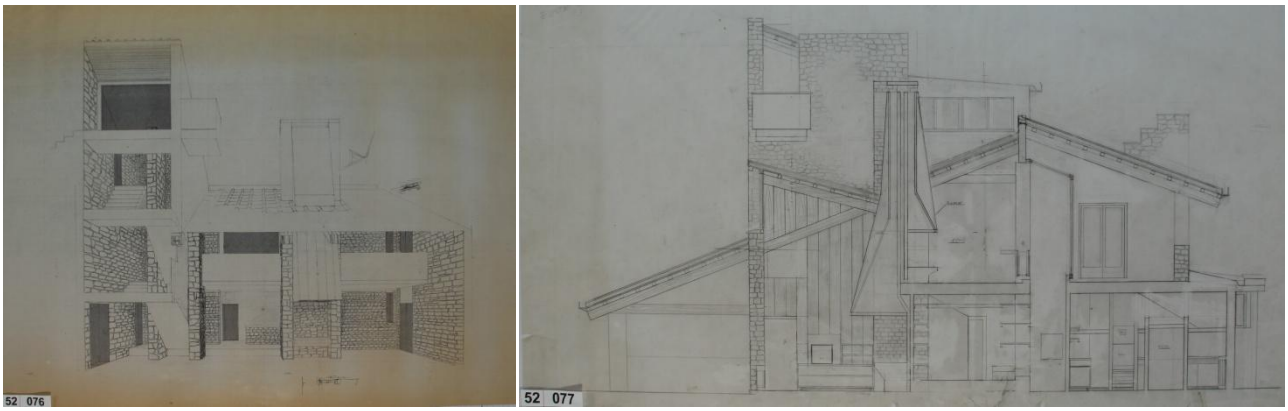

Fig. 6, 7: Sketches of view over the living room on two levels and of the staircase (1988-1990) and section of fireplace and living room area (1990). Archivio Architetto Bruno Sacchi.

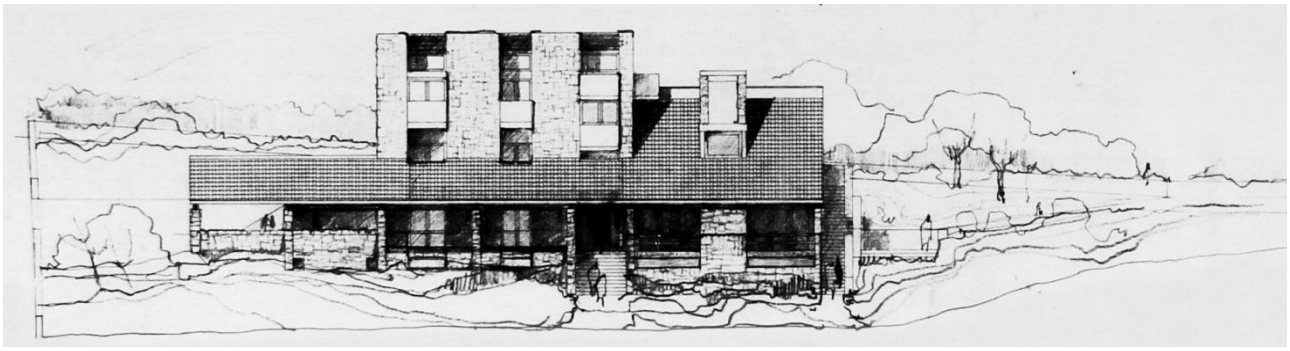

Fig. 8: Drawing of main façade- 1988. Archivio Architetto Bruno Sacchi.

The Villa has a gross area of 700sqm and develops on three floors above ground, plus a basement, and is surrounded by a garden which is wider than 3000sqm, and abuts on two sides with the roads and on the other sides with two lots, one of which was Mazzoni's estate.
The main access to the villa is situated on the main road, downstream-side, and here we can find a partially underground private garage which is outside the villa; a secondary entrance, which is both vehicle and pedestrian accessible, leads through a ramp to the underground garage; a third entrance is situated on the higher part pf the garden, close to the secondary stair inside the villa. This entrance comes from an upstream road and leads both to an external stair leading to the ground floor entrance, and an external gangway linked to the first floor. At the basement, which can be reached through a service stair in addition to the external access and the garage ramp, there are a large storage, a pantry, a laundromat, a garage and the thermal plant room, which is located in the middle of the building. The ground floor is divided in two main areas: a living area consisting of a kitchen, a dining room and a living room which unfolds on two floors, and a night area, with two bedrooms and a studio. At the first floor there are two more bedrooms, for Cambi's children, with their own bathrooms, an atelier and one more living room facing the lower floor. The second floor is an attic with a storage closet. The Villa is integrated by a set of loggias and external paved spaces which allow to walk freely through the whole building perimeter. The façades are characterized by *alberese* stone, béton-brut, steel structures left in sight and timber components, with a structural function or coupling the steel structures. The lower buildings are covered by a gable roof and the higher one by a mono-pitch roof, which faces the valley. The roof covering is made of traditional *cotto* tiles.
A permission to build was required, canceling the previous one, on the 22nd April 1988, and it was released on the 2nd January 1990.

3.1 Plan variations and realization of building

During the building construction two variations at the original plan occurred, but they didn't generate any significant change to the former project. The first variation, which dates back to December 1990 – that is, a few days before Michelucci's death, is due to an update to the architectural plan caused by the executive structure and plant drawings (structures were calculated by Eng. Mazzoni on February 1990). Little changings in the spaces arrangement were introduced as well, consisting of the addition of typical Sacchi's architectural features, such as a shower cab placed above the stairs leading to the lower ground floor. The perspectival asset was partially changed as well, mainly to improve the natural lighting of internal rooms.
The structures and their works supervision were made by Engineer Gino Mazzoni, while the Structural Certified Verification on concrete and steel structures, carried on by Eng. Michele Abruzzini, are dated back to 12/14/1993. The executing company results to be the *I.C.E. s.r.l.* from Prato. The building was finished at the end of 1993, as it can be inferred from the archive photos and from what declared in the Report of the Structural Certified Verification.
On the 21st of March 1994 an "as-built" final drawing was issued, in which – as stated in Sacchi's technical report – the changings in the plan were due to the clients' specific requirements, such as turning the central goods lift into an elevator in order reach the basement, adding a barbecue in the first floor loggia or organizing the ground floor living room to a single-floor space.
Since the Villa results with full rights a posthumous work, a comparative study was performed, between the original design - made by the two architects in partnership - and the building as it was realized, so as to underline the contributions to Sacchi's drawing after the master's passing.
In comparison to other posthumous buildings studied, this one turns out to have undergone little changings between the plan's first issue and the building itself. They consist mainly of a natural improvement of the plan, deriving from executive drawings, in addition to the changings required by the client or by constructive demands. Sacchi's personal distinctive features can be clearly identified in the accurate study of furniture, in small spaces exploitation, as well as in the study of natural daylighting and the large use of transparent surfaces.

4. Design rules and distinctive features

Many architectural patterns typical of Michelucci's work can be identified inside the Villa's plan, some of which are related to the architect's latest working period in collaboration with B. Sacchi.
The Villa may be catalogued as belonging to a minor Michelucci's composition line which was defined by, in Ludovico Quaroni's words, "*[..] E' l'architettura che predilige i materiali tradizionali prendendoli come sono, senza lavorazioni che ne snaturino l'essenza, ma riesce da questi mezzi semplici a trarre effetti spaziali che nascono dalla consuetudine col passato, e si sviluppano poi sfruttando la più consumata, attuale arte di determinare i singoli spazi di vita, mettendoli in relazione dinamica fra loro, e questo calibrando una per una le pareti, una per una le bucature e la presenza, o meno del vetro, ma sempre cercando di rapportare dinamicamente i volumi, rendendo il sistema ricco di prospettive, di interrelazioni fra interno-casa e esterno-paesaggio [..]."* ("[…] It's the architecture that prefers the use of traditional finishing materials, without processing and thus distorting them, and by this way succeeding in creating space effects that arise from familiarity with the past and develop by taking advantage of a more seasoned, up-to-date art of creating life

spaces, putting them in relationship with one another, and all this by measuring, item by item, walls, openings and the presence of glass, always trying to dynamically bond volumes, enriching them with perspective views, with connections between the inside/the house and the outside/the landscape[…]") [5].
In the Villa layout we can recognize the effort to isolate the minor functions rooms below the ground, where the landform allows it, as formerly done with *Villa Strozzi Limonaia* and with the *Contrada di Valdimontone* headquarter [6].
The close relationship between inside and outside spaces is clearly defined as well, which follows the idea of "open architecture" [7]. It is put in practice by means of a paths and entries system which lets the inside spaces of the ground floor, and some of the first one, intertwine with the outer spaces, through filters created by the loggias, projecting the house on the outside and by this way creating a close relationship between the house and the landscape.
A typical feature is a multiple-layers way of arranging spaces: this is carried out in the Villa as well, even though it is a private house, since the very first sketches, even if not completely put in practice during the construction phase.
In the Villa, the theme of a dynamic exploitation of architectural spaces is pursued by alternating central spaces, such as the double-level living room with a two-faced fireplace, with serial rooms such as bedrooms, bathrooms and other day-zone rooms [8].
From the analysis of geometrical-dimensional rules followed in planning, a typical "composing measure" was detected in this Michelucci's work, recognizable in the internal rooms arrangement but also in the structural planning, in multidisciplinary logic, in this case measured on the function of the house, pursued by the master after his long teaching experience in Bologna Faculty of Engineering.
The internal spaces are defined by a pattern of 4,50m, that we may call *A*, while the routes pattern is of 2,80m, named *B*. Instead, the secondary rooms, especially the first-floor rooms, are arranged by subtracting half of the module B from the main module. In fact *B/2* is the measure used by designers to define secondary paths like corridors, service stairs and secondary loggias. Although the Villa may look as an extremely complex building with convoluted façades, it can be noticed that the main façades are organized according to a void/full balance set on the basis of the internal pattern, which moreover regulates the loggias spaces but also the large central flue, that even hosts a window, in the main living room.

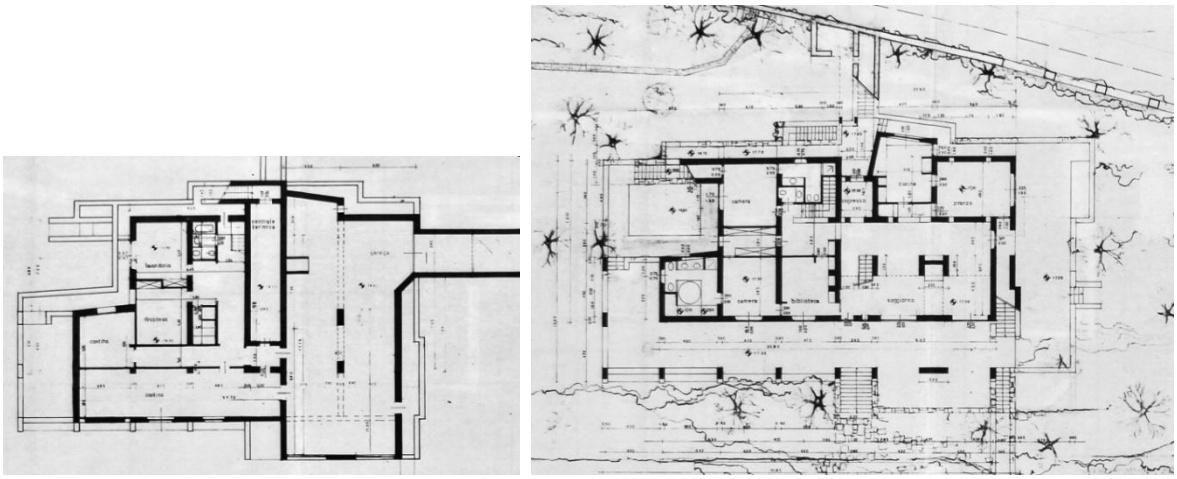

Fig. 9, 10: Plan of the basement and of the ground floor - 1994. Archivio Architetto Bruno Sacchi.

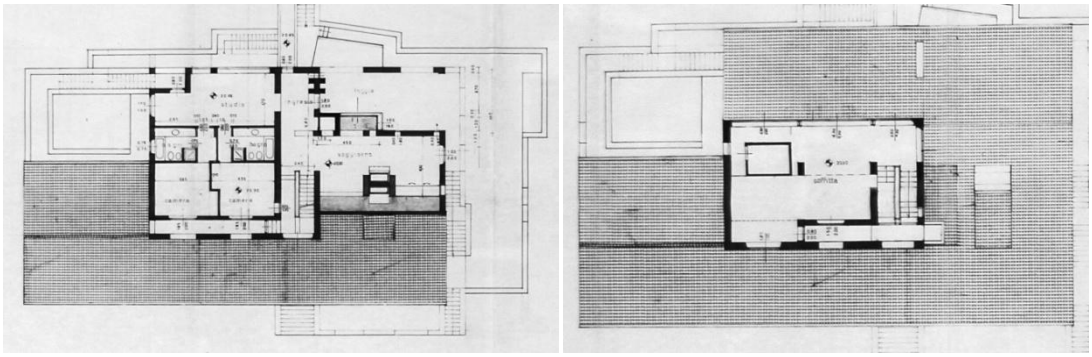

Fig. 11, 12: Plan of the first floor and of attic - 1994. Archivio Architetto Bruno Sacchi.



Fig. 13: Analysis of geometrical-dimensional rules followed in planning

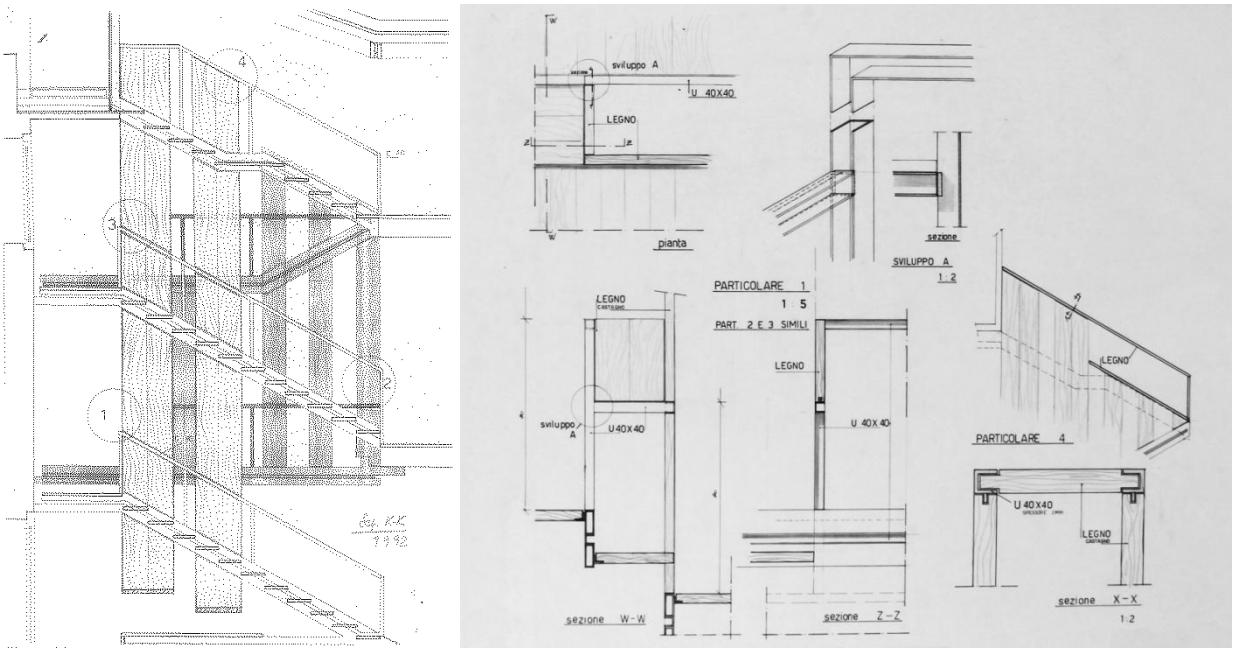

Fig. 14, 15: Section (1992) and details (probably 1992) of the main staircase. Archivio Architetto Bruno Sacchi.

A critical analysis of the Villa and its drawings allowed to detect many distinctive features of Michelucci's work, but also the ones used by the both architects during their collaboration and also the typical characteristics of his pupil B. Sacchi.

The theme of the walkable space and the multiplicity of pathways, which is best expressed in public buildings, is well defined in the Villa: the entries system, described before, allows to go through different horizontal and vertical paths in the house, with different hierarchies.
The steel-and-chestnut wood stair project was carried on by Sacchi, who performed different solutions before coming up to the final one, thinking, as usual, of the stair as an important piece of architecture and furniture.
Sacchi's stairways seem to be light and suspended above the floor, that's why he made them of steel and wood. They are often detached from the floor and often even from the side walls.
The same care is used to the design of the fireplace, which according to Michelucci is a cornerstone of hearth and family life, so it is designed at the center of the living room and is the main defining and distinctive element in the room, enhancing its spatial features.
Like Michelucci, Sacchi always paid great attention to the design of fireplaces [9], making them unique in all his projects, starting from the one in his own house *Casa Torre* in Bagno a Ripoli.
The individual contribution of Sacchi to the Villa project and realization is clear for what concerns the careful study of natural and artificial lighting of space. "*Soffusa o violenta, filtrata o piena*" (*"*Suffused or violent, seeping or full*")* [10], as much natural as possible, light is a cornerstone of the architect's work: it is an essential mean to enlighten spaces, material textures and bearing components.
It is though necessary that the sun and the luminous bodies are not directly visible [11]: from this requirement, the use of roof openings, the protection of vertical windows with screens or loggias, the use in internal spaces of screened luminous bodies, mostly with neon lamps, arises.
Sacchi inserts in the Villa openings from the attic to the childrens' study, from bedrooms towards stairs, and lighting spots in key points. Despite the house large size, Sacchi exploits, as he refines the original plan and as usual in his design approach, every unemployed space, creating recesses, utility rooms or even enlarging a bathroom by creating a shower stall above the service stair landing. He also develops the design of many fixed pieces of furniture, such as those in the library, the living room but also in the bedrooms.
As regards the materials choice, in this case as well modern technologies are put together with traditional matter: béton-brut and steel are placed side by side with *alberese* stone, laid down on regular rows, wood and *cotto* tiles.

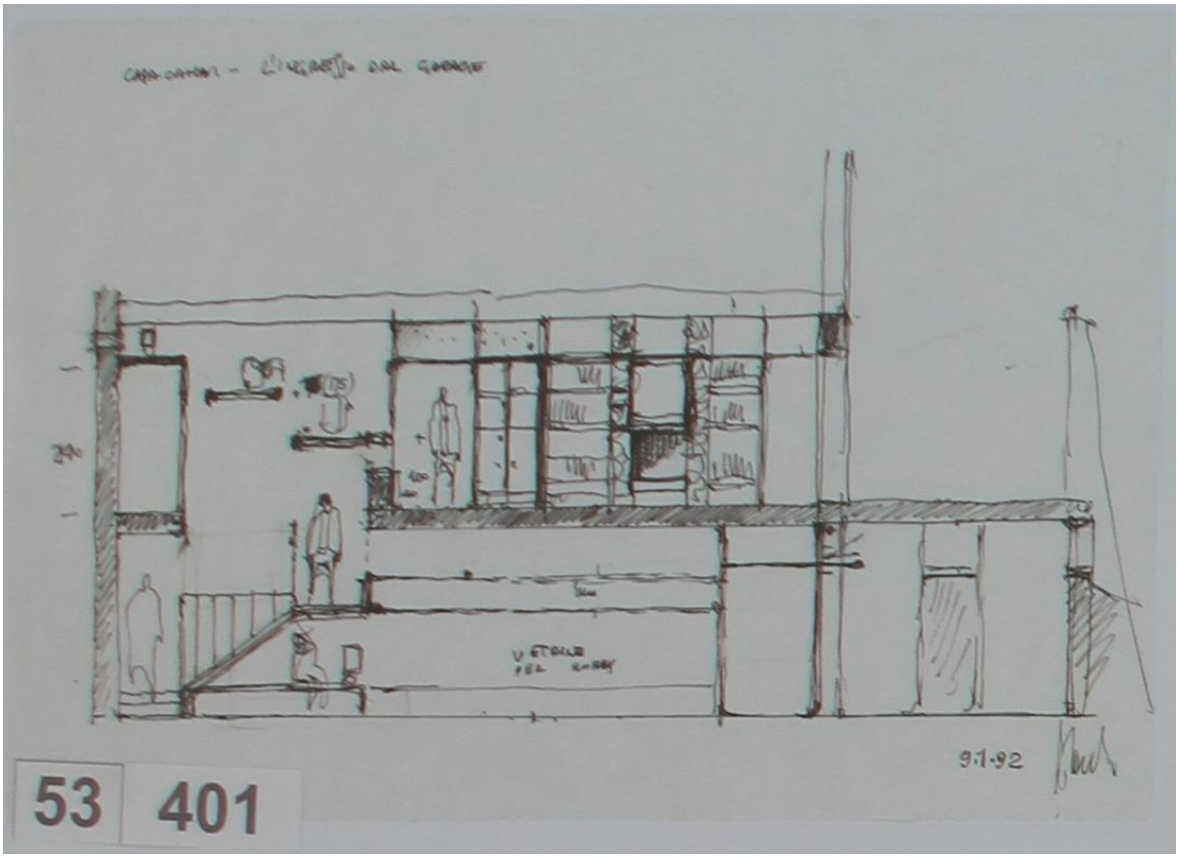

Fig. 16: Section of the staircase leading to the basement area - 1992. Archivio Architetto Bruno Sacchi.

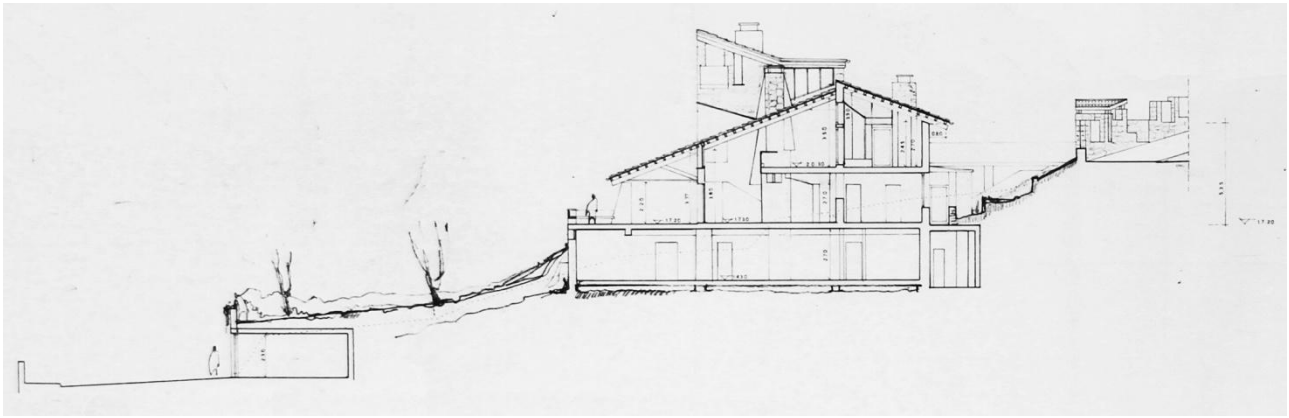

Fig. 17: Drawing of transversal section - 1994. Archivio Architetto Bruno Sacchi.



Fig. 18, 19, 20: View of the Villa during the construction - 1993. Archivio Architetto Bruno Sacchi.

5. The building

5.1 The structure

The building foundations lay on *alberese* stone, previously cleared from the above clay ground; the foundations are continuous under the concrete walls and plinths under concrete columns, and they are all connected one another by ring beams or 70-cm-high foundation beams. Two different constructive systems are defined: concrete and steel. The basement is totally made of concrete structures, walls and columns up to the ground floor slab. At the ground floor, steel columns arise in the day-zone and in the loggias, so they can be taken incorporated into the massive non-structural walls made of *alberese* stone.
In the double-floor living room, in the kitchen and in the dining room the columns are HE steel profiles, whereas in the loggias they are square-shaped, left in-sight to claim the non-structural function of the stone. In the remaining parts of the villa the structure is made of concrete columns with hollow bricks infill walls and stone external coating. The floors are made of 20-cm-thick concrete slabs. The ground floor slabs, with an orthogonal frame regarding the main building, are partially made of concrete plates reinforced with steel frameworks, lightened with polystyrene plus finishing concrete casting, and partially with hollow block floor. This last structural solution is used for the upper stories as well, except for the living room which is made of an unfinished white concrete slab, which is tapered at the top end to a thickness of 10cm. The roof recalls the local building tradition of wood and brick. Although steel is used for the main frame (150x100x14mm coupled angle brackets) and the secondary (T brackets tailored upon the roof slope), the minor frame is made of chestnut wood beams plus a finishing made of *cotto pianelle* (low-thickness bricks), in line with the local tradition. Steel structures are decorated with wooden pieces that leave the steel structure in sight. The roof is finished with a concrete cast, a thermal insulation layer and a *"alla romana"* clay coating. The pathway that leads from the road to the first floor is made of a U-shaped concrete slab with a 2,50m cantilever towards the house. The main stairway is made of steel and wood and has the function of a proper piece of furniture, besides its vertical connection function.

5.2 The adopted technical solutions

An executive section of the building was rebuilt in order to have a complete knowledge of the building itself. Only the drawings of the structures were found, related to the last modified version of the project, whereas archive documentation such as technical specifications, prices list, bills of quantities were not found.

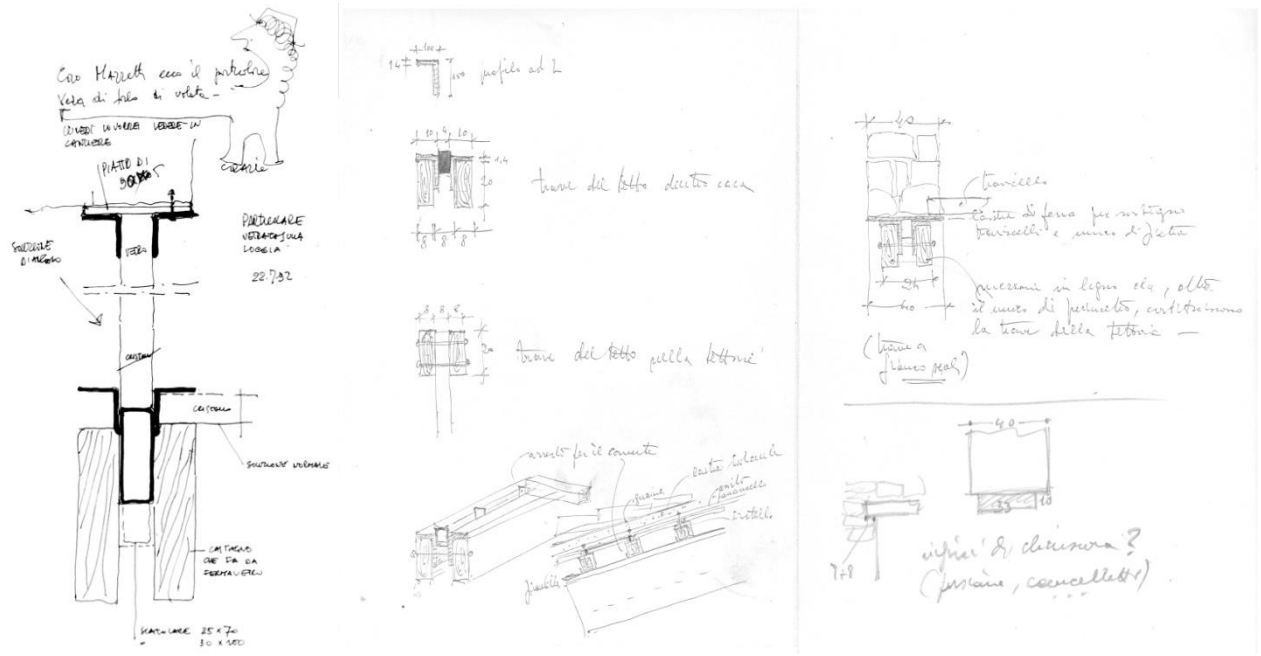

Fig. 21, 22: Details of the glass wall over the lodge (1992) and of the roof's joints. Archivio Architetto Bruno Sacchi.

Therefore the study of the building was based on notes and sketches of the Arch. B. Sacchi, as well as detailed drawings of horizontal sections related to an intermediate project phase, photos, and also based on the comparison with other projects made by the architect himself or in collaboration with Michelucci.
The building shows several analogies with many Michelucci's projects, for example the juxtaposition of materials such as stone, wood and brick, which remember the construction tradition, with materials such as concrete and steel which are always declared.
The technological solutions adopted for the vertical walls of the building are:

- Masonry, probably single-piece masonry, made up *alberese* fair faced stone with thickness of 40cm which covers the steel structure. This kind of masonry is adopted throughout the living area and it is also used for the portions of walls which divide such area from the night one, but finished with plaster.
- Masonry made up a double wall with 25cm *alberese* stone (on the external side) plus 12cm perforated brick (on the internal side) and 3cm insulation layer in the air gap between the two walls. This type of wall is adopted throughout the night area on the ground floor and in the kitchen. The bearing structure is made up reinforced concrete coated by 15cm *alberese* stone.
- Multi-layer masonry made up, from the external side to the internal one: *alberese* stone with thickness of 15cm, 25cm reinforced concrete diaphragm, 3cm insulation layer and hollow brick with thickness of 6cm. This wall is adopted at the basement and it is plastered at the portion that is above ground.
- Multi-layer masonry made up, from the external side to the internal one: 40cm reinforced concrete diaphragm, 3cm air gap and hollow brick with thickness of 6cm, plastered at the portion that is against the ground and on the cavity.

6. Conclusions

The study of archive documentation allowed to award the building project to Prof. Michelucci in collaboration with Arch. Bruno Sacchi. The Villa, built after the master death, as well as other more important buildings attributed to him, can be considered as a posthumous work currently not present in the list of Michelucci's works.
The realized building shows characteristics which can be recognizable in Michelucci's works of his latest production period in which he was assisted by B. Sacchi. The latter influenced such works with his design features and he was the architect who followed the construction of the incomplete buildings after the master's death.
At the same time, some solutions typical of Sacchi's work are clearly identifiable in the building. In reality the works supervision was assigned to the Arch. Massimo Cambi, owner's brother, but anyway Sacchi followed the construction developments. This is demonstrated by the large numbers of studies, realized by Sacchi, that are related both to the construction (coverage nodes, the steel truss, the use of wood for the porch, horizontal sections made on the various floors, sections on windows and doors, stairs, the fireplace and its

chimney and so on) and to the solutions for fixed furnishings and protective elements (furnishings of the library and of the kids' rooms, gates and so on).

Bibliographical References

[1] BAZZOCCHI, Frida, DI NASO, Vincenzo, MASI, Andrea, Problematiche di progetto e costruzione delle opere postume. In AA.VV. *Ricerche ISTeA per l'ingegneria dell'architettura. Isola d'Elba 17-19 Giugno 2010*. Florence: Edizioni Medicea, 2010. ISBN: 978-88-901744-9-0.

[2] *Riabita*. Savio, Andrea. Il museo Marino Marini a Firenze (June 1994, n° 6). Milan: Rima Editrice. ISSN 0393-4411.

[3] *La nuova città*. Geddes da Filicaia, Marco. L'opera e l'autore (January 2001, n° 1). Florence: Edizioni Polistampa. ISSN 0393-4411.

[4] BAZZOCCHI, Frida, DI NASO, Vincenzo, MASI, Andrea, Fra Michelucci e Sacchi: quattro opere postume di un maestro dell'architettura moderna. In AA.VV. *5° Proceedings of the International Conference History of Engineering, Naples, 2014 May 19th - 20th. Naples:* Cuzzolin editore, 2014. ISBN: 978-88-87479-80-5.

[5] QUARONI, Ludovico, DI PASQUALE, Salvatore, LANDUCCI, Giovanni. *Giovanni Michelucci, La pazienza delle stagioni* (edited by SACCHI, Bruno). 1ª ed. Florence: Vallecchi editore, 1980.

[6] BUSCIONI, Cristina, BRUNETTI, Fabrizio, NALDI, Fabio. *La città di Michelucci*. 1ª ed. Florence: Parretti, 1976.

[7] CONFORTI, Claudia, DUILIO, Roberto, MARANDOLA, Marzia. *Giovanni Michelucci 1891-1990*. 1ª ed. Milan: Electa, 2006. ISBN: 978883704092.

[8] BERTAGNI, Stefano, COLONNA, Emiliano, NUTI, Franco. *La sede della Cassa di Risparmio di Firenze di Giovanni Michelucci - Progetto e costruzione*. 1ª ed. Florence: Polistampa, 2013. ISBN 9788859613008.

[9] *Casa Vogue*. Odoni, Giovanni. Protagonista un camino-scala (January 1982, n°126). Milan: Edizioni Condè Nast.

[10] *Professione: architetto*. Sacchi, Bruno. Museo Marino Marini a Firenze (May-June 1989, n° 3). Florence: Alinea Editrice.

[11] *Casa Vogue*. Corsini, Giuliana. Bruno Sacchi: il cielo in casa (October 1983, n°145). Milan: Edizioni Condè Nast.

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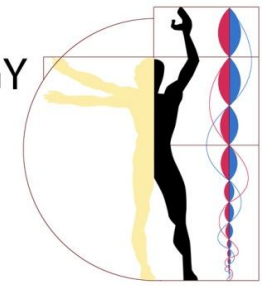

"Sensing to the past" like a new paradigm: knowledge and experience on fortified architectures

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Abstract

The *architectural stratification*, as a *sign* of its *spatial, historical and temporal* reality, is a condition that represents the continuous activity of the man who builds, modifies, adapts a pre-existence to its needs: systems of protection and punctual defense of the territory and its population, specialize their functions and turn into castles.

The pages of the "story" of this construction are *stone words*, written by many hands, that tell transformations, changes and are the witnesses of an architecture enhanced by new meanings: a complex system of "signs of time", *cultural signs* related to the methods of construction and *natural signs* linked to the duration of the things in their interaction with the environment that is shaped and corrupt with new configurations by the human action. These signs identify the "character" of architecture: its *aura*.

Aura considered as an aesthetic-cognitive experience linked to "sensing" the past, the object's uniqueness and unrepeatability, that special, sacrosanct *quid*, that special fascination that emanates from an object and that in its materials retains the signs of its life throughout space and time.

The aim of each intervention becomes not to miss this experience's opportunity that have to be protected as "the most precious heritage" that the past leaves us. Hence the need of the project as a *words of the story* of this knowledge path: an "unveiling" that cross the "threshold" between what it was and will be. The project of a new use is configured as a "*timid* write" that draws by fragile relational grafts, scenarios of perception and enjoyment able to generate new "life cycles".

This perspective of our study will be developed through some works on fortified buildings of different contexts, where the theme of the ruin and the rest returns the "memory" as remembered present, simultaneously evoking an absence and a presence, an intersection between the visible and invisible.

Keywords: Heritage, Architecture, Conservation, Cultural landscapes.

1. Architectural stratification

Architectural stratification, insofar as the *sign* of the discipline's *spatial, historical and temporal* nature, is a condition that represents men's on-going activities: building, modifying, and adapting the pre-existent to meet their needs. *Walls* constitute pages that "recount" this construction: *words of stone,* written by several hands, narrate transformations and changes, and bear witness to an architecture enriched by new meanings. *Walls* are also a complex structure charting the "signs of time".

These are *cultural signs* associated with building techniques and *natural signs* that, by registering the duration of objects in their interaction with an environment, shape and degrade men's actions with original forms. The wall is an extraordinary opportunity to discover the history of a building by virtue of the *traces* left by men's actions as also to understand architecture's character: its *aura*.

The expression *aura* should be understood as an aesthetic-cognitive understanding associated with "experiencing" the past.

This is a special *quid sacrale*, or fascination that we can perceive in architecture, whose materials record the signs of life left in its own dimension of space and time, which makes it unique and unrepeatable. Hence, the purpose of the design project is to ensure that the possibility of perceiving this experience is not lost; an experience that should be safeguarded as the "most precious heritage" that the past can leave us, and which is obtained by establishing a relationship with new structures in the form – usually minimal – of *implants*. The

objective would be to attribute new meanings to extant works in order to reconstruct the “memory” of places, where just perceptible traces remain.
Such reactivation measures can consist in the inclusion of "delicate" elements, i.e. temporary or permanent minimal equipment. In the cases at hand, the project should experiment with signs that can give new life to far-flung landscapes and buildings, a kind of faint "overwriting" to promote tutelage, accessibility, new uses, perception and unhurried enjoyment through design strata able to engender a new life cycle with respect to the pre-existent.

2. From the *visible* to the *invisible*

Various considerations emerge when we bring these reflections to bear upon a special theme that characterises present-day culture, namely, the series of First World War constructions.
For many years, the Great War has become a subject of great interest for an ever-greater number of persons and bodies: scholars drawn from various disciplines, historical-cultural associations, volunteer groups and public bodies. This interest goes hand-in-hand with a cultural climate characterised by numerous initiatives that have slowly contributed towards the understanding that the "vestiges" of the Great War represent cultural artefacts to be safeguarded and treasured.
Various questions have emerged in this period as regards the *destiny* of a cultural heritage and of *works* that are both so vast as to make a full and considered evaluation necessary. Moreover, this evaluation has gradually begun to involve many different disciplines, thereby bringing to the fore the need for a dialogue between various "approaches" to architecture, territory, and landscape so that we may understand how the value of such works lies in the testimony they can and must represent for our own present.
Law No. 78/2001 on the “*Safeguarding of the historical heritage of the First World War*” recognises «*the historical and cultural value of the vestiges of the First World War*», with regard to both sides in the conflict and which, with its light, non-intrusive approach to judicial tutelage, is promoting their recognition, cataloguing, maintenance, restoration, management and correct cultural deployment.
The law constitutes the point of arrival of a cultural path characterised by a growing demand for knowledge and responsible utilisation. However, the law is also an index of the concern that a heritage comprising constructions and structures may be lost, given the threat represented by neglect or uncontrolled and unconsidered actions involving the collection of *finds* and *memorabilia.* Thus, the risk being run by this heritage of artefacts and constructions refers to the damage potentially wrought by incorrect compilation criteria and procedures that do not appreciate their historical value. The risk of “loss of memory” [1].
As no measures were taken in the post-war, the first actions to salvage some Great War places for museum purposes had to wait until mid1970s. For example, work carried out in the area of Ortigara and Monte Cengio brought to light various Italian defensive lines, restored a number of structures and introduced pathways and signage [2]. From 1980 onwards, some public bodies began promoting actions to survey and catalogue these vestiges. Thus, the Autonomous Province of Trento, in its regulations on the cataloguing of Trentino's historical, artistic and popular heritage, makes reference to «*historical artefacts* […] *including the major military fortifications up until the First World War*». Similarly, the Veneto Region recognised in the «*special historical, architectural and cultural artefacts of the Great War*» that there was a series of works requiring «*measures for their census, recovery and enhancement*». The Friuli Venezia Giulia Region in dealing with the subject issued “regulations for the recovery and appreciation of the historical and cultural heritage and of First World War sites” [3]. In preparing the ground for the legislator in 2001, some experiences acquired during pilot projects are of special interest. These include, in 1986, the «Sentiero della Pace» (Peace Path), the «Ortigara Project», carried out by the Sette Comuni Mountain Community in 1996; or the «Great War Project» in Trentino, which began to take shape at the end of the 1990s. These cases reflect an important cultural tension: the awareness of the need to surmount fragmented initiatives in order to define coordinated projects informed by the knowledge that the complexity and extension of the Great War heritage must be treated as a system with the necessary planning, programming and coordinating of measures for its safeguarding, conservation and cultural deployment.
In point of fact, the *vestiges* of the Great War constitute a highly variegated set of artefacts. The word *vestiges* itself is highly significant: its meaning of *vestigium* refers «to a sign left on the terrain by walking», and is a synonym of *a* trace, footprint or indicative sign. In the plural, the word indicates footprints in the sense of their being «traces of a passage »*,* while *vestigare-investigate* means «following traces».
The word also refers to an «act, work, monument that remains as a document and memory» and in the plural it means: ruins, remains, relics. Hence, a complex meaning that simultaneously evokes absence and presence, an intersection between the *visible* and the *invisible*. A footprint is the physical sign that chronicles something’s occurrence or passage. It leads us to the condition of "fragment": the *frag-mentum,* which comes from the same root as “*fragile”* and *“frangere”,* and can indicate either «a piece of something broken» or, by inverting our standpoint «a piece preserved from an artefact».
Reference to a system of relations seems to emerge from the pulsing heart of this word; a system whose coordinates and meanings are to be sought on various material and immaterial scales or dimensions: the

dimension of the single structure (the fort, barrack, etc.) abandoned or totally derelict among rubble and ruined by the degradation wrought in its turn by man's and nature's violence; the territorial dimension, where the various types of vestiges form a defensive system that had a profound impact upon the *identification* of the territory itself and the dimension of the possibility of a *memory* with respect to the concrete presence of objects from the past.
The "effort" necessary to understand and have these relations understood should be a lymph nurturing a school of thought accepting responsibility for the destiny of such *vestiges*. In other words, a search to give *sense* to our actions, where conservationist *care* must take into account possible, alternative management and cultural deployment scenarios whenever its remit is not to alter «*the material and historical characteristics of vestiges*» as stated in the provisions of law No. 78/2001, which proscribes such alterations [4]. This prohibition is also reinforced by «*technical and scientific criteria*» for safeguarding and conservation measures [5]. Such criteria set out the principle of non-alteration by explicating it in relation to the various types of artefacts defined as vestiges. As concerns «*territorially-based artefacts*» - thus artefacts that are not finds, memorabilia, records - «*unjustified*» removal and replacement measures are prohibited.
Conservation, understood as an action designed to arrest degradation processes, is preferred insofar as allowing for the «*reading of all the structure's life cycle*». The option of modifying a function for a new use is only allowed if it complies with the criterion of «*compatibility with pre-existent characteristics*».

3. Experiencing the past

The *non-alteration* objective takes us to the current debate concerning interventions on pre-existing structures where various "approaches" or "schools of thought" jockey for position. From the 1980s onwards, it seems that the conservation of *artefacts* as an *end* in itself and the *subject* of measures to be taken on the pre-existent is the accepted position, where *degradation* is seen as the main problem to be resolved. It is recognised that «*matter, by virtue of the events occurring to it, and the passage of time*» is the place in which signs bearing *messages* are stored. These messages embrace an existential horizon that ranges from messages about construction data to those addressing contemplative aspects, whose loss would eliminate the possibilities of knowledge. Any loss is the impoverishment of a series of meanings to which matter bears testimony, and, at the same time, generates. Reference, for example, can be made to the meaning of a document whose sense involves not only the «*testimonial values of material facts*» but also man's spirituality in all its possible expressions, in a sense much wider than the document's mere philological meaning [6].
From this standpoint, the word *degradation* also merits reconsideration. Its sense goes beyond mere material decay and indicates the set of an artefact's evolutionary dynamics recognisable by the signs impressed upon it. Decay becomes a *pointer* to a construction and transformation process and begets questions on origins, past completeness and possible intactness - it acquires the active function of knowledge production. Signs of decay are also the *product* of the signs of history, and the use made of buildings over time. They may be the *medium* for a cognitive relationship between subject and object, where the subject is exposed to the dimension of the passage of time, and thereby, by virtue of this perception, a meaning can be sought in a relationship with objects from the past [7].
If we deploy the concepts of *matter*/*decay* with this interpretive key, the objective of not altering the material and historical characteristics of *vestiges* must accommodate a special approach that, every time, permits the reading and understanding of "that which remains", as also of particular states of disrepair and damage, and how such remains can give us a vision of the future.
For example, the forts have had a complex and variegated history [8]; military architecture characterised by construction techniques ranging from masonry to compressed concrete, steel beams and reinforced concrete. At present, they appear to be result of a paradox: many were already out-of-date when they were built, and quickly rendered superfluous by updated artillery and new war strategies. Therefore, they remained *marginal*, in military terms, given the developments in pitched defences. Some were subject to bombardments that undermined their physical integrity, and reduced them to ruins, while others were brought to a state of complete disrepair/ruin by "recuperanti", i.e. salvage scavengers, who after the war and systematically in the 1930s, blew up heavy concrete structures to extract rebars or remove armoured domes and shields, and floor and roof beam reinforcements.
Different histories have left different signs: signs connected to life in the fort and full of information on military architecture and the soldiers' life; signs connected to war damage, bombardments, disarmament, salvage scavengers, and neglect. Signs whose stratification represents the *hic et nunc* that characterises these structures' character in a *unique* and *unrepeatable manner* and help us to discriminate between them, even when construction types were repeated.
The attention given to stratification for its testimonial value is not new in restoration and design culture where it figures as the «*old-new dialogue*» [9]. However, whether new or different, the fact remains that interventions on Great War constructions must show more "sensitivity" when dealing with these stratifications. They should employ «affective knowledge» [10] - a process of awareness in which different strategies of thought coexist.

On the one hand, there is the aspect of observing, describing, and clearly and minutely recording stratification in its various components: the desire for *precision*, the practice of surveying and analysing *skills*. On the other, as this desire for knowledge unfolds, a kind of *participation*, *and affective identification* develops that can nullify the distance between «the world in which there are things and the world in which their names are pronounced», by grasping the *intimacy* between things no longer sensed as «opaque and closed objects» but intimately part and parcel of our lives – part of a *created design* where the life of things, the life of man, and that of nature are necessarily intertwined [11].
This experience opens up the road to *care* [12], understood as the *reason* for our behaviour towards things; a behaviour linked to a «new ethical and aesthetic propensity» [13], where «attention and respect» co-exist and the aesthetic dimension is understood as a «sensorial experience» [14]; the experience of a «perturbed and moved» spirit faced with vision of what the *vestiges* of the war can evoke and generate, because the possibility of *memory* functions as a means to help us construct our own *possible memory of the Great War*.
From the cognitive viewpoint, *memory* is very complex and intricate. It does not operate like a storeroom, or an archive with many drawers in which images and information are kept in an immutable and fixed form. Instead, it is a continual process of re-composition, and re-invention that every time recognises reality, or rather cognises it anew: a “present remembered” [15].
Every time we open a drawer, we are different and observe in a different manner. Thus *storing the memory of the Great War* may also mean «committing ourselves to bringing to life, at today's temperature» all that the Great War entailed in order to create a culture of peace. Taking care of, or making proper use of these "cultural assets" may mean augmenting the possibility and the opportunities for their utilisation in such a way that they can continue to acknowledge a relationship between the «observer who observes» and «the system observed». However, it is very important that this relationship safeguard the work of memory - in order that a ruin or a fragment may be recognised, memory must be at work [16].
Consequently, the responsibility assumed by the design project for this special heritage must be that of safeguarding precisely this status as *fragment*, especially within the framework of the possible uses for the forts and of the various systems connected to them, and which will bring them within a new circuit of sustainable utilisation - a condition where "what remains" suggests an *approach* whereby the state of disrepair, the deficiencies, wear and tear, gaps, and discontinuities can be seen as the expression of an artefact’s *authenticity*, a kind of "opening up to the senses", as a reference for a project that must come to terms with such features' testimonial value and find the manner and the techniques to ensure its conservation and cultural leverage.
Thus, it is a matter of keeping a set of relations alive between men and their artefacts where the latter can continually "speak with their own voice" about their own history. But it is also a question of facilitating the narration of a journey in the nooks and crannies of past experience, where the special condition of the *existence* of such artefacts enables us to *glimpse* possible *chronicles* hidden in the meshes of abandonment and disrepair that had a profound impact on their material and immaterial makeup.

4. The fragment's reality

Some of the measures carried out, albeit with different approaches and operating arrangements, seem to address this idea. Some references, albeit not exhaustive, can be cited. For example in Trentino, the restoration of extensively damaged forts, such as Forti Tonale and Mero in Alta Val di Sole or Forte Strino, Forte Garda and Forte Batteria di Mezzo on Monte Brione.
These cases are characterised by an approach that interprets *fragments* as an *evocative reality*: here structures have been rendered safe in order to guarantee a minimum level of selective accessibility and walkability, i.e. limited to a few sections that provide for an understanding as the possibility to narrate its history.
Any additions are interpreted as "facilitating the reading" or as a "crutch" or "aid" for understanding, with special attention being given to *creativity* as a function of the observer's imagination; confiding in the investigator's contemplation to recognise the possibility of narrating *things*. Thus, they evoke a hope, a *resilience*, or a possibility of being able to handling traumatic events in a positive and constructive manner; the possibility of a positive cognitive reorganisation in the face of attendant difficulties.
Some cases, instead, interpret the *fragment* as an *operating reality* for new and independent settings whose purpose is to protect pre-existing structures or provide an occasion for new ways of using it with the addition of elements that evoke missing parts or even parts that never existed through the force of contrast or suggestion; for example, Forte Pozzacchio on the slopes of Pasubio, Fort Sommo Alto.
Other cases suggest that restoration is a search for completeness, and thus the fragment is seen as an *operating reality* serving to reconfigure or fill in spaces that contribute towards the narration of the fort as a full-blown war machine; for example, Forte di Cadine, Forte Corno in Praso, Forte Interrotto, Forte di Campolongo.
These are cases where, depending on the level of damage, various languages operate to supplement the missing parts: from the "neutral and simplified form", to analogy with the restoration of structural principles and techniques, and evocation by affinity [17].



A: Forte Tonale: before and after the intervention.



B: Forte Batteria di Mezzo - Riva del Garda; limestone fortress, roof covered with concrete: after the intervention.



C: Forte Campolongo - Altopiano di Asiago; reinforced concrete fortress: before and after the intervention.



D: Forte Strino – Vermiglio; fortress in stone masonry, severely damaged by “recuperanti”: after the intervention.

Fig.1: Fortified architectures in Trentino and Veneto regions: before and after the intervention.

5. A resilient mosaic

However, the forts, as stated, only represent a part of the complex system connoted by *vestiges* of the Great War. When understood as a *defensive system*, such vestiges become a coordinated and reciprocally functional set of artificial elements constructed in response to the morphological characteristics of the territory and connected to various communication routes: in other words, a general, militarised pan-territorial system modifying the territory to build permanent fortifications, excavating and digging trenches, shelters in caves, galleries and tunnels, and also designing transport and military service works and infrastructures such as railways, military roads and mule tracks. A system that embraces all *residues* directly related to wartime operations that include, with the echo of the soldiers' words, a narrative whose reading influences our capacity to work out and make sense of the various contexts described. The reference to the territorial system denotes the knowledge that such vestiges must be understood as a "mosaic"*,* a metaphor for a system comprising *fragments* characterised by a relationship of reciprocal coherence. Consequently, safeguarding and cultural deployment should not only address single, isolated artefacts but the whole context within which the *traces of the memory are deposited*; because respect for the context also implies paying due attention to the landscape as also to the tutelage and respect for the environment in the widest sense.

The material and immaterial cultural heritage of twentieth-century wars was identified in the Horizon 2020 programme as one of the fundamental starting elements with which to bring new "identities, geographies and economies" to life. This set of traces and signs of the war can play a decisive role as an element in reinforcing a modern European historical identity. And in this context, the design project will be able to redefine its actions insofar as it commences from a resilience based upon its re-organisational capacity to achieve a new dynamic, never static, equilibrium in order to create new conditions for territorial re-equilibration [19].

In the north-eastern Italian regions, the traces of trenches, the ruins of forts, and the signs of bombardment of the Great War constitute a complex and intricate system of architecture, infrastructure and networks, which have not only profoundly modified vast areas but, for many years, constituted an eloquent symbol. However, over time an architecture of memory representing these territories as a series of monuments and fixed points has been superimposed upon the original war infrastructure, nurtured, as it was, by accounts of heroic acts and battles. This quality of war, capable of generating powerful and meaningful representations, has gradually lost its force and at the same time, its residual traces and signs have been obscured. This occurs when historic values and events cease to be a shared heritage, and when war scenarios are transformed by modernisation, and urban sprawl, while the development of Alpine tourism has in part re-utilised the complex military organisation for access routes or ski facilities thus giving them a new lease of life.

There is work to be done at the *margins* - in outlying territories orphans of policies that benefited the economically stronger territories - in the "fragile" and neglected wartime locations where traces and signs, although safeguarded, risk appearing opaque and faded, and where it is necessary to take action to ensure the continuation of a life that, nourished by the past, can project itself into the future.

Understanding vestiges is the constituent principle that binds the territories to their landscapes and peoples, fortifying relations, reappraising signs and traces in the landscape by bringing different times together. In this way, this potential heritage of value and design can acquire a capacity to resist, maintain a position, and address the future notwithstanding the deformations sustained [20]. In this new dimension, with the co-mixing of landscape, time, memory, present and past, its fragility will become "anti-fragility" [21]; rediscovering new relational meanings, reformulating appropriate spatial configurations, and by leveraging the present through traces of the past, the multiplicity of material and immaterial artefacts at wartime locations can acquire a decidedly new role and strength.

The war not only produced "ruins and debris" but also created a network of accessible and recognisable places, and invented new "topographies" to represent the landscape. Earth and earthworks constitute the dominant themes in constructing the relationship between fortifications and the landscape. Not only by constructing forts, roads, bridges, railways, stations but also by "recycling" mines and shelters, and excavating trenches, tunnels and galleries did the war shape the terrain to create communications, disguise defensive works and hence profoundly modifying it. Uncovering this "quality" of the military strategic design also means recognising that architecture stands "next to" the landscape, which becomes the real protagonist, providing a vision that returns us to the idea of a park designed for scenes to be appreciated in movement [22].

The war represented this landscape through selected panoramas: from above, by photographing territories and producing abstract images and from below with eye-level panoramas. Thanks to the availability of the first portable cameras, life in the war zones was documented by such interlocking views. These views along with selected panoramas, periscopes and galleries, observatories that were sometimes shooting emplacements, sometimes places to observe and be observed, Alpine passes controlled and mountains transformed into observatories, seem to portray wartime landscapes as cinema sets.

The entire system, when set out on a map, can still today reveal an architecture-landscape in terms of points and dynamic lines; a *system to be explored* that promises unexpected results. Thus, in different situations it seems useful to imagine up-cycle actions that imply the construction of a new life-cycle commencing from an object that has completed its preceding mission; namely, that which determined the construction. Such action can thus be understood as restituting a new quality, an additional *meaning* to what lies derelict and abandoned [23]. All of this can commence from relational thinking that can grasp the intelligence of the locations, because a place is not always imbibed with meaning if it remains a vestige in ruins: a place persists if something is performed that establishes relations with it.
Therefore, the question is how to imagine relations that link different events materially and immaterially, *burrowing in depth* into all that which constitutes connections: after all, this is how "beauty" is created.
In situations in which landscape quality still survives, in the marginal mountain environments of the Alpine range, this means paying more attention to what has been produced and abandoned, and more operational actions as between conservation and restoration, architecture and landscape, thus avoiding those disciplinary divisions and rigidities, between competences and separate authorities, that lead to the present-day risk of loss and abandonment.
Selecting traces, reconstructing networks, identifying relations, constructing relational systems, designing pathways, and imagining new uses for war zones, offers us the possibility of "giving new meanings" to large areas of territory.
The introduction of new design proposals in the marginal territories has important cultural and landscaping implications in terms of the economic and protective promotion of those multiple and distinct identities that constitute the territory. The idea in question goes far beyond the conservation and maintenance of infrastructures and landscapes as it concerns a new design capacity based on the set of residual traces of fortress infrastructures, a new *narration* of/in the contemporary landscape [24].

6. Re-activation of networks and themes

Re-appropriating the war-zones means constructing designs for a long-term, and widespread "care", whose strategies, new technical and spatial dimensions, can only be produced by the recombination of various, existing elements.
This, first and foremost, entails the "re-appropriation" of a strategic military standpoint, i.e. the continual movement between the various dimensions in order to re-activate the aptitude of architecture, infrastructures, and networks to "take the measure" of the territory, by enriching nature with artifice, but it is also essential to identify new uses that can harness the economic values generated by these transformations.
In order to capitalise upon this mosaic of stratifications it is necessary to work within the community, as the latter constitutes the specific identity of this widespread territorial reinforcement of traces and residual signs.
An important opportunity, for the province of Trento, was provided by the Valle Community, which has the remit for safeguarding Great War artefacts, and for future planning and landscaping.
In this context, the development of experimental research projects, such as for example, the case of the fortress of Riva del Garda, Mattarello (Tn) follow directions that are capable of triggering off a complex system of relations in order to re-establish the utilisation of isolated territorial fragments to reactivate networks and themes, comprising panoramic hills and passes, vineyards and forests, cultivated and uncultivated, urbanised or non-built areas.
Itineraries to discover artefacts may be one of the best *tactics* for territorial re-utilisation: a narrative structure of territories, in which sequence, distance, time, the experience of the various elements, rhythm, perception, movement, selective and multi-scale panoramas become essential materials for transmuting the war-time territories into a "great framework of important minor places" by reviving a widespread system of networks for slow excursions and introducing some "fundamentals" in their itineraries: small places to receive and accommodate visitors - shelters, stations, observatories – as successfully experimented with in other European countries [25].
Without this attempt at *representing* the war's identity, which in the past was a sustaining force for entire geographical areas, signifies running the risk of losing and forsaking meaning.
A design approach could be adopted that respects conservation but which - for the principle of duration and performance – is not opposed to a process of transformation.
Commencing from the uncovering of a memory reactivated in time, war artefacts, machines and landscapes can become a principle of memory and a formal invention by calling upon architecture to perform those tasks peculiar to it: reconnoitring and seeing to absorb the presence of history; choosing special points of view, giving leverage to significant remains; transforming marginal territories to accommodate visitors.
Small architectural structures and the inclusion of new elements constitute valuable opportunities for exhibiting stratified contexts. The relational up-cycle is the operating tool that will accompany the transformation of the anthropic space and indicate a dynamic process at work. It is not a return to a preceding state but a programme able to reactivate memory, transforming an abandoned element into

something that can return to the "fray", and thus goes well beyond mere "recycling". It corresponds to a new vision of architectonics and territory.

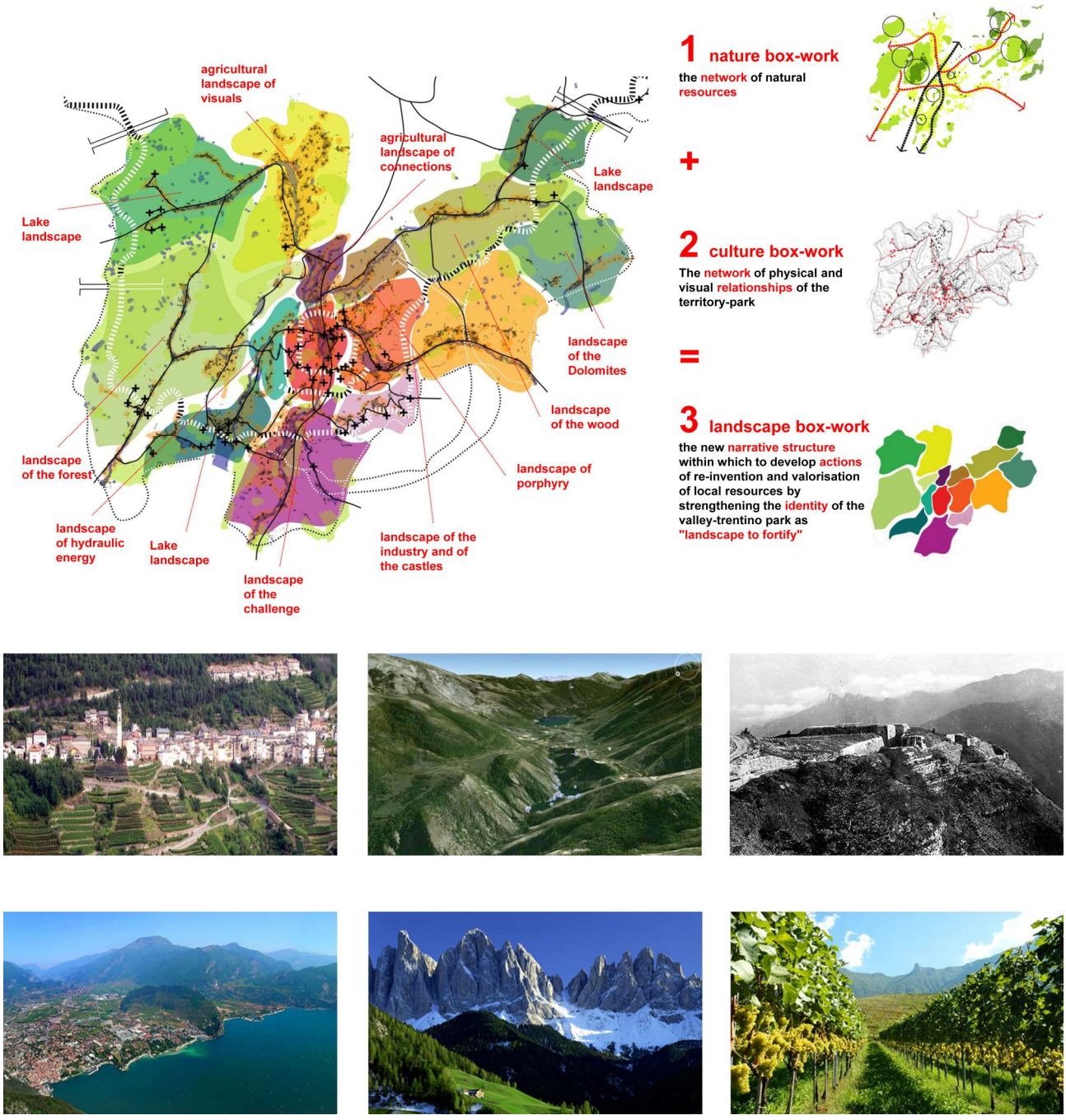

Fig.2: The Trentino War Park in the Alto Garda territory (From the Research "Ex Fabricas. The landscapes of war in Trentino", University of Trento - Dicam, 2011).

7. Conclusions

The themes of "memory" and the "transmission of testimony" with respect to fortified systems acquire ever-greater complexity and call for a line of thinking that entail consultations between many different types of knowledge in order to highlight the contributions that various disciplines can make towards understanding the "sense" of this particular heritage characterised, as it is, by artefacts that are highly complex in terms of construction types, extension and size and by a set of infrastructures that have profoundly modified and scarred our landscape. Bringing hidden relations to light; reactivating signs; uncovering material and immaterial relations over a wide area comprising logistical rear lines, battle fields, ample margins, peripheral areas: these are all strategies and practices associated with a memory that can reread history in the present day, and indicate the elements that can form part of a *collection*. The memory project is thus conservation

and action. It is not a device for static accumulation but rather a process that combines dynamic elements. Reactivation means repositioning an object in the memory, reusing, and re-generating it; in other words, transforming the abandoned war zones into something active, able to resist obsolesce, and produce new meanings, in addition to those already acquired, in order to reposition things in time.

Quotations and Bibliographical References

[1] RAVENNA D., *Il quadro normativo precedente e l'iter parlamentare della legge n. 78*, in RAVENNA D., SEVERINI G., *Il patrimonio storico della Grande Guerra*, Udine: Gaspari, 2001, p. 29-62.

[2] PIVA M., ZADRA C. (edit by), *La Memoria della Grande Guerra in Trentino. Progetti ed iniziative di recupero e valorizzazione nel quadro della legislazione nazionale e provinciale*, Trento: Provincia Autonoma di Trento, 2005.

[3] Provincia Autonoma di Trento, L. 2, 14-02-1980; Regione Veneto, L.R. 43, 16-12-1997; Regione Friuli Venezia Giulia, L.R. 14, 21-07-2000.

[4] Art. 1, comm. 5, L. 78, 7-03- 2001.

[5] D.M. 04-10-2002.

[6] BELLINI A., *Teorie del restauro e conservazione architettonica*, in VV.AA., *Tecniche della conservazione*, Milano: Franco Angeli, 1990, p. 9-56.

[7] QUENDOLO A., *Il restauro delle facciate esterne di Palazzo Antonini a Udine*, Udine: Ed.Della Laguna, 2006; TORSELLO P., *Figure di pietra. L'architettura e il restauro*, Venezia 2006; DOGLIONI F., *Nel restauro. Progetti per le architetture del passato*, Venezia: Franco Angeli, 2008.

[8] GATTI M.P., *Il processo progettuale e costruttivo del paesaggio fortificato austroungarico*, in Storia urbana, 144, Milano: Franco Angeli, 2014.

[9] CARBONARA G., *Architettura d'oggi e restauro. Un confronto antico-nuovo*, Torino: Utet, 2011.

[10] BENJAMIN W., *Tesi di filosofia della storia (1940)*, in *Angelus Novus. Saggi e frammenti*, trad.it. R. Solmi, Torino: Einaudi, 1962.

[11] RELLA F., *Critica e storia. Materiali su Benjamin*, Venezia: Marsilio,1980.

[12] QUENDOLO A., *Riflessioni sul concetto di autenticità nell'ambito dell'attuale dibattito sul restauro architettonico, PhD Thesis,* Politecnico di Milano 2000.

[13] GARGANI A. G., *Stili di analisi. L'unità perduta del metodo filosofico*, Milano: Feltrinelli,1993.

[14] BAUMGARTEN A. G., *Lezioni di estetica*, Palermo: Ed. Aesthetica, 1998, p. 7-22.

[15] MORELLI U., *Il presente ricordato: immagini e tracce della storia nella mentalità contemporanea*, in TREVISANI E., LARCHER F. (edit by), *La memoria nella pietra. Censimento recupero e conservazione delle opere militari 1915/18 tra storia, didattica e memoria*, A.P.T. Trento, 1998, p. 59-67. ISNENGHI M. (edit by), *I luoghi della memoria. Strutture ed eventi dell'Italia unita,* Roma-Bari: Laterza,1997.

[16] AUGÉ M., *Rovine e macerie. Il senso del tempo*, Torino: Einaudi, 2004.

[17] FLAIM S., DALLEMULE M. (edit by), *Il recupero dei forti austrungarici trentini*, Trento: Nuove Arti Grafiche, 2014. QUENDOLO A. (edit by), *Paesaggi di guerra. Memoria e progetto*, Udine: Gaspari, 2014.

[18] TURRI E., *Semiologia del paesaggio italiano*, Venezia: Marsilio, 2014.

[19] MENHAFFY M., SALINGAROS N.A., *Towards Resilient Architectures*, Essays in *Metropolis,* 2013**.**

[20] BATTAINO C., *Forti, architettura e progetti, Rovereto: Ed Nicolodi, 2006; BATTAINO C., ZECCHIN L., Paesaggi di Guerra in Trentino. Re-Invenzione di una rete infrastrutturale"* in *Paesaggio 150. Sguardi sul paesaggio italiano tra conservazione, trasformazione e progetto in 150 anni di storia*, Roma: Aracne, 2012

[21] TALEB N.N., *Antifragile - Prosperare nel disordine***,** Milano: Il Saggiatore, 2014.

[22] BATTAINO C., *Natura e città* (PhD Thesis, Venezia -1997), Trento: Ed. Università di Trento, 2012.

[23] MC DONOUGH W., BRAUNGART M., *The Upcycle: Beyond Sustainability. Designing for Abundance,* New York: North Point Press, 2013; MARINI S., *Post-produzioni o del problema della scelta*, in MARINI S. SANTANGELO V. (edit by), RECYCLELAND, Roma: Aracne, 2013.

[24] BATTAINO C., *Paesaggi di margine. Architettura e progetto per i territori montani fortificati,* in Paysage Topscape, Milano: ed. Paysage, 2009 p. 88-98.

[25] BATTAINO C., *Ricerca Ex Fabricas, Paesaggi di Guerra in Trentino*, Università di Trento 2011-2012.

HERITAGE and TECHNOLOGY
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Introduction to the study of the Apice territory

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Abstract
This study is part of the researches led by Christian and Medieval Archeology Chair of the Second University of Naples, under the direction of Professor Marcello Rotili, aimed to understand the dynamics of settlement between the Late Antiquity and the Middle Ages in Campania inland. The numerous topographical studies conducted in Miscano, Calore, Fredane and Titerno valleys, have identified a settlement pattern which shows clearly the passage of spread setting, typical of the Roman period, the hilltop sites between the Late Antiquity and the Early Middle Ages. This study aims, through the methods of the ancient and medieval topography, to verify and confirm the applicability of this model in an area located in the eastern Benevento and hanging in the district of the municipality of Apice. Hill town in the province of Benevento, the city of Apice, located 225 m. a.s.l. and lapped by Ufita, Miscano and Calore rivers, preserves the ruins of a Roman bridge, an infrastructure related to the route of the Via Appia.The current town is topped by a castle of probable early Middle Ages due to its topographical location, located to control communication routes and rivers. The research will involve the systematic exploration of the territory and the study through all the available documentation.

Keywords: Cultural landscapes, history, culture, documentation, heritage.

1. Introduction
The territory of Apice, 12 kilometers from Benevento, is part of a wide area sloping down the middle basin of the Calore river (fig.1). It is a hilly territory touched by the rivers Calore, Ufita and Miscano, between the provinces of Avellino and Benevento. Its clayish soil is characterized by outcropping sandbanks typical of the right located heights of the Calore. During the Roman period this area was part of the territory between the *ager Beneventanus* and the *civitas* of *Aeclanum* and it was crossed by the Via Appia whose archaeological evidence is given by the Ponte Appiano ruins.
This study is part of a wide research project led by the Department of Christian Medieval Archaeology under the supervision of Professor Marcello Rotili aimed to understand the settlement dynamics in the Campania inland from the Late antiquity to the Middle Ages, the research has been upgraded by the latest surveys in the territories of Benevento and Avellino and in particular in the Miscano, the Calore, the Fredane and the Titerno valleys. This territory has been analyzed according to the ancient and medieval topography methodologies, e.g. the systematic and direct study on the territory [1], the study of bibliographic, topographic, iconographic and epigraphic documents from the classic to the modern period, as well as the photo-interpretation of aerial surveys and satellite imagery. The Firenze IGM official maps represent our referential cartography: in particular Document 173 Benevento scale 1:100.000 of 1957, Document 174 Ariano Irpino scale 1:100.000 of 1972, Tablets 173 II-NE Apice of 1957 and 174 III-NO Bonito of 1955 and regional technical maps scale 1:5000. All the sites recognized so far have been placed on the IGM tablets and characterized by global position location (latitude and longitude). This study will lead to the creation of an archaeological map with all the evidence of the area being studied.

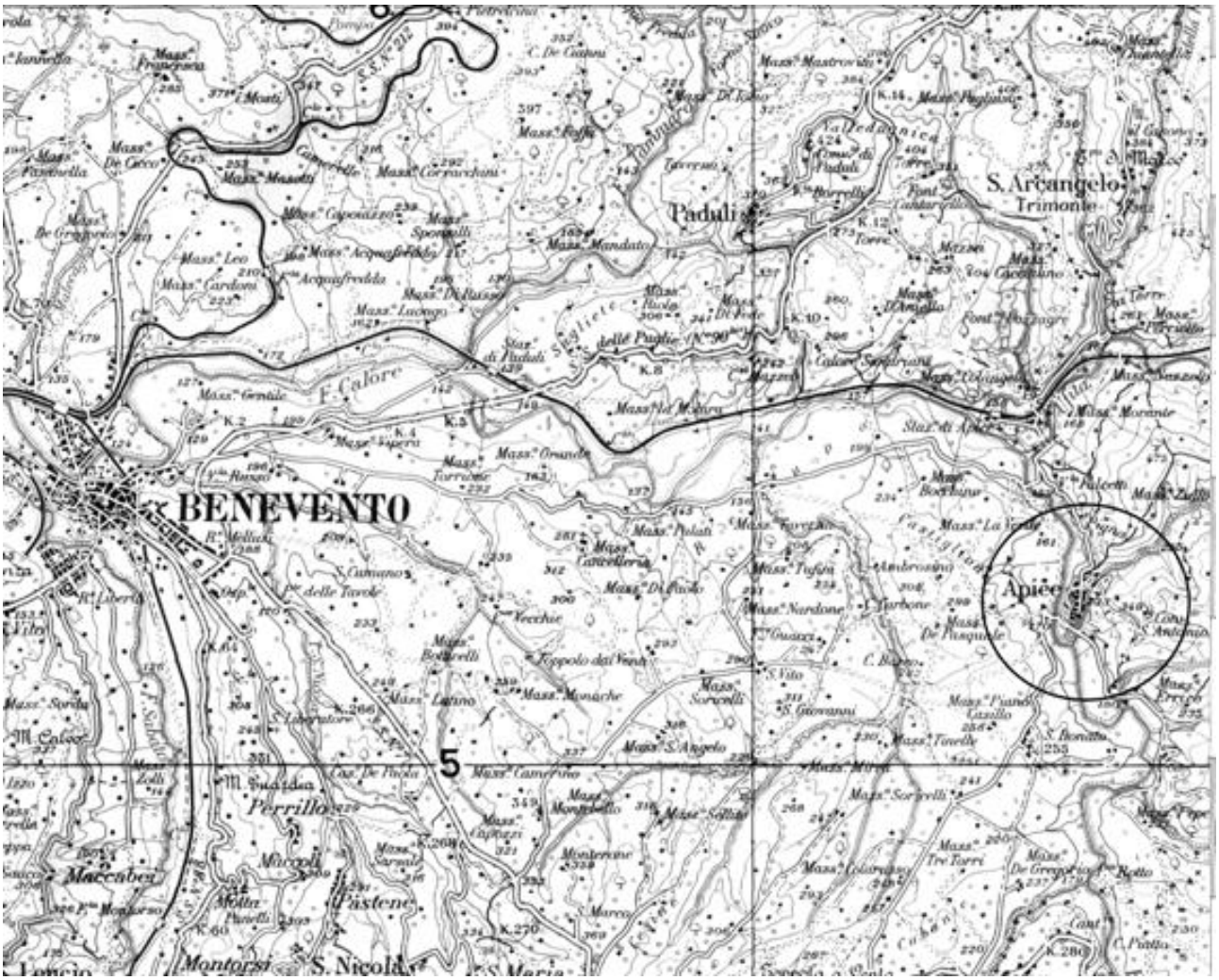

Fig. 1: Benevento document 173 detail - scale 1:100.000, location of Apice territory.

2. Via Appia and the Ponte Appiano.

As mentioned before, this territory has been interested by the passage of the Via Appia during the Roman period, whose Benevento-Brindisi road section represented an important element for the Southern Italy road network from its construction until the Middle Ages. It was built from 312 b.C. for Appio Claudio Centemmano "the Blind" will, this road was completely paved in basalt and 14 feet wide, lined with sidewalks with a total width of 10.20 square meters [2]. The road section *Beneventum-Aeclanum* was very interesting indeed, the Via Appia gained access into the city of Benevento after having passed Leproso Bridge on the river Sabato and then it became again an extra-urban road after having passed the area where Santa Sofia Church [3] would have been built some centuries later. The road moved forward to modern Pastene reaching the first *mutatio* that is to be located in the 4th mile in Cancelleria district. Furthermore, the Via Appia, after having passed "Ponte delle Tavole", trod the Calore River upon the Appiano Bridge, nowadays known as "Ponte Rotto". The Via Appia, after crossing the bridge, forked into a valley route and a mountain route. The first one crossed *Aeclanum*, Frigento, Taverna Monte, Forcuso, Taverne di Guardia Subromula, Aquilonia, then, the second one crossed the territories of Fioccaglia di Flumeri, Ponte Rotto until it reached Sferracavallo district through Ufita valley to finally join with the mountain route at Serroni di Bisaccia [4].

The via Appia, known as *Regina Viarum*, had been restored several time during the years, e.g. 123 A.D. the Emperor Hadrian wanted a restoration of the road in numerous points, like the section between *Beneventum* and *Aeclanum*. Those interventions are attested by various *miliaria* that the emperor made position in this section, like the very important milestone made from travertine, 1.78 meters high. It was found in Benevento in "via Capitano Rampone" and it is referred to the Ponte Appiano (fig. 2) located in Morroni di Apice district [5]:

X / IMP. CAESAR / DIVI TRAIANI / PARTHICI F. DIVI / NERVAE NEPOS / TR/ / / / ANVS HADRIANVS / AVG. PONT. MAX. TRIB / POT VII COS III / / / / IAM APPIAM PER / MILLIA PASSUS / X/ / / / DCCL LONGA VETVSTATE AMIS / / / / / AM ADIECTIS / / / / / / / / / XI/ XLVII AD HS. DLXIX C / QVAE POSSESSORES / AGRORVM CONTVLE / RVNT FECIT / CLXXIIII.

From this it is possible to understand that the bridge on the Calore was built in 123 A.D., it was 130 -150 meters long and 11.50 meters high and it was characterized by seven/eights arcades with eight/nine pylons with an average length of 17 meters. The arcade, still intact, presents a clear span of 13.95 meters, the pillars at the base are 5.80 meters long, the carriageway was 2.65 meters wide with a sidewalk of 60 cm. The building technique is in square blocks, the archs and the West pier are dated to the Hadrian period and are made in *opus caementicium* mixed with tuff flakes and lines of *bipedales*, furthermore the West embankment walls are made in *opus reticulatum* with lines of bricks and *bipedales* [6]. Near the extreme arch on the right river bank of the Calore some structures have been found out, according to Johannoswky [7] they are pertinent to a watermill whose structures are linked to those of the Hadrian period: the building consists of a room whose dimensions are the same of the arch, a basin on the top and a water pipeline with tile banks. It may be possible that this mill was designated to mill the wheat coming from Puglia and probably direct to Rome.
Another intervention which concerns a work under Marcus Aurelius in 167 A.D. is shown by an epigraph found out near the Ponte Appiano [8]:

IMP. CAES. / M. ANTONINO/ AVG. ARM. PARTH. / PATRI PATRIAE / VIA AD PONTEM / AVF. ET VENVSIAM / AQVAR. INTERRVPT. / ET LATROCINIIS / RESTITVTA / AECLANENSES / D.D.

The methodical survey in the territory of Ponte Rotto has led to the identification of four unknown sites named 3-4-5 and 6 (IGM 1:25.000, 173 II-NE *Apice* e 174 III-NO *Bonito*).
Site 3 (41°05’ 09.06’’ N; 14° 55’ 50 69’’ E) placed 136.33 meters from Ponte Appiano ruins is characterized by a barely tilled soil; the survey shows very fragmentary materials dispersal due to repeated plowings. It is possible to notify: black gaze pottery, African terra sigillata, unglazed ware, painted pottery and metal fragments, roof tiles, bricks and shingles too.
Site 4 (41°05’ 14. 94’’ N; 14°56’ 11. 74’’ E) is placed 248.73 meters from the bridge is characterized by uncultivated land, the survey shows very fragmentary materials dispersal and we can notify: unglazed ware, fire pottery, African terra sigillata, post medieval glazed pottery and fragmentary earthenware and bricks. This site is accounted as continuous function because of the quantity of the pottery not coeval to each other.
Site 5 (41°05’ 15. 13’’ N; 14°56’ 20. 13’’ E) situated 317.86 meters from the Via Appia structures is characterized by tilled soil, the surveys suggests very fragmentary materials dispersal like unglazed ware, fire pottery and painted pottery and numerous bricks.
Site 6 (41°05’ 20. 89’’ N; 14°56’ 15. 74 98’’ E) is located 415,31 meters from the bridge ruins is characterized by uncultivated soil, the survey shows very fragmentary materials dispersal: unglazed ware, fire pottery, tin-blue glazed pottery, flint shards concerning the production of domestic utensils and a relevant number of bricks.

3. Settlement aspects between Late Antiquity and the Middle Ages

The territory of Apice is part of an extra-urban contexts combination which during the Late Antiquity were connected to important road networks, in this specific case the Via Appia. This road was restored by Theoderic [9] in the VI century but later it became unsuitable because of a bad maintenance in particular during the Gothic War; from the VII century the maintenance activities became more and more sporadic.
However, Ponte Appiano was restored in the Early Middle Ages, during the Lombard period; a support pillar using elements from funeral buildings of imperial period was placed there. The bridge was no more in use during the Late Middle Ages, another smaller structure was built 68 meters North from the old one indeed (fig. 3). The bridge of the Middle Ages period showed three arches and re-used blocks from ancient buildings in particular lime flagstones probably belonging to the Via Appia, they were placed underneath the archs.


Fig. 2: Apice, Ponte Appiano.

From superficial surveys and the materials found out and previously presented, it is possible to postulate the existence of extra-urban mansions near the river Calore then abandoned during the VI-V century, as the ceramic evidences reveal.
The transition from the Late Antiquity to the Middle Ages is marked by a drastic change: the valley floor sites were abandoned in favor of the upland which offered more protection, according to the model elaborated by Georges Duby in 1962 and supported by excavations and surveys in the nearby territories (Miscano valley).
This change is also recorded in extra-urban contexts of the Campania inland [10] in Irpinia like Montella and Sant'Angelo dei Lombardi where the archeological research in the "Caracciolo del Sole" fifteenth century residence proved its settlement from the III-IV century when a cemetery connected to an upland residential area was placed. This hypothesis is also confirmed by surveys in the nearby territory, in Miscano valley where the valley floor sites were abandoned from the end of VI and the half of the following century and the consequent development of the upland residential area of Montegiove [11].
It is possible to suppose, thanks to bibliographical study and methodic survey on the territory at issue, that this transformation also interested the territory of Apice, where the ceramic evidences show a rest from the V-VI century.
After the Late Antiquity, several documents are referred to the existence of a hamlet in Apice placed on a high ground of sand rock currently hosting the old center of Apice, abandoned after the disastrous earthquake of 1962. The oldest documents about the hamlet of Apice known so far are two. The first one is a *Cartula oblationis* dated to January 797 edited in Benevento in which the Gastald Guacco gives life estating the new house with the yard to his wife Tasia "*lascia in usufrutto vitalizio alla moglie Tasia la casa nuova con cortile sita sulla platea erga S.Arthellais, la casa con una terra vacua comprata Aodemari , con il casale sub Apice…..*" [12]
The second document a *Cartula Oblationis* too in which Guacco will donate Maria's house with the helmet of Apice to his wife. Another document is a concession certificate of Montecassino,

reported by Gattola in *Historia Cassinensis* [13]. It is possible that the term "*casalis*" is referred to a village developed in the current Apice vecchia during the Early Middle Ages, as it is reflected in contexts of Tuscany [14] and of coast Campania, where the term is mentioned in written documentation from the IX century [15].
The Norman presence in southern Italy from the half of XI century and the reorganization of the villages managed by them led to the development of new residential areas or to the renovation of former villages. The village of Apice may have been fortified with walls and a *castrum* exactly in the second half of XI and the first half of XII century.

From Falcone Beneventano's *Chronicon Beneventanum* [16] we find out that Apice was characterized by a castle and city walls, exactly a village, in 1133. The whole center was defended by a military garrison and belonged to Earl Ariano Giordano's domain. Still from Falcone it is possible to deduce that Apice underwent several attacks from 1113 to 1138. This source informs us that Apice was equipped of a remarkable castle and a considerable military presence in the XII century, for the same reason the *Catalogus Baronum* [17] informs us that: "*Comes Rogerius Bonialbergi dixit quod de manium suum Terre Beneventane, de Apice est feudum sex militum* …".
The territory was consigned to the county of Buonalbergo under the property of Ruggiero di Buonalbergo and under the kingdom of Guglielmo II; later it passed to Filippo di Balbano as it can be deduced from a diploma of Benevento Cathedral Chapter house dated to 1186. In this diploma Filippo di Balbano, lord of Apice, allowed the *jus patronatum* on Santa Lucia Church to the arcibishop of Benevento [18].
At the end of the XII century Apice was pillaged and taken by cardinal Pelagio, but it was soon recovered by Frederick II's army. Francesco Maletta was Earl of Apice too and after him Roberto di S. Giorgio who died without heirs, so his sister Roberta, Guglielmo di Sharon's wife, led Apice under the family of Sharon. During these years Apice was habitual battleground. Furthermore, the first was shown in a Clemente's VI seal of 1351 pertinent to the boundary delimitation of the territory of Benevento.
The presence of the castle is also attested in the *Statutum de reparatione castrorum* [19]: *"Castrum Apicii et domus domini Imperatoris, quesunt ibidem possunt reparari per homines eiusdem terre, Cripte Navnardi, Murronis, S. Severi et Regini….."*.
As we can read from Ricca [20], Ermengaldo di Sabrano was lord of Apice and then, in 1415, Francesco Sforza. In 1435 Apice was family Guevana domain and later, in 1567, it was taken by Giulia Carafa and then by Antonio Gesualdo in 1570. From 1577 it was property of Francesco Carafa, then in 1580 Apice passed to the family Pisaniello until 1600 when it became domain of the Galluccios. In 1639 the territory of Apice was acquired by the family Tocco and in 1776 it passed in property of Restaino Tocco Cantelmo Stuart, after him the territory became part of Carlo's domains.
The presence of a *castrum* in the chronicles about the assaults to the castle in XII century makes us suppose that the village of Apice was defended with walls whose marks are no more visible because of dwelling continuity until the half of XX century that has deleted and absorbed the fortified wall. The castle is probably characterized by modern configuration, with two towers joining a baronial palace, and it is located on the upland top north from the historic center entrance. Nowadays the building is under restoration.
It is worth to mention S. Bartolomeo Church, destroyed by the earthquake in 1732 and afterwards absorbed in S. Nicola Church, so it became S.S. Bartolomeo and Niccolò. Furthermore, S. Maria Church, dated to 1300 (figg. 4-5). It is possible to identify two building stages analyzing the structures and the building techniques. The first one with East-West orientation (figg. 4-5), is attributable to the first building phase and it is confirmed by a protomaiolica fragment in the apse external wall. The wall is in *opus incertum* with river stones, sand limestone blocks with gray cement: we can also find spoliation elements, among them a pillar and a limestone stringcourse alongside the apse.
The second one following the previous, is in the perpendicular and final part of the previous building, with orientation North-South, it was frequently restored; as the creation of a garden at the back after the earthquake of 1930. Spoilt elements (fig. 6) have been found out in this garden like a millstone. The bell tower has also been renovated, on the West side two single lancet windows are plugged and some spoilt blocks are visible.


Fig. 3: Medieval bridge near Ponte Rotto.

It is not possible to visit the whole church, on the northern side there is a funeral stone related to the burial of a Saint Bishop, still under study.

4. Conclusions

The territory of Apice is divided into two centers (fig. 7) named Apice Vecchia and Apice Nuova, born after the desertion of the old center caused by the earthquake of 1962. From the bibliographical examination we found out several sites discovered during the XIX century: Colonna mentions several necropolis in different districts.In locality Cinfurio 5 kilometers from Apice emerged brick worked graves and parallel limestone graves covered with tiles in Ponte Rotto district, 4 kilometers from Apice.

Five parallel broken down graves were discovered during farming works in Santo Auditorio district, 4 kilometers from Apice; the tiles pertinent to those graves measured m. 0,42x0,14x0,02 and presented two engraved concentric circles in the middle of the shutters.

In Carosa land, located in Canneto county 2 kilometers from Apice, remains of buildings in concrete were found out underneath the planking level, they were oriented East-West and formed by a 3 meters long wall on which several compartments, filled with virgin soil, rest on. Several graves were discovered 40 meters from these structures, they sloped down the Calore river and showed tiles and relevant skeletons.

Furthermore, the discoveries in Starza district are bibliographically well known: documents report a discovery of golden, silver and bronze coins dated to the Roman period, and epigraphs, bronze seals, cameos, oil lamps, pottery and other domestic tools [21].

A prehistoric settlement emerged from the survey as it is shown by flint fragments and earthenware discovered in Ponte Rotto district.

To summarize we can affirm that during the Late Antiquity the territory was still connected to the road network; the Via Appia, in the sector included in the territory of Apice, was still in use during the Early Middle Ages as the restoration works of Ponte Appiano, made during the Lombard period, show; the building technique recalls the Lombard walls of Benevento indeed.

In the Late Middle Ages this center was certainly defended by walls and a *castrum*; the Via Appia route was probably modified as it is confirmed by the medieval bridge up close to Ponte Rotto.

Researches in this territory suggest scattered populated areas until the V-VI century (confirmed by pottery fragments related to this period) when the valley floor is abandoned and the better defended upland site was formed.
Thanks to the archeological survey it possible to argue that some sites of Irpinia arranged their territory in a previous period than the *ager Beneventanus* and in some cases the sites alongside the Via Traiana developed during the first years of VII century.
Archeological researches in the fifteenth century residence of the Caracciolo del Sole, in S. Angelo dei Lombardi [22], in the high valley of Ofanto, demonstrated the occupation of this territory from the III-IV century, when a cemetery placed alongside an upland residential area. Another important context of Irpinia is Montella [23] developed in the VI century after the valley floor abandonment.
In conclusion we can assert that this settlement model also characterizes the territory of Apice in the passage from the Late Antiquity to the Middle Ages.



Fig. 4: S. Maria church.



Fig. 5: S. Maria church, particular.



Fig. 6: Spoil element (column).



Fig. 7: Apice vecchia.

Bibliographical References

[1] QUILICI, Lorenzo, QUILICI GIGLI, Stefania. Considerazioni metodologiche sulla cartografia dei Beni Archeologici: introduzione alle ricerche topografiche nella valle del Sinni. In QUILICI, Lorenzo, QUILICI GIGLI, Stefania; edited by. *Architettura e pianificazione urbana nell'Italia antica*, 1st ed. Roma: L'Erma di Bretschneider,1997, pp. 231-240.
QUILICI, Lorenzo, QUILICI GIGLI, Stefania. *Introduzione alla topografia antica*. 2nd ed. Bologna: Il Mulino, 2007.
[2] QUILICI, Lorenzo. *La Via Appia da Roma a Bovillae*. 1st ed. Roma: Bulzoni, 1977.
[3] ROTILI, Marcello. *Benevento romana e longobarda. L'immagine urbana*, Napoli-Ercolano: La Stampa di Ercolano, 1986.
ROTILI, Marcello. Cellarulo e Benevento la formazione della città tardoantica. In ROTILI, Marcello; edited by. *Benevento nella Tarda Antichità. Dalla diagnostica archeologica in contrada Cellarulo alla ricostruzione dell'assetto urbano*, 1st ed. Napoli: Arte Tipografica Editrice, 2006.
[4] GANGEMI, Giuseppe. *Osservazioni sulla rete viaria antica in Irpinia*. In L'Irpinia nella società meridionale. II, 1987, pp. 117-123.
[5] MAIURI, Amedeo. *Benevento-cippo milliario della via Appia*. In Notizie degli Scavi di Antichità. Nn. 4-5-6, 1929, pp. 219-222.
[6] JOHANNOSWKY, Werner. *Appunti su alcune infrastrutture dell'annona romana tra Nerone e Adriano*. In Bollettino D'Archeologia. IV, 1990, pp. 1-13.
[7] JOHANNOSWKY, Werner. Canali e fiumi per il trasporto del grano. In AA.VV., *Proceedings of Le ravitaillement en blè de Rome et des centresurbains des dèbuts de la rèpublique jusqu' au haut empire*. Napoli-Roma, 1994 pp. 159-163.
[8] VOLPE, Giuliano. *La Daunia nell'età della Romanizzazione. Paesaggio agrario, produzione, scambi*. 1st ed. Bari: Edipuglia, 1990.
[9] QUILICI, Lorenzo. La viabilità dell'Italia tardoantica fra continuità e discontinuità. in ROTILI, Marcello; edited by, *Proceedings of Memoria del passato, urgenza del futuro. Il mondo romano fra V e VII secolo. Atti delle VI giornate di studio sull'età romanobarbarica* (Benevento 18-20 giugno 1998). Napoli,1999, pp. 175-193.
[10] ROTILI, Marcello. Benevento e il suo territorio: persistenze e trasformazioni, in AA.VV., *Proceedings of I Longobardi dei Ducati di Spoleto e Benevento. Atti del XVI Congresso Internazionale di Studio sull'Alto Medioevo* (Benevento-Spoleto 2002). II. Spoleto, 2003, pp. 827-879.
[11] BUSINO, Nicola. *La media valle del Miscano tra tardoantichità e Medioevo. Carta archeologica di San Giorgio la Molara, Buonalbergo, Montefalcone di Valfortore, Casalbore. Dal pianoro della Guarana al torrente la Ginestra. Ricerche archeologiche a Montegiove*. 1st ed. Napoli: Arte Tipografica Editrice, 2007.
[12] MARTIN, Jean-Marie, CUOZZO, Errico, GASPARRI, Stefano, VILLANI, Matteo; edited by. *Regesti dei documenti dell'Italia Meridionale 570-899*. 1st ed. Roma: École française de Rome, 2002.
[13] GATTOLA, Erasmo. *Historia Abbatiae Cassinensis per saeculorum seriem*. 1st ed. Venezia, 1733.
[14] FRANCOVICH, Riccardo. Villaggi dell'altomedioevo: invisibilità sociale e labilità archeologica, In VALENTI, Marco*. L'insediamento altomedievale nelle campagne toscane. Paesaggi, popolamento e villaggi tra VI e IX secolo*, 1st ed. Firenze: All'Insegna del Giglio, 2004, pp. IX-XXII.
[15] ROTILI, Marcello. Città e territorio in Campania. In VITOLO, Giovanni; edited by. *Le città campane fra Tarda Antichità e Alto Medioevo*. 1st ed. Salerno: Laveglia editore, 2005, pp. 29-60.
[16] FALCONE di Benevento. *Chronicon Beneventanum. Città e feudi dei Normanni*, D'ANGELO, Edoardo; edited by. Firenze 1998.
[17] JAMISON, Everyn Mary; edited by. *Catalogus Baronum*. 1st ed. Roma: Istituto storico italiano per il Medio Evo, 1972.
[18] CIARALLI, Antonio, DE DONATO, Vittorio, MATERA, Vincenzo*. Le più antiche Carte del Capitolo della Cattedrale di Benevento (668-1200)*. 1st ed. Roma: Istituto storico italiano per il Medio Evo, 2001.
[19] STHAMER, Eduard. *L'amministrazione dei castelli nel Regno di Sicilia sotto Federico II e Carlo I d' Angiò*. 1st ed. Bari: Adda editore, 1995.
[20] RICCA, Erasmo. La Nobiltà del Regno delle due Sicilie. 1st ed. Napoli, 1839.
[21] COLONNA, Ferdinando. *Apice-scoperte di antichità avvenute in Apice e nel suo territorio.* In Notizie degli Scavi di Antichità. 1929, pp. 393-395.
[22] ROTILI, Marcello (a cura di). Sant'Angelo dei Lombardi. Ricerche nel castello (1987-96). I. Settore sud-est e ambiente 12. 1st ed. Napoli: Arte Tipografica Editore, 2002.
[23] ROTILI, Marcello (a cura di). Montella: ricerche archeologiche nel donjon e nell'area murata (1980-92 e 2005-07). 1st ed. Napoli: Arte Tipografica Editore, 2011.

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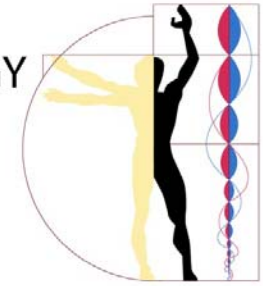

Unveilings. Mnemonic design of the archaeological invisible landscapes

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Abstract
The moments of *crisis* teach us to *cultivate* what is essential, a *feeling* that we often forget. And the *ruins* earn our attention, because they make us *feel* the time, they are the mirror of our existential condition, generous promises that turn our attention in emotion. It is not just to preserve the past, we must be able to *feel* their breath. To design the existing we have to think in a mnemonic way, the emotional artifice that helps to transform the traces in *memory* of the actual experience.
This study is focused on the role of the contemporary project as narrative and mnemonic device in the archaeological invisible landscapes.
Times. These are *timeless places* for excellence, *fragile* contexts where the contemporary project is called to verify the *creative*, *emotional* and *relational* possibilities of new architectural figures, *timid* but necessary to ensure the *permanence*.
Traces. The issue of the conservation of partial and marginal *ruins* refers to the sensitive insertion of the new with the ancient, as a tool to re-activate a *memory* of residual facts and spaces. To protect the excavations, the weak archaeological traces, or to reconstruct the *invisible* signs, means generating reciprocal relationships between the parts, to put the places in safety and give them new identities, to work on *stratification* by defining *analogical* relationships useful to express the presence to the contemporary.
Networks. In the background, there is a need to think about the *archaeological plan* as an *imprint* of the city's past and as a strategic design of/in the city of the future. Relational practices are related to the materiality and physicality of *archaeological landscapes* where the project can generate networks that increase the permanence of the relationships between users and spaces, people and places.
Spaces. The topic will be expressed through the analysis of best practices and the applied experimental design for the case study of Aquileia.

Keywords: Heritage and Memory, Architecture and Landscape Design, Archaeological Invisible Landscapes

1. *Times*. The veil of Maya
The moments of *crisis* are precious, they allow us to see what remains in *life*, despite the destruction. The *crises* teach us to *cultivate* what is essential, a *feeling* that we often forget. And the project, as the operation of choice to throw forward the existing, can play a fundamental role of knowledge and transformative interpretation. This is even more evident in the dense layering places that coexist or collide with the physical complexity of the contemporary city.
Architecture's aim is to show while covers, such as the veil of Maya. The intervention of the new with the existing must create the precise conditions for which the meaning of architecture can be transformed in a continuous metamorphosis: the project can start from what shows or hides itself, from what is clear or opaque, visible or invisible. From a recognized texture of objects and materials, architectural intervention does not necessarily need to track down an image hopelessly lost, it can establish links between the various fragments and play with freedom in the manipulating of space or sense. At the same time, through establishing relations with the *preexistence*, the project of the new defines its own scale and action in the visible and invisible strata of *memory*. "The game of destruction-construction-returning to light" produces a new collection, bringing together elements that were not contemporaries. "The result is a landscape, that is

the meeting of different temporalities" that "won't play in full any past and intellectually alludes to a multiplicity of pasts." [1].
In this context, *shy, fragile and relational operations* propose a reasoning that has to do with the *duration*, the *architectural re-cycle* and the *creative permanence* of existing [2]. The *fragility* (of time, context, planet) implies a different force that can help to achieve greater well-being and beauty by working where there is greater sensitivity, where the less is more. *Anti-fragile* architecture [3] can draw from traces of contemporary and archaeological landscapes, a new foundational disorder for a project more resilient and open to unexpected. Resilience is here understood as the ability to persist in the future, is closely linked to the *care* of the *e*xisting, to the old-new relationship such as *durable* re-signification.
Durability (from the Latin *durare*, is the ability to endure, similar to inflexible, resistant, means that which continues to be, occupying space of time, which would resist the causes of destruction) and *fleetingness* (from the Latin *transitus,* indicates brevity of what passes, which survives for a short time and it is therefore temporary, brief, transient, fragile, momentary, provisional) although opposites, the two terms preserve a linguistic gap of meaning that is useful for architectural experimentation. Referring to the Vitruvian *firmitas* of an architecture designed to survive, and to the events of an architecture dismantled shortly after it was built, both converge towards the *transmutation*, as a form of continuous adaptation to reality, moving through different places. Time is the element of convergence. This principle of reversibility, element of convergence of the two concepts, gives them a vibrant ambiguity through time.
Each action of *architectural re-cycle* establishes a relationship between the new, the existing, the *memory*. This ratio changes as a function of cultural values that are ascribed to the heritage and the significance of the new intervention. The *dia-logos* between a new architecture of the existing and the *memory*, has a spatial, visual and mnemonic dimension. Every *architectural re-cycle*, in fact, implies a new interpretation and a different narration, on its wider meaning. In the contemporary city, increasingly layered and complex, where each physical or conceptual *Tabula rasa* is impossible, the relation *contrast-analogy*, understood as imaginative proposal tied to *knowledge*, can operate in a *creative* way. As some artistic and linguistic experimentation demonstrates - from the becoming other by self in the succession project-realization-use-waste-reuse, to the *ready-made* and the de-contextualization of simple objects, residues, ordinary materials - any intervention on the existing can be an imaginative proposal that recognizes and reuse the significant structures of the historical materials as trace for a new mnemonic architecture.
In the old-new comparison, the idea is that through minimal actions - in terms of dimension, flexibility and cost-effectiveness - we can offer new opportunities. In this sense, the *creative re-cycle* can be sustainable if it is able to elevate the existing fragments to new forms of *permanence*. This applies even more when we refer to a *creative permanence* of the visible or invisible archaeological landscapes.
Permanence is independent from the mere physicality of things, it exists in the *memory*. In some cases, it may happen that what has been built to last physically shortly is designed for durability in the collective imagination, in several cases the *permanence* is an unintentional outcome. For example, in the construction of the Teatro del Mondo by Aldo Rossi the emotional and symbolic value is not diminished by the spatio-temporal fragility. A smart architecture can only be associated with this particular idea of *memory*, reshape itself compared to the complexity of the events that have stratified cities, to be *emotionally durable*. Some great structures of the past are poetic not only because monumental: we can design even through minimal actions, engaging users on a deeper level, offering sophisticated and intense experiences that penetrate the psyche of the user more slowly, for longer periods and more satisfying over time. This means to increase the quantity and quality of the relationships between people and places.

1.2 Intersections between places and *memory*

The *invisible city* is made up of relations, "between the measures of its space and the events of its past" [4].
In the contemporary stratified context, the *ruins* earn our attention, because they make us *feel* the time, they are the mirror of our existential condition, generous promises that turn our attention in emotion. The *ruins* are silent figures that emerge partly from a background or that are incorporated in it. This duality is rich in meaning and requires sensitive actions that allow the continuous resurface, to not stay in the background forever. It is not just about preserving the past, we must be able to *feel* the breath: for design in relation to existing we must think in a mnemonic way the emotional artifice that helps to transform *fragile* traces in *memory* of the actual experience. In the places rich in traces and signs, the project cannot be exhausted only in the preservation of the *preexistence* or in the creation of the new: the two elements can coexist and compete in a continuous interaction of the *fragile* layers of history.
The need to establish a more meaningful relationship within the complex and stratified contemporary landscape, corresponds to the new approach about the theme architecture-archaeology. Here, the archaeological value is expanded with a wealth of different elements, tangible and intangible, traces and *ruins* that require to reformulate the space. These presences can be defined as the "*inverse limit* […] in which singular spaces delimit or include different types of fragments" and the new interventions "while protecting and displaying the artifacts, re-establish their value as a *memory*, as identity and as an exception but also in certain cases as decoration" [5].

Traces and *ruins* have a complex meaning that recalls an absence and presence, an intersection between visible and invisible. *Ruin* is a polysemic term, it can indicate a process of decay of a whole, or a result of the destruction. In this second case the ruin is represented by the remaining parts, still present, of the initial unit that is disintegrating over time.
The experience of *ruin* is different from that of the *fragment*. The *ruin* is a process, a continuous transformation from shape to shape. Otherwise, the *fragment* relates to a singularity. It is therefore to see the *ruins* not as something that refers to a *fragment*, as part of a whole now lost, but as something that falls in the construction of other things [6]. We can remember the *ruins* of Piranesi that become a new whole.
This idea of the *fragment* [7] implies a new relationship of man with the things of the past, not as a whole unchanged and unchanging, but as a continuous process of composition and re-composition. The *fragment* indicates the *fragile* thing, but also the preserved part, it has a meaning that refers to a complex system of relationships where the meanings are to be found at different scales: the scale of the artifact-*ruins*, the scale of the territory, the scale of the *memory*.
Literary writings help us to grasp the salient features of the relationship between the places of *memory* and the contemporary *stratified* project. The current territories are thickly layered, without more precise paths [8]. It is necessary to take away to re-see, “abandon keeping, solution against the ingenuity of an abandonment which not preserves and of a conservation that does not abandon” [9]. The authentic meaning of our time can get away from the past, only if it continues to “look at the face and hear the breath”. In other words, any assumptions about the future of architecture cannot prescind from the relationship with history, from the notion of necessary relationship of belonging to a context, a tradition, a culture. The idea of *voluntary belonging* is the ground for the transformative invention [10]. This notion can also refer to the principle of *collage*, the *objet trouvé*, the new orders through the de-contextualization and reuse with new meanings of things that belong to the heritage of *memory* and that make up the introduction of materials that have not been processed by the artist. It is therefore necessary to point for a method that makes it possible a compositional read of the materials that remain, changed or disappeared. The *archaeologist’s eye* [11] makes it possible to recognize in the *ruins* of the contemporary city a different way to remain and provide semi-finished products to the architect. The eye of the architect will then transform these materials in architectural parts, by using the *empty space*, the impure, the excavation, by abandoning the idea of returning the *fragment* to a condition of whole now lost [12]. The excavation, which precedes the process of foundation, put in connection with the *memory* of a place. It is the tool to search for in the depth of a place the direct testimony of uncovering *ruins* and invisible *fragments*.
The evidence of the invisible is to project the sense of acting in the enhancement of places, where the landscape is the primary mnemonic device. With the recruitment of the landscape as referent of the game nature-culture - able to offer directions to save symbolic or environmental aims, to provide aesthetic or economic bodies, to meet production and relaxing needs - corresponds the possibility of acting on it, working both within the subjective representations of reality and on the production relations that are the source [13].
The landscape as a mnemonic device of the invisible, implies an active action by who observes and takes *care*, the ability to make it perceptible is element of architecture [14]. The ability of the project is to compete with the *stratification* of the signs of a territory, with the *memory* of its events, and to go inside of contemporaneity. The project entails the ability to understand the visible and invisible dimensions of the actions that are under, of which between them may be erased, integrated, partially or completely. The intervention on the archaeological invisible landscapes implies a stratified knowledge, an ability to reverse signs so that they become active matter of the transformation. And a knowledge that is able to excavate the sites, looking for the actions that they have products, a result of ideas and imaginations, material of realities and relationships, of new inverse *palimpsests*.
The term *palimpsest*, in fact, refers to the traces of a page that has been written, then erased and written again. On the idea of re-writing is present the idea of cancellation, that is the design action around which today architects-archaeologists must working [15], to make emerge the invisible, through projects build on the oxymoron absence-presence. What we can leave cancelled, what to re-emerge and what to add for a *palimpsest* in which its structure is still open and comprehensible for the future?

2. *Traces*. Through layers

In *fragile* and timeless places, the contemporary project is called to verify the *creative* possibilities, *relational* and *emotional*, of new architectural figures that are necessary to ensure *permanence*.
Invisible archaeology is made by areas completely re-buried after the excavation surveys, often located within contemporary urban structures. The archaeological invisible landscapes require appropriate models of protection and narration. It is not easy to communicate the possible sense of partial elements that often do not have a monumental character and which are generally difficult to understand compared to their ancient structure. Through a patient dialogue between archaeology, architecture and landscape, contemporary project may delineate a historical narration able to make comprehensible a *fragile stratification*, by the

highlight of different layers. *Stratification* is the mnemonic device of the archaeological invisible landscapes that works on time, traces, networks and spaces.
The issue of preserving the partial and marginal remains can relate to the *sensitive graft* of the newest in the ancient: to protect the excavations and archaeological weak traces, or reconstruct the memories of the invisible elements, means generate relationships between the different parts, give a new identity by acting on the safety of archaeological places and working with/on *stratification* within useful *analogy* figures and links able to express the presence in contemporaneity. Central becomes the need to think in terms of the *archeological plan* as a trace of the past city and as a strategic design of/on the city of the future. In this sense, the recent Ministerial Decree concerning the "*Guidelines for the establishment and enhancement of archaeological parks*" [16], suggest a scientific design approach that draws up specific plans related to the protection, enhancement and management. The necessity of historical contextualization of the remains is highlighted, as well as the requirement that the scientific plans take landscape architecture and urban analysis, with particular attention to services and "border areas", which define relationships with the external context (access paths, parking areas, fences, etc.). These are *relational practices* strongly linked to the materiality and physicality of archaeological landscapes, where the project can generate networks that increase the duration of established relationships between users and spaces.
On the lines and figures of the paths made by the multitude of variables that we rely and cling, the thought emerges between city and nature, ecology, archaeology and urban space. In the archaeological areas the sensitive data, elements and construction references, can be intelligible or not. Here, the aim of the project is not so much in the overlay of distinctive signs, but in the find ways to orient actions of transformation, which you can build via *subtractions, grafts, lining-out*, or through *work on the ground* as the diaphragm between above and below, present and past, visible and invisible. The *living thickness of the ground* is not merely a pretext for the relocation of new devices. Design tactics work on the ground as matter and subject, on which act the transformations that excavate, contain, corrugate, split, stamp, engrave, level, drill, bend, extend, show, play, digs, sculpt, flake off.

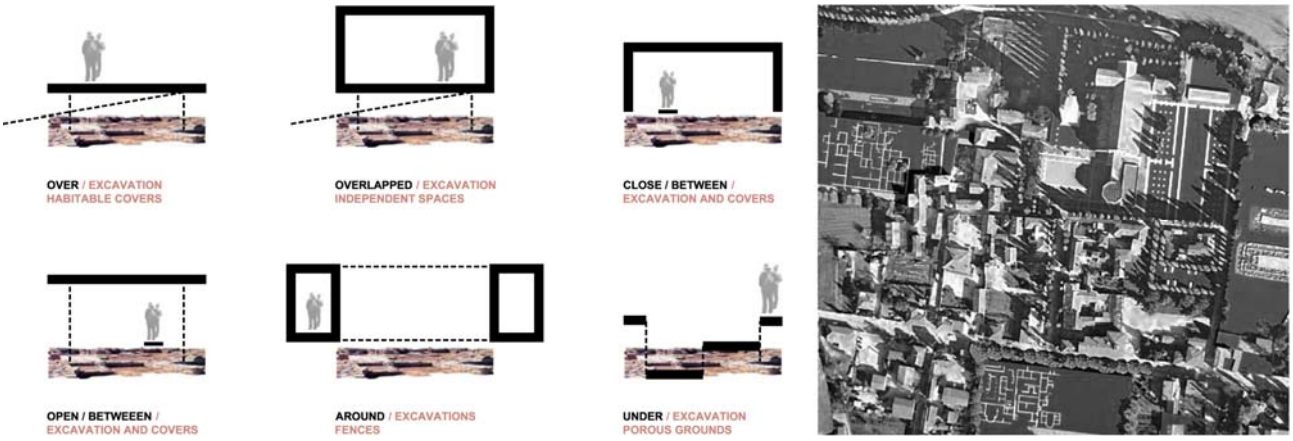

Fig. 1: Architecture-archaeology *grafts*: strategies and tactics. *Other Visions*.

2.2 Strategies and tactics

Starting from several contemporary design best practices, some strategies and tactics, implemented in relation to archaeological remains, are highlighted. These design actions can be combined into three groups corresponding to the *stratification of: the existing elements, the margins, the absence.*

Stratification of the existing elements, or build up the existing, concerns at the historical heritage that emerges in the state of ruin. In this case the architectural devices serve to understand the places. The stratification of the place can be understood as a distinction between the level of the excavation and the level of the new architecture as in the Roman Museum in Merida (Rafael Moneo, 1986). This architecture incorporates the remains of Roman building fabric. The idea of ancient Romanity is not only evoked, but also interpreted and translated into modern forms. The re-activation, re-signification of the ruins is underlying the project of the Museum of the Historical Stratigraphy in Toledo (Francesco Venezia, 2006) through inventions that are not repetitive or camouflage. The architectural fragment is the used material and it suggests a creative relationship with the context. Minimal interventions are made with simple materials and elements as in the archaeological site Praca Nova in Lisbon (Joao Gomes da Silva, Joao Luis Carrilho da Graca, 2010). These spaces of great emotional impact and able to stimulate the visitor interaction, are obtained by using the strong sign of perimeter fence, a margin space with different thicknesses, and through the paths. The

theme of the route which passes through several layers of the city is underlying the project of the Archaeological Museum in Cartagena (Rafael Moneo, 2008). The concept concerns a historic unification in space by keeping totally separate the ancient from the new. The designed parts, like stairways, benches or columns, have no chance of being confused with the archeological finds, on each intervention the camouflage is clearly rejected. As a stratigraphic process for parties overlays, the architectural operation is composed of different several parts as in the Archaeological Park in Olmeda (Ignacio Garcia Pedrosa, Angela Garcia de Paredes, 2009). An immense coverage leaves the free space view of the entire site and the original space is recreated through the inclusion of metallic semi-transparent walls, hung from the ceiling. The recovery of visual continuity and the reassembling of enclosure integrity are underlying the intervention on the Nazarì Wall in Granada (Antonio Jimenez Torrecillas, 2009) that shows the monument like the original figurative stadium, if it is observed from far away. The interior hollow space of the wall, turns into an empty really unique: a step, allowing us to walk inside the wall. This reinterpretation transforms the defense wall as a building and no longer a barrier, spatial and functional element which reorganizes the context and the movement. The hollow box is a device that reveals while protecting such as in the Roman Ruins in Coira (Peter Zumthor, 1986). The new lightweight structure, formed by inclined wooden slats, recreates the old body while filters the air, light, wind and sound. The protective structure suggests the original position and is conceived as an abstract reconstruction of ancient volumes. Reveal the story, in immediate and clear ways, is underlying the project of the Museum Domus Des Bouquets Vésone in Perigueux (Jean Nouvel, 2003). The plan of the Domus is rebuilt by reflection on the dark ceiling that is transformed into a modern abstract framework. Big transparent openings allow the continuous internal-external and past-present comparisons, with the intention of creating a dematerialized architecture. The same relationship is vertically developed in the Archaeological Museum Madinat Al-Zahra in Cordoba (Fuensanta Nieto, Enrique Sobejano, 2009). The service building is structured according to a succession of underground external and internal spaces by using a design methodology careful to the vertical stratification and a narration of the archaeological area. Put order among the contemporary layered fragments is underlying the project of the Santa Giulia Museum and Domus of the Ortaglia in Brescia (Giovanni Tortelli, Roberto Frassoni, 2003), in which the references from the fragment to its context, from the part to the whole, from the old city to the contemporary one, emerge as inspiring theme of the project.

Stratification of the margins, or layering the border space, refers to the necessary protection of archaeological remains that often identify the areas where the diaphragm and the delimitation of the site are the central themes of the project. The enclosure element can have an added value, which is to be developed depending on the different boundary conditions of the place defined by the contemporary landscape, as in the Archaeological Park Selinunte in Castelvetrano (Matteo Arena, Franco Minissi, Pietro Porcinai, 1981). The design concept is to design and development, as an element of the park boundary, a device waterproof to view that is a new bastion in the ground. Along external border, instead, the fence becomes permeable to view. The margin may be the space of relationships between the contemporary reality and the past, as in the redevelopment of the Walls in Cairo (Sasaki Associates Incorporated, 2004) or in the redevelopment of the area of the Temple of Diana in Mérida (Jose Maria Sanchez Garcia, 2008) where the relationship between monument and archaeological-modern city edge is condenses. The result is a platform, a basement high two levels, detached from the soil, which helps to protect the soil and make it accessible. The operation on the old front offers an opportunity to redraw the boundary between natural threshold and built artificial as in the restoration of the Megalithic Walls in Cefalù (Pasquale Culotta, Giuseppe Leone, 2004). This project uses the principle for the implementation of urban continuity, between the historical city and the coast line, in the recovery of archaeological heritage. Building around the ruins to protect them, creating short-circuits between spaces and times, guiding the path and the view, dousing the light, are the tactics for changing place, including in the spatial structure the past testimony and the surrounding landscape, as in the project for the Museum of the history of the city in Pontevedra (Laura Peretti, Stefano Ghiretti, 2008). This is a project to see, a device that links the bridge to the city, the city to the River, the walls at the border, the plan to the section, by returning integrity and meaning to the site of the old bridge and its change over time, from artifact to ruin. The inclusion of the remains during the construction of sites configured by excavations - through the transformation of ground levels among the remains of a Domus and a series of subsequent stratifications along pathways - is underlying the project of the excavation for the foundations of the Fenice Theatre in Senigallia (Donata M. Tchou, Paolo Processi, 2006). Accessibility and usability of museum tours are the elements of transformation and enhancement, because they can interpret the reading of the remains and of the urban or landscape conditions as in the Trajan Market in Rome (Luigi Franciosini, Riccardo D'Aquino, 2007). New levels of path are composed and create outdoor spaces for the view of the ruins and for the overcoming of architectural barriers. On the margins of the archaeological areas, new minimal architectures can create access and services as in the Visitors Center in Malaga (Tejedir Linares & Associates, 2009). Here a margin-building - an autonomous light box, suspended on archaeological level - refers to the need to reactivate the built heritage of archeology even through new grafts that can overcome the pure conservation and trigger new life cycles.

Stratification of the absence, or preserving the invisible, indicates the strategy used in cases where the conditions needed to bring to light archaeological structures, aimed at giving value to the absence and emphasizing it. The translation of the story is carried out starting from the complete absence of material traces as in the Archaeological Park of the Battle of Varo in Osnabruck (Annet Gigon and Mike Guyer Architects, 1999). This project foresees the inclusion of minimal devices. The materials are the main paths within the park, designed to point out the historical reconstruction combined with the texture of the agricultural landscape. The design strategy is to provide a translation of the archaeological narration starting from the sensations evoked by the redesign of components of the contemporary territory. Through the architecture is possible to make evident the presence of archaeological level, even in the absence of material traces and ruins as the Archaeological Park of Civita in Artena (2T_R Architecture, 2007). This project proposes a system of fences, stratigraphic wells and paths, governing the visit of the site, referring to the negative image of the flooded underground Cistern that is present in each building of the historical city. The differentiation between fixed and variable elements is a central design theme as in the Archaeological Park of Claterna in Ozzano Emilia (MMVL and Tasca Studio, 2010). The permanent components reflect the historical traces of the agricultural structure based on Roman land division - centuriation - while the variable devices include the location, size and network connection between the different excavation areas. The emptiness is material to preserve and highlight as in the visitor center Topography of Terror in Berlin (Heinle, Wischer und Partner, Freie Architekten, Heinz W. Hallmann, 2006). This project works on the concept of absence - the emptiness of post-war destruction - which is underlined by the analysis of spatial relations and the rhythms of fullness and emptiness within the archaeological perimeter. The *lining-out* is a tool to facilitate the reading of the archaeological stratification where geometric and spatial aspects are invisible [17]. This is the marking on a horizontal plane of archaeological remains that are not directly visible because places within the ground or in a different dimension from the context. The *lining-out* can be evidenced by the variation in color or in flooring material, as shown by some recent projects (such as the Place de Nôtre-Dame in Paris, the Vesunna Museum in Périgueux, the Domus of the Ortaglia in Brescia. The horizontal examples of *lining-out* corresponds to the vertical one. The vertical *lining-out* is relieved on walls of buildings adjacent to the archaeological excavation, or on the walls of containment (such as the Roman Theater in Zaragoza, the Temple of Diana in Mérida). A kind of three-dimensional *lining-out* is that of the so-called *ghost structures*. These are wire reconstructions of archeological elements no longer recognizable (such as the Porta Praetoria in Windisch).

The contemporary project can therefore be mnemonic and narrative device in the archaeological invisible landscapes. This is the theme that developed in the recent debate about the contemporary intervention in archaeological areas, where excavation and remains lie in abandonment status. Here, the architectural project is called for a comparison with what is already existing, to put new life cycles into what appears to be outdated and invisible. In different forms, many European cities coexist with an archaeological heritage in the ground, in which the flow of time is stratified. This makes the invisible archaeology a theme of relevant interest that requires attention both to the conservation and to the disclosure of evidence, in relation to the dynamism of contemporary transformations.

3. *Networks*. Aquileia archaeological invisible landscape

In the different cases, the contemporary architectural approaches give significant contributions to the definition of design actions in relation to the archaeological heritage, ancient *ruins*, borders and paths that cross and qualify landscapes in transition. These interventions are aimed at establishing relationships with artifacts and archaeological areas, likely to be a relevant factor to the redevelopment of sites starting from their variable identities. The archaeological areas can imagine as real capacitors where the design interpretation of heterogeneous open spaces outlines a *contemporary archaeological landscape* able to fostering dialogue and coexistence between systems which are conflicting each other. This means to imagine a *resilient* project to improve functional performance of the infrastructures, environments and existing settlements.

The case study of Aquileia communicates with these different approaches and methods to the theme. And it represents an opportunity to reflect on the possible role of the archaeological project in the territories of the widespread urbanization, renewing the relationship between research, protection and enhancement [18].

Aquileia is a *thin* and *fragile* landscape that conceals a complex *stratification*. Its articulated *palimpsest* consisting of physical traces that remain and invisible and latent signs. It is one of the most important archeological sites of Europe, where much of the ancient city is still buried. From the 1998 Aquilaia is inserted in the UNESCO World Heritage Site. In some cases, traces of the past show themselves with the unmistakable character of the monument, in other cases the traces are brought to light by the excavations, which reveal tracks or fragments of isolated presences. The relationship between city and history is often conflicting: the intervals of which we perceive, pieces, traces, empty spaces. The presence and quality of diffuse value, in many cases remain, however, isolated as marginal areas, like facts excluded from the contemporary, from even occasional viewing and enjoyment. And yet the archaeological area is not

separated from the contemporary Aquileia, where the infrastructures and the open spaces, the car parks and squares, the fragmented and partial spaces, the monumental and residual areas, are all intersect in the urban textures. The non-use and the loss of the original figurative integrity need to combine the eyes of archaeology with the architecture, to lose to the archaeological enclosure, physical and conceptual, its original meaning and become a place of opportunity for contemporaneity and future.
Currently, the archaeological areas of Aquileia [19] stimulate the review of the design tools. The extension of the territory poses these areas as elements with a strong urban connotation. It is a difficult relationship, a mutual limitation, that requires an innovative vision in the opposition between the liveable city and the old city. The archaeological reality is mostly horizontal, suspended between the ruin spaces and the living spaces, including archaeological excavations and rural areas. The accumulation over time of archaeological sites and artifacts - museums, laboratories, offices, etc. - through the expropriation and purchasing, the annually organizing excavations, the presence of tourists, are all factors that constitute a double fruitful entity of Aquileia. These archaeological islands are isolated and protected, enclosures like the enclave, strangers to the contemporary territorial transformations. From the opposition between protection and urban development [20] is derived the urban dispersion. The actual Aquileia is not really a center, but a settlement of small hamlets scattered over a wide area. Crossing Aquileia is striking the deeply divided fact, the fragmentation between urban tissue and constructed perimeter, fencing areas of inaccessible *memory*, in which “the utopia of the conservator denies the needs of a living city, inhabited, which must be transformed, making them non-places so dense as to be impenetrable memories” [21].
The large areas subject of archaeological interest are the elements of a possible project of an Archaeological Park and cannot be regarded as disconnected from current areas of urban sprawl. This park is vertically and horizontally stratified - above and below the ground, between the visible and the invisible - such as a layered landscape that may still coincide with the innovation of the traces and the image of the Roman designed countryside (the agricultural reclamation “Agro Aquileiese”, the Anfora Canal).
Heterogeneous are the users who living these spaces: residents who have weak relations with the ruins and that perceive them as a constraint for the life of the city; hoteliers and restaurateurs who live of the archaeological heritage and of the linked tourism; the archaeologists and the Aquileia Foundation who would expand the excavation areas to rediscover the old city still invisible and submerged; the tourists, heading to nearby beaches, that often goes just quickly through these places during excursions of a few hours. All of these users require a systematic spatial rethinking, a radical innovation project able to working on usability and diffuse permeability such as opportunities for development and enhancement. The design actions could undermine the status of summation of isolated archaeological enclosures, imagining a territory-park alive and complementary to the urban and social reality of the city, by triggering new urban relations and a simultaneous use of the sites, by qualifying spaces to make the old city not isolated from the contemporary city, but an active resource. This is to provide a project of management and development that considers the contemporary Archaeological Park - visible as well as invisible - an active site of production of culture, expanding the traditional concept of the place of historic preservation.

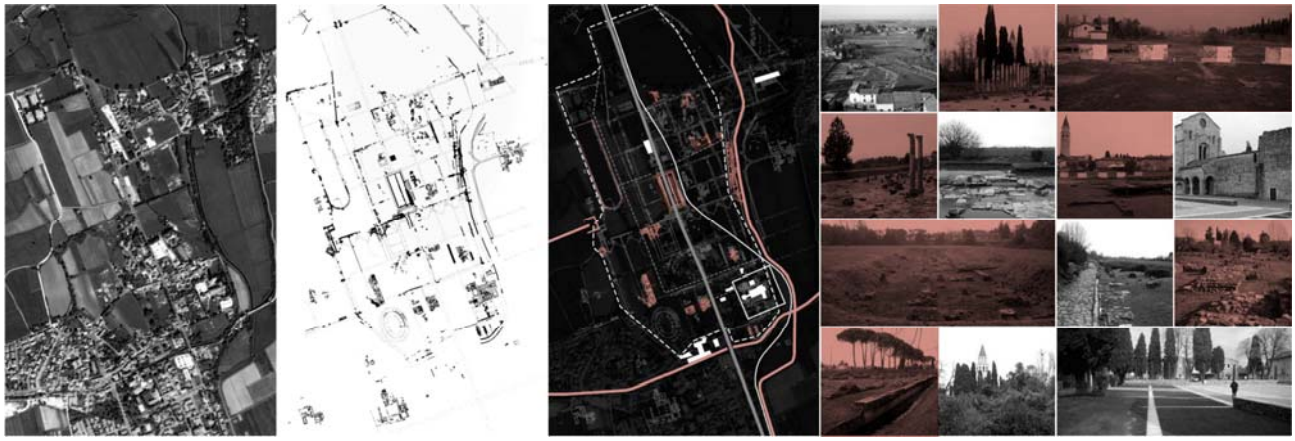

Fig. 2: The Contemporary Archaeological Park in Aquileia. *Other Visions*.

3.2 Margins of fragments and relationships

Starting from the great methodological lesson offered by the strategic plan for Aquileia of Marcello D’Olivo [22] - which it considers the identity of the city in the complex of relationships with the territory, by trying to combine the development of archaeological areas with urban population needs - the design experimentation *Other Visions* [23] proposes at the wide scale a *network park* able to relate sequences of areas with flexible

itineraries, according to the archaeological emergences and the existing city. The result is a landscape of different temporalities. The park is an integrated element and not a walled place, separated and crystallized, a living and enjoying element, a meeting point between the historic center, the recently suburbs, the urban and rural countryside. This means designing and promoting the contemporary use of archaeological areas through a *project of relationships* and a rediscovery of signs, against the fragmented proliferation of close fences and hidden excavations. In this manner Aquileia can live their contemporaneity, taking advantage of the current *crisis* as a generator of new opportunities. New chances that can come from the use of the *built landscape* through *minimal interventions* as a tool for the perception of the history, by allowing the user to discover times and views in progress, by including in the contemporary the stratified perception of the ancient and by reinterpreting in generative sense the concept of protection and security.
Fences and covers are structures for the defense and protection of the archaeological heritage. They have spread to the fragmented tissue of the current city. While they protect, however, they move away from the possibility of knowing and enjoying what they defend. The exclusion from the urban fabric of these fragmented areas, leads to invisibility and contrast. And yet from these devices the architectural design can re-sign the relationship with archaeology, by extending the meaning to transform demarcation lines in permeability spaces, *minimal margin-architectures* and places to live in the landscape. It is up to architecture to find useful strategies to overcome the conflict between preservation and contemporary uses. Because the everyday enjoyment of archaeological spaces is the only way to bring to life the history, making intelligible the *memory* and not only its fragments. For example, while in other contexts the ruins physically emerge into the urban fabric, in Aquileia we have only excavations with no prospects and no volume. Everything is almost invisible: this is the potential project of the *line-ground*, by integrating the research and excavation works in the everyday life, by opening the fences with permeable devices able to re-enter the archaeology in contemporary complexity. The project of the archaeological space can only be thought in relation to the city and its re-generation, for this reason the archaeological empty space still has an intense and unexpressed potential role in the redefinition of the different ways in which the city spaces can be crossed and used.
The design experimentation verified at the architectural scale in the Domus of the Fondo Cossar area, aims to find solutions to two issues: protecting the archeological excavations and experiment devices that can be repeated and adapted in other archaeological areas of the context, solutions that are able to generate relationships of reciprocity between the parties, to organize and classify spaces and paths, to confer identity to places.
The specific theme of the recognizability of the Domus is addressed by defining relationships of *analogy* between excavations and covers, to reinforce the image of some parts with the intention of expressing the adherence to the own time, without camouflage design, as also happens in other sensitive contexts.
The attractiveness and the recognizability of the place are connected first to the representation of the landscape, to the variety of the elements of which it consists, to the stratification of history and in its blend with nature. Various are the resources and elements in this part of Aquileia: the extraordinary presence of a “piece” of Roman *insula*, with at least three Domus, the Violin cowshed and the small historic village that surrounds it, the still buried ruins of the walls and the Roman tower, the via Sacra consists of rows of cypress trees and boxwood hedges up to the river port, the Natissa River as a boundary between the Roman city and the surrounding agricultural landscape, the extraordinary complex of the Basilica on the urban axis North-South.
The real problem that arises in this archaeological area is not freeze life in an only one historical instant. The *fragility* of structures and signs of the presences to protect does not resolve with the only preservation which excludes the existence or the use of our time, but with the constant flow of everyday life through them. So, the *limits-fences* can become more permeable, open and safe, as the thickness of experimentation that can keep referring to the *con-temporaneity*.
The evocative condition of the fragment and the experienced *analogic* relationship refer to: a projects that work to ensure a minimal level of accessibility/feasibility, even limited to certain areas, allowing for the understanding and the possibility of the narration of history; a projects that work on *additions*, understood as *facilities* for the reading by the observer, that with careful and creative look can tell things; a project that work on *grafts* introduced as new configurations, neutral and autonomous forms which may have security purposes or indicate new ways of enjoyment, in which adding contrast, evokes elements for allusion, missing or invisible parts, or never existed.
The main emerging themes of this design experimentation relate to: the definition in that the re-signification of spatial limits and margins, without which there is no space because we perceive shapes and figures across boundaries and borders; the definition of a thickness, the cover as a volume, a thick wall, a fifth facade.
The need to rediscover the Roman city through the construction of an identity and its new role in the context of the contemporary city, is the consequence. If we exclude the port, the forensic complex and the Roman burial ground, currently little remains of the old Aquileia at the sight of visitors. In particular, of the Roman isolates and Domus can be seen only fragments. In order to eliminate the marginality of this area, by enhancing the accessibility and then giving a new centrality to it, the project proposes a complex system of

paths that connects the Basilica with the Violin cowshed, enlarged and redesigned as a visitor center, overlooks the valley of the Domus. Plant species of the Roman period, in the form of hedges, enrich paths properly marked and illuminated.

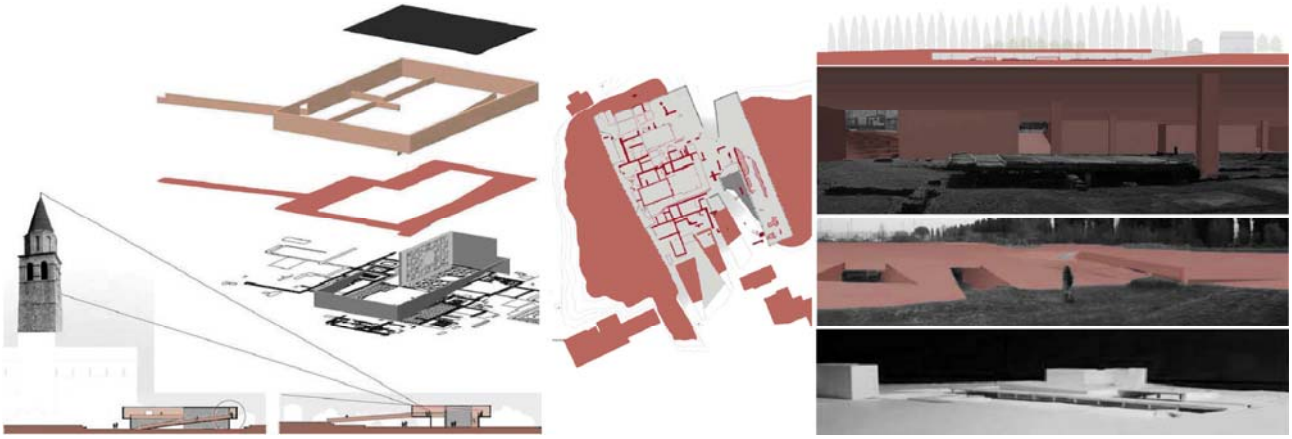

Fig. 3: Thin architectures, margins and thickness, for the Domus of the Fondo Cossar area in Aquileia. *Other Visions*.

4. *Spaces*. Conclusions of empty archaeological spaces

The relationship between *ruin*, current context and project, needs a dialectical approach to the architectural intervention in which experience is not limited to the contemplation of the ancient or the insertion of a new self-referential object, by outdoing the "fateful separation" [24] between knowledges of architecture and archaeology. This is to identify strategies for the reactivation of relations between sites and archeologies, contexts and *memory*, through the design lines able to combining the social-ecomonic growth with a sustainable use and development of territories.

The challenge and the role of the contemporary architectural design in the process of enhancement of the archaeological areas - particularly in urban archaeological contexts - is to exit, by recomposing, from the specialist knowledges. That is to indicate a device of regeneration and *re-cycle* of archaeological *ruins* that can respond to the need to insert and *graft* new uses next to the *ruins*, for their reuse and reintegration into the economic and life cycles.

The archaeological landscape, especially invisible beneath the city's current structures, presents characters of complexity due to the presence of distant parts between them, spatially and temporally, seen and unseen. Here the project is called to generate a dialogue to retrieve its value and sense through the construction of new open and stratified links. This implies considering the transformation as a creative interpretation of the relationship between *text* and *palimpsest*, by an idea of *reverse palimpsest* where the project is called no longer to delete, but to bring out the invisible traces into a new *text*.

For the project of an archaeological invisible and urban landscape the key issues are: the relationship between the city and the excavating area; the necessary integration between contemporaneity and archaeological site; the need to return the excavation area to the life of the contemporary city; the preservation of sites that must be protected and their protective devices may be places and figures of new projects, *porous fences* with and visual and physical integration with the context; the revelation, or unveiling, to guarantee the visibility of the ruins and the highlighting communication of its historical and archaeological character.

Learning from Aquileia, the architectural project is forced to examine the *emotional* and *creative* possibilities of new sustainable architectural figures of *permanence*. A stay that can no longer be *lifting* or reconstruction that refers to death, but temporary and relational *grafts*, as a result of a profound rethinking of the nature of residual materials and things. So just these archaeological invisible remains, can survive oneself, not one but more lives.

Invisibility and *memory* possess a specific dimension, such as dialogue between fullness and emptiness, and are elements from far away. The theme is the *limit dimension*, the *margin space*. *Temporary durability / transitional durable* and *con-temporary* and relational practices, are inextricably linked to the history, the materiality and the physicality of the residues. A project with a lot of times is necessary, a time of modification and transformation of and on the existing. So, an emotional architecture able to generate alternative uses, a poetic architecture of minimal gestures.

Bibliographical References

[1] AUGÉ, Marc. *Rovine e macerie. Il senso del tempo*. [2003] Torino: Bollati Boringeri, 2004.

[2] BATTAINO, Claudia. *On the margins of permanence. Fragile and relational exercises*. CZASOPISMO TECHNICZNE ARCHITEKTURA, vol. 8-A/2011/1, Year 108 Issue 15, p. 55-64.

[3] NASSIM, Nicholas Taleb. *Antifragile. Prosperare nel disordine*. Milano: Il Saggiatore, 2013.

[4] CALVINO, Italo. *Le città invisibili*. [1972] Milano: Oscar Mondadori, 2006.

[5] VANORE, Margherita. *Progettare con le rovine*. In VANORE, Margherita, MARZO, Mauro, edited by. *Luoghi dell'archeologia e usi contemporanei / Archaeology's places and contemporary uses*. Venezia: Università IUAV di Venezia, 2010.

[6] SIMMEL, Georg. *Saggi sul paesaggio*, [1913], edited by M. Sassatelli. Roma: Armando Editore, 2006

[7] ROSSI, Aldo. *Frammenti*. In *Architetture 1959-1987*, edited by FERLENGA, Alberto. Milano: Electa, 1987.

[8] CELATI, Gianni. *Il Bazar archeologico*. In *Finzioni Occidentali*. Torino: Einaudi, 2001.

[9] SEVERINO, Emanuele. *La città e le idee. La questione dei "centri storici"*. In *Tecnica e Architettura*, Milano: Raffaello Cortina Editore, 2003, p.110-118.

[10] GREGOTTI, Vittorio. *L'architettura nell'epoca dell'incessante*. Bari: Laterza, 2006.

[11] CALVINO, Italo. *Lo sguardo dell'archeologo*. In *Una pietra sopra*. Torino: Einaudi, 1995.

[12] MONEO, Rafael. *La solitudine degli edifici e altri scritti*. [1976-1988] Torino: Allemandi, 2004.

[13] TURRI, Eugenio. *Semiologia del paesaggio italiano*. [1979] Venezia: Marsilio, 2014.

[14] TURRI, Eugenio. *Il paesaggio e il silenzio*. [2004] Venezia: Marsilio, 2010.

[15] CARAVAGGI, Lucina, MORELLI, Cinzia, edited by. *Paesaggi dell'archeologia invisibile. Il caso del distretto Portuense*. Macerata: Quodlibet, 2014.

[16] MiBAC, Ministero per i Beni e le Attività Culturali. *Linee guida per la costituzione e la valorizzazione dei parchi archeologici*. Ministerial Decree April 18, 2012.

[17] RUGGERI TRICOLI, Maria Clara. *Urban archaeology without the archaeology / Archeologia urbana senza l'archeologia*. In *Urban archaeology enhancement / Valorizzare l'archeologia urbana*, edited by GERMANÀ, Maria Luisa, RUGGERI TRICOLI, Maria Clara. Roma: Edizioni ETS, 2013.

[18] BATTAINO, Claudia. *Other visions. Aquileia archeological ruins*. In *Valorizzazione fondo ex Cossar. I progetti del Concorso di idee*. Udine: Fondazione Aquileia Edizioni, 2012, p. 92-94.

[19] The State (Demanio) of Cultural Heritage covers a total land area of 221.000 sqm, the estate is 10.800 sqm distributed in 20 buildings. On 128 overall, approximately 90 parcels were acquired through expropriation for public utility. Difficult is the access to archaeological sites, on a total surface of 205.723 sqm, the 60% is not currently open to the public. Cf. FOZZATI, Luigi, BENEDETTI, Andrea. *Per Aquileia: realtà e programmazione di una grande area archeologica*. Venezia: Marsilio, 2011.

[20] ARGENTON, Lino. *Aquileia paese di vincoli: il libro bianco sui problemi del centro attuale*. Udine: Del Bianco Editore, 1972.

[21] RICCI, Andreina. *Attorno alla nuda pietra. Archeologia e città tra identità e progetto*. Rome: Donzelli, 2006.

[22] D'OLIVO, Marcello, et. al. *Piano archeologico monumentale di Aquileia*, 1972. Cf. D'OLIVO, Marcello. *Architetture e progetti 1947-1991*. Milano: Electa, 1998, p. 83, 118.

[23] BATTAINO, Claudia, MENTIL, Federico, ZECCHIN, Luca. *Progetti del Workshop di Progettazione Architettonica Other visions. Aquileia archeological ruins*. In *Valorizzazione fondo ex Cossar. I progetti del Concorso di idee*. Udine: Fondazione Aquileia Edizioni, 2012, p. 94-105.

[24] VENEZIA, Francesco. *Luoghi dell'archeologia e usi contemporanei*. Conferenze at the University IUAV of Venice, 19/20 November 2009.

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UAV Surveys for Representing and Document the Cultural Heritage

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Abstract
The new survey techniques allow for a more detailed depiction of the characteristics of the cultural heritage of which our country is so rich. Unmanned Aerial Vehicles (UAV) are emerging as a key engineering tool for future environmental survey tasks. UAV aerial imagery offers both timely (on demand) and more detailed (higher resolution) information than comparable satellite imagery. In the present study the opportunities of obtaining more detailed documentation of cultural goods throughout UAV survey have been investigated. The survey was conducted on an ancient Aragonese watchtower of the seventeenth century, located near the Abbey of San Vito in the countryside of Polignano a Mare (in the province of Bari, Southern Italy) (Fig.1). The high resolution of the produced images, approximately 1 cm x pixels, allows to obtain all elements of both structural and qualitative information required for a conservative restoration project of the monument. The peculiarity of the transportation vehicle of the camera has also made it possible to detect the top surface of the roof covering of the building, normally not accessible, with the presence of a chimney and an access hatch, on which to intervene for the proper disposal of rainwater. The research refers to the metric characteristics, accuracy, level of detail, the particular crack patterns, etc., reachable by photogrammetric methods, with the help of dedicated software (Agisoft PhotoScan) such as Computer Vision methodologies.

Keywords: Aerial survey, UAV, Photogrammetry, Cultural heritage

1. Introduction
UAVs are increasingly seen as an attractive low-cost alternative or supplement to aerial and terrestrial photogrammetry due to their low cost, flexibility, availability and readiness for duty. In addition, UAVs can be operated in hazardous or temporarily inaccessible locations.
The UAV is an acronym for Unmanned Aerial Vehicle, which is an aircraft with no pilot on board. These vehicles are remotely controlled, semi-autonomous, autonomous, or have a combination of these capabilities. The new terminology UAV photogrammetry describes a photogrammetric measurement platform, which operates remotely controlled. The combination of photogrammetric aerial and terrestrial recording methods using a mini UAV (also known as drone) opens a broad range of applications, such as surveillance and monitoring of the environment and infrastructural assets. In particular, these methods and techniques are of paramount interest for the documentation of cultural heritage sites and areas of natural importance, facing threats from natural deterioration and hazards. Today, UAVs can be used as a precise, automated and computer controlled data acquisition and measurement platform, thanks to the recent developments of low-cost sensors such as off-the-shelf digital cameras, GPS/INS (Global Positioning System / Inertial Navigation System) based stabilization, navigation units and laser scanners.

2. The Aragonese watchtower



Fig. 1: The study area with the Aragonese watchtower located in the seashore area of San Vito (Polignano a Mare, in the Bari province, Southern Italy)) and the GPC (Ground Control Points) location

The object site of this study is located along the Adriatic coast about 3 km north of the town of Polignano a Mare, in the Bari province (Fig. 1). Summer destination of many bathers, the small beach of San Vito has been for centuries a flourishing center of commerce. Featured with an attractive natural harbor, during the centuries it was a favorite destination of foreign populations and invaders. Originally the place where now stands the monastery should correspond to the ancient Απανεστε - name of Greek origin - a stopping place along the Via Traiana. Thanks to the particular location and easy connections with the hinterland villages, between the fifth and seventh centuries Basilian monks settled here, finding accommodation in rock refuges of which the area is particularly rich because of the karst nature of its territory. It was precisely the monks of St. Basil, according to legend, to house the relics of San Vito and his preceptors, Modesto and Crescentia, arrived in Polignano with Princess Fiorenza of Salerno in the year 801. The legend tells that Fiorenza, rescued from a storm on the river Sele own by St. Vito who appeared in the tragic moment, made a vow the Saint to preserve his mortal remains. So the Princess of Salerno bought some estates of Castrum Polymnianense and donated them to the Basilian monks who became the guardian of the remains of the Saint. Later, perhaps in the tenth century, the Basilian monks, which were succeeded by the Benedictine in the eleventh century, began the construction of the abbey. Then, in the seventeenth century the monks erected a watchtower positioned to defend the Abbey. The whole site is very interesting from an archaeological point of view: natural harbor on the Adriatic, at the mouth of a “lama”, and *statio* (changing station horses) on the Via Traiana. There are visible signs of a defensive system against invasions from the sea: the outer walls, the tower farm of the sixteenth century into the walls and the coastal tower outside. Such a tower of sighting, defense and communication are dotted about much of the Adriatic coast of Southern Italy and are often very interesting from architectonic point of view. Fig. 2 shows a view of the tower of San Vito on which the survey was carried out.



Fig. 2: The San Vito tower and the UAV control equipment

3. UAV Photogrammetic Survey

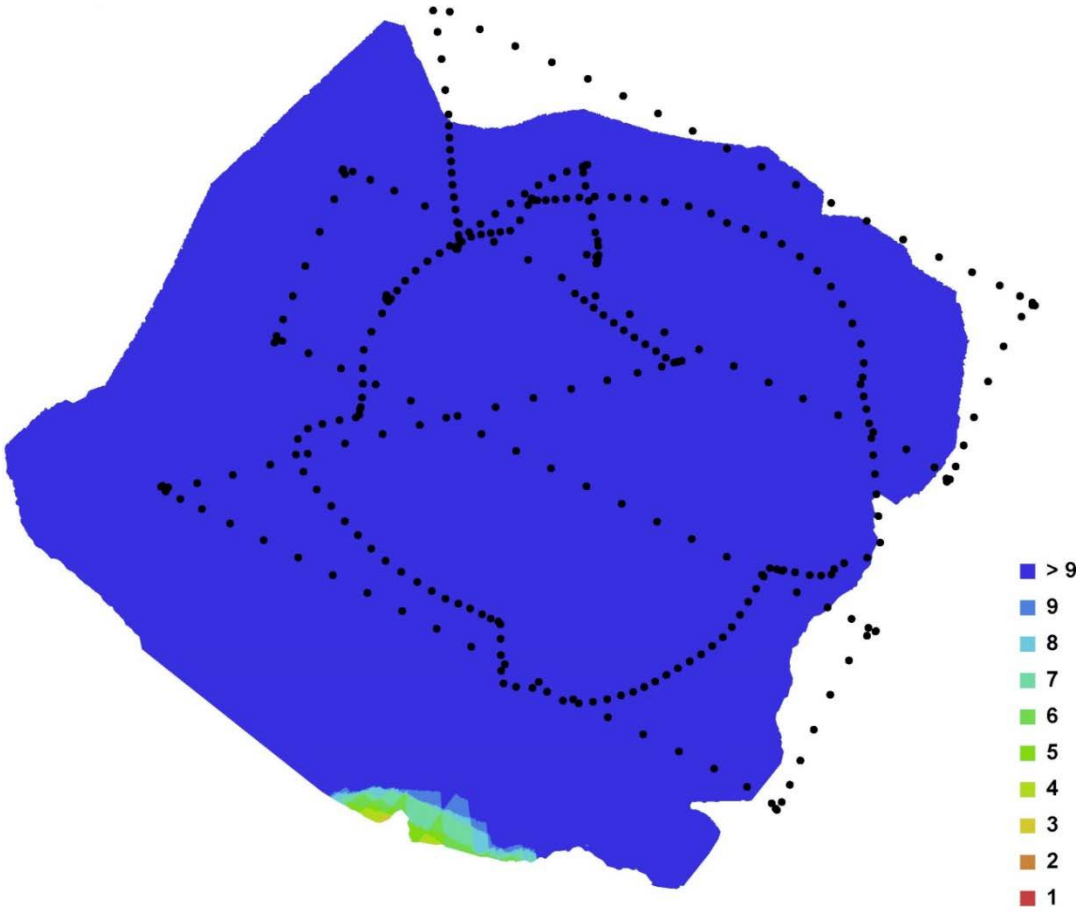
UAV aerial imagery in combination with photogrammetry are emerging technologies providing an innovative approach to 3D documentation of cultural heritage., an unmanned aircraft system (UAS) includes ground stations (control points and check points) and other elements besides the actual aircraft (Fig. 3 and Fig. 4).
The UAV survey was executed on 22th January 2015 in collaboration with SAL Engineering (Modena, Italy) which has done three flights at about 65 m of altitude with a “esacopter” equipped with a brushless electric motor and a GNSS satellite positioning system, that is necessary to determine the photogrammetric lens centers and IMU inertial system for the flight attitude.



Fig. 3: UAV vehicle (on the right corner), instrument control panel (on the left) and GPS control point.



Fig. 4: Detail of the GPS instrumentation on a Ground Control Point nearby the Benedictine Abbey.



Number of images:	330	Camera stations:	330
Flying altitude:	64.6829 m	Tie-points:	524607
Ground resolution:	0.010096 m/pix	Projections:	3009806
Coverage area:	0.0218499 sq km	Error:	0.558543 pix

Fig. 5: Camera locations and image overlap

Table 1: Cameras mounted on the vehicle

	Resolution	Focal Length	Pixel Size	Precalibrated
Canon EOS 550D(25mm)	5184x3456	25 mm	4.4036x4.4036 um	No

Nearly 330 nadiral and inclined images were taken with CANON EOS 550D calibrated camera with 18 mpx APS-C sensor. Thanks to the GPS-Position-Hold technology a framework of 4 Ground Control Point (GCP) has been set on the study area and for internal use and further error checking 2 more points (check points) were collected using dual frequency Trimble GPS receivers. The location of Ground Control Point (GCP) and surrounding check points have been reported in Figure 1.
Next Table 2 shows the location errors of GCP points. Note that the total error obtained is sub-centimetre that is a very satisfactory result.

Table 2: Ground Control Points (GCP) location error

	X error (m)	Y error (m)	Z error (m)	Error (m)	Projections	Error (pix)
01	-0.003413	-0.008488	-0.003379	0.009753	17	0.354712
17	-0.004003	0.005222	-0.004245	0.007831	33	0.267975
19	0.000385	0.000743	0.008380	0.008421	83	0.292264
35	0.007249	0.002697	0.000630	0.007760	11	0.257297
Total	**0.004483**	**0.005176**	**0.005001**	**0.008479**	**144**	**0.292577**

In table 3 the check points location errors are reported. Also in this case the results (total error = 0.028 m and error/pix = 0.50 m) are encouraging.

Table 3: Check points location error

	X error (m)	Y error (m)	Z error (m)	Error (m)	Projections	Error (pix)
15	-0.017510	-0.018104	0.021604	0.033182	10	0.431421
34	-0.010674	0.004906	0.017138	0.020778	18	0.539213
Total	**0.014500**	**0.013263**	**0.019499**	**0.027684**	**28**	**0.503373**

4. Results

The image processing was carried out with photogrammetric and Structure from Motion software (Agisoft PhotoScan) and, as a result, a cloud of 524.607 points with a 0.010096 m/pix resolution were calculated starting from 330 nadiral and inclined images (Fig. 6).
The tower's model was extracted from the whole point cloud using ESRI ArcGIS 10.3 software.
Therefore it was possible to build the three classic architectonical projections: plans, façades and sections. Furthermore the 3D model was used in order to retrieve some assonometric views, nadiral images of the northern façade and a detailed orthophoto map.
Figure 7 shows an assonometric reconstruction of the point cloud with a local reference system.
In Fig. 8 the retrieved Northern façade of the tower is outlined, where it is possible to recognize at least two different construction stages.



Fig. 6: Aerial View of the Aragonese watchtower

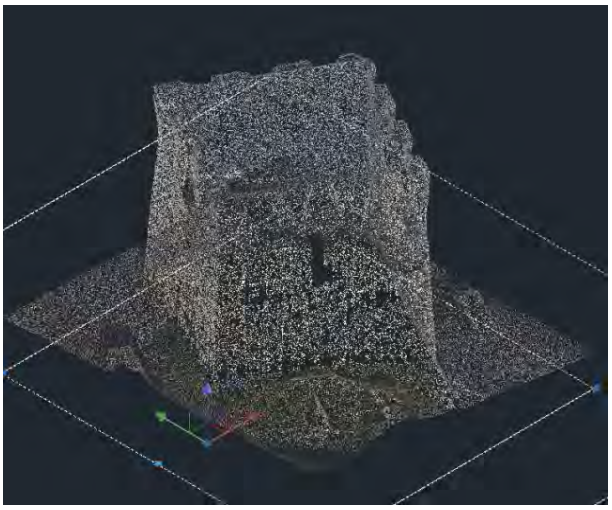


Fig. 7: 3-D view of the point cloud



Fig. 8: Northern façade of the tower

This kind of survey is the only one which allows to highlight some peculiarities of the tower.
In Fig. 9 the point cloud plan at roof covering level, obtained in ArcGis environment, is reported, showing the presence of a trapdoor and of a chimney.
Figure 10 shows a very clear shot of the roof that has been extracted from the UAV shooting survey. It provides a detailed view of the roof of the tower with the trapdoor fitted out with a stair and the chimney.
It is also possible to note the peculiar slope of the roof inclined north-west-wards.

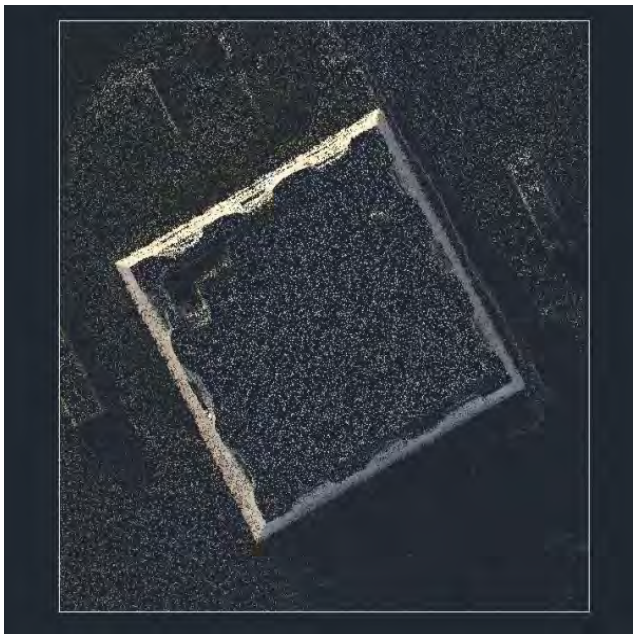


Fig. 9: Point cloud plan at roof covering level



Fig. 10: Shot of the roof covering plane

5. Conclusion

UAV photogrammetry opens various new applications in the close range domain, combining aerial and terrestrial photogrammetry, but also introduces low-cost alternatives to the classical manned aerial photogrammtery. The new terminology “UAV photogrammetry” (Eisenbeiss, 2008) describes a photogrammetric measurement platform, which operates remotely controlled, The platform is equipped with a photogrammetric measurement system. Current standard UAVs allow the registration and tracking of the position and orientation of the implemented sensors in a local or global coordinate system. Hence, UAV photogrammetry can be understood as a new photogrammetric measurement tool.

Major advantages of UAVs compared to manned aircraft systems are that UAVs can be used in high risk situations without endangering a human life and inaccessible areas, at low altitude and at flight profiles close to the objects where manned systems cannot be flown.

In addition, one fundamental advantage of using UAVs is that they are not burdened with the physiological limitations and economic expenses of human pilots. Moreover, supplementary advantages are the real-time capability and the ability for fast data acquisition, while transmitting the image, video and orientation data in real time to the ground control station.

The UAV-images can be also used for the high resolution texture mapping on existing DSMs and 3D-models, as well as for image rectification. The rectified images and derivates, like image mosaics, maps and drawings, can be used for image interpretation.

An important field of application is the Cultural Heritage one; in other words, this kind of survey can provide useful detail for the cataloging of architectural monuments or the tourist information collection.

In conclusion it is possible to say that this survey provides essential elements in order to execute a restoration aimed at the recovery of the tower itself.

Bibliographical References

Briggs I. C.. Machine contouring using minimum curvature, Geophysics, 39: 39–48,1974)

Burrough P. A. . Principles of Geographical Information Systems for Land Resources Assessment, Oxford University, New York. (1986),

Eisenbeiss, H. The Autonomous Mini Helicopter: A powerful Platform for Mobile Mapping, In: The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, ISPRS Congress, Beijing, China, XXXVII. Part B1, 977-983, 2008

Eisenbeiss, H., Lambers, K., Sauerbier, M. and Zhang, L. Photogrammetric documentation of an archaeological site (Palpa, Peru) using an autonomous model helicopter, International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences, CIPA, Torino, Italy, Vol XXXIV-5/C34, 238-243, 2005.

Oliver M. A., Kriging: A Method of Interpolation for Geographical Information Systems, International Journal of Geographic Information Systems, 4: 313–332,(1990)

Smith W. H. F., Wessel P. .Gridding with continuous curvature splines in tension, Geophysics, 55: 293–305, (1990)

Terzopoulos D., The computation of visible-surface representations, IEEE Transactions on Pattern Analysis and Machine Intelligence, 10: 417–438.(1988)

Watson D. F., G. M. Philip. A Refinement of Inverse Distance Weighted Interpolation, Geoprocessing, 2:315–327,(1985),

Zhang, C.. Photogrammetric processing of low-altitude UAV imagery, ASPRS 2009 Annual Conference, Baltimore, Maryland (U.S.), 2009

Zischinsky, T., Dorfner, L. and Rottensteiner, F. Application of a new Model Helicopter System in Architectural Photogrammetry, In: International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences, ISPRS Congress, Amsterdam, the Netherlands, XXXIII, B5/2, 959 – 965, 2000.

HERITAGE and TECHNOLOGY
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The environmental engineering in Vesuvius National Park

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The bioengineering represented the first significant sign of new course of management Vesuvius area, and of course to help increase the connection between different ecosystems of Park. The natural engineering, as is known, is a technical discipline that uses: renaturation techniques aimed at creating an atmosphere appropriate to the species or plant communities and / or animals; live plants or parts of them such as building materials, alone or in combination with other materials; materials, even inert, infrastructure and other measures designed to provide favorable conditions for the life of animal species.
The purpose of these interventions, as is now widely recognized, are mainly four: technical and functional, natural-ecological, aesthetic-landscaping, economic.
In Vesuvius National Park, since 1997, have been made and are still being realized numerous works of arrangement erosion and slope stabilization representing a wealth of experience for the accommodation of unstable areas in Mediterranean mountain. The lines of action carried out within territory of Park have provided only activities with minimum environmental impact, using the techniques of bioengineering and its small mechanical equipment.

Keywords: environmental, renaturation, bioengineering

1. Introduction

The environmental engineering represented the first significant sign of new course of management Vesuvius area, and of course to help increase the connection between different ecosystems of Park. The natural engineering, as is known, is a technical discipline that uses: renaturation techniques aimed at creating an atmosphere appropriate to the species or plant communities and / or animals; live plants or parts of them such as building materials, alone or in combination with other materials; materials, even inert, infrastructure and other measures designed to provide favorable conditions for the life of animal species.
The purpose of these interventions, as is now widely recognized, are mainly four: *technical and functional:* resolution of technical problems such as the consolidation of a river bank or stabilization of a slope in landslide; *natural-ecological*: not easy "to restore green", but recreation of the ecological base for the initiation of processes tending towards ecosystems evolved with the highest biodiversity and heterogeneity; *aesthetic-landscaping*: reintegration of the works in the natural landscape; *economic*: as works often competitive with traditional ones.
Target areas ranging from control of hydrogeological with slope stabilization and hydraulic arrangements, the recovery of degraded areas, to the works of reducing environmental impact and renaturation and, in particular:
- Accommodation side anti-erosion, stabilizing and consolidating;
- Forest hydraulics systems and hydraulic agrarian;
- Engineering on the plains and re-naturalization of wetlands;
- Realization of crates expansion and bridles restraint;
- Accommodation and coastal dune;
- Creations of ecosystems filter;
- Creation of purification tanks of water coming from the drainage white road;
- Mitigation of the impacts of linear infrastructures (revegetation of slopes, embankments, the residual areas);

- Mitigation of noise through construction of noise barriers or green belts of vegetation;
- Reduction of air with vegetated filter strips;
- Revegetation of rocky slopes (quarries, road slopes, entrances to tunnels, rocky slopes in general) and former landfill;
- Creation of mitigation works for wildlife (overpasses and underpasses, protection zones, etc.).

2. Intervention guide of naturalistic engineering in Vesuvius national park

In Vesuvius National Park, since 1997, have been made and are still being realized numerous works of arrangement erosion and slope stabilization representing a wealth of experience for the accommodation of unstable areas in Mediterranean mountain.
Concrete and brilliant results have been obtained as part of the reorganization of hydrogeological slope Somma-Vesuvius through the use of Naturalistic Engineering techniques. The territory of Vesuvius National Park is marked by a strong slope instability, with dense urbanization of the slopes accompanied by spacious mountain and hill abandoned, resulting in decreased maintenance of works intended to protect the soil and increase the possibility of triggering degradation phenomena.
An approach based primarily in the emergency has favored, in recent decades, realization of works for intensive risk reduction in lowland areas where it has the highest level of urbanization, often neglecting the mountainous part of the catchment area, where the erosion begins to establish itself more strongly.
In the hilly and mountainous areas of park (Monte Somma, Vesuvius cone, low and middle slopes of the volcanic), there is an extensive network of trails used in the past to reach the wooded areas and cultivated fields. Most of them, some of which driveways (denominated stradelli), is presented in a state of instability with numerous landslides localized, that limited considerably and in some cases have hindered the practicability. In fact, the presence of loose pyroclastic materials on the slopes and in gullies, which serve as watersheds, in case of heavy and prolonged rain, landslides involved with the consequent disruption of the internal roads of the park, which is fundamental for the maintenance and control of the territory.
Consequently, Park Authority has set among its priorities the accommodation and the reopening of the trails and slope stabilization contiguous, in order to ensure greater control against hydrogeological.
The lines of action carried out within territory of Park have provided only activities with minimum environmental impact, using the techniques of bioengineering and its small mechanical equipment.



Fig. 1: Before interventions



Fig. 3: After interventions

3. Techniques and work performed

The work performed on Somma-Vesuvius volcanic complex are:
- Realization of break is wooden and chains underlying lava stone;
- Compaction of the bottom of the small roads and revegetation;
- Was of absorption and water collection;
- Drywall;
- Support poles double and single;
- Support poles double and single "Vesuvio";

- Support poles sec. Florineth;
- Grates "Vesuvio";
- Trellis poles;
- Bridle in timber and stone;
- Channels in timber and stone;
- Recovery and cleaning of ancient hydraulic works in lava stone;
- Protection works;
- Fences;
- Maintenance works

The realization of the bridle in wood and stone, stone walls and palisades double support, together with the hydraulic works and dredging, reached the design objective of securing the embankments for the restoration of the feasibility of the trails.

In the ravines and valleys, excellent results were obtained with palisades chestnut that resisted well to mechanical stress induced by the distance of the trails with jeep service and light trucks weighing up to 3 tonnes.

Pole double "Vesuvio" is a variant of double poling alive, born from the experience and has in it the advantage of a greater clamping to the ground in the site, but with the disadvantage of being more expensive. Uses the same principle of driven poles in loose material, thus improving both the interface soil/structure is the stamina global work.

3.1 Support poles double wall

It was used to consolidate the scarps and allow the expansion of the headquarters of the small roads. These works are able to withstand small ground movements without suffering structural alterations. For the construction of the poling alive was necessary to build a foundation base. Below you placed the roundwood chestnut taking care to realize small joints between the poles through the modeling of support points and setting the poles between them with nails or steel bars.

3.2 Support poles single wall

The structure was built in the presence of limited space and there where the design choices required light opera with prevailing stabilization function than that of consolidation.

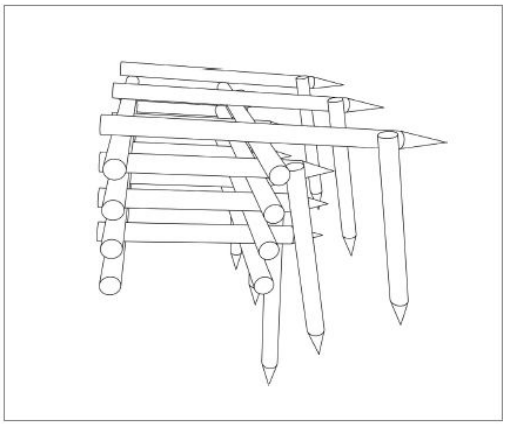

Fig. 3: Axonometry

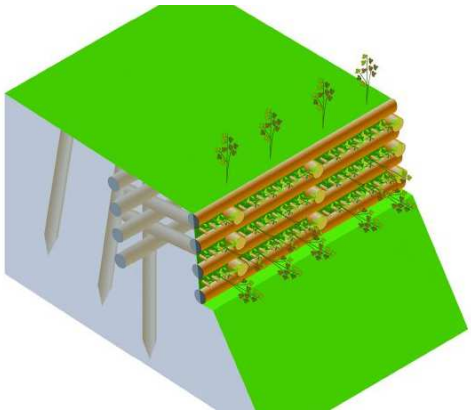

Fig. 4: Axonometry final intervention

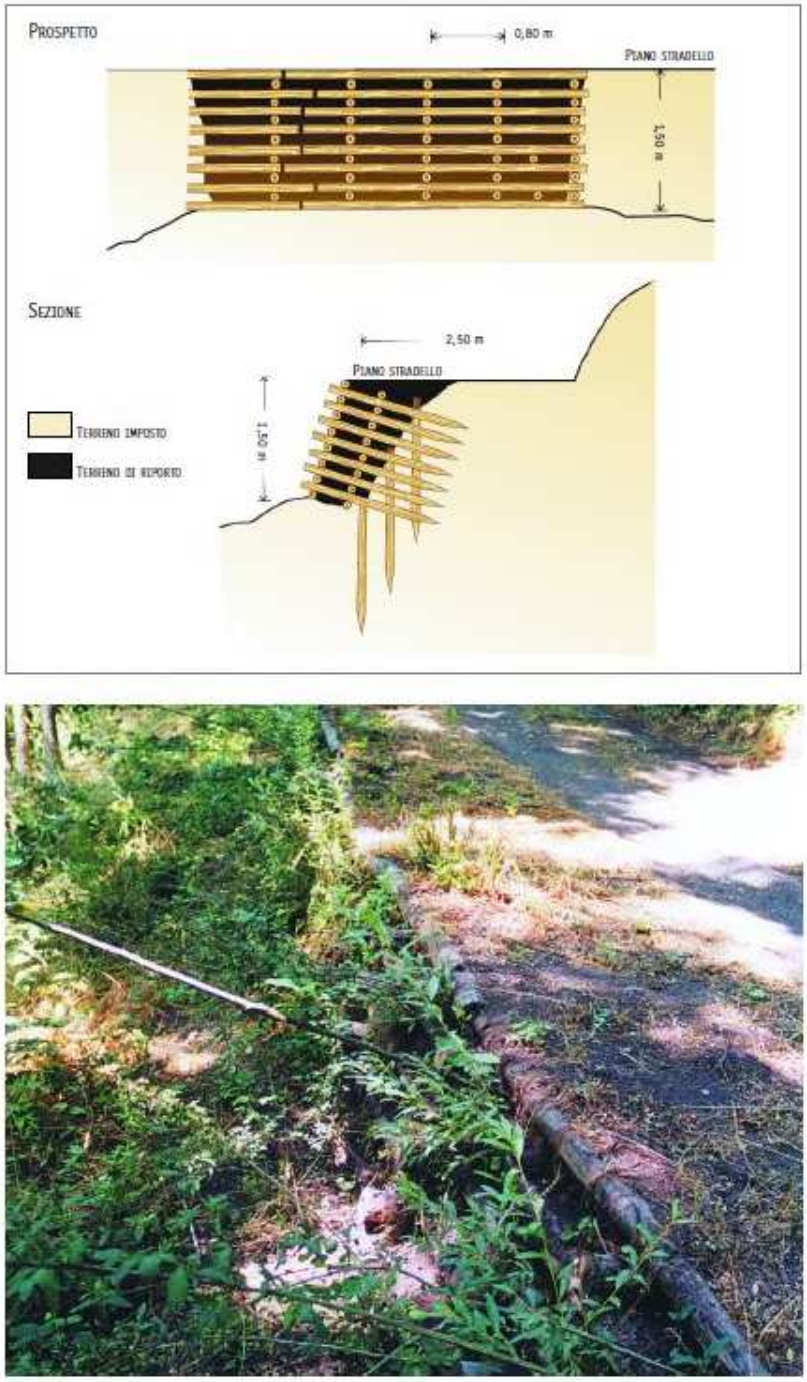

Fig. 5: Support poles single wall

3.3 Drywall

These walls were made using lava stone, sourced on site, placing shards of lava stone, previously shaped by hand.

3.4 Fence

In areas of the Park has taken advantage of this type, mainly on steep slopes slightly. The intervention of stabilization of slopes consisted in the construction of structures in the timber transverse to the line of maximum slope, consisting of pegs driven into the ground, placing of poles upstream of the pickets and planting of live plant material obtained in the large step. We proceeded to the insertion of staples into the ground positioned at a distance of 80-200 cm, fixed in the ground for at least two thirds of the length, with its axis vertical or slightly upstream in counter. Upstream were taken small steps where they were planted seedlings rooted.

3.5 Bridle in timber and stone

It was made by running one hand digging for the construction of a containment bin in chestnut wood is bark, with poles such as to allow machining without the aid of mechanical means, filled by hand, then, with stone material of various sizes , retrieved locally.
In stakes used were created and used for the joints unions nails and metal staples. The wings have been well incorporated into the banks and, at the top, care was taken to create a coating of lava stone with function and erosion.

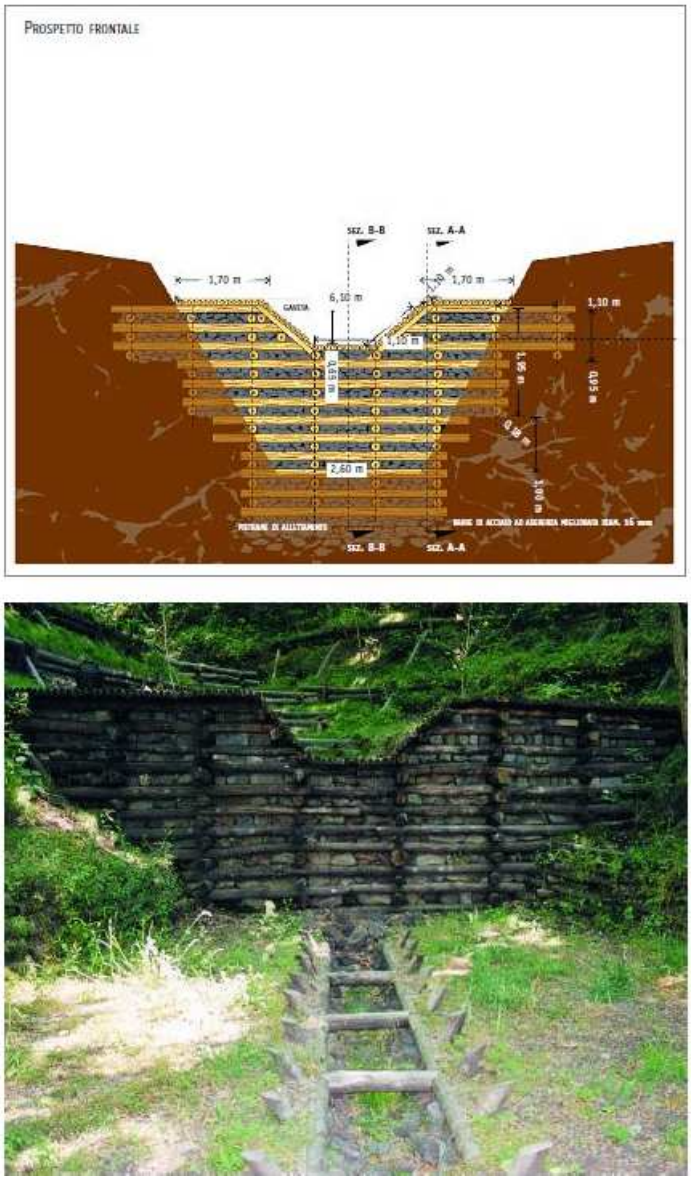

Fig. 5: Bridle in timber and stone

3.6 Grate "Vesuvio"

In was used for the stabilization of steep slopes in erosion with steepness of between 45 ° and 55 ° a nd heights not exceeding the then meters. In stable ground making multiple palisades, two or three poles of the longitudinal diameter of 8-12 cm and a minimum length of 2-3 m placed at a distance from each other along the line of maximum slope of about 2m. Subsequently, on the slope are arranged trunks connected to the palisades, on which are fastened with nails and rods further horizontal logs for the construction of the grate. The dimensions of the chestnut logs are debarked diameter of 12-14 cm and a length of 2-4 m. Daughters vertical elements were arranged at a distance of about 1.5-2 me, horizontal ones to a distance of 1.5-2 m.
With the use of earth augers combustion creates an invitation for the first 80 cm of the support poles of the grille to the side that subsequently are driven to the ground with a mallet until rejection; the size of said poles are: diameter of 10-12 cm and a length of 2 cm. The grate is filled with soil sourced on site and along the

horizontal logs is willing prunings comb and performed sowing broadcaster entire surface. They are also planted native shrubs.

3.7 Support poles double and single "Vesuvio"

Used for the consolidation of the slopes and landslides in the works for counter paths driveways made along the hillside, with piling in roundwood chestnut bark-diameter 12-16 cm. Places alternately in the longitudinal and transverse to form a castle in timber and fixed together with iron nails or rods of diameter 10 mm. The poles longitudinal, before being fixed to the castle, are fixtures, until rejection, hammer blows in the excavation face. When the excavation and during the positioning of poles driven into the slope, must be placed upright poles having a function of tie rod that will be connected with nails to the latter.
The entire structure is filled with earth from the excavation and, in the interstices are allocated hardwood cuttings of willow, hazel, alder and poplar or other suitable species to plant breeding. The cuttings must project for 0.10-0.25 m from poling to get in the back until the natural terrain. Will also be placed both on the top and on the outer face of the poling, rooted plants of shrub species pioneer. The double wall is formed by a row of longitudinal trunks both outside and inside. The poles can be realized for individual sections not higher than 1.5 m.

4. Bioengineering in Campania Region

The rules for the implementation of the interventions of environmental engineering in the Region of Campania is issued with Resolution n. 3417 of July 12, 2012 (Presidential Decree no. 574 of July 22, 2002).
Establishes *"... concepts and principles to be followed by binding to the regional offices that operate in the field of soil conservation, reclamation and environmental recovery, infrastructure and water works, environmental protection and other organizations eventually dealers for the realization of interventions in the above sectors, in various stages of planning, design, approval and execution of the works of competence of the Campania Region, under article 4 of the Regulations. It is also one discipline both for the evaluation of similar works, to be followed by latri entities, public or private, and for the issuance of permits and go-ahead of regional competence, when required by applicable law, that for every action funded even partially with public funds. "* With Regional Council Resolution n.4084 of 20/09/2002, has been integrated the Technical Annex of Regulations for the Implementation of interventions Naturalistic Engineering in Campania Region, with tables of tree species, the descriptions of the individual technical solutions base, product specifications and updated rates obtained from specific analyzes.

5. Conclusions

The challenge is this: to transform Vesuvio from risk to the resource; protect the most famous volcano in the world and, at the same time, to maximize the attraction of its peculiarities not only strictly volcanological, but also nature and which constitute the rich biodiversity; implement an integrated system of compatible development that sees the protected area of Somma- Vesuvio which main pivot to enhance an area rich in tourist attractors such as the ruins of Pompei, Ercolano and Oplonti, villas of Miglio D'Oro, Gulf of Naples.
Using the best possible European resources, the POR Campania and the Environment Ministry has tried to eliminate the degradation material still exists to provide local communities not only hope but also certainty.
A concrete and brilliant results obtained by Ente regards the restoration of hydrogeological slope of Somma-Vesuvius through the use of their techniques of bioengineering. The testing of these techniques in the Mediterranean area, still in place, made the Vesuvius National Park leading, both for the innovations, both for the acquisition by about former LSU center workers, a unique know-how in the field, and especially in an expendable labor market expanding more and more attentive to sustainable land management.

Bibliographical References

[1] AA.VV., 1990 - *Tecniche di bioingegneria naturalistica negli interventi di recupero ambientale*. Acer 6

[2] AA.VV., 1995 - *Sistemazioni in ambito fluviale*. Quaderni di Ingegneria Naturalistica. Il Verde Editoriale

[3] AA.VV., 1995 - *Opere e tecniche di ingegneria naturalistica e recupero ambientale*. Regione Liguria, Ass. edilizia, Energia e Difesa del suolo.

[4] AA.VV., 2001 - *Interventi di Ingegneria Naturalistica nel Parco Nazionale del Vesuvio*. Ente Parco nazionale del Vesuvio.

[5] Bruschini, Castello, Cornelini 2006 - *Linee guida per gli interventi di riqualificazione idrogeologica e vegetazionale nelle aree percorse dal fuoco* Sito internet del Ministero dell'Ambiente

[6] Carbonari A., Mezzanotte M., 1993 - *Tecniche naturalistiche nella sistemazione del territorio. Prov. Autonoma di Trento*

[7] Cornelini, 2002 - *Criteri e tecniche per la manutenzione del territorio ai fini della prevenzione del rischio idrogeologico* - Sito internet del Ministero dell'Ambiente

[8] Fiengo G.,1988 – *I Regi lagni e la bonifica della Campania Felix durante il viceregno spagnolo*. Leo S. Olschki

[9] Lavaca P., 1914 – *La sistemazione idraulica forestale dei monti Somma e Vesuvio dal 1° Luglio 1906 al 30 Giugno 1913*. Tip. Meridionale Turi, Napoli

[10] Simonetti R., 1912 – *La bonifica e la sistemazione idraulica dei torrenti di Somma e Vesuvio*. Giornale Genio Civile, Napoli

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Methodological study on the application of the stratigraphic analysis to the New Villages of Middle Age.

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Abstract

New Villages are little villages that grew up in the Middle Age, as a result of a sharp increase of population, in the twelfth-thirteenth centuries. These new settlements were not born spontaneously, but they were the result of the initiative of territorial lords, in order to extend their control over a certain territory and increase their revenue.

The object of the research is the definition of an Atlas of urban history, a study on the representation of the history of the city in its early stages of growth, depression and rebirth, in order to identify a method of graphic rendering applicable to the New Towns of subalpine area because, currently, there is a total absence of historical atlases city of Piedmont, while these interventions are available in other parts of Italy and especially in the central and northern Europe.

This study is also supported in Italy by Francesca Bocchi and Gina Fasoli for the cities of Bologna and Bassano del Grappa. A similar work is curated by Enrico Guidoni for the city of Talamone. On the international field is remarkable the work edited by Dany Sandron and Philippe Lorentz.

The aim of the work is to find a method of restitution of all tissues stratified over the years, applicable to Villae Novae, analyzing the relationship between historical and cartographic analysis, with the intent to regenerate the memory of places and encourage a program of cultural action, recovery or protection.

Keywords: New Tows, Villae Novae, Middle Age, Stratigraphic analysis

1. The New Villages: birth and development.

This paper proposes a study on some of the new subalpine villages. The subject of the PhD research is the definition of an atlas of urban history, a study on the representation of the history of the city in its early stages of growth, depression and eventual rebirth, identifying an effective protocol of graphic rendering. The choice of the geographical area reflects the state of the art: currently there is a total absence of historical atlases city of Piedmont, while these interventions are available in other parts of Italy and especially in the central and in the northern Europe. Unfortunately, documentary sources are often deficient, so it's almoust necessary use exclusively material sources visible in the architecture of buildings.

Between the twelfth and fourteenth century the western and central Europe was hit by a wave of recovery: it were built new villages and cities, and, at the same time, existing population centers developed, the population grew up and the agricultural landscape spreads in natural landscape[1]. To meet the needs arising from urbanization and the need to supply the city, new lands were colonized, while the subsistence economy became economy of exchange for products and goods. In northern Italy, the transformation

process was promoted, initially, by local people, but in the second half of the twelfth century, the lords replaced ordinary citizens, that manage to escape the political power and the possession of the territory to the *domini loci*. The need to attract or retain the men of the county determines the formation of "New Villages" and "Borghi Franchi."

These new settlements, also called *Villae Novae* did not grow spontaneously, but they were always the result of the initiative of the great gentlemen landowners, who wanted to extend their control over the surrounding territories, increasing their revenues. They inclined farmers themselves to joined in the new centers, providing them with a less heavy taxation or exemption of their for a certain period of time, giving them more rights and deductibles. They obtained an increase in production and the extension of crops even in marginal areas, not sufficiently exploited. The maximum increase of foundations planned was between the beginning of the thirteenth century and the first half of the fourteenth century, with the expected growth in the Piedmont of the Savoy, the Marquis of Monferrato and Saluzzo. The new foundation was not always automatically a settlement with geometric preordained plants, and besides the recognition of morphological tracked regularly does not imply the existence of a moment or an act of foundation[2]. These settlements were divided into two categories:

- New Villages of communal age: promoted by the great lords landowners in order to make available marginal production areas through reallocation of the population and to increase revenue;

- New Villages of ladylike age: promoted by the great lords landowners, since the early decades of the thirteenth century with the intent to consolidate its rule over the territory. The focus, therefore, iwas pinned on existing settlements, that, contrary to what was recorded in the communal age, were fortified at the time of foundation.

So a New Village is, therefore, an agglomerated settlement structure, built from nothing or totally rebuilt where it was previously in other locations, with or without the intervention of an authority which orders or favors the foundation.

Overall villages founded in Piedmont, that it is possible to document their origin, are 66, some of that (for exemple Fossano, Mondovi, Avigliana) were quick to assume the role of ordinary citizens in the thirteenth and fourteenth centuries. The vast majority of the population centers formed in the period under review demonstrates the intelligence given to the choice of locations for the new settlements. It was presided over the good sense and the perfect knowledge of the places from those who had the task of providing for their development. Not always, however, it could happen to have a site considered impregnable. The choice could be influenced by the orientation, by the goodness of the land, the ability to easily find the site in the necessary material for the construction of the case[3].

It’s important to highlight the link between these centers of new foundation and the religious buildings: it is not uncommon to encounter cases where, in fact, the only thing that kept its own centrality, in addition to the pole of the noble, the castle, was the church or churches. It is possible to show a systematization of this approach that various promoters, in time, showed against social structures and territorial consolidated at their establishment.

The religious building could not punishin the choice of the site where the New Village was founded, losing its symbolic value: it is the first case, named of "indifference" to the site: often the formation of new places of worship led to the destruction of preexistence. This approach was typical of the communal age. This is the example of Mondovi, La Morra, Fossano, Busca.

There is a second instance called "selective indifference": the site where the new village was born was indifferent to the place of worship, but it maintained its symbolic value. This is the case of San Maurizio Canavese, Frossasco, Demonte, Saluzzo, Priero.

The third case is linked to the choice of a place of worship as a "Polo" of reference: it is the example of Canale, Bra, Barge.

The last case is quite exceptional, and therefore, difficult to place in any category. It correspond to an attitude of substantial "indifference" towards the site but accompanied by the award of a high symbolic value in certain religious buildings of the area, to the point of determining the transfer in the New Village; it is the case of Cherasco.

The birth of Cherasco occurred in 1243, because of a merger of some nearby settlements. The settlement is characterized by a smooth and orderly urban plant, which develops according to a strict geometry quadrilaterals defining blocks of constant modulus, starting from the intersection of two main streets, forming secondary roads parallel to the axes generators (Fig.1). The village is divided into districts: St. Peter, St. Margaret, St. Iffredo and St. Martin.

Although the urban grid was of absolute rigorous, the track wall was not so smooth because of the orography of the site, located upstream of the confluence of the two rivers (Stura and Tanaro), so it could be defended by two parts, it was an appropriate choice that allow, until the eighteenth century, the use of fortifications almost exclusively on the southern front. Most important was the *Platea*, designed as a way of trade and then a parade where palaces of ruling families lined up to frame the center of power[4].

In this design the organization of civic life prevailed on the ancient custom of focus settlements in function of sacred buildings. The center, marked by crossing the main road, focuses the attention on the civic center and the market, with almost the same determination of the past, where new plant were made to gravitate to the temple and on the hole. The churches where also transferred with the family groups, from the surrounding villages, to the individual districts of relevance, in the direction of the original villages. Around their, lived people with the same origin, resulting in four districts with their identity.

A striking example is the parish of St. Peter (Fig. 2), which took part part of the noble families coming from the original village of Manzano, it was attested for the first time in 1259, a few years after the founding of Cherasco. About the original building is still visible the facade, a part of the south side adjacent to the bell tower and the same tower [5].

The church was built in the first flowering of the gothic is a deliberate reference to the past because of some of its archaic characters visible in the facade, one of the finest examples of late Romanic in Piedmont. The central portion of the facade is one that, over the centuries, has undergone several transformations; most recently, in 1933, it were restored the central mullioned window and the four arches of the underlying registry.

The elevation seems marked by a rigid mesh composition determined by pilasters and horizontal bands; the first divides it into three fields corresponding to the internal allocation, with centerpieces that are longer in the high crowning square; the second, made of stone pieces of reuse, divided the facade into three registers, the last one is topped with a blind gallery. The decorative bands are complemented by horizontal strokes survivors of eaves, while the upper band is made up of marble recovery. Additional strips are located at the entrance, in the piers and in the overlying arc.

The church has several renovations, the most significant enlargement was the addition of the side chapels. In the seventeenth century, those were built on the left and on the right in the next century. Subsequently it was raised the roof and the columns were replaced by pillars. There is no evidence of the original shape of the apse, because it was completely changed since the early years of the eighteenth century

The reuse of St. Peter, although composed by cut and decontextualized pieces, was not a destructive reuse but conservative. In this case the reuse seems to take on a dual function: at first it updates classic pieces by placing them in the medieval fabric, then it makes a "reliquary" use of the pieces from the St. Peter church in Manzano. The reuse, therefore, is a fundamental emotional towards the church in which communities are indentified[6].

Since the second half of 19th century, the grandiose phenomenon of the population and the new urban design intrigued historians medievalists. The first scholar who took charge of the New Villages was the notary from Vercelli, Vittorio Mandelli, who consulted the codes and statutes of the thirteenth century, preserved in the municipal archives and transcribed the acts of liberation of twenty villages placed in the territory between Dora, and Po Sesia; nobody before him had ever dealt with this theme[7].

The first systematic operation of graphic rendering of the structures of the New Villages of Piedmont is attributable to the pioneering work undertaken by Giampiero Vigliano, an urban planner and protagonist of the debate on planning the Piedmont between the Second World War and the passage to the regions to the competence on the territorial government. Combining technical expertise and historical sensitivity, Vigliano had the merit of including within the planning regulations the "Cultural Heritage Environmental", in particular environmental goods such as New Villages, shelters, squares and arcade streets[8].

The synthetic schemes proposed by Vigliano in the mid sixties espoused different representation techniques: identification of plots roads and important buildings on the current plot or historical plot documented by cartography, return of intuitive schemes system, synthetic reconstructions divided into phases.

Vigliano, therefore, does not limit its inquiry to the historical-analytical analysis, but he also focuses attention to the transformation of the settlements and their contemporary dynamism, based also on the ability to set systematic and comparative analysis[9].

The comparison of the documentary sources, the reading material of settlements and the existent literature led Vigliano to the definition and representation of an abacus patterns of buildings of medieval New Villages, where he recognizes the following geometric patterns: rectangular and square with uniaxial two access doors (Villanova d'Asti, San Damiano d'Asti), rectangular biaxial and four gateways (Gattinara and Borgomanero), checkerboard biaxial (Cherasco, Frossasco) and without axes prominent (Villafranca) shaped trapezoidal uniaxial (Poirino), triangular (Bistagno) and three parallel axes (Nizza Monferrato).

The systematic nature of the representation and the comparative attention to the geometry of the forms led to overshadow the periodization of the transformative processes of organisms and the relationship between geometry and tissues, but it made clear, and effective, the interest in the theme of the geometric plants of medieval villages, becoming a shared basis for further historic research[10].

A few years later, Pierre Lavedan, author of the first systematic investigation of the history of urban twenties, census and describes the French bastides making a clear distinction between urban history and architectural history; the latter was limited to analyze the monuments regardless of building and environmental context. He specified that it was not his intention to write an history of medieval cities, but he considered only a particular context: "Le plan de la ville", trying to show how knowledge of the plant is essential for understanding the history of a city; this was, therefore, a study of urban morphology in which the shape of the plant is subject to explanation and classification[11]. Thanks to the work of Jeanne Hugueney (1921-2008), there were redrawn, with stretch uniform, the planimetric patterns of 200 bastides. There were the studies on the persistence of the tracks in the medieval urban forms of the historical city of nineteenth century. Lavedan adopts an abacus more simplified than Vigliano, considering only three types: a single longitudinal axis, two perpendicular axes, and tringular shape[12].

During the studies of Lavedan and the work of Hugueney on french bastides, or to the research of Maurice Beresford (1920-2005) on the New Towns of english foundation[13], in Italy, Enrico Guidoni (1939-2007)[14], between 1965 and 1967 sets the historical-urban medieval age, he was devoted to the analysis of the graphic centers foundation. Its focus was the cultural interpretation about urban forms, conducted through reconstructive graphic schemes reduced to grids of settlement systems and fragmented from cadastral maps on which the scholar casts geometric models of tracking. Of great importance is the study conducted for the city of Talamone: the work consists on a superposition of information concerning the land registry of today with that of Leopold 1756. Each element drawn on paper is numbered and each number is matched to a specific symbology. The structural elements of the village in question are: the tower, the villa,

the station, the church, the convent, the cemetery, the railroad, the paths made in the twentieth century and those existing in 1824, the old tracks and the municipal boundary.

Gina Fasoli (1905-1992)[15] and Cristina Bocchi (professor at the University of Bologna)[16], have carried out studies for the town of Bassano del Grappa and Bologna: the first work was based on the overlap of information relating to the land current registry to the Austrian one, while the second compares the Land registry today with the Papal States, dating back to 1833. In both cases, the structural elements of the current land registry are: parcelling, built, architectural work, porches, cultivated areas and gardens, public parks, avenues and flower beds, streets and squares, waterways; while structuring elements such registers historians relate the partition of disappearance, the built environment, the architectural, porches, walls, roads disappeared, the city gates.

In the international field is remarkable the work done by Dany and Philippe Sandron Lorentz[17], professors at the Sorbonne in Paris; it was a representation of the historical evolution of the french capital, from the Middle Ages to 1850. For each period analyzed it was given an historical chronology of the major events, a card depicting the land uses and spatial evolution of the area from the previous period analyzed, and the map of land use overlapped with the current road conditions. In each study period are referred the structural elements, the lines of communication, private and public buildings, gardens and cultivated areas.

The goal of the research, as a result of the case studies, is to find a real strict protocol of restitution of all tissues stratified over the years, applicable to Borghi Nuovi of the subalpine area (with the emphasis on medieval bult of Savoy's origin), because the research done to date have focused on a philological approach rather than a refund topographic data, analyzing the relationship between historical analysis and cartographic one, with the intent to regenerate the memory of places and encourage a program of cultural action, recovery or protection.

The case studies chosen are the city of Moncalieri and Rivoli: they both are locations of Savoy residences and Unesco sites, they are characterized by a different development: the site of Moncalieri develops earlier the birth of the castle, while the village of Rivoli takes shape around its pole of stately power, castle.

The hypotheses proposed are designed to systematize the criteria of representation not only of the geometric shape of the plant, but also the dynamics of settlement and the social value of the places. To ensure a first criterion of uniformity and comparatività, the support of the representation in all cases studied is constituted by the current plot register and it is assumed one dimensional scale of restitution. The cartographic support be adopted, report the historical analyzes to the current stays, both material and mapping, favoring an operational use of restorative schemes, at the end of the government of the transformations of the settlements and the enhancement of sites.

It will, therefore, be necessary, on the route of the existing urban fabric, highlights the road structures generating, distinguishing the historical routes of communication established (usually preceding the settlement preordained) from the axes rectors planned. From the relationship between axis and morphology of settlements will be highlighted isolates the relevant the building activities in villanova object (distinguishing axes recognized those conjectural) and tissues thet recognize medieval structures, in particular the arcade streets.

The identification of the original settlement pattern will be recognizable by the use of autopsy methods (aerial photo, interpretation and consistency of the material built), but also from regressive reading cartography and historical iconography, made through the interpretation of documentary sources and the critical literature, both by projecting graphics of historical maps of the modern age on the current. It will

important to identify the poles structuring the identity and life of the settlement, such as the spaces of civic power (with indication of palaces and towers left), market areas, places of residences or territorial powers and higher level ecclesiastical centers.

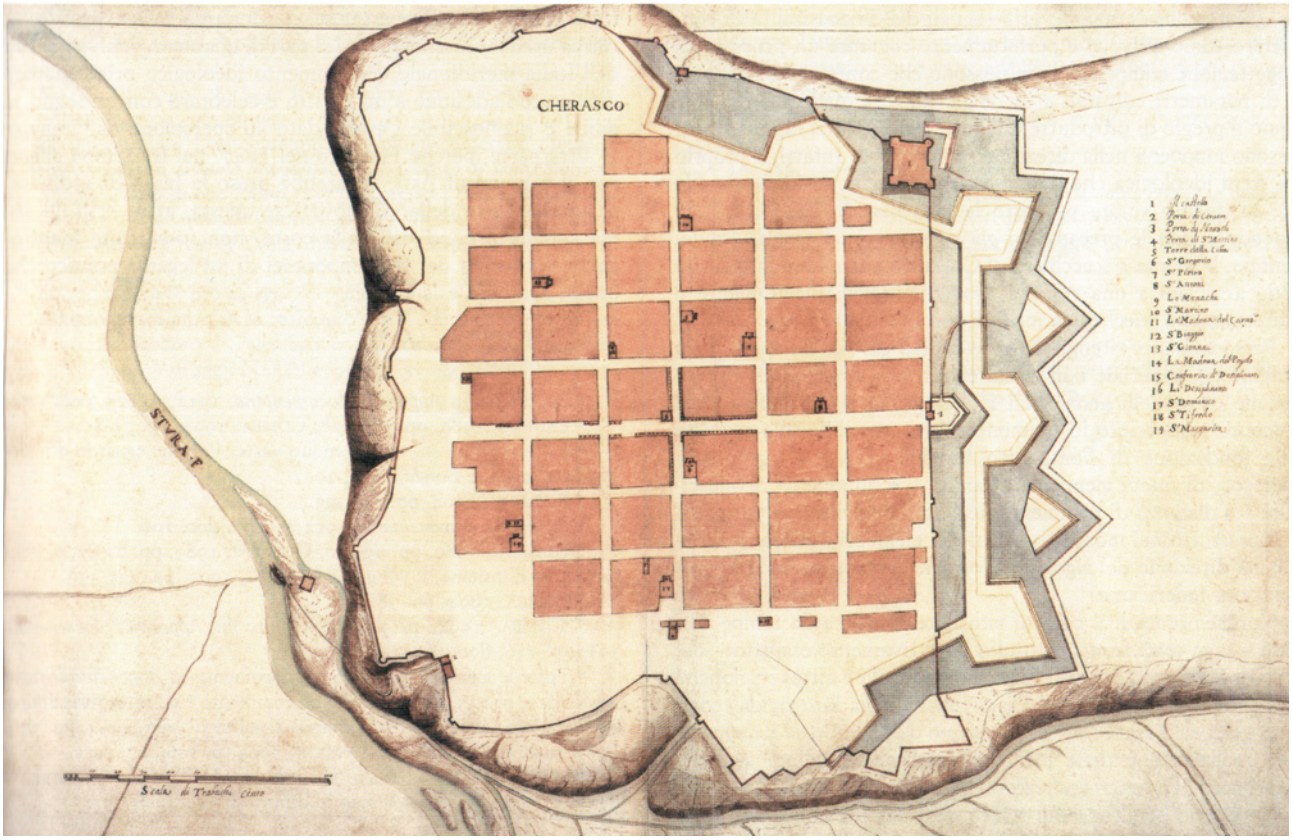

Fig. 1 Carlo Morello, Plant of Cherasco, 1656. (BRT, Manoscritti, Militari 178, 23).



Fig. 2 Facade of St. Peter's Church, Cherasco. (http://archeocarta.org).

Bibliographical References

[1] *Rivista di storia arte archeologia per le province di Alessandria e Asti*. Vigliano Giampiero, LXXVIII, 1969/70, Alessandria, pp. 97-127.

[2] *Storia dell'urbanistica.* Bonardi Claudia, XXXI, 2012, Roma, pp. 77-89: 83-84.

[3] *Rivista di storia arte archeologia per le province di Alessandria e Asti*. Vigliano Giampiero, LXXVIII, 1969/70, Alessandria, pp. 97-127.

[4] Bonardi, Claudia, *La costruzione di una villanova. Cherasco nei secoli XIII-XIV,* Cuneo: Società per gli Studi Storici Archeologici ed Artistici della Provincia di Cuneo, 2004, pp. 8-10.

[5] Bonardi, Claudia, *La costruzione di una villanova. Cherasco nei secoli XIII-XIV,* Cuneo: Società per gli Studi Storici Archeologici ed Artistici della Provincia di Cuneo, 2004, pp. 13-15.

[6] Bonardi, Claudia, *La costruzione di una villanova. Cherasco nei secoli XIII-XIV,* Cuneo: Società per gli Studi Storici Archeologici ed Artistici della Provincia di Cuneo, 2004, pp. 21-23.

[7] Mandelli, Vittorio, *Il comune di Vercelli nel Medioevo,* Vercelli: Società Sorica Vercellese, 1857-1861, pp. 167-281.

[8] The definition of "Cultural Environment" refers to the Declaration XXXIX of the Commission Franceschini, discussed for the salvation of Cultural Property in Italy. *Atti e documenti della commissione d'indagine per la tutela e la valorizzazione del patrimonio storico, archeologico, artistico e del paesaggio.* I, 1967, Roma, pp. 69-70.

[9] Vigliano, Giampiero, *Beni culturali ambientali in Piemonte. Contributo alla programmazione economica regionale*, Torino: Unione Regionale delle Camere di Commercio, 1969, pp. 57-106.

[10] Vigliano, Giampiero, *Beni culturali ambientali in Piemonte. Contributo alla programmazione economica regionale*, Torino: Unione Regionale delle Camere di Commercio, 1969, pp. 108-109.

[11] Lavedan, Pierre, Hugueney, Jeanne, *L'urbanisme au Moyen Age*, Paris: Arts et métiers graphiques, 1974, pp. 60-61.

[12] Lavedan, Pierre, Hugueney, Jeanne, *L'urbanisme au Moyen Age*, Paris: Arts et métiers graphiques, 1974, pp. 161-164.

[13] Beresford, Maurice, *New towns of the Middle Age. Town plantation in England, Wales, and Gascony,* London: Medieval Academy of america, 1967. Beresford's approach is to primarily economic-historical: he refunds graphic highlight especially the inclusion of built in agricultural plot, in roads and hydrography, while the themes of geometry and building layers remains in shadow.

[14] Guidoni, Enrico, *Talamone (Orbetello)*, Roma: Bonsignori, 1994, p. 32.

[15] Fasoli, Gina, *Bassano del Grappa*, Bologna: Grafis, 1988, pp. 52-53.

[16] Bocchi, Francesca, *Bologna,* Bologna: Grafis, 2, 1996, II, pp. 154-157.

[17] Sandron, Dany, Lorentz, Philippe, Referring Web Pages Web: http://paris-atlas-historique.fr.

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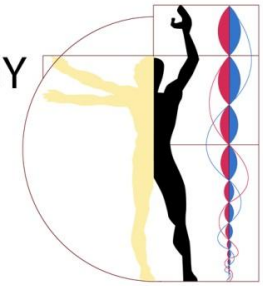

The immaterial city
An innovative look at the unrealized projects for 20th century Spoleto

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The immaterial city.
Unrealized projects for the twentieth-century Spoleto

The proposed contribution intends to present the preliminary results of a research carried out by the Civil and Environmental Engineering Department of the University of Perugia, aimed at surveying and cataloguing architectural unrealized projects belonging to the Umbrian territory, which are the expression of an immaterial cultural heritage uncharted until now.
In particular the research focused on the twentieth century that is linked, both in Umbria and in the national territory, to important urban and social aspects (like tourism promotion, viability optimization, hygiene issue, etc.), which assume very special significance in a strongly historical context.
The study moves from the particular case of Spoleto city, because considered an example of the changes taking place in Umbria during the twentieth century. Through a dedicated documentary research, the investigation touches on the unrealized projects, testifying both wealth-creating and the complexity to intervene in a territory particularly characterized by historical, architectural and environmental landmarks.
Looking into projects rather than building works, the study aims to furnish a methodology which makes it possible to compare in a critical way between what is, what has been and what might have been. In this sense, the research intends to give back to the community an unknown historical heritage, which is memory and identity and which is an indispensable knowledge instrument to serve anybody working on the management, recovery and transformation of the territory.

Keywords: Knowledge, documentation, image of the city, immaterial cultural heritage, collective identity

1. The immaterial city: an heritage to know

"The never seen Milan (…) is a Milano which could have been, if the sliding doors of the history had been opened or closed with a different time" (1)
The theme of the possible city, remained under trace, which has never been since the historical circumstances have decided a different destiny, has attracted several scholars and designers over the years: consider the refined intellectual operation represented by the experience of Piero Sartogo's *Roma interrotta* (2) who wonders about the possible evolution of the capital city "as if" the more than two centuries transformations, following the last coherent urban drawing (signally the one realized by Giovanni Battista Nolli in 1748) had never happened.
And it is still true today, considering how topical is the exhibition Milano Mai Vista (3), submitted in the context of the recent Milanese Triennial and conceived and developed by Fulvio Irace and Gabriele

Neri, whose context presents an exposition of unrealized projects, substantiated through a selection of Author's Archives materials, which realizes an image of the "other" city, which can go on living in a dreamlike dimension or, at least, in the collective memory.
On the other side, the same theory about the analogous city formulated by Aldo Rossi (4) summarizes through a quite stunning expressive charge, blinding to say the least, the stratified nature of the city, where the streets and the junctions, the hypothesis and the second thoughts, the linearity and the obliquity overlap in an intricate collage of works and projects, called to coexist in an openly not-existent space but potentially real at once.
Indeed, the unrealized architectural projects represent an Intangible Cultural Heritage as precious as not adequately realized widely: postulating this, the image of a city actually visible can be interpreted as the tip of a complex and articulated iceberg, destined to remain largely hide in the maze of Historical and Documentary Archives.
Being understood the intention to enhance the present cultural identity of the cities through the knowledge, the rediscovery and the disclosure of the ideas made for them throughout history, it's evident how the innovative multimedia technologies of our time constitute a prodigious chance to lead and to sustain search paths able to cross the retrospective limit and to project itself in the "tangible" experience of hybrid spaces between real and virtual.
Along these lines forms part the research focused on surveying and cataloguing architectural unrealized projects belonging to the Umbrian territory which, under a path aimed to the total development of the recent Umbrian architecture, which has committed for a long time the Civil and Environmental Engineering Department of the University of Perugia research team, led by Paolo Belardi (5), restricts the interest to the 20th century period, seen as a model time window where all the urban and social planning aspects (like tourism promotion, viability optimization, hygiene issue, etc.), find an explicit application which inevitably influence the concrete city development and assume very special significance in strongly historical context such as those represented by Umbrian centers.
The issue of the imagined city has been faced, also in the Umbrian context, through some existing studies which, on the basis of precise investigation areas, have realized a census of unrealized projects under a well-defined chronological period (6); even in the wake of such references, the research is intended to investigate systematically the specific case of Spoleto city, considered particularly exemplifying of the changes taking place in Umbria during the 20th century. Assuming the real city and the historical architectural skills acquired so far (7) as a starting point, the study, through a dedicated documentary research mainly based on unedited works, focuses on the unrealized projects, testifying both wealth-creating and the complexity to intervene in a territory particularly characterized by historical, architectural and environmental landmarks.
In particular, the survey shows that the transformations, "dreamed" for the twentieth-century Spoleto, are linked to figures not only important at local level but also at national one, and they have imagined through the drawing project, elective place of forerunner, a system of urban settings able to show its newness again. From this topical imprint follows the hypothesis to give back to those forerunners the concreteness they couldn't find, through the tools provided by digital technologies: employing the groundwork overlap between physical and virtual reality in order to allow an "augmented" enjoyment of the urban setting where a set of multimedia information layers adds up to the observed reality.

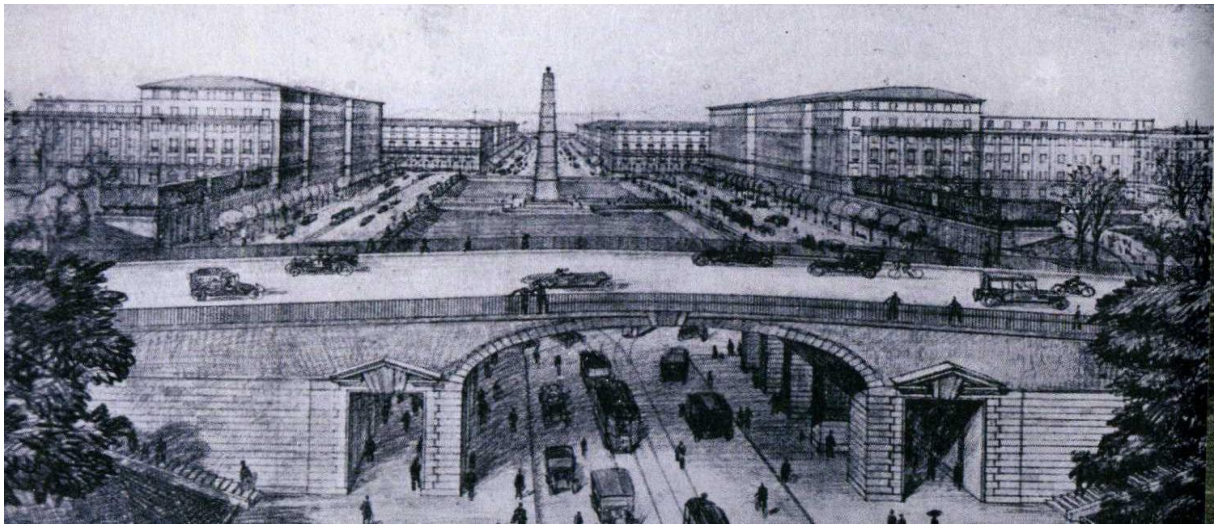

Fig. 1: Club degli Urbanisti, Forma Urbis Mediolani, Bird's eye view of the Triumphal Road, 1927. In, IRACE 2015, p. 40.

2. Paolo Fidenzoni: walking in the historic center of the city

Among the figures who greater contribute to the designing heat for Spoleto, Paolo Fidenzoni stands out, whose projects reiterate, within two decades, the ambition to realize a modern urban image.
Paolo Fidenzoni (8), is born in Spoleto in 1896, but he spends most of his life at Rome, pursuing until 1925 to teach paint, art and architectural drawing and then takes up an intensive professional activity, both in his home town and in Rome, and divided between public administration and liberal profession. Fidenzoni works for the Social Housing Autonomous Institute until 1937, when he nails the position of Architect in Rome municipality. He deals with urban planning, designing and, above all, restoration, achieving the main result with the Marcello theatre, on which he intervenes between 1926 and 1957. (9)
In Spoleto Fidenzoni acts especially in the historical center, in particular through projects aimed to redefine public spaces. For Spoleto, physically and ideologically placed between the Perugia-Assisi pole and Terni city, the Fascist regime doesn't clearly indicate a reference urban image to guide the proposals of intervention (10); individual initiatives are done, predominantly aimed to answer to specific questions not related to the existing land-use planning, generating therefore a rather ambiguous image of the city. The revolutionary project by Fidenzoni to renewal the Madonna degli Orti district (1936) (11) answers clearly to such ambiguity, proposing the reconfiguration of a whole urban area at the base of the Cathedral, in the old town centre, with the aim to lend to the city an image ascribable to the Fascism ideology and thus to the Modern Architecture. The architect, directly tasked from the podestà Domenico Spinelli under the overall district's rehabilitation policy, refers to the "pick of healing" in order to legitimize the courageous demolition of much of the existing district offering the vision of a carefully and uniformly drawn shred's city, able to connect the "borgo" to the historical centre allowing at the same time, through well studied points of view, to benefit from the hillside and monuments surrounding context.
Fidenzoni also deals, several times and proposing alternative scenarios, with the definition of Libertà square (XXVIII October square in the Fascism two decades), that has been until the beginning of twentieth century a private court among the building owned by Ancaiani Family (the namesake Palace, the stables, a Church later demolished and a hanging garden). Not only the square is placed in the historical urban centre, amounting to the urban life's cornerstone, but it also faces with the monumental presence of the roman theatre whose ruins, identified by the archeologist Giuseppe Sordini in 1891, are discovered between 1938 and 1954. In 1935, during the Fascism period, Fidenzoni proposes, for the square, the Casa del Fascio project which should have been relate with the theatre directly, defining one of the wings for it. This project can be placed under the typological study about the Casa del Fascio (12), carried out from 1932 through a competition held in Bologna then extended to all Italian architecture schools and ended in 1936 by the Giuseppe Terragni's building at Como (13); indeed, we note all the elements identifying the designated typology like the lictor's tower, the harangue balcony, the lictors' guild, the imperial eagle. The project would have authoritatively introduced an object clearly originating from rationalism, producing both a defined boundary for the square (to the detriment of the then-existing Ancaiani ex stables) and a connection between square and theatre through an exceptional point of view on the theatre itself, although the real extension of the ruins was unknown yet. In 1949 Fidenzoni is called again to answer to the need to organize coherently the square: the architect proposes two different hypothesis, considering resolving the strategy to place there an hotel (which is necessary because of the tourist vocation of the city and the consequent increasing of visitors flow) that replaces the Palace's volume inheriting however the front. A coffee shop-cinema is functional to the unifying role of the square, and it is imagined by Fidenzoni exactly in the same place where in 1935 the Casa del Fascio should have appeared. (14) But the palace destiny isn't clearly its demolition: in 1951 not only the square seems not to have found a definitive arrangement, but it is also required to find a placement to the city postal office which, if a new realization, could represent the opportunity to resolve an urban space so long left hanging. Once again Fidenzoni is looked for thinking about the same area that lies Ancaiani stables, which are definitively demolished between 1952 and 1953, as the project provided for. (15) But the own roman theatre ruins, with which the architect several times faced, cause once more a different ending: being incompatible with the new building volume, they are finally brought to light. The unrealized projects for the square should introduced, in all instances, a contemporary city fragment, "other" compared with the urban image mainly exemplifying of the majestic collection of history that identify the city. But that visionary projects are destined to converge in a full of compromise solution and, inevitably, with a less significant impact: the restoration and the buildup of Palazzo Ancaiani, whose ground floor is destined to the Postal Office (16), and the preservation of the Ancaiani stables survived façade, which is made a curtain through a "zero volume" intervention and which becomes both an element dividing two open spaces (the square and the roman Theatre) and a permeable front, able to invert the observer's point of view.

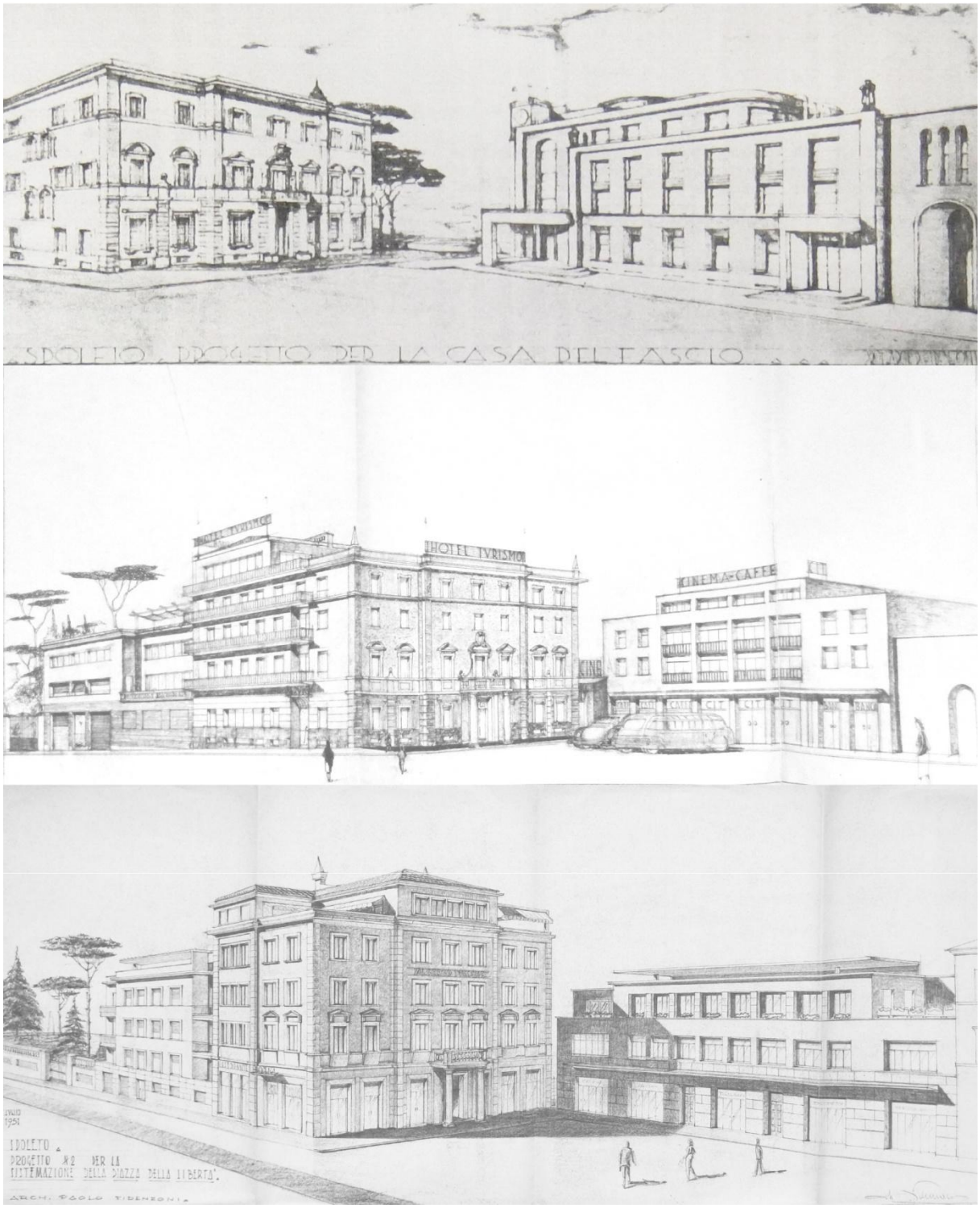

Fig. 2: Paolo Fidenzoni, projects for Libertà square. From the top: Progetto per la Casa del Fascio, 1935; Progetto per un cinema/caffè, 1949; Progetto per la sistemazione della piazza della Libertà; progetto di un ufficio postale,1951 (ASSp, Raccolta cartografica, grafica e fotografica, cart. 16, fasc. 1).

3. Dante Cipriani: reaching the city from south

In the framework of Spoleto architectural context, the figure of Dante Cipriani lies between the concreteness of the many realizations and the immateriality of the ideal proposes remained on the drawing board. Cipriani (17) works in Spoleto during the first half of 20th century, with studio in Giustolo street and in Norcia, where he is podestà in 1928, with studio in corso Sertorio. He realizes various projects in different areas of the city, disclosing a clear aptitude for eclectic style: in 1928, at the gates of the historical centre, he intervenes in Vittoria square with the Agata palace, which marks a side of the square, showing a neorenaissance matrix porch; in 1933, in the heart of the well-established fabric, he works for the renovate of Sant'Angelo dé Gilibertis façade, in a perfect neoromanesque style; in 1939, on the margins of the urban walls, he inserts the new Sacra Famiglia Institute's house (currently seat of the Second level College of Science) with clear reference to protorationalism; in 1947, in an area aim of radical changes coupled with several demolitions and tools to define a dynamic image of the city for visitors coming from Rome, he takes up San Luca church and the convent reconversion into women's boarding school. Exactly near the college, outside San Luca door (demolished in 1935), Regina Margherita road (currently named Matteotti road) arrives, which as forecast by the "Spoleto City municipality extension Plan", edited by the engineers Martino Pompilj and Vincenzo Zicari (18) in 1919, is doomed to be bounded only by "residential villas" ("villini residenziali").
In this context, in 1925 the municipality grants facilitations for materials purchase and also for using water and system in order to favour and increase residences construction. The road, at the time tree-lined and surrounded by extended green areas almost completely free from buildings (excepted for Ambrosin ivilla, later demolished), represents a precious context. For this reason a lot of applications for new houses realization in Arcangeli ground, which numbers among Regina Margherita road, Brefotrofio street and Roma street, come to light. Then begin the partnership between Cipriani and the engineer and professor Giuseppe Barra Caracciolo, followed by that for boarding school, in 1947: in 1925 the two engineers design nine villas for as many owners in the Arcangeli area, but only one will be realized. Although the general plan absence doesn't make possible an overview of the project, it makes the single drawings reading in series easier, allowing to understand them as a planning reply to an exercise about the villa type, which offers a multiplicity of variation in the theme. Starting from giving an outline some variations, which call for a clear style, are introduced each time: from neoromanesque to neogothic, from liberty to déco. The composition rule provides for certains variations: little and united volumes (having a side of about 10 meters) made from the combination of two or three rectangular blocks, organization on two levels above ground, raised ground floor and resulting identification of the entrance by a little access staircase, stucco eaves cornice, pitched roof. This components represent the type base in which the range of possible variations fits, always characterized by a careful realization of details: the emphasis on the horizontal line (realized through the use of cornices indicating floor divisions and the wrapping strips around the entire volume) and the elegant railings in Novelli villa; the turret with three-light windows in correspondence to the last level in Dragonetti villa; the important decorations made of stone and bricks in Collesi villa; the original four-light windows which identified the first floor in Liberti villa; the stonework base and the imposing entrance decorated in stucco and bricks in Soldoni villa; the stonework finishes and the wooden outflow strut which support the shingle refering to neogothic style in Paciotti villa; the elegance liberty decorations and the planimetrical unity refusal in Morelli villa; the cornices indicating floor divisions and the eaves cornices both treated with stucco in Bevilacqua villa. (19)
After trying typological variation in fine fabric, in 1932 Cipriani tests himself, next to the architect Gino Venanzi, with the largest scale of San Matteo degli Infermi Hospital project, located in San Paolo area, near Regina Margherita road. (20) Already at the beginning of 20th century there was the awareness of the necessity to realize a new hospital service as a result of the suddenly appeared needs of adaptation to functions and modernization of the health establishments as well as of the need to increase health activities of the city. The project proposed presents an overtly symmetrical system and shows a neorinascimental taste made it clear especially in elevations, through the ashlar-work base, the regular lights diversified by various levels and the introduction of pilaster strips. Although the hospital is both typologically and dimensionally different from the previous residential villas, it's possible to recognize the same key aspects: the stucco eaves cornice, the pitched roof of the main buildings and the decoration made of stone and bricks. The project tables, rich in details' graphic art, prove that Cipriani saves the same care for details as about little objects designed to change punctually the image of a limited part of the city as about big volumes which involved in the territory with the measure of a city into the city.



Fig. 3: Dante Cipriani, Giuseppe Barra Caracciolo, projects for the construction of eight villas along Regina Margherita road, 1925. From the top-left: Novelli villa, Dragonetti villa, Collesi villa, Liberti villa, Soldoni villa, Paciotti villa, Morelli villa, Bevilacqua villa. (ASSp, Amministrativo 1925, b. 1849).

4. Enzo Milani and Mario Zocca: reaching the city from north

With studio in Rome at number 3 of Francesco Denza street, the architect Enzo Milani and the engineer Mario Zocca (21) are two of the most important figures in the historical-architectonical context of Spoleto city during the 20th century.
The first one, son of the most famed architect Giovanni Battista, closing from Rome to Spoleto starting from 1934 when, as a results of his father purchase of villa Milani located in Colle Attivoli district, he becomes a Spoleto citizen of adoption. The second, member of the Governing Council of the Urban planning National Institute in those years, gives assistance in the preparation of the text Aspetti urbanistici ed edilizi della ricostruzione (next to Aldo della Rocca, Saverio Muratori, Luigi Piccinato, Mario Ridolfi, Paolo Rossi De Paoli, Scipione Tadolini ed Enrico Tedeschi) (22) and as professor and Director of the Urban planning Institute at the Architecture University of Napoli, he plans advanced training initiatives (like the 2° Convegno sull'insegnamento dell'Urbanistica, summit in Napoli in 1959, cooperating with the professor Ludovico Quaroni and the architect Arturio Rigillo).
The two designers' contribution to Spoleto architectural-cultural scene mainly lies in the aftermath of the Second World War when, with Ministerial Decree dated on 25 June 1946, the lower town reconstruction plan is approved (it has entrusted to them since 1943 but whose proceedings will be suspended because of the war).(23) In 1945 the municipality of Spoleto, "having regard to the war demage made in and around Garibaldi square" ("visti i danni di Guerra apportati alla piazza Garibaldi ed adiacenze"), shall decide to hold an interregional competition involving engineers and architects coming from Lazio, Umbria and Toscana regions.
According to "moral urban planning criteria" ("criteri di urbanistica morale"), the invitation recommends proposal that respect both the "monumental nature of that area because of San Gregorio Church and Sanguinario Bridge presence" ("carattere monumentale della detta zona per la presenza della Chiesa di San Gregorio e del Ponte Sanguinario") and the area's representative role that as "main entrance to the city" ("entrata principale della città"), needs to play its "local character" and "natural decorum" ("carattere locale" and "natural decoro"). (24)
Between the different aspects covered by the invitation, it provides for the Leonina doors reconstruction (destroyed by war in 1944) that, allowing the entrance to the town from Perugia and the train station, it is able to offer a monumental separating architectural element between Tigli field, and Garibaldi square, beginning of the urban centre. (25)
Five groups taking part into the competition (whose results should then be exposed to the New Theatre's XVII September room)(26), each one characterized by a motto: "G.F.2" (Franco Minossi, Giorgio Milani and Fabrizio Giovenale architects), "Spoletium 14" (Saul Greco architect), "S. Gregorio 2" by offering two solutions A and B (Mario Zocca engineer and Enzo Milani architect), "Ren 46" (Alberto Tonelli architect) and "Spoletium Resurgit 1946" (Dante Cipriani engineer, Rodi Palazzetti and Averardo Garbini professors). In june 1946 the commission (consists of nine members including Paolo Fidenzoni architect as Municipal Council Trustee) assigns the number one to Enzo Milani and Mario Zocca's team (winner of the national competition to Partigiani square in Perugia the same year) (27) for studying in an exeplary manner "the question of Sanguinario Bridge's highlighted both as a decorum element of the city entrance and as value element of the distinguished and rare Ancient architectural artifact" ("il problema della messa in luce del Ponte Sanguinario, sia come elemento di decoro dell'entrata cittadina, sia di valorizzazione dell'insigne e ormai raro manufatto architettonico dell'Antichità"). (28)
The project proposal, towards the final shape dated 1947 (29), makes the bridge highlighted closely linked to the door reconstruction, in a mutual dependence and development, through a formal solution that is so extremely simple to results more contemporary than ever.
Bringing the bridge to the surface by a pedestrian passage, this one, orthogonally placed compared to the door, comes into and goes through it and, ideally bringing Garibaldi street, goes into the city historical fabric; in addition, using a preexisting underground passage and making it 8 meters larger, the east side of the bridge comes free.
The altimeter connection between the bridge and the street level, that is guaranteed introducing the staircase volume, makes pedestrian motion's continuity and fluency possible, swerving the vehicle flow to the two sides of the bridge itself.
Although the Superintendence of Antiquity for Marche and Umbria, by letter dated 5 march 1947, considers "the relighting and solution of the Sanguinario Bridge" the "main aim of the project" ("la rimessa in luce e la sistemazione del Ponte Sanguinario" "scopo principale del progetto") (30), declaring the solution's surrender unacceptable, the actual fulfillment is restricted to the door reconstruction, by entrusting to the two project perspectives' expressive strength the purposes and the meanings.

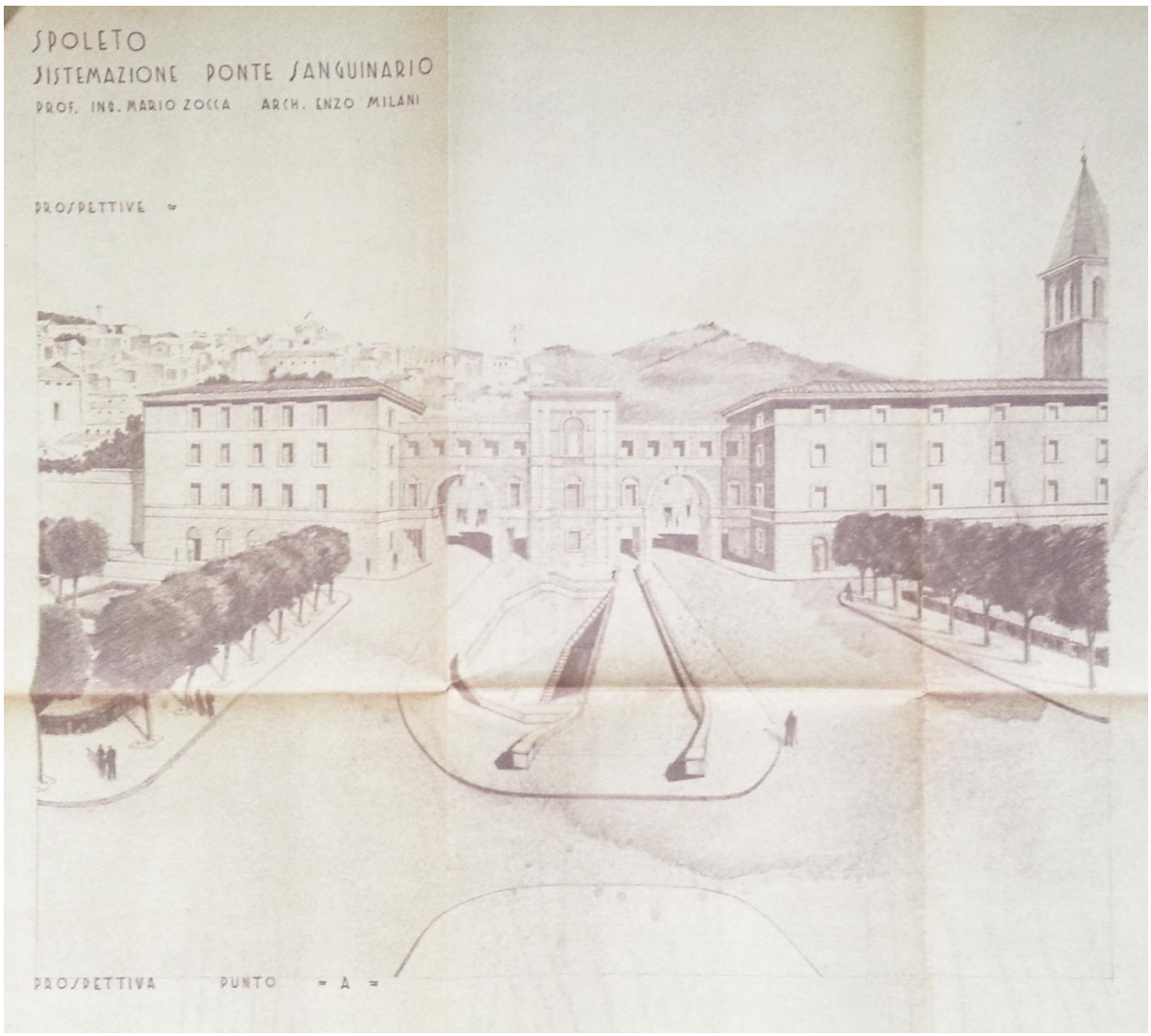

Fig. 4: Enzo Milani, Mario Zocca, *Spoleto. Sistemazione Ponte Sanguinario, Prospettiva punto A,* 1947 (ASSp, b. 2663, cat. 10, cl. 1, fasc. 7).

5. The immaterial city: a heritage to transform

Every path aimed at cultural heritage's stewardship and promotion cannot ignore the awareness of its present value and how it represents the result of the intrigue put together by history. The current form of the city is just one of possible configurations, all also possible if dropped in the respective chronological contexts: the imaged city can live with the real one in an improving synergy, directed towards amplifying its intimate knowledge. In this sense the ongoing research on the case of Spoleto bucks for rule of critical comparison methodological prototype, potentially repeatable in other territorial contexts, intended to return to community, also, and above all, through renewed educational ways, an unknown historical heritage, which is memory and identity and which represents an indispensable tool of knowledge for anyone who works for territory's management, recovery and transformation.

(1) Cfr. IRACE 2015, p. 7.
(2) Cfr. ARGAN, NORBERG-SCHULZ 1978. The iniziative was subsequently updated by the show *Roma interrotta 2008* in the framework of 11. International Architecture Exhibition of Venezia directed by Aaron Betsky. The iniziative has inspired the recent design workshop *Disegnare Foligno tra storia e utopia. Omaggio a Giuseppe Piermarini* (science director Paolo Belardi), held in 2010 in the framework of the 200th anniversary of Giuseppe Piermarini death. Cfr. BELARDI 2010a, pp. 6-7. Cfr. BELARDI 2011a, pp. 29-34.
(4) Cfr. ROSSI, REICHLIN, REINHART, CONSOLASCIO 1976. The table, shown in occasion of the first Biennale di Venezia, is based on the famous Canaletto's painting Capriccio con edifici palladiani (1756-1759) and it represents the synthesis of a theoretical research which has already as a result the

refined collage by Arduino Cantàfora *La città analoga*, exposed in 1973 during the Mostra internazionale di Architettura organized by Rossi himself in the framework of the 15th Triennale of Milano. About the connection between the designed Venice and the real one. Cfr. also ROSATO 2008, pp. 37-45.
(5) Cfr. BELARDI 2011b. Cfr. BELARDI, MENCHETELLI 2012. Cfr. BELARDI, BORI 2013. Cfr. BELARDI 2014.
(6) Among these, cfr. for example BATTONI 1985. Cfr. BORI 2011, pp. 89-99.
(7) MACCHIA 2012. Cfr. GENTILI 1986. Cfr. DI MARCO 1999. Cfr. DI NUCCI 1992. Cfr. MENCHETELLI 2011, pp. 123-133.
(8) ASSp*, Archivio Fidenzoni Paolo*, Vita; see also GENTILI 1986, DI MARCO 1999, MACCHIA 2012.
(9) ASSp*, Archivio Fidenzoni Paolo*, Vita; Cfr. FIDENZONI 1970.
(10) BELARDI 2011c, pp.55-65. Cfr. BELARDI 2010b, pp. 119-128. Cfr. DI NUCCI 1992.
(11) *Progetto di recupero del Rione Madonna degli Orti,* 1936 (ASSp, *Raccolta cartografica, grafica e fotografica*, cart. 14, fasc.1).
(12) *Progetto per la costruzione della Casa del Fascio,* 1934 (ASSp, *Raccolta cartografica, grafica e fotografica*, cart. 14, fasc. 1).
(13) Cfr. MANGIONE 2003. Cfr. CAPOMOLLA, MULAZZANI, VITTORINI 2008.
(14) ASSp*, Archivio Fidenzoni Paolo*, b. 9, fasc. 30.
(15) ASSp, *Aministrativo* 1957, Tit. X, cl. 15, fasc. 7.
(16) ASSp*, Archivio Fidenzoni Paolo*, b. 9, fasc. 30.
(17) Cfr. GENTILI 1986. Cfr. DI MARCO 1999. MACCHIA 2012.
(18) MACCHIA 2012.
(19) ASSp, Amministrativo 1925, b. 1849.
(20) ASSp, Raccolta cartografica, grafica e fotografica, cart. 18, cc. 60.
(21) MACCHIA 2012.
(22) Cfr. RUSSO 2008, pp. 215-216.
(23) Piano Regolatore, ASSp 1946, b. 2618, cat. 10, cl. 1, fasc. 6.
(24) Spoleto municipality, Bando di concorso a premi per un progetto di ricostruzione sistemazione definitiva della Piazza Garibaldi, anno 1946, (ASSp, b. 2618, cat. 10, cl. 1, fasc. 7).
(25) Provveditorato generale alle OO.PP. per l'Umbria. Progetto di ricostruzione Porta Leonina di Spoleto, adunanza 5 marzo 1948 (ASSp, Progetti vari miscellanea 1946-1949, b. 10).
(26) "Il Messaggero dell'Umbria", 1946.
(27) About the Bando di concorso a premi per la sistemazione dell'ex piazza *d'Armi* del 18 ottobre 1946. Cfr. BELARDI, BIANCONI 2012, p. 28.
(28) Spoleto municipality, *Verbale dei lavori della Commissione Giudicatrice del concorso per la sistemazione di piazza Garibaldi e adiacenze*, 14 giugno 1946 (ASSp, b. 2618, cat. 10, cl. 1, fasc. 7).
(29) *Piazza S. Gregorio, Ponte Sanguinario e Porta Leonina: Sistemazione,* 1947 (ASSp, b. 2663, cat. 10, cl, 1, fasc. 7).
(30) *Risposta alla nota del 27/2/47 n°13200*, 5 marzo 1947, letter sent by the Marche and Umbria Ancient Superintendence to Spoleto municipality (ASSp, b. 2663, cat. 10, cl. 1, fasc. 7).

Bibliographical References

[1] ARGAN, Giulio Carlo, NORBERG-SCHULZ, Christian, (eds). *Roma interrotta. Piero Sartogo, Costantino Dardi, Antoine Grumbach, James Stirling, Paolo Portoghesi, Romaldo Giurgola, Robert Venturi, Colin Rowe, Michael Graves, Leon Krier, Aldo Rossi, Robert Krier*. Roma: Officina, 1978.

[2] BATTONI, Pietro, (eds). *Foligno, la città vera e quella possibile. Progetti e realizzazioni tra il 1840 e il 1940*. Catalog of the show (Foligno, Chiesa del Suffragio, 9-24 novembre 1985). Spello: Dimensione Grafica, 1985.

[3] BELARDI, Paolo. Architectura Ficta. La ricostruzione digitale di nove folies piermariniane. In *Disegnare Foligno tra storia e utopia. Omaggio a Giuseppe Piermarini*. Foligno: 2010

[4] BELARDI, Paolo. «Povera architettura nostra!». La ventata razionalista dell'Accademia del Disegno di Perugia. In *Ikhnos.* 2010, pp. 119-128.

[5] BELARDI, Paolo. Giuseppe Piermarini (e la Foligno che non c'è). In GAMBARDELLA, Carmine (eds). *Le Vie dei Mercanti. Med Townscape and Heritage Knowledge Factory*. Acts of the 8th International Study Forum (Napoli/Capri, 3-5 giugno 2010). Napoli: La Scuola di Pitagora editrice, 2011, pp. 29-34.

[6] BELARDI, Paolo, (eds). *Semplice semplice ma italiano italiano. Architettura moderna in Umbria*. Foligno: Edizioni Orfini Numeister, 2011.

[7] BELARDI, Paolo. L'altra modernità. L'architettura in Umbria tra le due guerre. In BELARDI, Paolo, (eds). *Semplice semplice ma italiano italiano. Architettura moderna in Umbria*. Foligno: Edizioni Orfini Numeister, 2011, pp.55-65.

[8] BELARDI, Paolo, BIANCONI, Fabio. *Sostenibilità e/è bellezza. L'acropoli moderna di Perugia e il Palazzo della Regione Umbria.* Perugia: EFFE Fabrizio Fabbri Editore, 2012.

[9] BELARDI, Paolo, MENCHETELLI, Valeria, (eds). *Da case popolari a case sperimentali. Un secolo di architettura nell'edilizia residenziale pubblica della provincia di Perugia*. Perugia: EFFE Fabrizio Fabbri Editore, 2012.

[10] BELARDI, Paolo, BORI, Simone, (eds). *1861-1839. L'architettura della Perugia Postunitaria*. Perugia: EFFE Fabrizio Fabbri Editore, 2013.

[11] BELARDI, Paolo, (eds). *NAU. Novecento Architettura Umbria*. Foligno: Il Formichiere, 2014.

[12] BORI, Simone. Perugia. Il disegno della città che non è stata. In BELARDI, Paolo, (eds). *Semplice semplice ma italiano italiano. Architettura moderna in Umbria*. Foligno: Edizioni Orfini Numeister, 2011, pp. 89-99.

[13] CAPOMOLLA, Rinaldo, MULAZZANI, Marco, VITTORINI, Rosalia. *Case del Balilla. Architettura e Fascismo*. Milano: Electa, 2008.

[14] DI MARCO, Liana. *Spoleto: una città-cantiere durante il Ventennio*. Spoleto: Del Gallo Editore, 1999.

[15] DI NUCCI, Loreto. *Fascismo e spazio urbano. Le città storiche dell'Umbria*. Bologna: Il Mulino, 1992.

[16] GENTILI, Lamberto. *Spoleto formato cartolina. Album di storia urbana 1890-1940*. Spoleto: Arti Grafiche Panetto&Petrelli, 1986.

[17] Il Messaggero dell'Umbria. La sistemazione di Piazza Garibaldi nel giudizio di uno che ama la sua terra. Anno 68, n. 100, 22 agosto 1946. Cronaca locale.

[18] IRACE, Fulvio. Dietro la trasformazione. In IRACE, Fulvio, NERI Gabriele. *MilanoMaiVista*. Catalog of the show. (Milano, Triennale di Milano, 27 gennaio - 22 febbraio 2015). Milano: Editoriale Domus, 2015, p. 7.

[19] MACCHIA, Giuliano. Spoleto: vedere il Novecento. Urbanistica e architettura nella prima metà del XX secolo. In *Spoletium.* 49/5. Spoleto: Tipografia "Nuova Eliografica" snc, pp. 21-39.

[20] MANGIONE, Flavio. Le case del Fascio in Italia e nelle terre d'oltremare. Pubblicazioni degli archivi di Stato. Roma: Ministero Beni Attività Culturali, 2003.

[21] MENCHETELLI, Valeria. Spoleto, Orvieto, Bastia Umbra. La città storica, la città militare, la città industriale. In BELARDI, Paolo, (eds). *Semplice semplice ma italiano italiano. Architettura moderna in Umbria*. Foligno: Edizioni Orfini Numeister, 2011, pp. 123-133.

[22] ROSATO, Lucio. Venezia e il Novecento. In ROSATO, Lucio. La città negata. Identità e modificazione. Milano: Franco Angeli, 2008, pp. 37-45.

[23] ROSSI, Aldo, REICHLIN, Bruno, REINHART, Fabio, CONSOLASCIO, Eraldo. La città analoga, 1976.

[24] RUSSO, Michelangelo. L'insegnamento dell'urbanistica: dall'architettura della città all'intersezione dei saperi. In RUSSO, Michelangelo. 75 anni di storia della Facoltà di Architettura di Napoli. Napoli: Clean, 2008, pp. 215-216.

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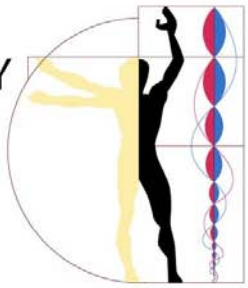

Paper's Title : PLANNING DIMENSION OF RESTORATION

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Abstract (

"Historical city": this expression implies a new planning dimension of the city
The legislative and financial action of European Community have been an impulse to plan according to methodologies of analysis and intervention in historical cities knowing that only through a different relation between city Centre and contemporary urban sector is possible to reach higher general urban quality.
During the last ten years this new methodology gained ground when the debate about contemporary city has more and more questioned "zoning" as instrument to control territory.
Historical centre is no more seen as a marked out and separated area, on the contrary it is considered as an integral part of contemporary city to restore by planning a global requalification based on the principle of active preservation.
Nevertheless, traditional policy based on identification of historical area (zonig) has been an efficient approach to requalification. Take, a stock of the situation we can say that in Italy we have had good results if we consider that council and population have reached a new awareness about economic and cultural value of this area of the city.
This policy has been efficient in many ways but it can't protect and preserve city landscape and it is now more and more unsuitable to face the massive social pressure put by new urban economies and new architecture.

Keywords: Historical centre, requalification,active preservation, city landscapes.

Planning dimension of restoration

"Historical city", this expression implies a new planning dimension of the city.
The legislative and financial actions of European Community have been an impulse to plan according to methodologies of analysis and intervention in historical cities knowing that only through a different relation between city centre and contemporary urban sectors is possible to reach higher general urban quality.
During the last ten years this new methodology gained ground when the debate about contemporary city has more and more questioned "zoning" as instrument to control territory.
Historical centre is no more seen as a marked out and separated area, on the contrary it is considered as an integral part of contemporary city to restore by planning a global requalification based on the principle of active preservation.
Nevertheless, traditional policy based on identification of historical area (zoning) has been an efficient approach to requalification. Take a stock of the situation we can say that in Italy we have had good results if we consider that local council and population have reached a new awareness about total economic and cultural value of this area of the city.
This policy has been efficient in many ways but it can't protect and preserve city landscape and it is now more and more unsuitable to face the massive social pressure put by new urban economies and new

architecture. "Classic" urban preservation policies haven't been able to recognize the patrimonial value of important areas of the modern city and they have excluded them from preservation.

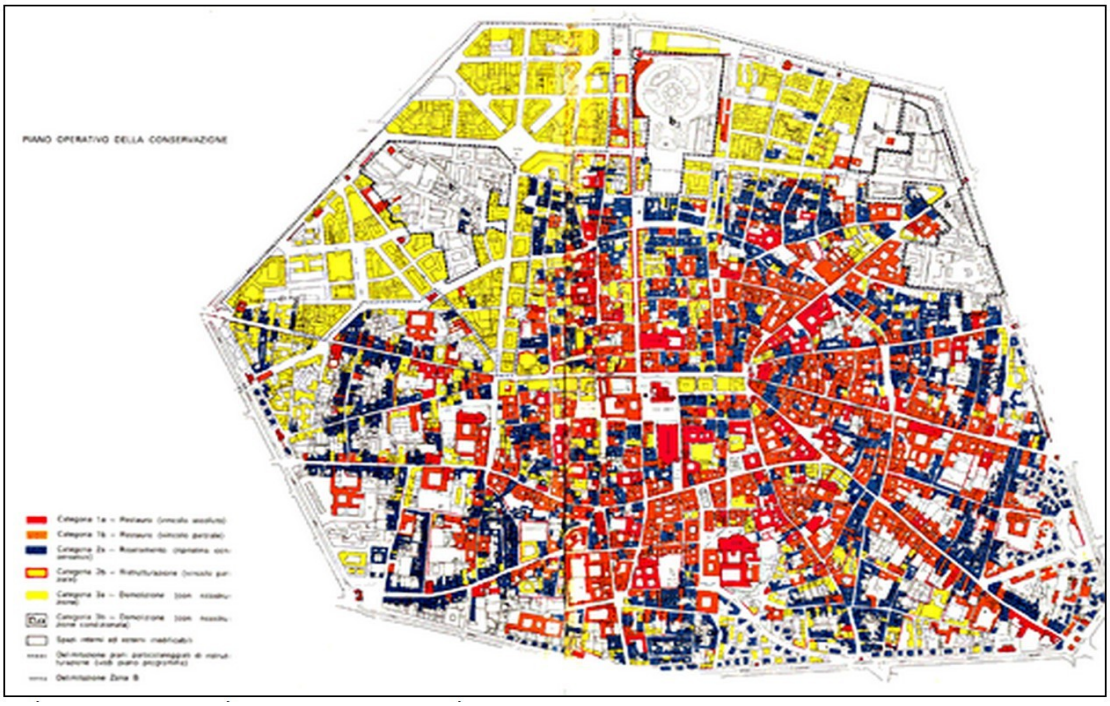

Fig. 1: x Bologna, 1969. Urban conservation Plan

If we analyze local state of affairs we easily notice that in modern city it has been very difficult to face the effects of new social and economic changes as immigration, for example, and mass tourism.
To give an outline of the international situation we can affirm that local councils have been rarely able to balance between development and new ways of carrying traditional functions.
Historical city - if we mean by this not only the old centre but also the sprawls of the early twentieth century, the most recent, and related parks and gardens- is at the core of many fundamental problems concerning urban development because of the different urges not only regarding material changes, through demolition and reconstruction of some areas, but also functional and social changes.
Actually, changes in historical city are always subject of debates, some of them have been very high pitched, as in the case of the Mejer's Ara Pacis Museum which has been for long time focus of e mass- media attention.
These different concepts originated from structural transformations in the city. Some decades ago, city was represented by spatial and social models deriving from the ideas of "centre" and "suburbs", terms which symbolized ruling class culture opposite to lower class culture.
These terms symbolized also the concentric structure of the city that sprawled around a "nucleus" in which we can find the economic and social head offices, which have rare branch offices in suburbs. In this scheme historic centre is the place which determines habits, values and behaviors that must be preserved. In the last decades, in Italy as in the whole Europe, we have seen the beginning of structural changes in city zones, above all for what concerns relationship between centre and suburb. Recent phenomena such as immigration, urban sprawl mad the occurrence that the centre has lost its tertiary and fourth sector functions, have introduced new variables in actual urban policy.
Historic centre seems to be just a part of the city more and more deprived of its traditional function, closed, blocked and, for these reasons, rejected as a place of residence and destined as a place for commerce, tourism, and to pass spare time.
Both central zones of the city and suburbs reflect the complexity of our society deriving from the increasing chances for their inhabitants, from different ethnic and religious groups, to pass from a social and cultural class to another. This heterogeneity gives birth to new meanings of functions such as "living" and calls into question the definition of citizenship in itself.
Contemporary city structural complexity can't be studied through the relationship between "centre" and "suburb", but must be seen as a peculiarity of a new culture of the city.
Especially European and Mediterranean cities, must defend their historic traditions stressing the need of taking account of the complex relations among people that have different culture and religion not as an accidental but as a structural datum.



Fig. 2: Example of urban rigeneratio inTorino, Parco Dora

The opposition between "conservatives" and "innovators" related to the possibility of demolishing and rebuilt in a historic city, it seems not to quiet: the prospect of a "creative restoration" and the need of showing the current building ways and techniques, are elements of a debate that give us new possibilities of working in a historic centre: in Torino they are planning a "historic city-friendly skyscraper".
Nevertheless, today "center" and "suburb" aren't considered as opposite but as complementary element since economic and social complexity of contemporary city is a unity that can't be fractioned. According to this point of view, today's culture has taken a quality leap giving attention not only to a favored part of the city or territory but to the whole city in its entirety.
The principle of sustainability, in fact, isn't carried out just in favored areas but by complementary relations among different areas, historical centers or modern structures, such as shopping centre, underground stations, residential district, that are often characterized by structures which are very
competitive from a formal point of view.
The main changes don't consist in planning works even more spectacular but in preservation by the mean of study, safeguard, planning for historic city, and the respect and defense of ecological and structural values of the territory. These more complex and less evident steps will allow us to save
the identity-making traits of European and Mediterranean city.
It is pointed out that, today, the relation between historic city and landscape and ecological values gives new importance to issues regarding development and safeguard of territory and to a territorial and ecological planning, in which problems about sustainability obtain more and more regard and evaluation.
The matter of material and immaterial heritage enhancement, proved itself as one of mean to assure the development sustainability. In the field of cultural heritage enhancement, Italy can boast about a veritable “pattern” that acknowledge in the heritage body of constructions and landscapes making e prestigious feature of national identity.
Cultural patrimony must be considered as element of a wider, more complex and medium-and long-term strategy, in which culture and environment can become stimulus for a more balanced development. All of this is very important just for region where the increasing dependence on tourism of local economy begins to become a sustainability issue.
In this logic, the improvement of human resources is a veritable “condition sine qua non” through which promoting, on one hand, the restoration and re-diffusion of traditional knowing how and, on the other hand, investing on new specialization able to “read”, understand and plan sustainable development of territory

beginning from the existing cultural and environmental heritage, aware that the architectonic and monumental heritage is always related to environmental heritage.



Fig. 3: Bologna, 1969. Urban conservation Plan.

Another fundamental principle at the base of heritage improvement is its restoring and re-use, where its original function failed. The re-use allow, thus to continue ”living”, and playing a role in town development. From this point of view, functional conservation and re-use of traditional and historical places be a factor of development, on condition that assure a balance between the faithful restoration and the modern needs of building, that is among, the manifold elements and meanings.

The issue of migrations and the more considerable people movements, analyzed in terms of effects on cities layouts has been long one of the themes of interest by the urban planning studies.

This interest is defined by the need to understand the effects that the presence of migrant communities produces on cities and territories about urban and socio-economic layouts changes as well as the opportunities that different cultures mix, which different modalities of living correspond to, could provide for the improvement of urban quality.

Moreover, the problem connected to migrations, for the effects they pose in terms of culture and social integration, are one of the main issues of the UR political and economic agenda which has addressed its attention on cities to experiment new and more suited policies able to favour social and cultural integration at the same time or rather to check situations of social conflict and urban decay, but also seek for new models and instruments of action good for managing the problems and the complexity of contemporary cities.

Since from the document of the European Spatial Development Perspective Policies (1999) even the next EU programmes have been projected to ensure a sustainable development of the Union territory, intended to its unity but also as synthesis of the different dimensions of the social life and as sphere where it is possible to encourage objectives: cohesion and social equity, competitiveness and development, environmental resources safeguard and valorization.

One into of the most important things is that the urban fabric, do not cause contrast, but instead, allows us to shave the principle of respect and civil co-existence.
Technological innovation is producing a deep change. The fact of being able to use, the product of technological innovation means having to re-evaluate how facilities operate and make full use of these technological possibilities.
The city becomes ever more complex due to the number of things to do to handle, and to transmit; due to the increased number of things in general; due to the interactivity that these things create and impose. This complexity, means that town planners, have new problems to face.
I have condensed these new types of problems, these are the principles that we must call our own if we are to a place in which the city is conceived as a site of interaction.
So one of the most important things to ensure is that the urban fabric, do not cause contrast but instead allows us to shave the principle of respect and civil co-existence. Technological innovation is producing a deep change.
The fact of being able to use, the product of technological innovation means having to re-evaluate how activities, function and services operate and make full use of these technological possibilities; in order to maximize the effects in all social levels.
The city becomes ever more complex due to the number of things to do to handle, and to transmit; due to the increased number of things in general; due to the interactivity that these things create and impose. This complexity means the town planners have new problems to face.
It is desirable that these factors become the principles of a future engagement, where is acquired, how widespread awareness, concept of city as a space of values and interactions.

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Fig. 1: Figure caption (Arial – 9 pt, Lower case letters – Left aligned – Number style 1, 2, 3).

Bibliographical References

[1] BONFANTINI B, *Progetto urbano e città esistente,* Libreria Clup. , Milano (2003)

[2] CECLA F., *Contro l'Architettura,* Bollari Boringhieri, Torino (2008).

[3] DONADIEU P., *Una nuova proposta di paesaggio*, Donzelli, Roma (2006) .

[4] EVANGELISTI E. ORLANDI P, PICCINI M., *La città storica contemporanea,* Urban Center, Editai, Bologna (2008).

[5] MARTINOTTI C., *Metropoli. La nuova morfologia sociale della città,* Bologna, Il Mulino, (1993).

[6] ROMANO M., *Costruire le citta,* Skira, Milano , (2004).

[7] ROSSI P.O. La città contemporanea e la carta della qualità, *Urbanistica 116,(2001)*

[8] RYKWERT J. , *The Dancing Colun. On order of architetture,* Mit Press,Cambrige(Mass) (1996).

[9] SALZANO E. , *Ma dove vivi,* Corte del Fondego, Venezia (2007).

HERITAGE and TECHNOLOGY
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A dialogue between architecture and technology. Methodological processes for the knowledge and preservation of buildings of value in the eastern part of Sicily

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Abstract
The figurative unity of architecture consists of the complete and complex image deriving from the synergistic relationship between knowledge and perception. Even when the physicality is broken up, it can survive through its representation based on its remains, thanks to a preservation and rebuilding project.
For this purpose this study focuses its attention on the peculiarities of the investigation work made through digital instruments in those cases in which, either in small or large-scale, the remaining architectonical elements are just ruins.
The real matter is whether an extremely detailed observation can be useful or not in such an area (Eastern Sicily) where the details are quite often unreadable. Another problem is the relationship between the survey and the perceptive image of a real drawing made, either during the survey work, or in the past.
Taking into account the semantic value of the ruins, the connection between the potentiality of the survey made by modern digital instruments and the contextualized drawing of what already exists becomes of fundamental importance, as it establishes a dialectic relationship between past and present, substance and its representation.

Keywords: Memory, Fragment, Territory, History, Survey

1. An articulated itinerary between traces and transformations *(G. Taibi)*
Our towns and the morphology of contemporary sites are often the result of interventions of devastating effects which have, most of the time, radically changed the places and memories to give space to satisfactory solutions for an unqualified culture of the town.
The episodes which, specifically, characterize the functional environment where we live, that is the place, are to be considered as a continuum of historical evolution of emotional processes which are always fixed in our interior lives, in our perceptive images.
These testimonies of real life regulate our inner balance and powerfully strengthen our minds towards the reconstruction, even if virtual, of invigorating historical passages and of synaptically connected episodes, so to recover the backbone where to weave and reassemble all the pillars of the endemic analysis of our towns.
Finding in our towns the perennial marks of a past referring to and consolidating our cultural interests is a unique form of experience.
Tracing in Catania the references of the main axes of the Roman centuriation and town planning, the cardus and the decumanus, means to live a symbiotic experience which allows us to confirm and write again the contemporary urban events along the past we are children and heirs of. In Ortygia, whose background is particularly stratified, it is possible to detect a meaningful knowledge process in the material consistency and architectural quality of its remains following a logic itinerary, articulated between Porta Aretusa and Porta Urbica.

It is important to detect, precisely, a portion of the examined territory so to virtually simulate facts and evolutions of the material context, adding specific peculiar remarkable and intriguing cultural items which characterize that territory. Also, to open the door of communication to a more and more extensive cultural context, referring not only to the Arethusean population but to its surrounding area too, in order to use an investigative method which can be an updatable and implementable means of information able to document and capture in real time the attention and interest of visitors. The main purpose is to enlarge the focus and eventually increase the surveyed sample in order to monitor, step by step, the mutations and transformations in a predetermined time space and to allow through a series of visual overlappings, the reading of history and the reconstruction of all the stratifications occurred in the past.



Fig. 1: Syracuse: Temple of Apollo; Porta Urbica.

It is otherwise meaningful to focus attention on some typical features, cornerstones of the town planning. They are elements which, on their own, can represent and can be considered as monumental symbols of a glorious past but looked under the light of an ever changing drawing (progression) of a virtual reconstruction of the past, they have certainly fixed the milestones to trace an outline, meaningful for the venous texture and muscle structure of the town and altogether for the vascularisation system of the tracks, projected in the dynamics of the becoming.
The Temple of Apollo, then, no more considered as a symbol-capturing element, isolated in a strong historical frame, has to be read and inserted in an organic context that is specifically the Greek town organization, rediscovering and revisiting the ancient Via Sacra, Via Dione nowadays, together with Via Roma, along which the strong presence of the Temple of Apollo of the Athenaion and of the Artemision can be detected. Diametrically opposed to this there is the prevailing connection of the road axis between Via Amalfitania and Via delle Maestranze especially where the intersection with Via Sacra defines a well characterized fulcrum, Piazza Archimede, with its historical key role.
The itinerary, articulated with a structural nexus and with a strong internal compulsion, captures and intrigues…

1.2 A diachronic interpretation of the town *(S. Giuliano)*

The identity of a place often depends on the functions it assumed in its historical past. Investigating on the stratified urban system means to come diachronically closer to the place, analyzing in an endemic way the relations between architecture and function, pólis and polítes, civis and civitas.[1]
As such, the small island of Ortygia, which is under the present investigation, represents a magnificent example of stratified towns where all the elements, in the architectural and urban scale, come together, hide themselves and contextually emerge in the present structure.
An analysis based, first of all, on the overlapping of the historical iconography and cartography with the present survey, looking for the old urban tracks which often, as for Ortygia, originated in Greek times.
It is now the case to consider the Greek plan of the Arethusean island and in particular the Via Sacra – the road axis which connected the Temple of Apollo with the Temple of Artemide and the Temple of Athena, the so called Duomo – still readable in its complexity, presently characterized by Via Dione with its extension to Via Roma.
Focusing on the 1842 Buildings Plan of the Real Piazza we can better understand the track of Via Sacra as the main axis of the island since the town hadn't experienced yet the demolitions which characterized several European towns at the end of the XIX century.

The demolished axis, the present Corso Matteotti, develops close to Via Dione which, in this case, can be read as the rear of the same axis and has the advantage of a large road section with all the problems concerned with the old and the new building criteria.



Fig. 2: via Dione and corso Matteotti.

The marks which can hide the past, are not only connected with the “urban system” like that concerning the juxtaposition of Corso Matteotti to Via Sacra, they can also refer to precise architectural works.
We had lost any traces of the Greek Temple of Apollo until 1860, because following some interventions in Roman times it was transformed into a Church during the Byzantine period, later on in a mosque of which remains as a proof an inscription in Kufic characters on the cell wall.
During the Norman period it became the Basilica of SS. Salvatore – where the opening of an acute arch on the cell wall, still visible, was the entrance of the church itself – later deconsecrated and partially demolished, in the same area military barracks were built during the Spanish period. Only in 1860 at last, it was possible to understand what important Greek monument the barracks had hidden from view.
Apart from the elements incorporated in other buildings, there are other works where the urban stratification process has homogenized the floor levels.[2]
It is the case of what remains of Porta Urbica, discovered in 1977, gateway to the Fortress of Ortygia and unique remains of the Dionysian fortifications on the island.
The only visible parts of Porta Urbica today are the bases of two quadrangular towers of more than eight meters per side, which probably allowed the entrance to Via Sacra, connecting the Temple of Apollo to the Temple of Athena.
Unfortunately, the conservation of all these works appears, most of the time, completely worn out by the effects of the past centuries. It is difficult to start researches with the appropriate level of thematic in- depth regarding the transformation of the same works.
A second form of impossibility regarding the study and the documentation of these works is connected to the means of representation: the drawing.

The canonical representation usually produces two-dimensional objects according to the orthogonal projections where the result of the product of the two incident planes leads into a straight line.
In the case of the representation of such works where it is impossible to detect the hypothetical planes of the work itself with the consequent representation according to the product of their orthogonal projections, it is clear that the classical means of representation – the two-dimensional drawing – can be considered an obsolete instrument.



Fig. 3: Porta Urbica: survey.

In order to catalogue all the "marks" spread over the territory – as it is the case of the present research in Eastern Sicily – a direct dialogue between drawing and technology becomes fundamental.
The modern means of representations allow an object modelling activity which can appear amorphous at first sight.
In particular, thanks to the Laser Scanning Survey Technology, depending on the characteristics of the instruments used, it is possible to conduct a survey on very large and complex areas, receiving the surveyed data as clouds of tridimensional points. The modern means of digital drawing are able to shape the surfaces which make the single detected object as clouds of points produced by the laser scanning survey, with a high level of flexibility on the part of the surveyor-drawer.

2. A language for the drawing of fragmentary details *(R. Valenti)*

Assuming that any form of knowledge is based on the ability of perceiving and discerning, it is possible to state how complex this activity can be when it is conducted on architectural works where the original unity must be searched through the interpretation of fragmented marks. Specifically, the totality of fragments is the only potential structure able to give expression to the whole with a gradually growing level of certainty as the disintegration of matter decreases and the amount of the existing material indications increases.
We can state that in this process, aiming at the recovery and restoration of architectural heritage which maintains traces of its own history only in a specific way, the applied research is fundamental. It makes possible to start comparisons and detect analogies especially on the geometrical and building methods which gave birth to the architecture in relation with the historical context.
Through the instrumental survey, metrically precise, it is possible to carry out the necessary readings aiming at the detection of qualitative and formal aspects: the exact quantitative data induces observations about the material conformation so to specify the identifying aspects.
As such, the survey methodology deals with the ability of recognizing the spatial aspects sensitive to the touch through a reading mediated by graphical codes which critically represent the historical evolution and which permit to be in tune with the present reality which safeguards, only fragmentarily, the events which determined the material mutations.



Fig. 4: Rose window. Syracuse, Church of St. John the Baptist. Buccheri, Church of St. Andrew.

The purpose is to detect the geometry and the proportions presenting analogies in different contexts, considering the potential uniqueness of language and expression and of the transverse modelling of the details in the space, so to spread a culture made of interventions and based on the reasoned knowledge of the context: the dialogue with a place is possible only if its elements are fully recognized.
Considering that “nothing is built with the ruins but everything is built on the ruins”[3], particularly interesting is the theme of the survey and modelling when the details to study are broken or in a ruined state.
Specifically, the instrumentally precise survey, returns the matter with its gaps and its geometrically imperfect parts, susceptible of accurate studies about the stone cutting technology, the decodification and the interpretation of the original patterns.
The research, developed on the occasion of a university thesis drawn with the technical-computerized support of the “Laboratorio della Rappresentazione della S.D.S. di Architettura”, was possible thanks to the fundamental help of the tridimensional laser scanning technique which in the field of architectural survey represents a real turning point and which, referring to particularly degraded architecture, can be considered as the most appropriate tool for the metrical and formal interpretation.

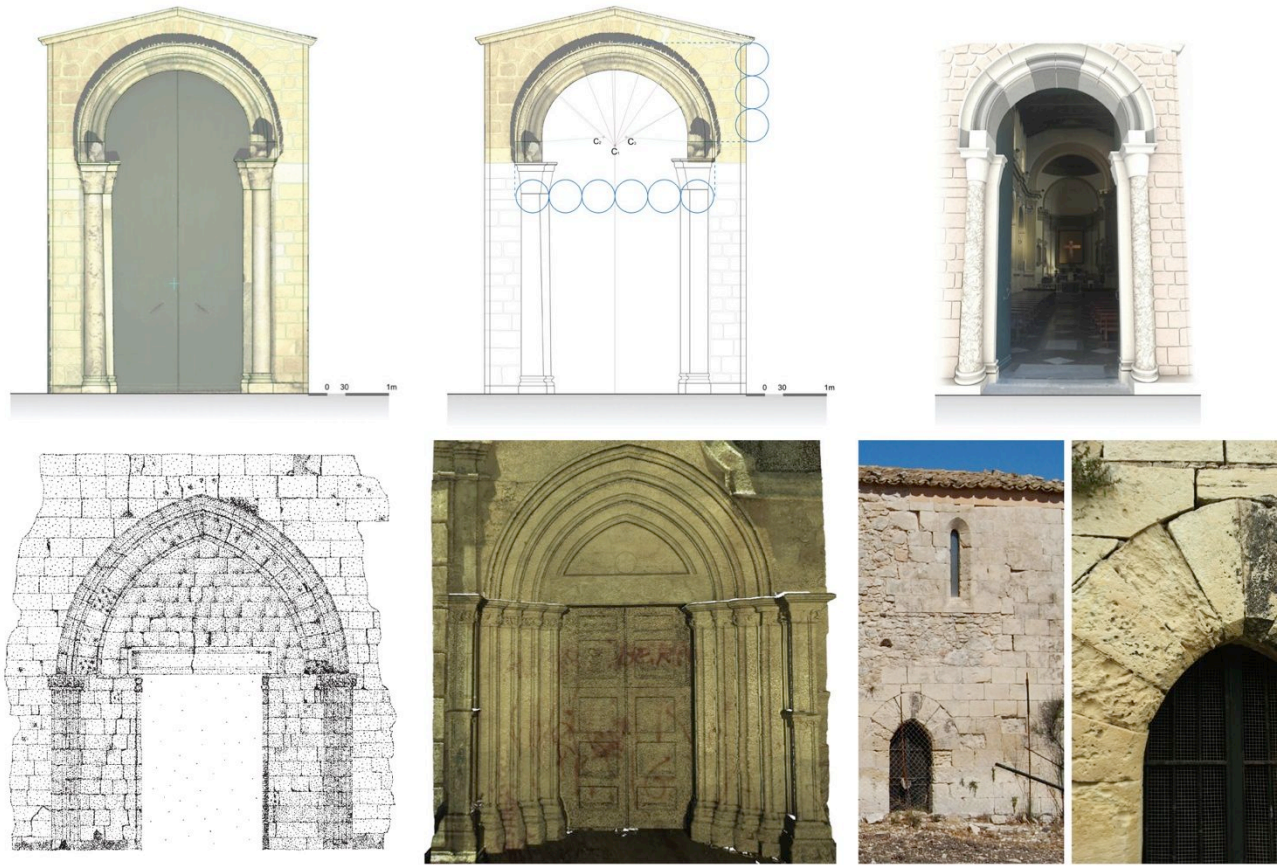

Fig. 5: Portals. Geometries, survey and models of fragments.

The interest for the remaining fragments of historical architecture is based upon semantic considerations: they represent real tiny monuments of memory, landmarks passed down and references to the present time, against any form of barbarism.
The study and analysis of degraded and transformed architectural parts, specifically, represent an interpretation of the remaining reality; in particular, the use of technologies based on RGB value range[4], such as the laser scanner, or on the metrical or topological survey such as the total station, ensures easier tridimensional drawings through the 3D modelling. The recourse to this technology even in the phase of the realization of the model doesn't leave out the active and critical participation of the modeller researching the geometry which corresponds to the original reference. In the case of a particularly damaged matter, the research compared homologous elements for the specific historic period and spatial collocation. This made possible to create models which represent the synthesis between survey and research. The representation of the models of fragments contextualized in the real location, through the photo rendering procedures and the modelling technique allow a coherent reading of the architecture in relation to the diachronic process of conformation highlighting the observed historical and architectural values. The application of the methodology to specific items in the urban landscape in Paternò and in the countryside around Buccheri offered different levels of difficulties and substantially confirmed the particular expressiveness of the modality of representation relating to the purpose.
The collection of data, the stereometric and geometric analysis, contribute to the formation of a reasoned catalogue of all the surviving elements in the form of fragments, spread all over the territory, allowing the formulation of assonances and constructive references.

2.2 Survey and modelling experiences of remarkable elements *(E. Paternò)*

Starting from the knowledge of the historical context, attention was given to all those characterizing and widespread elements, marks produced by history and by the culture of a specific geographical area and which have been registered, read and collected as a huge amount of data.
Specifically, the survey was directed towards parts of architecture, real fragments of a building language typical of the Middle Ages in Eastern Sicily.
The study of the Church of S. Andrea in Buccheri (SR) has made possible to define the presence of particular elements such as the single lintel arch which are arranged as marks of a lost scenery rather than

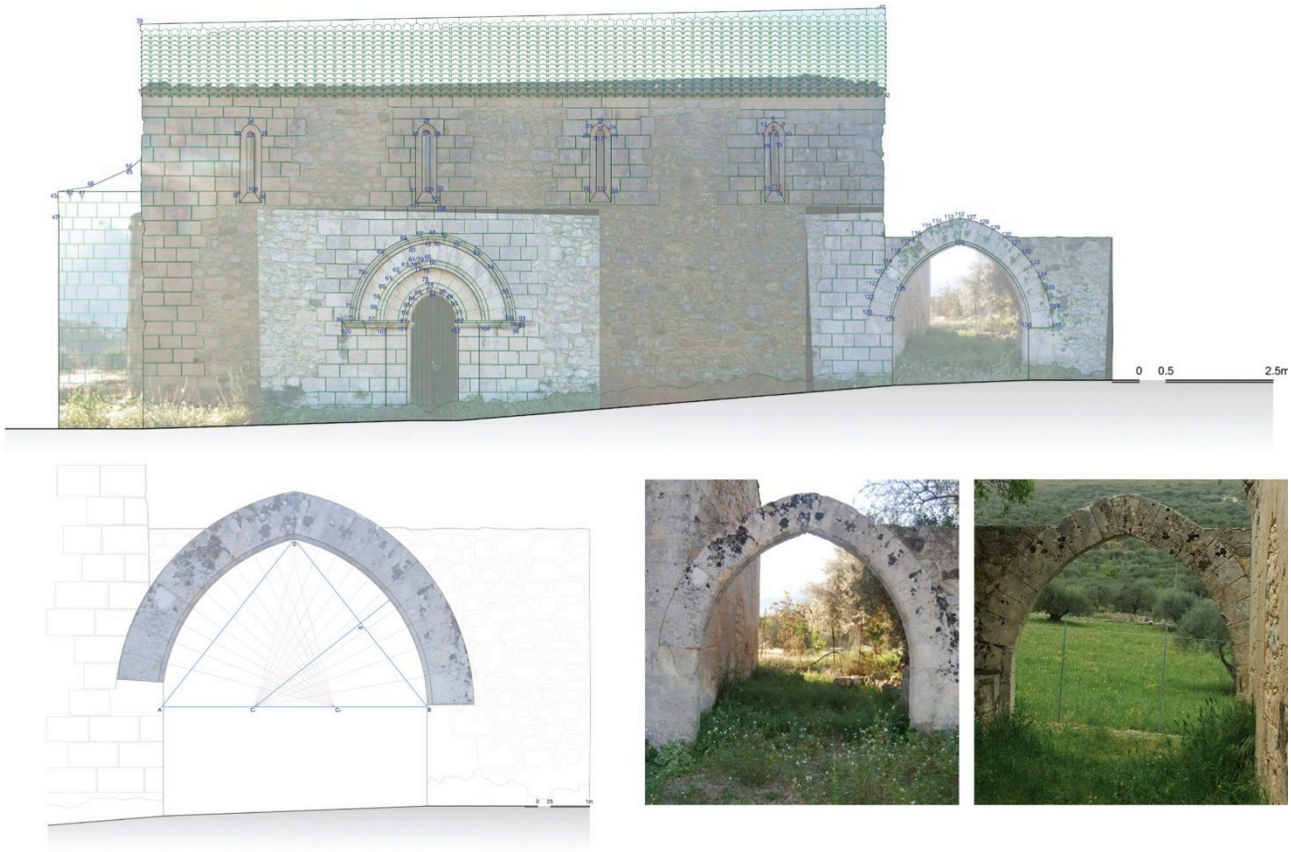

Fig. 6: Rose window. Syracuse, Church of St. John the Baptist. Buccheri, Church of St. Andrew.

real architectural emergencies. In fact, from a first visual analysis the arch seems to be decontextualized even if the survey and the historical documents confirm its being part of a more extended complex estate which included the church and other parts completely destroyed by now. It stands out not only as a mere architectural element but as a perceptible and cultural landmark which evokes a distant past.
There are, at the same time, detailed elements which seem to be specific and codified remains of a precise historical period. It is the case of the rose window in the above mentioned church which is badly damaged and whose survey itself couldn't give back its original integrity. It is necessary in such a case to make a comparison with similar elements dating to the same historical period and with a similar geographical position and also an accurate study of the historical documents and a detailed virtual reconstruction to bring to light what has been forgotten.
These remarkable elements, which survive in a ruined state and as such need a urgent cataloguing and conservation intervention, attract the interest and become the subject for the application of the modern survey technologies. Thanks to the recent development in the survey methodology and in the representation of metric data it has been possible to adopt instruments such as the 3D laser scanner which is able to recreate a virtual model identical to the original one, correct in size and photo-realistic. When the virtual representation of reality is built, starting from precise data such as that obtained after a surveying campaign, the tridimensional model gains a high communicative impact and scientific value. Moreover, the 3D model can be useful for further use, from scientific researches to virtual and museum propagation; the proposed remarkable elements specifically represent real "stone documents", fragmented presences of a coherent past.
The study of the portal of the Church of S. Andrea refers to another portal, that of the Church of S. Maria della Valle di Josaphat in Paternò (CT) similar in structural conformation and belonging to the same historical period.

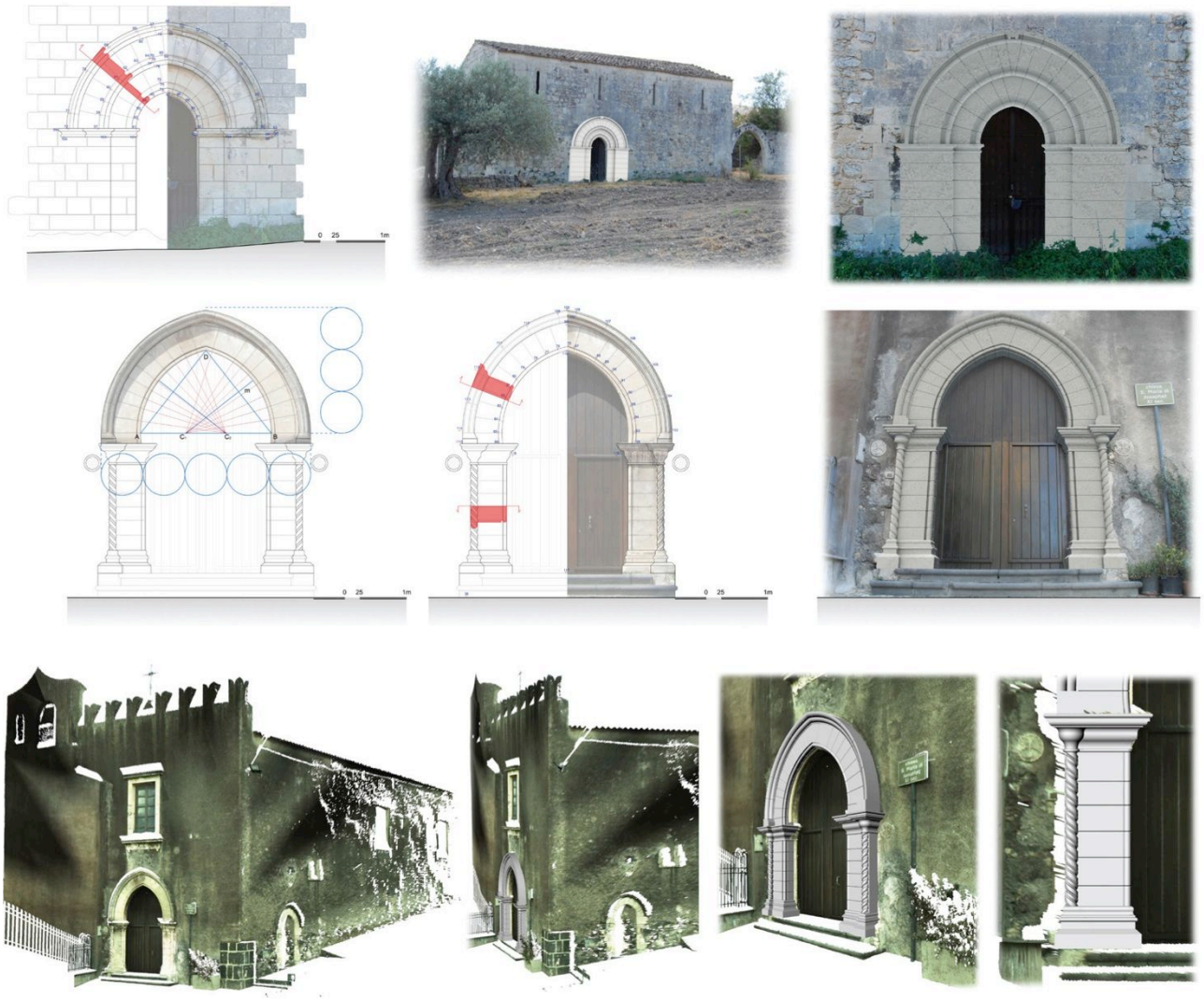

Fig. 7: Church of St. Andrew and church of St. Mary from Josaphat. Portals, study and models.

In both cases, starting from the data obtained from the survey, it was possible to develop, with specific software, real tridimensional models. In particular, the 3D laser scanner was able to generate an output file (Cloud of Point) which can be read and developed by a software such as Cyclone which is able to render the orthophotos. Thanks to the use, in the specific case, of open source programs, such as Meshlab, it was otherwise possible to convert the Cloud of points in a polyhedral surface (mesh) afterwards covered by photo images (texture) which allow a photo realistic visualization of the surveyed structures. In the case where the laser scanner survey refers to architectural elements with a better level of details the simple use of open source software is not enough and it is necessary to use specific programs. The laser scanning methodology has supported the development of searchable and user-friendly models created through software modellers such as Rhinoceros. Finally, it was appropriate for the graphic drawing to carry out photo renderings which allow the contextualization of the produced 3D model, inserting it in a photo image, comparing and overlapping the Cloud of point and the processed tridimensional model.
What has been said confirms that the modern software tools can easily guarantee the possibility of safeguarding and spreading the architectural heritage in order to monitor its state and to repair or restore part of it, more or less extended, so to stop its degradation. Considering how dangerous is the situation of a great number of remarkable and precious historical elements of our territory, considering that the timelines and the examination of the risk involved cannot guarantee their protection, considering also that a lot of them are not yet classified and subjected to protection, a methodical and careful cataloguing and a faithful documentation based upon the new survey technologies could represent a first documentary archive, a kind of “digital memory”, as a base for their safeguard, estimate and propagation.

Bibliographical References

[1] BELLAFIORE, Giuseppe. *Architettura in Sicilia nelle età islamica e normanna (827-1194).* Palermo: Arnaldo Lombardi Editore, 1990. ISBN 88-31725335.

[2] BRUSAPORCI Stefano (a cura di). *Sistemi informativi integrati per la tutela la conservazione e la valorizzazione del patrimonio architettonico e urbano.* Roma: Gangemi Editore, 2010.

[3] CENTOFANTI, Mario. Il rilievo della città storica e la sua rappresentazione. In AA.VV., *Trame e stratificazioni urbane. Casi studio a confronto*. Siracusa: LetteraVentidue, 2012, p.16-33. ISBN 978-88-6242-072-3

[4] CIOTTA, Gianluigi. *La Cultura Architettonica Normanna in Sicilia.* Messina: Società Messinese di Storia Patria, 1992.

[5] RAPISARDA, Carmine. *Chiesa di Santa Maria de Valle Josaphat.* Paternò: Centro sociale “Quartieri”, 1997.

[6] VALENTI, Rita. *Dal rilievo alla rappresentazione. I dettagli e i frammenti di Ortigia.* Ed. digitale. Siracusa: LetteraVentidue, 2012. ISBN 978-88-6242-071-6.

[7] VALENTI, Rita, GIULIANO, Sebastiano. Paths to knowledge for the preservation of identity culture. In GAMBARDELLA, Carmine (a cura di). *Best practice in heritage conservation management. From the world to Pompeii.* XII International Forum Le vie dei Mercanti, Aversa-Capri 12-14 June 2014. Napoli: La scuola di Pitagora Editrice, p. 494-502 ISBN 978-88-6542-347-9

[8] ZORIC, Vladimir. *La chiesa* sveva *di Sant’Andrea. Buccheri e il feudo di Rachalmemi.* 1ª ed. Siracusa: Arnaldo Lombardi Editore, 2003. ISBN 88-7260-136-3.

[1] Cacciari, Massimo. La città. Villa Perrucchio: Pier Giorgio Pazzini editore, 2009. Quarta edizione. pp. 7-19.
[2] Taibi, Giacinto, Valenti, Rita, Liuzzo, Mariangela: Il laboratorio della memoria: engrammi del tracciato di Ortigia, in: Patrimoni e siti Unesco. Memoria, Misura, Armonia. Matera: 2012
[3] Adolfo Natalini, *Un hotel sulle rovine,* in DOMUS n. 977 febbraio 2014 p.66
[4] Laser scanner Leica C10 a tempo di volo

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Morphological Investigations and Virtual Reconstructions of the Domus of the Northeast Quarter of Volubilis (Morocco)

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Abstract

Along the 1st and the 3rd centuries A. D. the city of Volubilis was developed as an important administrative and economic center. Proofs of its prosperity are the ruins of several splendid Domus that were built in the Northeast Quarter, on both sides of the Decumanus Maximus. These Domus were excavated and investigated in the sixties by the archaeologist Robert Étienne.
Fortunately, through the declaration of Volubilis as a World Heritage Site by UNESCO in 1997, its progressive spoliation has been paralyzed. Nevertheless, after Robert Étienne, no significant researches have taken place on these great residential architectures.
In recent years we worked on some of the best preserved Domus: House of Venus, House of the Labours of Hercules, House of Dionysus and The Four Seasons, House of Flavius Germanus, House of the Sundial, etc. We used them as sources for teaching about investigation and virtual reconstruction of the Architectural Heritage in our School of Architecture.
Several reconstructive hypotheses of these houses have been carried on the basis of texts of Vitruvio and Pliny, Ancient Roman architectural examples, planimetric surveys made by Robert Étienne and some own graphic material gathered in situ. We built virtual models with unwrapping textures and we achieved to merge them in its real environment by using Camera Match techniques. Our final goal was to recover some sort of the perception and the emotional reaction that those disappeared architectonic spaces could arouse in their former inhabitants.

Keywords: Volubilis, Romano-African Domus, Virtual Reconstruction, H-BIM categories

1. The archaeological site of Volubilis and its Northeast Quarter

Located in a fertile agricultural area on the foothills of the Jebel Zerhoun, 30 km from Meknes, the ancient city of Volubilis was founded in the 3rd century B. C. under the Carthaginian influence [1]. In the 2nd century B. C. it became part of the tribal Berber kingdom of Mauretania which was joined to the Roman Empire in 40 A. D. For two centuries, Volubilis was an important administrative and economic nucleus of the imperial province of Mauretania Tingitana and the city experienced its golden age: a new urban pattern was developed, widening the already existing one; the Aqueduct was constructed to supply Baths, public fountains and some private residences; the monumental center began to take shape with buildings and spaces as the Judiciary Basilica, the Forum, the Capitolium or the Triumphal Arch; a new luxurious residential quarter, made up of magnificent Domus, was erected in the Northeast area [2].
Unfortunately the city was soon left on its own fate, when Roman authorities and Army were all transferred in 285 A. D. An earthquake in the 4th century is believed to have caused extensive damage in a still inhabited city but from the 7th century and during the period of Arab rule, it was converted into an open quarry for the new buildings of Meknes. Its name and its history were forgotten.
It was not until the late 19th century when the ruins of Volubilis were identified by Charles Tissot [3]. Excavation at Volubilis was opened in 1915 by Hurbert Lyautey, gobernor-general of the French protectorate of Morocco. It was carried on with German prisoners of war as workmen and it was focused on the Basilica and the Triumphal Arch areas [4]. In subsequent years (1917-1919), the archaeological ruins of the Forum and several nearby Domus were rediscovered, making clear the existence of a whole buried city.

Almost one hundred years later, after more than 2.000 excavations made by numerous institutions, only the third part of Volubilis has been cleared. One of the most studied areas is the Northeast Quarter, which is split in two by a twelve meters wide Decumanus Maximus. On both sides of it, twenty-three houses with columned courtyards and elaborate mosaics were excavated and well documented by the archaeologist Robert Etienne in the early sixties [5]. After that, no more significant researches have been made; neither reconstructive hypothesis has been published.
Since the ruins of these magnificent Domus present an important level of authenticity and integrity we decided to face the morphological investigation and the virtual reconstruction of some of the best conserved ones: the House of the Labours of Hercules, the House of Flavius Germanus, the House of Dionysus and the Four Seasons, the House of the Wild Beast, the House West of the Palace of Gordian, the House of the Two Presses, the House of the Sundial and the House of Venus.

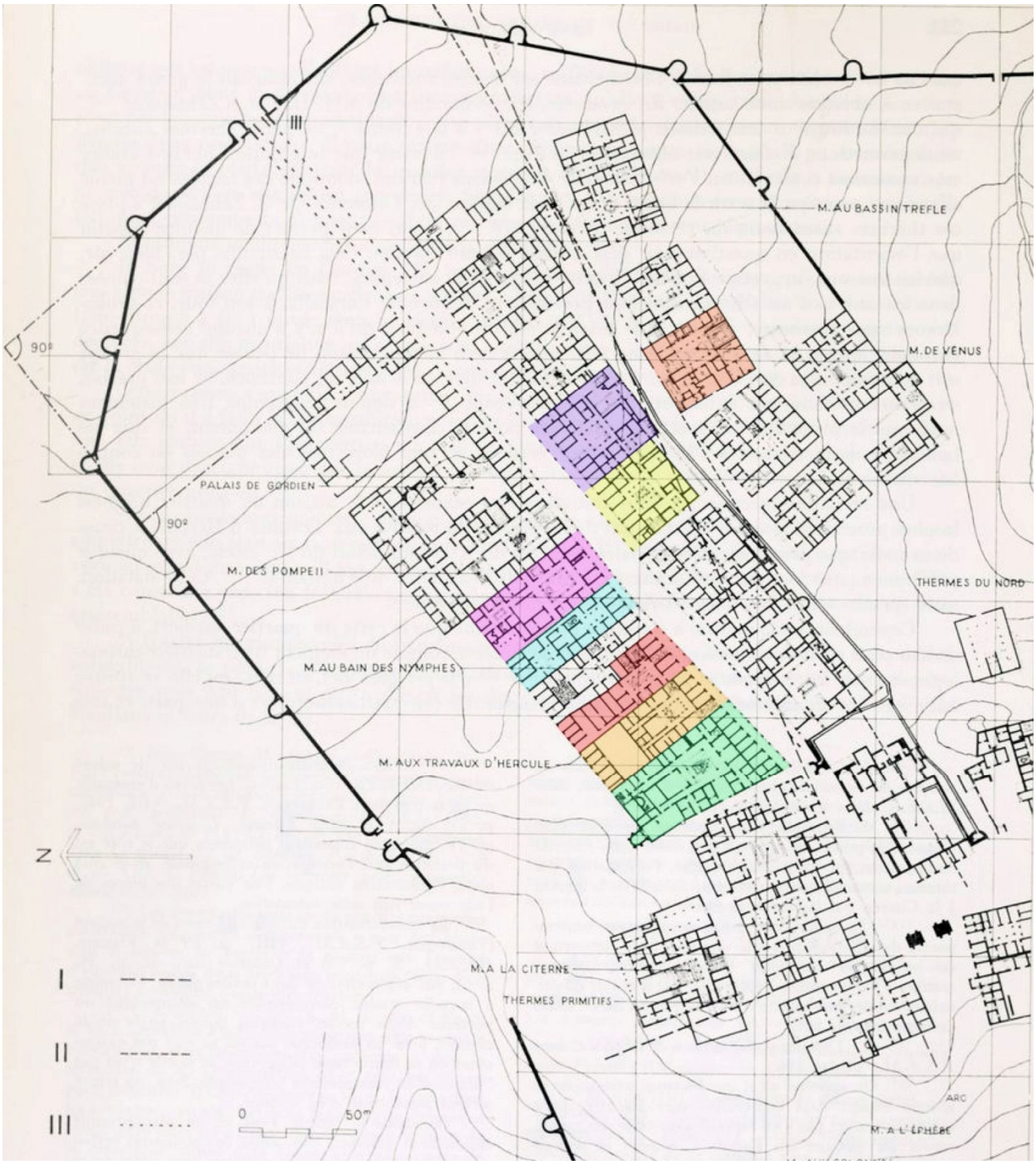

Fig. 1: The Northeast Quarter of Volubilis. The analyzed Domus appear highlighted in color. (Based on Rebuffat, 1965)[6]

2. Methodology

Our investigation was initiated with the deep study of the documental and bibliographical sources concerning past and contemporary analogous architectures. We collected plans and information about the Romano-African Domus in general [7] [8] [9] and the Domus of the Northeast Quarter of Volubilis in particular [10] [11]. Later, we move up to the archaeological site with the aim of make a complete survey of the preserved remains by photogrammetric techniques and direct measurement procedures. From these previous data and on the basis of functional and constructive criteria, we began to make some morphological hypotheses of the eight selected Domus.

In order to address the subsequent process of virtual recreation, we developed a technical document that should differentiate diverse types of 3D elements. Our goal was to raise the basic categories of objects that could organize any H-BIM model, whether the represented is real or digitally reconstructed:

Category 1: Archaeological Remains
Category 2: Physical Anastylosis
Category 3: Digital Anastylosis
Category 4: Virtual Representation of Physical Evidences
Category 5: Virtual Representation of Documentary Evidences
Category 6: Virtual Representation by Physical Analogy
Category 7: Virtual Representation by Documentary Analogy

The first two categories correspond to well-positioned pieces and elements, which can be documented *in situ*.

The "Digital Anastylosis" category is referred to objects that exist in the physical world but do not occupy their original position, so they are digitally repositioned. An example would be the capital that belonged to one of the columns of the Peristyle but now lies on the ground.

From the fourth category onwards, the objects completely pertain to a virtual sphere. None of the elements of these categories exists *in situ*. A case of "Virtual Representation of Physical Evidences" could be the digitally-modeled columns which are used to make the virtual completion of a portico where only an entire column and the base of the other ones are conserved.

In the fifth level of uncertainly, we would find the category of digitally-modeled elements which are created from historical graphic and textual documents (pictures, plates, literary descriptions, etc.). It is important to note that these documentary evidences have different levels of reliability, so the definition of some sub-categories could be possible.

The last two categories, "Virtual Representation by Physical Analogy" and "Virtual Representation by Documentary Analogy" are undoubtedly the most uncertain ones but the total completion of the virtual reconstruction model would not be possible without them. The objects that belong to these groups are digitally-modeled from analogous contemporary architectures which are preserved elsewhere, or from the historical documents that describe those architectures. In our specific case for example, the writings of Vitruvius were particularly important to produce objects of the seventh category.

Once the research work and the virtual reconstructions were completed, we thought it would be interesting to lead our graphic results towards an emotional way. There are two reasons for this:

The first of them is that we believe that survey plans and scientific reports will hardly captivate receivers who are not knowledgeable or not interested about these issues. Therefore, we try to look to the general public, who should be the final beneficiary of all our investigations.

The second and main reason is that we are architects and we have some specific objectives. In the field of the Virtual Reconstructions, each specialist pursues his own goal, depending on his educational background. Our specific goal could be summarized as "recovering the perception of a disappeared architectonic space with the final aim of provoking an emotional reaction that could be similar to what the former inhabitants of this space would experience".

This is a very sensitive issue because there is always the risk of the research could be considered fictional, gratuitous or even unscientific. It is not our case. We have founded all our decisions on the basis of a firm support and all the hypotheses and levels of uncertainty have been documented. We cannot expect that the resulting images offer a faithful reproduction of what existed: this is not possible. However, we can accept that, for example, a disappeared capital can be digitally replaced by other similar. The perception of the architectural space will not change. Another example could be the *frescos* that would decorate the walls of these houses. In 1960, Robert Etienne described the remains of a pictorial decoration, preserved in the walls of the House of the Wild Beasts and forty-five years later, we can still see some of them. With this in mind, we allowed ourselves to recreate *frescos*, with similar geometry and colors, in other Volubilitan Domus. Although we know this is not correct from the archaeological point of view, thanks to the Virtual Representation by Physical Analogy, we could at least get closer to the emotional impression that the architectural space would communicate in its early days.



Fig. 2: Remains of pictorial decoration in the House of the Wild Beast of Volubilis**.** On the left, as they were documented by Robert Etienne in 1960. On the right, as they are preserved today.

3. Results

3.1 Morphological Scheme of the Volubilitan Domus

After our analysis we can conclude that the typical Volubilitan Domus usually have an extremely wide rectangular plan, sometimes extending over more than 1500 m2. They use to have several entrances, but the main one is distinguished from the others because it is composed by a large door flanked by pilasters and a small door. The first one was opened on special occasions and it was designed for the passage of *lecticae*. The second one was the common door for pedestrian use.

The *Vestibulum* is one of the largest rooms. It is usually paved with large stones and includes a room for the doorkeeper. It would serve as a transitional space to a central courtyard. In contrast to Italic Roman houses, there is no *Atrium* in the Domus of Volubilis. There is a broad *Peristilum* that often occupies more than 300 m2 and which is always surrounded by porticoes supported on columns. A pool is located in the center of its open-air portion. It is supplied by water from the city aqueduct so it cannot be seen as a typical roman *Impluvium*.

Two different reception rooms are normally located around the *Peristilum*: the *Triclinum* and the *Oecus*. The *Triclinum* is a luxurious dining room with squared proportions. It usually has a three-bay entrance and a U-shaped floor mosaic. The *Oecus*, also called *Exedra* or *Tablinum* by some authors, would be the most important reception room in the house where the patron would receive his clients during the *Salutatio*. The *Triclinum* and the *Oecus* are usually placed in orthogonal positions: so if the *Oecus* has a northern location, the *Triclinum* will have an eastern or western one. Most of the times the *Vestibulum*, the *Peristilum* and the *Oecus* are aligned, but some Domus have a bent entrance to preserve intimacy so they do not follow this axial design.

The preservation of some stair steps and the use of stone reinforcements in certain walls suggest that, in some cases, the houses could have had a second floor. The conserved vestiges do not allow us to be accurate, but we have raised some hypotheses based on the constructive and functional logic. In respect to the covering system, a sloping tile roof or a flat roof could have been used since remains of both solutions have been found in the archaeological site.

In addition to the *Peristilum*, a secondary courtyard called *Atriolum* usually exists. It is smaller, normally framed by four columns. It ensures access to natural light and ventilation for the private apartments that are distributed around it. The apartments are often heated by hypocausts that would keep rooms warm in winter.

Because the rich owners of these Domus used to engage in the exploitation of wheat and oil, most of the times an industrial area –with oil presses, mills, grain warehouses, ovens, etc- appears as a part of the Domus. This industrial area uses to be completely isolated from the residential area and has a separate entrance from a side or a back street.

Some of the products made in the industrial area would be sold in small shops, called *tarbernae*, which also belong to the Domus. They are usually located in the façade area, on either side of the main entrance of the house. Probably some of the *tabernae* would be rented by other merchants, thereby increasing the benefits of who owns the whole Domus.

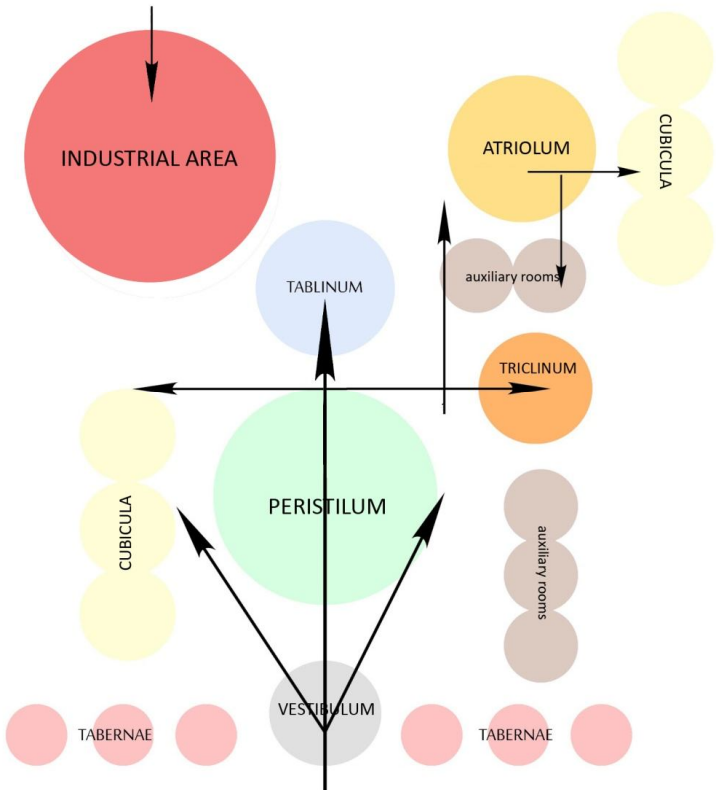

Fig. 3: Morphological scheme of the typical Volubilitan Domus.

Therefore, the Volubilitan Domus seems to have four different functional areas: a public residential area which is organized around the *Peristilum*, a private residential area around the *Atriolum*, an independent industrial area and a commercial area in the zone of the façade.

3.2 Individual cases: Virtual reconstructions

Due to the limited length of this paper, although eight Domus were digitally reconstructed we will only expose the results concerning three of them: the House of Dionysos and the Four Seasons, the House of Venus and the House of Flavius Germanus.

3.2.1 House of Dionysus and the Four Seasons [12] [13]

Brief morphological description:
This Domus seems to have three different historical stages. The main entrance is composed by one-bay door. The *Vestibulum* changed its central position to a lateral position over the years, so it lost its alignment with the *Peristilum*. The rectangular *Peristilum* was supported on ten Corinthian columns. Twin *Oeci* to the North. *Triclinum* to the East. Commercial area on the façade: four *Tabernae* with entrances from the Decumanus Maximus. No *Atriolum*. Complete mosaic floor in the *Triclinum*. The industrial area has an independent entry for carts from the back Decumanus. It would be composed by grain warehouses and four more *Tabernae*. One of them might have been a bakery.

HBIM-object categories (general position):

- Category 1: *Decumanus Maximus* portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Oeci*, *Tabernae*, Industrial Area
- Category 2: walls, *Peristilum*, *Triclinum*,
- Category 3: walls, *Peristilum*, *Triclinum*, *Oeci, Tabernae*, Industrial Area
- Category 4: *Decumanus Maximus* portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Oeci*, *Tabernae*, Industrial Area
- Category 5: *Peristilum*, *Triclinum*, Mural Paintings, Industrial Area
- Category 6: *Decumanus Maximus* portico, main entrance, walls, *Triclinum*, *Oeci*, Mural Paintings, *Tabernae*
- Category 7: Main entrance, walls, *Vestibulum, Peristilum*, *Triclinum*, *Oeci*, *Tabernae*, Industrial Area, Roofs, Other Architectural Spaces

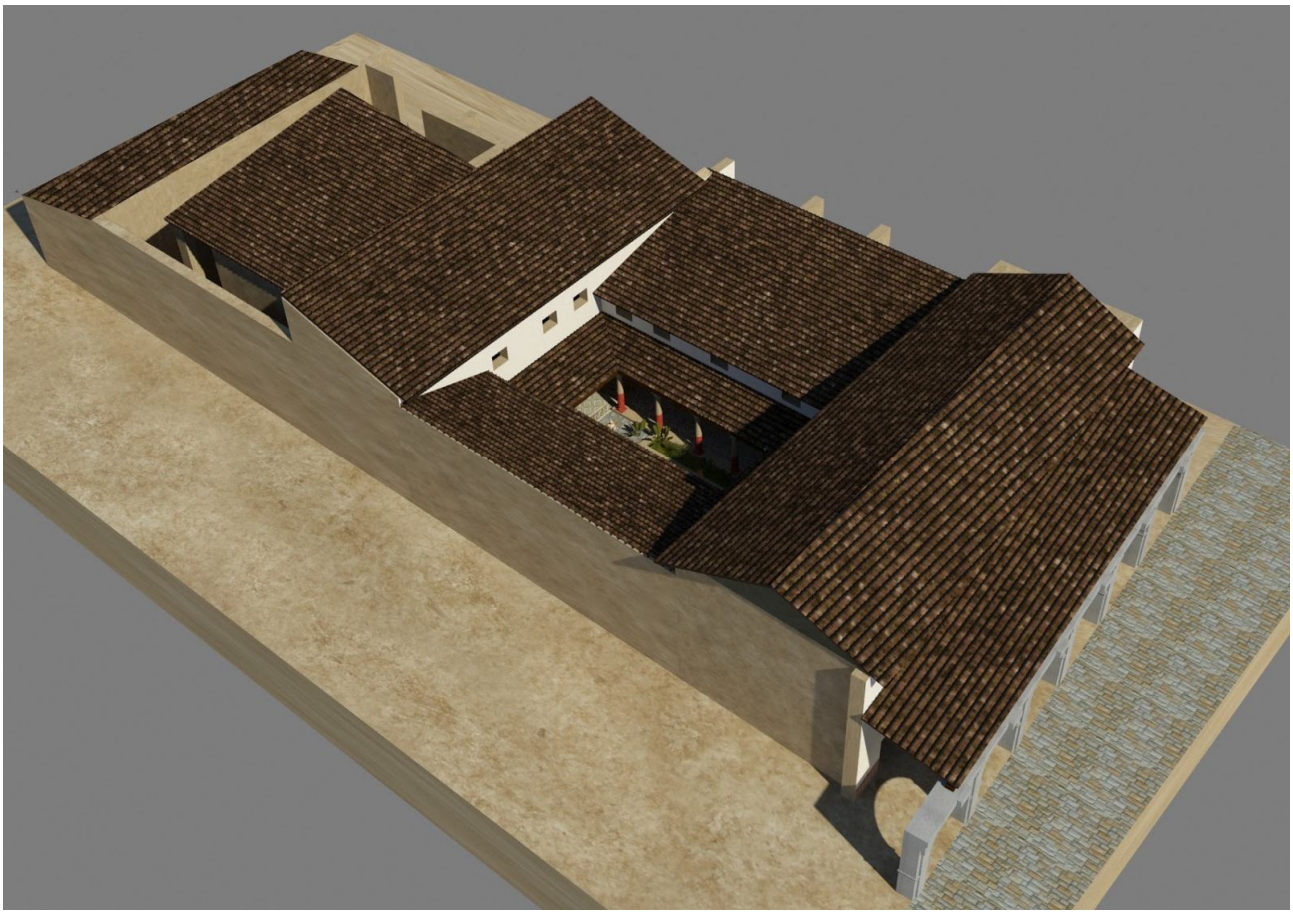

Fig. 4: House of Dionysus and the Four Seasons: General view of the Virtual Reconstruction (3rd Stage), courtesy of S. Bustos.



Fig. 5: House of Dionysus and the Four Seasons: Virtual Reconstruction of the Peristilum, courtesy of H. Qamhiyeh.

3.2.2 House of Venus [14]

Brief morphological description:
This house seems to have two different historical stages. In the last of them, the entrance portico was walled and annexed to the inner space of the house. The main entrance is composed by a large door and a small door. The *Vestibulum* is nearly in line with the luxurious *Peristilum* and *Oecus*. The *Peristilum* is almost squared and it was built on eight sandstone columns with truncated pyramid-shaped capitals. The pool is double T-shaped. *Oecus* to the South, *Triclinum* to the West. The Atriolum with a lobed pool and the private apartments around it are located to the South-West. Mosaic floors preserved in eight rooms (including *Oecus*, *Triclinum* and Private Apartments) and seven corridors. No industrial area. This house has private *Termae.* It probably also had a second floor as we can inferred from the stone reinforcements that are preserved inside the walls of the North-East area.

HBIM-object categories (general position):

- Category 1: main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Atriolum*, *Cubicula*, *Termae*
- Category 2: main entrance, walls, *Vestibulum, Peristilum*, *Triclinum*, *Atriolum*, *Cubicula*, *Termae*
- Category 3: walls, *Vestibulum Peristilum*, *Triclinum*, *Oecus, Atriolum*, *Termae*
- Category 4: entrance portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Oecus, Triclinum*, *Atriolum*, *Cubicula*, *Termae*
- Category 5: *Peristilum*, *Oecus, Termae*
- Category 6: entrance portico, main entrance, walls, *Peristilum, Oecus*, *Termae*
- Category 7: Main entrance, walls, *Vestibulum, Peristilum*, *Triclinum*, *Oecus*, *Atriolum*, Mural Paintings, Roofs, Other Architectural Spaces



Fig. 6: Domus of Venus: Front view of the Virtual Reconstruction (2nd Stage), courtesy of J. Perez.



Fig. 7: Domus of Venus: Longitudinal section of the Virtual Reconstruction (2nd Stage), courtesy of J. Perez.

3.2.3 House of Flavius Germanus [15] [16]

Brief morphological description:
The main access is located on the western corner of the house. It is composed by a large door and a small door. The wide *Vestibulum* has a room for the doorkeeper at the bottom. It produces a bent entrance to the *Peristilum* which was composed of fourteen Corinthian columns: five on the long sides and four on the short sides of the porticoes. The pool is small and it is not excavated in the ground. The main portion of this Peristilum was probably planted with herbaceous vegetation. *Oecus* to the North. *Triclinum* to the East. There are two commercial areas: four *Tabernae* with entrances from the Decumanus Maximus and five more *Tabernae* on the back side of the house. No *Atriolum*. Complete mosaic floor in the *Triclinum* and two *Cubicula*. No industrial area. A wide *Hortus* would exist between the Domus and the secondary commercial area.

HBIM-object categories (general position):

- Category 1: *Decumanus Maximus* portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Oecus*, *Tabernae*
- Category 2: *Decumanus Maximus* portico, main entrance, walls, *Peristilum*, *Triclinum*, Oecus, Tabernae
- Category 3: *Decumanus Maximus* portico, main entrance, walls, *Peristilum*, *Triclinum*, *Oecus, Tabernae*,
- Category 4: *Decumanus Maximus* portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Oecus*, *Tabernae*
- Category 5: *Peristilum*, *Triclinum, Oecus*
- Category 6: *Decumanus Maximus* portico, main entrance, walls, *Triclinum*, *Oecus*, Mural Paintings, *Tabernae*
- Category 7: Main entrance, walls, *Vestibulum, Peristilum*, *Triclinum*, *Oecus*, *Tabernae*, Hortus, Roofs, Other Architectural Spaces



Fig. 8: Domus of Flavius Germanus: Virtual Reconstruction of the façade, courtesy of L. Ciocarlan.



Fig. 9: Domus of Flavius Germanus: Actual view of the *Peristilum* and the same view in the Virtual Reconstruction, courtesy of R. Lopez-Toribio

4. Discussion: About emotional representations

Several years have passed since the 3D modeling appeared. Today, it can be considered a daily tool for the research of the Architectural Heritage, so the risk of generating virtual reconstructions based solely on the admiration to the digital techniques seems to have vanished. Now, we can concentrate on the authentic objectives of our scientific investigations.

As mentioned, the ultimate purpose of our research about the Domus of the North-East Quarter of Volubilis was to recover some sort of the perception and the emotional reaction that those disappeared architectonic spaces could arouse in their former inhabitants.

We are architects and we conceive Architecture, and by extension Architectural Heritage, as the material realization of an ideal form that arises as a result of a creative process that involves affective, cognitive, social, volitional, personal and spiritual factors. To fully assess or to know an architectural work, we have to visit it, we have to get the sensory experience of perceiving the articulation of the space, we have to see its scale and light, we have to feel its textures, we have to test its functionality, we have to verify its location in the landscape, etc. So we have tried to reconstruct the qualities of these experiences through the virtual recreation offered by a 3D computer model. It obviously does not substitute a direct observation of reality but we must admit that it recovers some of the spatial attributes that once would define the architectural essence of these Volubilitan Domus.

In addition, we think that the “emotional representations” make the Architectural Heritage more accessible to the general public. Survey plants and literary descriptions can hardly impress an ordinary user. People are not usually well versed in the historical, archaeological, architectonic or technical subjects that researchers habitually manage so they need a prior motivation that could encourage them to study these scientific documents. The observation of the images of the virtual reconstructions produces something magic and special into the spectator. These images reveal the mystery of what happened in the past and the viewer experiences a kind of excitement that could be compared with the feeling he perceives when he thinks about what will happen after death: Thinking about the past before we have born and thinking about the future after we have died, both belong to the same world.

The ruins of Volubilis symbolically connect us to the past of the city, but the digital images of the virtual reconstructions of those ruins connect us to the eyes of their former Roman inhabitants. Therefore, synthetic images have in some way the ability to immerse us in the Roman world.

In any case, we believe that this kind of “emotional” representations provides a wide and very valuable vision that substantially improves our knowledge and architectural comprehension of the Architectural Heritage. We consider that they could be used as a consistent method of analysis of many other historic buildings.

5. Acknowledgments

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Bibliographical References

[1] EUZENNAT, Maurice. Le temple C de Volubilis et les origines de la cité. *Bulletin d'Archéologie Marocaine*, 1957, vol. 2, p. 41-64.

[2] PANETIER, Jean-Luc. *Volubilis. Une cité du Maroc antique.* Paris: Maisonneuve & Larose, 2002.

[3] TISSOT, Charles. *Recherches sur la géographie comparée de la Maurétanie Tingitane.* Paris: Imprimerie Nationale, 1877.

[4] CHATELAIN, Louis. Les fouilles de Volubilis (Ksar-Faraoun, Maroc). In *Bulletin du Comité des Travaux Historiques.* Paris: Imprimerie Nationale, 1916, p. 70-92.

[5] ETIENNE, Robert. *Le quartier Nord-Est de Volubilis.* Paris: E. de Boccard, 1960.

[6] REBUFFAT, René. Le développement urbain de Volubilis au second siècle de notre ère *Bulletin du Comité des Travaux Historiques et Scientifiques,* 1965, 1-2, p. 231-240

[7] REBUFFAT, René. *Thamusida*. Paris: Collection de l'École français de Rome, 1965.

[8] REBUFFAT, René. Maisons à péristyle d'Afrique du Nord : répertoire de plans publiés. *Melanges d'archéologie et d'histoire*, 1969, T. 81, p. 659-724.

[9] REBUFFAT, René. Maisons à péristyle d'Afrique du Nord. Répertoire de plans publiés (II). *Melanges de l'Ecole français de Rome. Antiquité*, 1974, T. 86, p. 445-499.

[10] AKERRAZ, Aomar. Nouvelles observations sur le quartier nord-est de Volubilis. In AA.VV. *L'Africa romana, Atti del IV Convegno di Studio*. Sassari, 1987, p.447-457.

[11] MAKDOUN, Mohammed. Nouvelles recherches sur le quartier nord-est de Volubilis. *Bulletin du Comite des Travaux Historiques et Scientifiques. Section Afrique du Nord,* 1996-1998, 25, p. 41-51.

[12] http://ipat2013-silviabustosmoreno-grupoa2.blogspot.com.es/

[13] http://hartecipat2013.blogspot.com.es/

[14] http://ipat2013joseperezgarridogrupoa3.blogspot.com.es/

[15] http://ipat2013-lauraciocarlan.blogspot.com.es/

[16] http://rafaellopez-toribiomorenoipat2013.blogspot.com.es/

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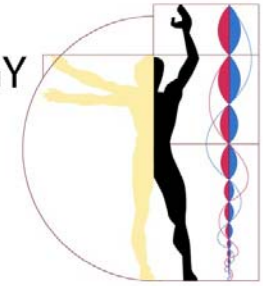

A model of strategies used for traffic calming in an urban environment

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Abstract

This paper presents a collection of network optimization strategies that aim at aiding the local practitioner in selecting, implementing and evaluating appropriate strategies to achieve community goals and objectives in the urban environment. The urban environment is often challenging due to the plethora of activity and variety in mode choice. Growing interest in sustainable transportation practices along is leading to the growing use of non-motorized modes of transportation, such as walking and bicycling. The combination of high population density and mixed land use in the urban environment creates unique safety and operational challenges. This paper aims to give a synthesis of strategies designed to improve local transportation safety and efficiency by targeting speeding and cut-through volumes, as improving pedestrian and bicycle facilities in urban areas, such as those found in Albanian environment. Additionally, the evaluation of two local network optimization strategies; speed cushions and reverse angle parking, shall be realized as well. The effectiveness of the speed cushions in achieving the community's goal of reducing speeds was evaluated and determined to be a recommended strategy for future implementation, especially when couple with enforcement.

Keywords: strategy, transportation, environment, network, evaluation;

1. Introduction

More Albanians are utilizing non-motorized modes of transportation, such as walking and bicycling, especially in urban environments. They are making efforts to increase non- motorized forms of transportation. At the same time, however, populations are still rapidly increasing and so is the number of cars on the road. While pedestrian and bicyclist attitudes and behaviors may be changing, congestion is still increasing on most albanian roads. Traffic calming and related strategies aim at improving safety and efficiency in the busy urban environment.

Traffic calming and related strategies can increase safety through a combination of physical, behavioral and psychological strategies. Traffic calming seeks to maintain flow and circulation through a network, while guiding traffic through optimal routes at safe speeds for all users of the network. Through the implementation of mainly physical measures, traffic calming can improve safety in the urban environment by decreasing travel speeds, cut-through traffic and making facilities safer and more accessible to pedestrians and bicyclists. The definition of traffic calming can be limiting and a broader umbrella of strategies should be examined, which aim to achieve common goals and objectives. [1]

There is a wide range of improvements that can be made through the implementation of traffic calming or related strategies to improve traffic safety in a community, when properly selected and implemented. Care must be exercised when selecting, implementing and maintaining a chosen urban environment network optimization strategy.

Urban environments, such as those experienced in Albanian cities, are candidate locations for the implementation of traffic calming and other safety strategies. While there is some information about traffic calming and related strategies Albania, there is limited guidance on device selection and implementation. A lack of uniformity among the selected traffic calming measures in neighboring

communities may lead to driver confusion, which can negatively impact flow.
The design of the roadway network often leads to higher speed arterials traveling through small-town centers, posing a great risk for community residents. Another component of network optimization in Albania environment is a high, seasonal population. With more vehicles on our roadways and more people making an effort to walk or cycle, a unique network optimization challenge is presented.[2]

The objective of this paper was to design an urban environment network optimization strategy toolbox and decision flow chart for the local practitioner, as well as evaluate two selected local engineering measures. While there are many components of traffic safety, these four variables (speeding, cut-through volumes, pedestrians, bicyclists) are the focus of this paper, with the argument that, any improvement in any of these variables will have a positive effect on traffic safety in local communities.

2. Literature review

2.1 SafetyImprovements Need

Increasing trends in population, vehicle chilometers traveled and vehicle ownership are leading to more congestion and concerns about traffic safety. Driver demand is increasing, challenging networks which may be constrained by limited space, funding, and recent global warming awareness issues. An inefficient transportation network can be financially costly and emotionally taxing on its users. As congestion on major roads increases, drivers shift to alternate routes, often cutting through residential neighborhoods. Increased volume on local roads can present a community with many potential conflict areas and can be very unsafe. [3]
Urban environments contain many challenges for the local practitioner, due to the abundance of multimodal traffic contained within a small region. Furthermore, many urban environments continually experience increasing population trends along with an increase in vehicle ownership.

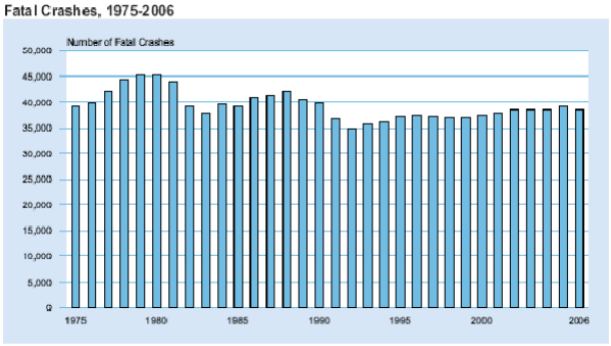


Fig. 1: Number of fatal crashes

The majority of fatalities occurring in Albania involved occupants of motor vehicles, while 4% involved motorcyclist riders, 3% involved pedestrians, and 2% involved bicyclists.
The causes of crashes are vast and complex, but speeding is often a significant contributor in many crashes and results in huge economic consequences. As shown in Figure 2, speeding-related crash frequency remains approximately stable. By decreasing the occurrence of speeding, as well as decreasing the speed differential, crash frequency can be decreased.

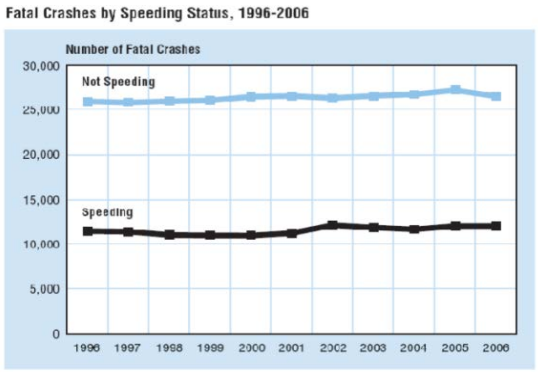


Fig. 2: Fatal crashes where speeding was a factor

Unfortunately, traffic safety cannot be completely isolated from its counterpart, efficiency, so measures are often considered with both goals in mind. As congestion on major roads increases, drivers shift to alternate routes, often diverting through residential neighborhoods at great risk. Increased volume of local roads serving as cut-through roads can present a community with many potential conflict areas and can be very unsafe. [2]

Pedestrian safety also deserves much attention as attitudes towards walking are changing; becoming more favorable. The majority of bicycle fatalities result from failure to yield the right of way, followed by riding, playing or working in roadway, and finally with improper crossing of roadway or intersection.

One popular approach to addressing issues of speeding, high cut-through volumes, pedestrian safety and bicycle safety is through the implementation of traffic calming measures. Traffic calming is a design implementation measure aimed at improving traffic safety by reducing vehicle speeds and potentially reducing cut-through traffic volumes, by altering the physical characteristics of the roadway. Traffic calming implementation can have many benefits for a community, when the appropriate measure is chosen and properly implemented. [4]

2.2 LocalSafetyChallenges

Albania is a unique geographic area with limited principal arterial roadways. Principal arterial roadways, only reach limited sections of this paper area. The resulting effect is a large reliance on minor arterials, that commonly travel through town centers. This high volume of traffic poses safety concerns for communities filled with high pedestrian and/or bicycle activity. The resulting effect may be speeding through the urban, highly populated, residential town centers. [5]

The size of the towns also leads to a limited network within each community, where high cut-through volumes are commonly exhibited, due to congestion and delay exhibited on main roads. Due to this congestion, these networks have been observed to operate over capacity during peak hours, often forcing drivers to seek alternate routes beyond the primary local roads. Furthermore, the improvement of pedestrian and bicycle facilities in urban settings can have a positive effect on traffic safety and help accommodate for predicted increases in pedestrian and bicyclist volumes.

2.3 Speeding

Speeding in urban environments can pose many safety challenges, due to the abundance of activity in these settings. The effect of speeding is an increase in the distance needed to react to a stimulus and stop a vehicle, as well as a reduction of a driver's ability to steer safely around obstacles in the roadway. Speeding occurring on roadways with accurate design speeds may also be a result of driver behavior. [3]

2.4 High Cut-Through Volumes

Traffic diverting to residential roadways from arterials pose many safety threats to occupants of residential neighborhoods. This traffic seeks to take a "short-cut" through a residential neighborhood to decrease travel time and delay, that would otherwise be experienced on the larger arterial roadway. Poor level of service (LOS) occurring on the arterial roadways forces impatient drivers to re-route, often traveling on roads that are not designed for higher speeds or increased capacity. An efficient transportation network can decrease this potential conflict by making the freely flowing arterial roadways more attractive, than using residential roadways, or physical measures are installed on the roadway to alter driver behavior. [6]

2.5 Pedestrians

Study areas, such as these, small urban environments, can potentially house a plethora of pedestrian activity when facilities are safe and efficient. Due to this increased volume, it is not surprising that the majority of pedestrian crashes occur in urban areas. A survey conducted supports these results, stating that albanians would like to walk more, if communities were designed better to decrease speeding and there were better facilities to improve convenience. Furthermore, this survey found that there is plenty of interest and public support for improved pedestrian a facilities; particularly for designing communities for slower traffic speeds and improving walking routes to schools for children.

Pedestrians with disabilities or older persons, for example, may require more crossing time. Pedestrian signal phase timing is determined by this default walking speed and the distance the pedestrian must cross. Pedestrian timing is merely one aspect of pedestrian safety at intersections.

2.6 Bicyclists

A safe and efficient bicycle network can effectively encourage more people to utilize bicycles as a mode of transportation. There are many factors which influence a person's decision to select cycling, as their mode of transportation. Primarily, eight factors have been identified to have the most influence over this decision and include: public attitude and cultural differences, public image, city size and density, cost of car use and public transport, income, climate, danger, and cycling infrastructure. When adequate space is not provided, cyclists may be forced to occupy an entire lane of traffic, ride on the shoulder or share a lane of the roadway, creating many opportunities for conflict and dangerous situations. Table 1 provides a summary of the either most common bike to vehicle crash types. [6]

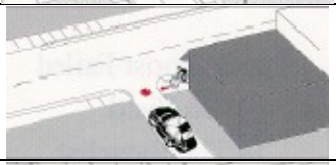
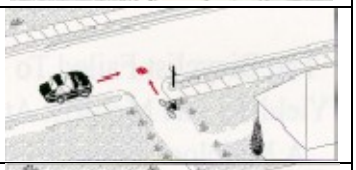
Crash Type	Description	Picture
Ride Out at Stop Sign	The crash occurred at an intersection at which the bicyclist was facing a stop sign or flashing red light	
Drive Out at Stop Sign	The crash occurred at an intersection which the motorist was facing a stop sign.	
Ride Out at Intersection- Other	The crash occurred at an intersection, signalized or uncontrolled, at which the bicyclist failed to yield.	
Drive Out at Midblock	The motorist was entering the roadway from a driveway or alley.	
Motorist Left Turn-Facing Bicyclist	The motorist made a left turn while facing the approaching bicyclist.	
Ride Out at Residential Driveway	The bicyclist entered the roadway from a residential driveway or alley.	
Bicyclist Left Turn in Front of Traffic	The bicyclist made a left turn in front of traffic traveling in the same direction.	
Motorist Right Turn	The motorist was making a right turn and the bicyclist was riding in either the same or opposing direction.	

Table 1 Eight Most Common Pedestrian to Vehicle Crash Types

3. LocalUrbanEngineeringStrategies

There are multiple approaches that can be taken in an attempt to improve safety and efficiency of the local urban transportation network. Traditional approaches to transportation problem solving include the three approaches consisting of education, enforcement and engineering.

3.1 Education

Education will be likely supplement to any strategy and may also be one of the first approaches taken to address such issues, due to its affordability, as well as, availability of resources. Education can be targeted towards residents and community members about transportation issues and problems, while others are aimed at educating roadway users, as to the conditions or laws of the roadway. [7]

3.2 Enforcement

Enforcement can be a useful approach or component to addressing local urban transportation issues. One challenge with utilizing enforcement may be the availability of resources and the costs associated with this service. Only when there is a consistent and continued presence of enforcement has it been found to be a useful approach.

3.3 Encouragement

Some techniques may consist offering incentives, or encourage the walking or bicycling. Providing adequate facilities for bicyclists include safe and secure bicycle racks and storage spaces and can significantly contribute to a person's decision to utilize alternative modes of transportation.

3.4 Engineering

When education, enforcement and encouragement do not sufficiently address local issues another approach, engineering, must be taken. Engineering may consist of modifications or additions of roadway design elements, roadside elements or a combination of approaches. There are a variety of definitions of traffic calming, but all have the same core values which are improving community livability and safety. [5]

3.5 DesignConsiderations

When selecting a traffic calming implementation measure more must be considered beyond need, cost and availability of resources. If a measure has been chosen incorrectly, or improperly implemented, it can have dire consequences on the safety, sustainability and/or efficiency of the network. It is important to take community needs and limitations into consideration. Some negative side effects of traffic calming implementation may include increase noise or air pollution, an increase in cut through or diverted traffic, drainage issues and maintenance responsibility issues. [8]
A cost-benefit analysis may need to be performed to determine if the safety benefits of a traffic calming measure are more beneficial, than a slower emergency vehicle response time where applicable.

4. Countermeasures

A thorough traffic engineering study should be performed to determine the extent of the problem(s) facing a community, an inventory of existing conditions and infrastructure and determination of the right of way. It is usually not sufficient to solely implement a countermeasure without supplemental education and enforcement, if not for the entire life of the selected strategy, then for the initial stages on implementation. Lastly, any measure should be periodically monitored for performance, which may unexpectedly change due to alterations in environmental, social or other conditions.

4.1 DynamicSpeedMonitoringDisplaysandDynamicSpeedDisplaySigns

Dynamic Speed Monitoring Displays and Dynamic Speed Display Signs are radar based interactive speed displays. They operate by using radar to detect a vehicle's traveling speed and displaying it for the motorist to view via immediate feedback. Such strategies have been proven to be effective in areas such as urban settings in both the short and long term.

4.2 SpeedHumps

Speed humps are physical measures installed in the roadway to reduce vehicle travel speeds, by providing a raised surface traversing across the roadway to control speeds. Designed to allow vehicles to travel with little discomfort at the posted operating speed, speed humps result in increasing discomfort when traversed at higher speeds. Speed humps have been shown to be an effective speed calming measure resulting in a net effect of speeds that are only slightly higher than the posted speed and are more effective than all way stop. [9]
Emergency vehicles utilizing a route with speed humps will have a decreased response time, because they will be forced to operate at lower speeds. The speed humps should be strategically placed so as to reduce the effects of noise pollution on communities.



Fig.3: Temporary speed hump



Fig.4: Permanent speed hump

4.3 SpeedTablesandRaisedCrosswalks

Speed tables, similar to speed humps, are physical measures installed in the roadway to reduce vehicle travel speeds by providing a raised surface traversing across the roadway to control speeds. Designed to allow vehicles to travel with little discomfort at the posted operating speed, speed humps result in increasing discomfort, when traversed at higher speeds. Speed tables are more comfortable to traverse for larger vehicle than are the speed humps. [10]



Fig.5: Speed table



Fig.6: Permanent speed table/raised crosswalk

4.4 SpeedCushions

Speed cushions are similar to speed humps, because they also have a flat-topped hump, but differ in that they do not fully extend across the roadway. A set of three speed cushions will be placed side by side in the cross section of the roadway with adequate spacing.

Speed cushions, like speed humps, target a reduction in speeds but can also result in a decrease in cut-through volumes. Similar to speed humps, noise and vehicle emissions may be increased due to frequent slowing down and passing over the cushions. Speed cushions may be permanent or temporary based on a community's needs as shown in Figures 7 and 8, respectively.

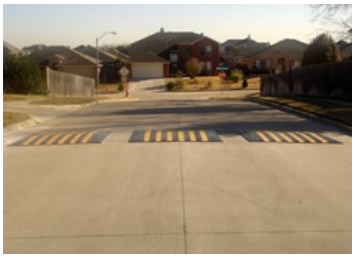


Fig.7: Permanent speed cushions



Fig.8: Temporary speed cushions

4.5 Roundabouts

Roundabouts can be effective tools in managing speeds and cut through volumes as well as providing opportunities for improved aesthetics through landscaping. Furthermore, roundabouts can aid in the improvement of pedestrian facilities. Roundabouts also offer pedestrian crossing islands

which decrease the distance a pedestrian must cross in one section and add to visibility. Roundabouts are also popular because of their relatively low maintenance costs. Roundabouts can be challenging for emergency vehicles and other large vehicles depending on size so they are not recommended for heavily traveled emergency vehicle routes. [10]

4.6 LaneReduction

Lane and width reductions have been shown to result in a decrease in crash rates. Reductions in the number of lanes or lane widths can decrease travel speeds along the roadway. The effect of reducing the number of lanes can result in lower operating speeds due to the decrease perspective of space. The reduction of lane width achieves the same effect, creating a more confined environment for drivers, in which they are no longer operating at higher speeds.

4.7 TexturedPavementinPedestrianCrosswalks

Enhancing crosswalks may include textured or colored pavement to help enhance the path of the crosswalk. Textured pavement and colored pavement may also help highlight the intersection of a crosswalk or pedestrian crossing path with the roadway, warning pedestrians of the changing roadway conditions. Textured pavement especially, may aid pedestrians in delineating the roadway, especially those with a disability.

4.8 PedestrianCrossingIsland

Pedestrian crossing islands, can improve traffic safety by providing refuge for a crossing pedestrian, decrease the pedestrian crossing distance, and decrease the amount of time the pedestrian spends in the roadway. Pedestrian crossing islands are usually located on roadways with a median separating opposing traffic streams. [4]

5. Study design: case studies

Two strategies recently implemented in local urban environments of Tirana city, speed cushions and reverse angle parking, were evaluated as part of this paper. Temporary speed cushions were installed in an attempt to curb speeding and lower cut-through traffic volumes on this residential area. This analysis contains an evaluation of each strategy.

5.1 TemporarySpeedCushions

A before and after study was conducted to determine the effectiveness of the temporary speed cushions in reducing vehicle travel speeds and cut-through volumes.

5.1.1. DataCollection Methods

Speed and volume data was collected by the students of University of Tirana, on my behalf. The study area consisted of three locations on Tirana city, a parallel roadway with no speed cushions which was used as a control.

Descriptive statistics which included: mean speed, 85th percentile speed, 95th percentile speed, median, mode, range, variance, standard deviation, 95% confidence interval for mean, and coefficient of variance were calculated for each study location. Average daily traffic (ADT) and 85th percentile speed plots were made for each location. [6]

5.3 Time Period Selection

Data collection efforts were organized to be consistent with data previously obtained by the Town of Tirana. A two month period was used to ensure adequate sample size. Data collection efforts were performed, when both the speed cushions were present, as well as, during their absence as a basis for comparison.

5.4 ReverseAngleParking

Reverse angle parking is an innovative design strategy aimed at improving the safety of angled parking on crowded roadways. Reverse angle parking is similar to tradition angle parking, but the angle is reversed, so that the vehicle must back into the space. The end result is a vehicle facing in the direction of travel and facing the travel way. The object of reverse angle parking is to maximize the safety and operational benefits through increased visibility when exiting the parking space. This not only gives exiting vehicles better visibility with which to re-enter the traffic stream, but also gives them a better opportunity to see approaching cyclists and pedestrians.

5.4.1 Data Collection Methods

Reverse angle parking data was collected using a video camera mounted to a light post so that it captures the entire row of reverse angle parking spaces located on the southbound side of Main Street between Center Street and South Street of the City analyzed. Data collection efforts resulted in 12 hours of real time data per each data collection date, except for one day, where filming was terminated early due to weather. [8]

5.4.2 Time Period Selection

Two weekdays (Wednesday and Friday) were selected as sample time periods for data capture. Wednesday is often chosen as a typical weekday that reflects many of the daily activities of commuters and residents. Friday was chosen to represent both local populations as well as a mixture of some tourists. Typically, Friday represents a day with more congestion than the typical weekday, but with some commuting behaviors not seen on the weekends.

6. Results and analysis

The results of the development of a traffic calming or related strategy selection flow chart, as well as the results of the evaluation of temporary speed cushions and reverse angle parking are contained below. The flow chart is designed to aid the local practitioner in utilizing the critical questions to help select an appropriate traffic calming or related strategy while the cycle is to be used to demonstrate the relationship between research and practice. The two case studies are designed for both the communities where implementation occurred as well as assist other communities from these experiences. The goal is to add to the library traffic calming measures and help the industry develop standards through the lessons learned in case studies, such as these.

TrafficCalmingSelectionFlowChart

The urban environment network optimization strategies flow chart is designed much like a medical diagnosis guide. The first step is identify the primary goal of the measure; whether it be to address speeding, cut-through volumes, unsafe pedestrian facilities, or unsafe bicycle facilities. There may be more than desired outcome of the selected strategy, however, this interrelationship between strategies is also shown on the chart. The second step is to consider the primary challenge (if one exists) and follow that link to a list of recommended strategies. [5]

The relationship between research and practice in transportation engineering is a critical link in the evolution of the field. Unfortunately, gaining an understanding of this relationship can be challenging and can result in a lack of shared information between the two realms. Bridging this gap, however, can quickly open up an array of resources and information that can aid the local practitioner in selecting and implementing appropriate strategies. Furthermore, the results must be shared in a way that provides access to a range of users who must then take that information and utilize it effectively. This brings us back to the top with the selection of another strategy or the continued use of an existing strategy.

SpeedCushionEvaluation

Temporary speed cushions was applied in an attempt to reduce vehicle travel speeds and cut-through traffic volumes. This study aimed at determining the effectiveness of those traffic calming treatments on achieving the town's goals and objectives.

Volume

Evaluation of the volume data demonstrates that both sets of speed cushions may influence traffic volumes on Tirana city. Furthermore, volumes may have decreased as a result of the removal of speed cushions, but more research needs to be conducted. The alternate routes exhibited by traffic potentially diverted from Tirana, as a result of the speed cushions, were not examined in this study.

Conclusions

The temporary speed cushions installed on Tirana city had a positive effect on reducing vehicle speeds and may have resulted in lower volumes. It is recommended that compliance be monitored with possible enforcement, as it was noted through field observations that some drivers avoided the 6.0' speed cushions by travelling down the centerline. While drivers did speed up between cushions, the 85th percentile speeds were still lower than 85th percentile speeds in the absence of the speed cushions.

ReverseAngleParkingEvaluation

Data collected via video data collection efforts were manually transcribed from video tape into an EXCEL spreadsheet. Three dates were selected for critical examination of parking maneuver

times and consisted of each Wednesday 12-hour period. This data was transcribed from video into a spreadsheet by recording the variables shown in Table 2. The variables shown in Table 2 were selected as performance indicators for the evaluation of the operations of the reverse angle parking.

Parking Space Number	Ended Parking Maneuver	Number Spaces Occupied
Event A	Entering Maneuver Time	Number Correctly Occupied
Event B	Began Departing Space	Correct Immediately Left
Flag Event A	Departed Space	Correct Immediately Right
Flag Event B	Exiting Maneuver Time	Number Alignment Adjustments
Flag No Events	Total Maneuver Time	
Began Parking Maneuver	Total Space Occupancy Time	

Table 2: Reverse Angle Parking Data Analysis Variables

Maneuver Time

Maneuver time was also extracted as a performance indicator. Entering, exiting and total parking maneuver time was examined for vehicles which had no events and the results are shown below in Table 13. Vehicles with events were extracted from this sample because of the influence each event may have on parking maneuver times. As anticipated, the reverse angle parking resulted in a smaller exiting maneuver time, but higher entering maneuver time when compared to traditional diagonal angle parking. The overall parking maneuver time was less for traditional angle parking than for reverse angle parking for both scenarios. Furthermore, the results demonstrate that the parking volume is higher for traditional diagonal parking than for either reverse angle parking scenario. [7]

Average occupancy times were comparable for both traditional diagonal parking as well as reverse angle parking immediately after implementation, but reverse angle parking long after implementation shows a much lower occupancy time. This may be due to the sample that was analyze because on this day, only 8 hours of data was eligible for transcription. Therefore, no conclusions can be drawn comparing this occupancy time. There were no recorded alignment adjustments with the traditional angle parking. Reverse angle parking, however, had alignment adjustment rates of 0.2 and 0.3 for the immediately after and long after scenarios, respectively.

Conclusions

Reverse angle parking was an innovative strategy implemented to improve traffic safety and operations. The theory behind reverse angle parking is that is both more safe and efficient due to the increased visibility resulting from 'heading out'. Results of this paper indicate, however, that with the current roadway configuration, community culture, enforcement practices and attitudes, reverse angle parking creates more conflicts and results in a decrease parking volume for those spots on Tirana City Streets analyzed in this paper. The increased rate of events, most of which involve crossing over the centerline, should create concern about increased safety challenges as a result of implementation. The decreased parking volumes also indicate that the spots are utilized less and are generating less revenue for the town. This may result in added congestion to other parking areas nearby and redistribute traffic negatively around this town center. [4]

With mediation and supplemental measures, reverse angle parking could be an effective tool for improving safety and operations at this location in the future. While this trial indicated that with the existing conditions diagonal angle parking results in fewer events and a higher parking load, it does not mean that reverse angle parking may never be an effective strategy.

7. CONCLUSIONS AND RECOMMENDATIONS

The local urban environment, similar to many of those found in communities of Tirana City, has many traffic safety and operations challenges. Often times these challenges arise from the centrifugation of a large number of people and vehicles within a limited space. The popularity of multimodal forms of transportation in this environment poses many unique challenges for the local practitioner. [2] Lastly, designing and remediating design for all users of the transportation network is another aspect that must not be overlooked.

Network optimization strategies for the urban environment include traffic calming and related strategies designed to improve traffic safety and operations in the local urban environment while also promoting community livability. The net effect of properly selected and implemented strategies is an overall improvement in the community through increased safety, efficiency and appeal. The strategies presented in this research merely touch on a wide range of strategies that can be effectively implemented in many communities to achieve goals. The urban environment network optimization strategy selection flow chart is intended to be used as a starting point for local practitioners and supplemented with a thorough engineering study and the cycle is to be used to demonstrate the relationship between research and practice. [10]

The two case studies presented herein are intended to add to the growing field of literature and case studies on topics related to addressing safety and efficiency in similar environments. This research evaluated the effectiveness of temporary speed cushions in achieving a community's goal of reducing speeds and cut-through volumes on a residential roadway. While the speed cushions were significantly effective in reducing speeds, there is not enough evidence to conclude that they were effective in reducing cut- through volumes. When coupled with enforcement, however, the temporary speed cushions are a recommended strategy for this community. An evaluation of the reverse angle parking trial indicated that reverse angle parking resulted in a lower parking volume and a significantly higher number of events, thus creating concern regarding safety. At the time of this evaluation and given present conditions, the reverse angle parking is not a recommended strategy because of its negative impact on safety and efficiency.

Bibliographical References

[1] Federal Highway Administration (FHWA). Manual on Uniform Traffic Control Devices for State Highways. Federal Highway Administration. [Online] US DOT, 2003. [Cited: October 28, 2007.] http://mutcd.fhwa.dot.gov.

[2] National Highway Traffic Safety Administration (NHTSA). Traffic Safety Facts 2005: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System. Washington : National Center for Statistics and Analysis, 2005. DOT HS 810 631;

[3] National Highway Traffic Safety Administration. Traffic Safety Facts 2006: Speeding. Washington : National Center for Statistics and Analysis, 2006. DOT 810 814;

[4] Federal Highway Administration (FHWA). Pedestrian Safety Implementation Plan for Reducing Ped/Vehicle Collisions. Federal Highway Administration. [Online] [Cited: January 24,2008.] http://safety.fhwa.dot.gov/PED_BIKE/docs/pedplan.pdf;

[5] American Association of State Highway and Transportation Officials (AASHTO). Standing Committee on Highway Safety. [Online] [Cited: Decemeber 10, 2007.] http://transportation.org;

[6] American Association of State Highway and Transportation Officials. A Policy on Geometric Design of Highways and Streets. AASHTO, 2004;

[7] Pedestrian Safety Guide and Countermeasure Selection System. http://walkinginfo.org/pedsafe;

[8] Typical Speed Cushion Cross-Section. Town of Amherst. Amherst : s.n., 2008;

[9] Walking Info. Engineer Pedestrian Facilities. Pedestrian and Bicycle Information Center;

[10] [Online] [Cited: January 10, 2008.] http://walkinginfo.org/engineering.
Typical Speed Cushion Cross-Section. Town of Amherst. Amherst : s.n., 2008;

HERITAGE and TECHNOLOGY
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Cultural heritage confiscated from racketeering. A course toward adaptive reuse and effective management

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Abstract
The real estate portfolio confiscated from racketeering includes several properties with significant cultural value, as well as great economic value. Such buildings are also endowed with strong symbolic meanings, as testimony of the fight that the State leads against mafias.
The difficulty in raising funds for building recovery and management, especially in the start-up phase, is the main obstacle to a rational reuse of a property portfolio intended to grow over time. New uses compatible with the needs of preservation, with the aims of social benefit and with the settlement demand of the area offer meaningful development opportunities, both for symbolic significance due to the return of property to the community, and for the boost that enhancement can give to economic and cultural growth of the country.
In order to highlight the relationships between choices of reuse, outcomes and problems encountered during operation, the study proposes the analysis of buildings with significant cultural value confiscated from racketeering, and broaden the case of the Medici's Palace in Ottaviano (NA).
The paper describes a method to support the decision-making process, in order to choose new compatible uses, and to identify more effective management models for the assets confiscated from the mafia, in relation to the legislative framework and the local development dynamics.

Keywords: cultural heritage, racketeering, confiscation, adaptive reuse, management.

1. Background
The prosecution of criminal organizations is top priority of the Italian state, as emphasized by the Italian President Sergio Mattarella in his inaugural address. In recent decades, the need to hit the economic structure and the assets of the mafia led to a progressive upgrading of the national legislative framework.
Since the 80s, by the entry into force of the Law Rognoni-La Torre (Law September 13, 1982, n. 646), the State has set procedures to confiscate properties directly or indirectly owned by members of mafia associations. The confiscation - usually preceded by the seizure, in order to prevent the transfer of ownership to figurehead or the sale of assets - can be extended to all persons, companies and entities holding assets at the suspects' disposal [1]. Confiscation combines the need to assert the principles of legality, as well as the need to suppress criminal power and the will to strengthen trust in the institutions, giving back to the citizens unlawfully stolen resources, that can be used for re-development of the territory (Fig. 1).
Data on the number of chattels, real estate properties and businesses confiscated to date (Fig. 2) emphasize the change of the mafias' economic organization and its widespread distribution in the territory. At the end of 2014 the assets of organised crime are significant part of the Italian economy, with more than 40,000 properties confiscated or seized, estimated more than 8 billion Euros.
The Mafia assets are not only concentrated in the native lands of the gangs (Sicily, Campania, Calabria and Puglia), but also, increasingly, in the regions that are symbol of political and economic power (Lazio and Lombardy). This trend confirms the paradigm of complexity theorized by Umberto Gambino, who defines the Mafia as a "series of criminal organizations [...] acting in a large and branched context of relationships, taking advantage of a system of violence and lawlessness aimed at the capital growth, together with the acquisition

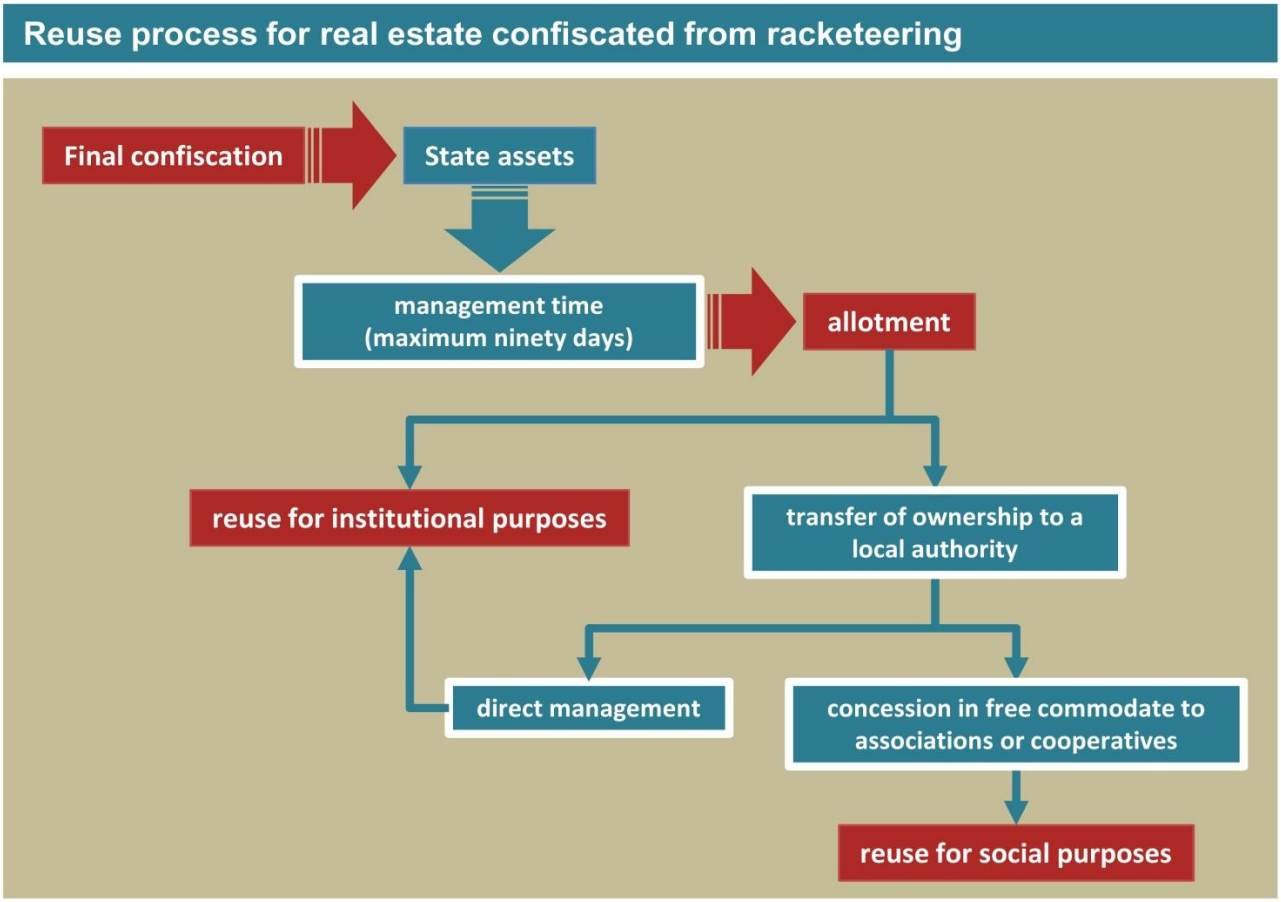

Fig. 1: Reuse process for real estate properties confiscated from racketeering.

REGION	REAL ESTATE	BUSINESSES	AMOUNT
ABRUZZO	53	1	54
BASILICATA	11	3	14
CALABRIA	1,650	161	1,811
CAMPANIA	1,571	347	1,918
EMILIA ROMAGNA	86	26	112
FRIULI VENEZIA GIULIA	18	1	19
LAZIO	505	140	645
LIGURIA	43	15	58
LOMBARDIA	963	223	1,186
MARCHE	20	4	24
MOLISE	2	0	2
PIEMONTE	168	13	181
PUGLIA	995	131	1,126
SARDEGNA	101	3	104
SICILIA	4,892	623	5,515
TOSCANA	57	12	69
TRENTINO ALTO ADIGE	16	0	16
UMBRIA	3	1	4
VENETO	84	4	88
AMOUNT	11,238	1,708	12,946

Fig. 2: Data on the number of real estate confiscated in Italy, updated to January 7, 2013. Source: National Agency for management of assets seized and confiscated from racketeering.

and management of powerful positions, making use of a cultural code and enjoying a certain citizens' approval" [2].
Another trend shown by the analysis of seized and confiscated assets concerns the purchase of luxury property or buildings placed in locations renowned for social and economic power (hotels and luxury residences, commercial activities in prestigious neighbourhoods, such as the Grand Hotel Gianicolo, the Café de Paris and the Bar Chigi, seized at the end of 2013 in Rome). The purchase of such property is not only effective for laundering of huge sums of money, but also for the exhibition of power and for the creation of social relationships useful to the development of criminal activities.
The significant effects of the measures of confiscation raise the issue of how to find financial resources for reuse and management of the assets rescued from the racketeering, in accordance with rules laid by the new Code of anti-Mafia laws (Legislative Decree of 6th September 2011, n. 159). Section 48 of the Code provides, in particular, the reuse of real estate properties for social or institutional activities (Fig. 3).

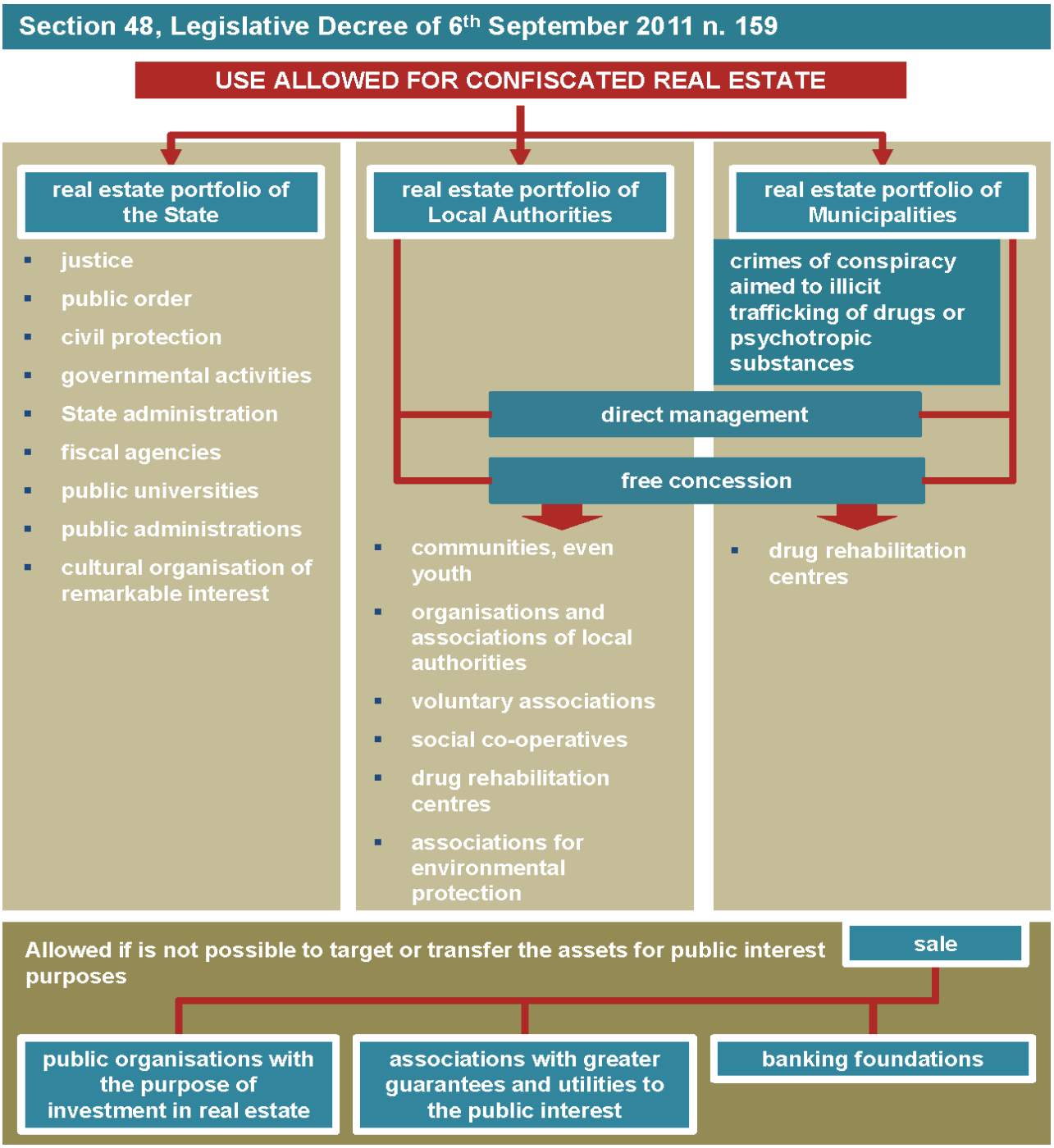

Fig. 3: Use allowed for confiscated real estate properties (Legislative Decree of 6th September 2011, n. 159).

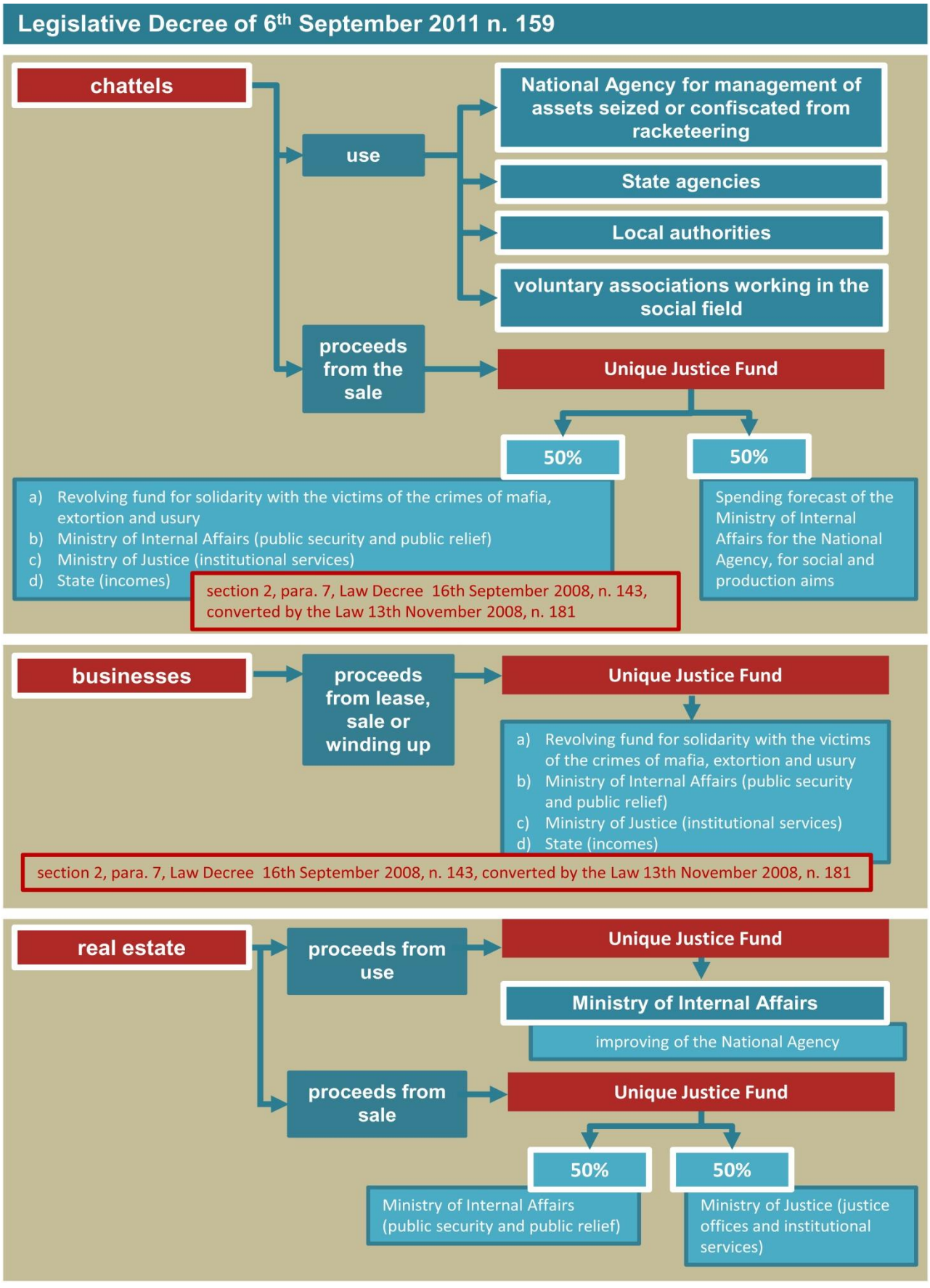

Fig. 4: Use of proceeds from confiscated assets (Legislative Decree of 6th September 2011, n. 159).

This constraint in the choice of new functions limits the opportunities to obtain profits from the management of assets, increasing public spending.
Currently, the reuse of real estate properties and the conversion of businesses are financed with public funds, partially arising from the Unique Justice Fund, and with grants from private foundations.
Money flowing in the Unique Justice Fund arises either from financial and insurance reports undergoing criminal/administrative seizure or from protective confiscation (paragraph 2, section 2, Decree Law 16 September 2008, n. 143), including the income from assets confiscated from the mafia (Fig. 4).
In case of final confiscation, resources are transferred to the State budget and reallocated to the Revolving fund for solidarity with the victims of the crimes of mafia, extortion and usury, to the Ministry of Internal Affairs (for public security, public relief, social and production aims) and to the Ministry of Justice (in order to improve justice offices and institutional services). In addition, many Regions have implemented measures to promote the social reuse of confiscated assets, through various forms of funding (grants, revolving funds, sinking funds, loans). But, since in the case of the businesses conversion, running costs may be covered by incomes from the production of goods and services, instead in the case of real estate properties to reuse for social service activities there are substantial difficulties to incur adapting and management costs. Indeed, the difficulties to find financial resources for adaptive reuse interventions and to cover the running costs of new functions are the main obstacle to the implementation of legal obligations concerning the use of confiscated assets. This is caused by inadequate public funding sources, and also by difficulties in obtaining credit and by poor ability to produce income arising from the new functions. In addition, considerable mortgage burdens bear upon many properties (in 2011, over 2,944 real estate to be allocated, 1,457 are bound by a mortgage).
The establishment of the National Agency for management of assets seized or confiscated to racketeering (Decree Law 4 February 2010, n. 4, converted with amendments by Law 31 March 2010, n. 50) and the constitution of Support Teams at the Prefectures (Section. 3, paragraph 3, Decree Law 4 February 2010, n. 4, as amended) testify to the constant monitoring that the State need to perform on assets entrusted to public authorities and voluntary associations working in the social field. Control activities are aimed to prevent that degradation conditions, obsolescence or use of property which does not comply to those indicated in the approval of reuse and management projects should occur over time. Constant monitoring also aims to enable the National Agency to restore conditions of use consistent with the social or institutional purposes, as required by the laws anti-mafia.
In this scenario, the reuse of historic and artistic heritage confiscated is a strategic action, because it combines the symbolic value of restitution of prime properties to the community, the social benefits due to new business set up in the buildings and the potential contribution to economic growth related to the assets' cultural value, important driving force for the development of local communities [3-6].
The paper shows an assessment methodology to address the needs arising from the new use of the real estate properties, able to protect the identity of the architectural heritage and to preserve its figurative and constructive quality, in a long range development perspective for the context. Through an effective structure of constraints, the conflict between the conservation demands and transformation instances due to the settlement of new functions can become an opportunity to trigger enhancement processes for the city and the territory.

2. The case of the Medicean Castle of Ottaviano

The study analyses the case of the Medicean Castle of Ottaviano (Fig. 5) - building with significant cultural value, confiscated the Camorra boss Raffaele Cutolo - in order to highlight recurring problems in the reuse of assets belonged to members of criminal organizations.
Although it can not be traced back to an exact building date, archaeological surveys conducted since 1947 by Amedeo Maiuri [7] prove the presence of an early settlement (castrum) built in the tenth century. In June 1084 the Castle hosted Pope Gregory VII, led in Salerno by Roberto d'Altavilla after the sacking of Rome [8]. In the first half of the thirteenth century the building was restored by Tommaso I d'Aquino, Count of Acerra. Confiscated by the Anjou, in the early fourteenth century was destroyed together with the nearby village, as a sign of reprisal after the riots of the local population against the royal family.
Rebuilt in the fifteenth century, after 1567 it was transformed into an elegant residence by the heirs of the Medici family: Don Bernardetto de'Medici, who bought the castle by Cesare Gonzaga, moved there from Florence with his wife Giulia. At the behest of the new owners, the features of defensive structure were deleted and the façade was transformed through the construction of large windows with frames in piperno stone. Afterwards, the eastern façade was enriched by a magnificent stucco decoration, unhidden after the recent restorations. The inner courtyard of the building is characterised by an open staircase, which occupies part of the south arm, and by a tripartite façade, marked by arches, pilaster strips and projecting cornices made of piperno stone, on the west side. At the end of the eighteenth century, Prince Joseph III de 'Medici commissioned the painter Angelo Mozzillo to decorate the main floor and to paint frescoes. From the same period the stables and the arrangement of the gardens, adorned with nymphs, fountains and rare herbal essences.

Medici's Castle in Ottaviano



Address	Via Palazzo del Principe 1, Ottaviano (NA)
Floor area	Ground floor of the Castle: 900 mq Outdoor green area: 5.600 mq Area of the former caretaker's house: 380 mq
Confiscated from	Raffaele Cutolo
Date of delivery report	24.04.2002
Intended use	Headquarters of the Vesuvius National Park
Manager organisation	Vesuvius National Park

FUNCTIONS

- ***ground floor***: registered office and headquarters of the National Park of Vesuvius;
- ***first floor***: assigned to the City of Ottaviano
- ***old stables***: conference hall and exhibition room
- ***former caretaker's house***: information point of the National Park of Vesuvius

1999 - first restoration project designed by the Superintendence for Architectural Heritage and Landscape for Naples and Province_ **2008** - granting of the Castle's ground floor and of historic gardens in free loan for 99 years to the Vesuvius National Park

	Medici's Castle	Former caretaker's house	Outdoor museum	Medici's Castle
Funding sources	Department of the Environment, Financial Law of 23th December 2000 n. 388	Budget funds of the Vesuvius National Park	Italy – Multiregional Operational Programme 2007-2013: Security for development (PON)	Italy – Multiregional Operational Programme 2007-2013: Security for development (PON)
Funding amount	€ 1,193,508.00	€ 335,694.82	€ 614,281.05	€ 1,146,485.10
Intervention	Structural reinforcement and recovery of outdoor areas	Reuse and structural reinforcement	Structural reinforcement and partial regeneration of gardens	«The Castle of Legality» - building reuse as theater workshop for children at risk







Fonte: Fondazione Pol.i.s.- http://fondazionepolis.regione.campania.it

Fig. 5: The Medici's Castle in Ottaviano.

Since 1894, after the death of the last male line descendant of Medici family, the Castle belonged only to female heirs, until it became property of Maria Capece Minutolo. In 1980, the noblewoman sold the property to the company "The Castle" of Castellammare di Stabia, belonging to the Camorra boss Raffaele Cutolo [5].
Seized in 1983, after the final confiscation (Judgment no. 3744/86 of 24 October 1986) the Medicean Castle was contracted out to the Municipality of Ottaviano. In 1998, the institution gave to Paolo Leon mandate to draw up a feasibility study for the identification of a new use. The analysis led to the economist's proposal of a new cultural function - Museum of Vesuvian Applied Arts - that integrates exhibitions, training, promotion of local crafts and a new "Gate" of the Vesuvius Park.
The partial restoration – granted with funds by the Multiregional Operational Programme 2007-2013: Security for development (PON) - allowed the public opening of the building in 2008 [9]. The ground floor has been given in free loan to the Vesuvius National Park, as legal and operational headquarters, and to the Center for Environmental Education of the Campania Region. The stables have been transformed into hall for conferences and exhibitions. The gardens are currently managed by a cooperative of young people with disabilities, who are restoring the ancient seeds and managing tourist itineraries. The main floor, assigned to the municipality of Ottaviano, requires new funding for additional restorations.
Despite the efforts of the institutions and voluntary associations, the Medicean Castle of Ottaviano is still far from the reuse and efficient management purposes established by law for the assets confiscated from the organised crime. Thirty years after the seizure, the insufficiency of provided funds, the long duration of building recovery and granting of concessions of the assets, the choice of functions that are not able to produce income to redeploy for maintenance and management, the under-utilization give a snapshot of inadequacy and degradation, which jeopardises the usefulness of interventions. In addition, the location of the building and the low attractiveness of its new function prevent the inclusion of the Castle in the traditional routes of tourist enjoyment, emphasizing the need to rethink reuse decisions.
The attractiveness of the Medicean Castle not only depends on cultural and symbolic value recognised by the community to the building, but also on the quality of the local context, meaning the quality of built environment and infrastructure, the diversification of the supply, the adequacy of services to users and to businesses dealing with cultural assets, the efficiency of local government, the security.

3. Methodology

The research addresses the main critical problem: institutions granting concessions of the confiscated property need to choose new uses able to generate significant benefits for the community. This need can not be fully satisfied only through the choice of functions compatible with the purposes of public utility established by law, since the high social cost of these functions usually exceeds the benefits achieved: the reuse must be an opportunity to activate enhancement processes in large scale. Compared to this need, the reuse of goods with cultural value is a priority, due to the most incisive effects that the action of public administration can imprint on the social and economic development through the promotion of tourism in the territory, along with the increase in income and in local employment levels [10-12].
By acting primarily on the historical and artistic heritage, the State and the Local Authorities implement a more profitable public investment by earning education towards legality, strengthening of cultural identity and implementation of production activities related to public enjoyment of assets. This opens the way for a critical review of the traditional management model for confiscated properties, mainly based on public funding and on case-by-case choices. The implementation of systematised strategies can be achieved by assessments involving sets of assets hired as a unit resource in the local framework. It allows to optimise intervention and management costs and to get more effective results in terms of enhancement of the territory.
According to this principle, the method developed allows to make a preliminary assessment of the effects produced by new uses on the context, at the planning stage, taking into account the whole real estate assets entrusted to each local authority. The choice among alternative functions is performed by examining accessibility, activities and facilities of the area in which each building is located, in relation to the goals of territorial enhancement that institutions pursue and to the economic resources available for interventions.
The method provides for a compatibility check carried out in two steps (Fig. 6). In the first step we compare the set of available real estate properties with the set of activities arising from the analysis of local needs; in the second step, the compatibility of each building with more alternatives function is assessed, in order to identify the reuse solution preferable in relation to the aims of assets safeguard and to available resources.
The first step of the check includes the analysis of the set of buildings entrusted in management to the institution, by implementing a database which provides information about the size of the assets, their location and the current accessibility conditions (lines that supplies service for the area, distance and journey times in relation to the main lines, minimum size of the access roads to the building, in relation to the requirements for the passage of emergency vehicles, etc.). Data on real estate assets are compared with the settlement needs surveyed in the land. To this purpose, an indirect analysis of supply is carried out (based on available statistical data concerning population and activities), in order to define the socio-economic profile of the area and to outline the active dynamics. A direct survey of demand, addressed to local authorities and voluntary

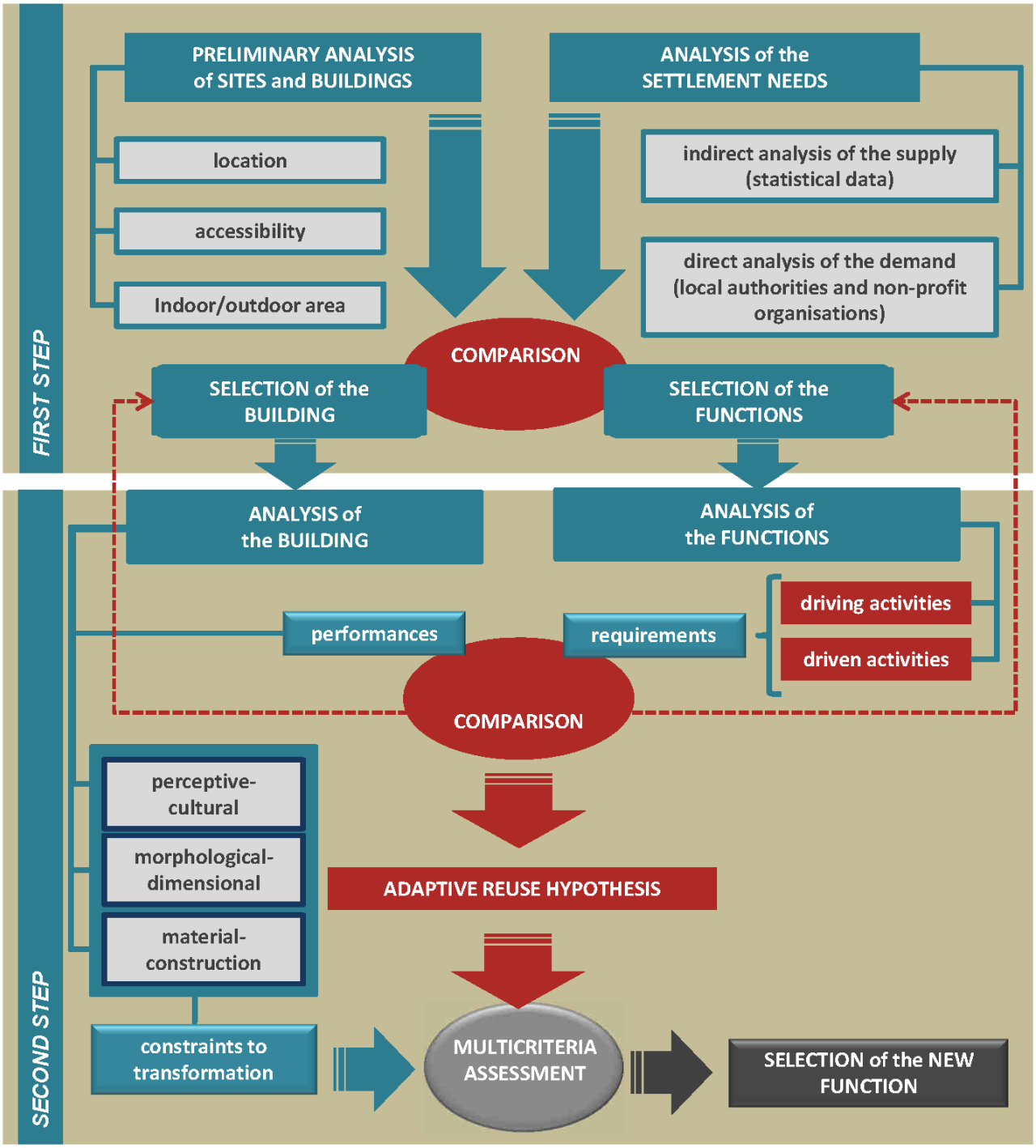

Fig. 6: Methodology.

associations, is performed. The comparison of available assets with activities required for the territorial development allows to associate with each building more alternative uses. These alternatives consist of systems of functions, including both activities that produce income (driving functions) and activities that meet the need of services for disadvantaged social groups (driven functions) [13].

In the second step a priority order among use options is established, by comparing the performance characteristics of the building with the requirements of the new functions. The compatibility between building and use options is assessed on the basis of a "system of constraints to transformation", conditions which must be met in order to preserve the identity of the building [14]. The coexistence of values which generate heterogeneous advantages (use values, cultural, symbolic, social, economic values, etc.) requires the applying of multi-criteria assessment methods to identify the preferable reuse solution [15-20].

4. Conclusion

The implementation of development and social inclusion policies can improve the quality of life in areas afflicted by the presence of mafias, restoring confidence in the intervention of the State to fight against organised crime. The reuse of assets confiscated from racketeering provides significant opportunities to launch processes of land development, through an action which affects social, economic and cultural systems. The chance to turn valuable properties from a symbol of criminal power into a shared heritage, providing services in support of citizens and implementing productive activities, is a real opportunity for social advancement.

The contribution of scientific research for a more effective action against the power of organised crime cannot be confined to a documentation work to complaint the phenomenon. The developed method allows to evaluate alternative scenarios of transformation of the built environment, according to the needs of local development highlighted by the subjects involved in the reuse process.

A more effective and efficient use of available resources for the conversion of Mafia assets should not only improve services to contrast social hardship, citizenship education, aggregation, integration and cultural promotion, but should also enhance productive activities and work integration, contributing to the socio-economic development of a society able to grow in respect of the law [21].

Investment in knowledge of cultural heritage confiscated from organised crime should be aimed at diversifying the usage models and at promoting also assets with lower attractiveness. The creation of thematic networks of cultural and environmental resources contributes to increase promotion and usability and to optimise the cost of services [22]. An integrated offer of real estate and services is a competitive advantage, that strengthens territorial identity and provides local heritage of added value, through a system that can satisfy different needs of use [23].

The proposed methodology, taking into account the whole real estate assets confiscated, allows each local authority to plan diversified enhancement measures and to direct public investment according to the value and the vulnerability of the assets, the social benefits that therefrom can derive, the use requirements and the different ability to attract private capitals.

Bibliographical References

[1] GIANNONE, Tatiana. *Dal bene confiscato al bene comune*. Roma: Ecra, 2012.

[2] GAMBINO, Umberto. *Dalla mafia alle mafie. Scienze sociali e crimine organizzato*. Soveria Mannelli: Rubbettino, 2006.

[3] BARILE, Sergio, MONTELLA, Massimo and SAVIANO, Marialuisa. *A service-based systems view of cultural heritage*. Journal of Business Market Management, vol. 5, no. 2, pp. 106-136, 2012. Available from: <http://nbn-resolving.de/urn:nbn:de:0114-jbm-v5i2.166>.

[4] BERETTA, Enrico and MIGLIARDI, Andrea. *Il patrimonio artistico e culturale nel territorio italiano: valorizzazione e ritorni economici*. EyesReg, vol. 4, no. 2, 2014. Available from: < http://www.eyesreg.it/2014/il-patrimonio-artistico-e-culturale-italiano-valorizzazione-e-ritorni-economici/>.

[5] DE MEDICI, Stefania. *Nuovi usi per la tutela e la valorizzazione del patrimonio costruito*. Milano: FrancoAngeli, 2010.

[6] GREFFE, Xavier. *Is heritage an asset or a liability?*. Journal of Cultural Heritage, vol. 5, no. 3, pp. 301-309, 2004.

[7] MAIURI, Amedeo. *Vecchie e nuove cronache dell'archeologia campana*. Napoli: [s.n.], 1955.

[8] RUGGIERO, Giuseppe. Nel castello mediceo la nuova casa del Parco. *Plinius*. Napoli: Ente Parco Nazionale del Vesuvio, no. 11, pp. 11-14, 2003.

[9] AGENZIA PER LE ONLUS, ed. *Beni confiscati alle mafie: il potere dei segni*. Milano, 2010. Available from: http://www.solcoct.coop/docs/1/ricerca-beni-confiscati.pdf.

[10] HAMPTON, Mark P. *Heritage, local communities and economic development*. Annals of Tourism Research, vol. 32, no. 3, pp. 735-759, 2005.

[11] LEON, Paolo. Prefazione. In AA.VV., *Linee guida per la gestione innovativa dei beni culturali*. Vademecum, Terzo rapporto del Ministero per i Beni e le Attività Culturali, Roma: Gangemi Editore, pp. 5-8, 2008.

[12] TUAN, Tran Huu and NAVRUD, Stale. *Capturing the benefits of preserving cultural heritage*. Journal of Cultural Heritage, vol. 9, no. 3, pp. 326-337, 2008.

[13] CATERINA, Gabriella. Criteri per la definizione di nuove funzioni. In CATERINA, Gabriella, DE JOANNA, Paola (eds.), *Il Real Albergo de' Poveri*. Napoli: Liguori Editore, 2007, pp. 348-349.

[14] PINTO, Maria Rita. *Il riuso edilizio. Procedure, metodi ed esperienze*. Torino: Utet Libreria, 2004.

[15] FUSCO GIRARD, Luigi and DE TORO, Pasquale. *Integrated spatial assessment: a multicriteria approach to sustainable development of cultural and environmental heritage in San Marco dei Cavoti, Italy*. Central European Journal of Operations Research, vol. 15, no. 3, pp. 281-299, 2007.

[16] LANGSTON, Craig, WONG, Francis K.W., HUI, Eddie C.M. and SHEN, Li-Yin. *Strategic Assessment of Building Adaptive Reuse Opportunities*. Building and Environment, vol. 43, no. 10, pp. 1709-1718, 2008.

[17] MAZZANTI, Massimiliano. *Valuing cultural heritage in a multi-attribute framework microeconomic perspectives and policy implications*. Journal of Socio-Economics, vol. 32, no. 5, pp. 549-569, 2003.

[18] NIJKAMP, Peter and RIGANTI, Patrizia. *Assessing cultural heritage benefits for urban sustainable development*. International Journal of Services Technology and Management, vol. 10, no. 1, pp. 29-38, 2008.

[19] RABUN, J. Stanley and KELSO, Richard. *Building Evaluation for Adaptive Reuse and Preservation*. Hoboken: John Wiley and Sons, 2009.

[20] WANG, Huey-Jiun and ZENG, Zhi-Teng. *A multi-objective decision-making process for reuse selection of historic buildings*. Expert Systems with Applications, vol. 37, no. 2, pp. 1241-1249, 2010.

[21] MALLACH, Alan. *Bringing buildings back: from abandoned properties to community assets*. New Brunswick: Rutgers University Press, 2006.

[22] BUA, Antongiulio, HINNA, Alessandro and MINUTI, Marcello, *Politiche e strumenti di valorizzazione a "rete" di beni e attività culturali*. IRER, Guerini e Associati, 2010; Available from: <http://www.irer.it/lombardia2010/testi/focus/buahinna-minuti.pdf>.

[23] BOWITZ, Einar and IBENHOLT, Karin, *Economic impacts of cultural heritage - Research and perspectives*. Journal of Cultural Heritage, vol. 10, no. 1, pp. 1-8, 2009.

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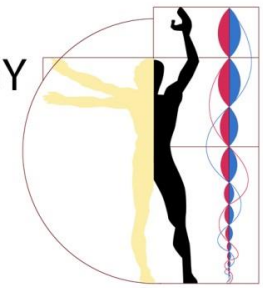

Tighremt Aslim_ Aguddim Taliwin: cases study in the Draa Valley

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1. Abstract

Ait Atta, Ait Sedrate, Ait Yafalmane are only a few of the Berber clans that have found the perfect habitat to develop their community in the area protected by the height of the High Atlas Mountains and encircled by the cities of Ouarzazate, Errachidia and Zagora.
In fact, in this area the Berber tribes, sedentary and native, have merged with the Arab ones, foreign and nomadic, to create one social and cultural community which is very rich and complex.
The buildings that rise in this desert area, named Ksour and Tighremt, are directly linked with local culture which represent, in some way, the emblem because both the technique and the materials are derived from the area. The presence of four big rivers, still rich in water, the fertility of the ground and the composition of the soil, this means that the technique of rammed earth can be used. This technique is useful for building wide, impressive, sumptuous buildings made with very poor local and renewable materials.
Recently, in this area, many survey campaigns have been made involving many operators to make a documentation of the architectural heritage.
The objective of this study is the systematic organization of the surveys, more than twenty tighremt and ksour, and at the same time, the elaboration of one strategy for the divulgation and valorisation of the heritage. Probably the mere survival of those buildings, really sensitive to the weather factors and the lack of maintenance, is linked more to local and global awareness than to concrete ideas of restoration.

Keywords: High Atlas, Aguddim, Berber, Tighremt, Survey

2. Themes and objectives of the research

Our work is part of a field of research, which has already been developed and tested and has two objectives: an overall reflection on the spontaneous architecture linked to the Berber culture in the Maghreb and the production of new surveys. The first objective concerns the theme of the Moroccans tighremt the latest chapter in a story that began over a decade ago with the cataloguing and analysis of the fortified granaries in southern Tunisia. In fact, the spontaneous architecture of the Maghreb is inextricably linked to the territory and it is the physical evidence of a culture now relegated to small territorial enclaves. The intense changes that these regions have suffered in recent years represent a critical step for the management of multiculturalism in these territories and for the preservation of an extremely fragile heritage. The preservation of this architectural heritage is at the basis of the second objective. In fact this tries to describe, with very detailed surveys, often assigned to laser instruments, the quality and quantity of the elements which characterize this architecture. The work here presented is a synthesis of the research conducted at the Mediterranean University of Reggio Calabria, Department of Architecture and Territory, by Marinella Arena and Paola Raffa. Measurements involved students of the Final Synthesis Laboratory “Mediterranean City” (2012) coordinated by prof. Massimo Giovannini, and students of the Atelier of Thesis “Central High Atlas: Ksour & Tighremt” (2014) coordinated by Marinella Arena and Paola Raffa.



Fig. 1 Localization of 26 ksour, tighremt and aguddim in Draa valley

The surveys, covered the four major rivers of the High Atlas: Ziz, Todra, Dades and Draa. In the valley of the Draa 26 ksour and tighremt were detected. (Fig.1) The wide documentation obtained, inserted only in part in this study, is the basis for some reflections on the morphology of the recurring elements in the architecture of rammed earth.

3. The Draa Valley

The Draa river [1] flow along the valleys of High Atlas Mountains. Here we can find six lush green oases, Mezguita, Tinzouline, Ternata, Fezouata, Ktaoua and Mahamid el Ghizlane, where the Berber tribes which were mixed with Arab ones in the past are living. (Fig. 2)

The Draa valley, at the beginning, is narrow and winding, in fact the river carves its path thorough the Djebel Sarhro, here the space for the oases is very small. After the town of Agdz, the valley widens and gives rise to six vast oases. The river is perennial, after the floods of the sixties a dam was built in 1975, this is located along the lake and regulates the flow of water in the Draa. Downstream of the oasis of M'Hamid, the Draa continues its journey under the soil.

Historically, the flow of water has always been controlled a by so-called “barrage”, barrier systems that allow diversion of the water to direct it into the fields and the palm groves. The “barrage” are determined by the morphology of the land: they are present where the valley narrows, and they are very important points of both geographical and social for the territory. Going on from north to south we can recognize: Barrage Mounseur Eddahbi, Barrage Agdz, Barrage Taliwin, Barrage Tansikht, Barrage Ifyl, and Barrage Barrage Azghat Bounou. To protect the barrage there are often isolated round towers or small square forts, “aguddim”. Tighremt, also known as “kasbah” an Arab term, are vernacular constructions built completely with earth, straw and water, according to the technique of rammed earth. They are dotted along the Draa River and are a strong, and at the same time fragile, a testimony of Berber culture. In In this paper I try to make a sort of comparison between the typology of aguddim, end tighremt using the two cases of study of Taliwin and Aslim.

4. Anthropic elements in the Draa Valley

The structure of the oases is made up of a few elements that are derived directly by context: the presence of the Draa water; the heights of the High Atlas Mountains, the Sarhro and Bani mountains (Fig. 3); the six oases where lush palm trees protect cereal crops from excess sun; the cultural and social development of these places.



Fig. 2 The Draa river



Fig. 3 The Draa valley: Djebel Bani

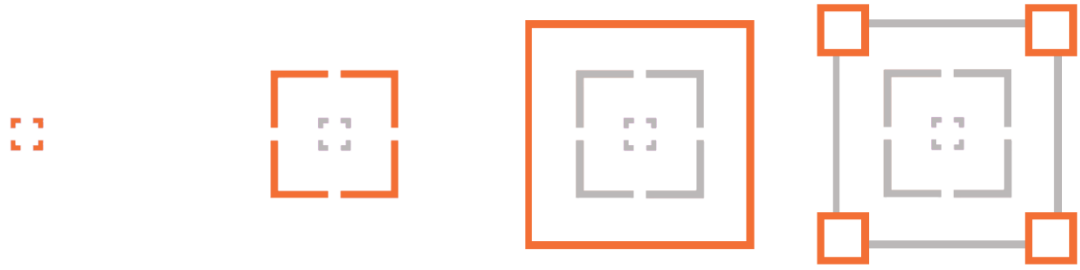


Fig. 4 The structure of the tighremt

In these areas the anthropic elements are the small rural fortified towns that are called “ksour” and which contain some common elements: the mosque, the square, the collective bathrooms, the collective barns, houses and the “dominating houses”. The latter are indicated by different terms, the most well-known is “kasbah” but we can also use the Berber term “tighremt”, in this case more appropriate. Outside the ksar we often find the mausoleum where the founder of the community rests, the “marabut”, and all around is the cemetery. Scattered throughout the territory, there are, however, individual settlements, tighremt, that have not been incorporated in a ksar, and which have maintained their shape. Around them there are some elements that increase their geographical importance: the fields, areas for threshing grain, the mosque "masjid", the wells or, in some cases, real “qanat”. In other cases, the isolated buildings are the watchtowers, “aguddim”, for managing the most valuable asset, the water of the Draa, or for the defense of borders between oases or for the protection of the barrages. In other cases, you can find small buildings that were used by the mills to grind grain products. (Fig. 5)

5. Tighremt

The tighremt consists of a very simple plan: the square courtyard is surrounded by perimeter walls supported by corner turrets. It is important to note that the Maghreb architecture is introflexed, and does not show its wealth and typology externally. In fact walking in the Tunisian medina or in the Imperial cities of Morocco, we can hardly distinguish one house from the other nor can we imagine the richness and complexity of the interior. In the Draa Valley, and in the whole region of the High Atlas, the typology of the tighremt is everted and it is shown clearly on the outside.

The tighremt, in fact, are fortified buildings, they are not granaries, such as “igerm” in the Middle Atlas areas, but rather “rural fortified houses”. The issue of territorial control, the need for continuous defense, as we have seen, springs from conflicts of Berber tribes, and interference from nomadic Arab tribes who raided the territory. Furthermore the Draa Valley is one of the trade routes between the African coast and sub Saharan areas.

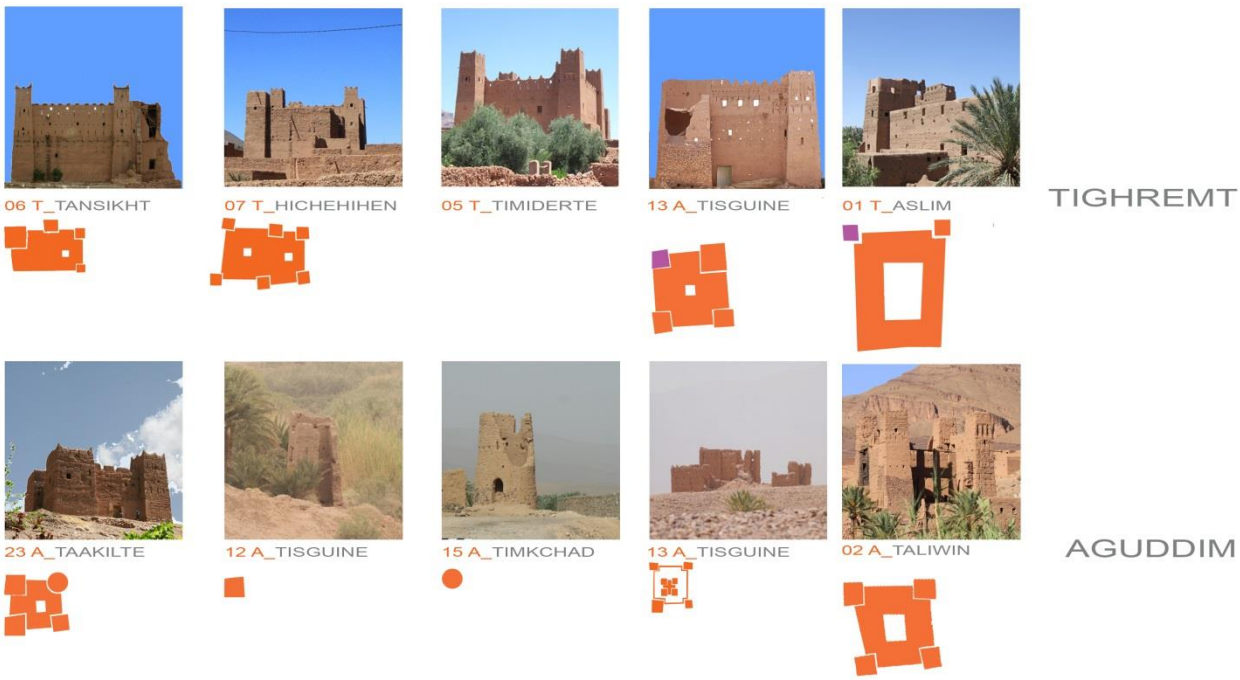
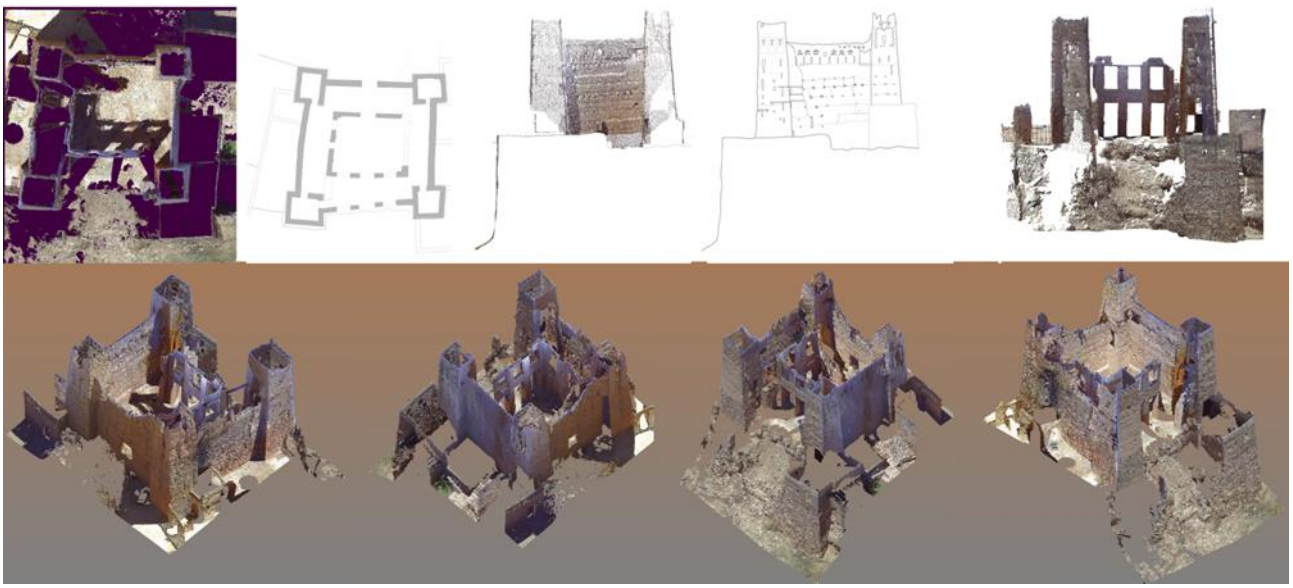
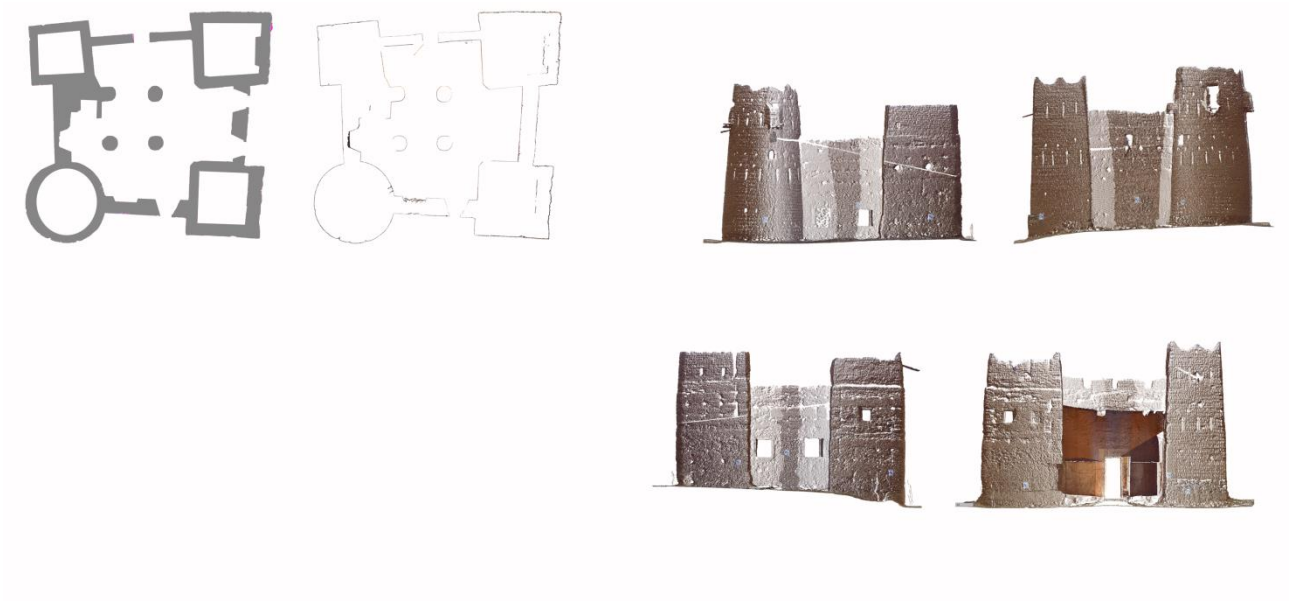


Fig. 5 Tighremt and aguddim in the Draa valley





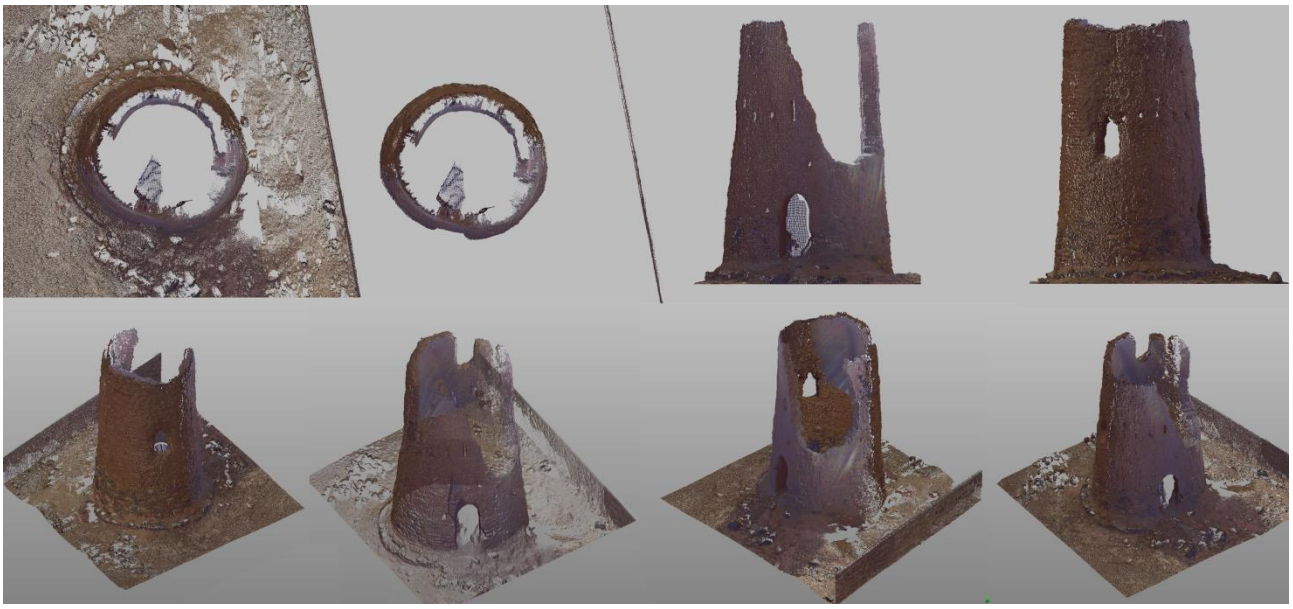


Fig. 5 Aguddim 02_Taliwin Fig. 6 Aguddim 23_Taakilte Fig. 7 Aguddim 15_Timckchad

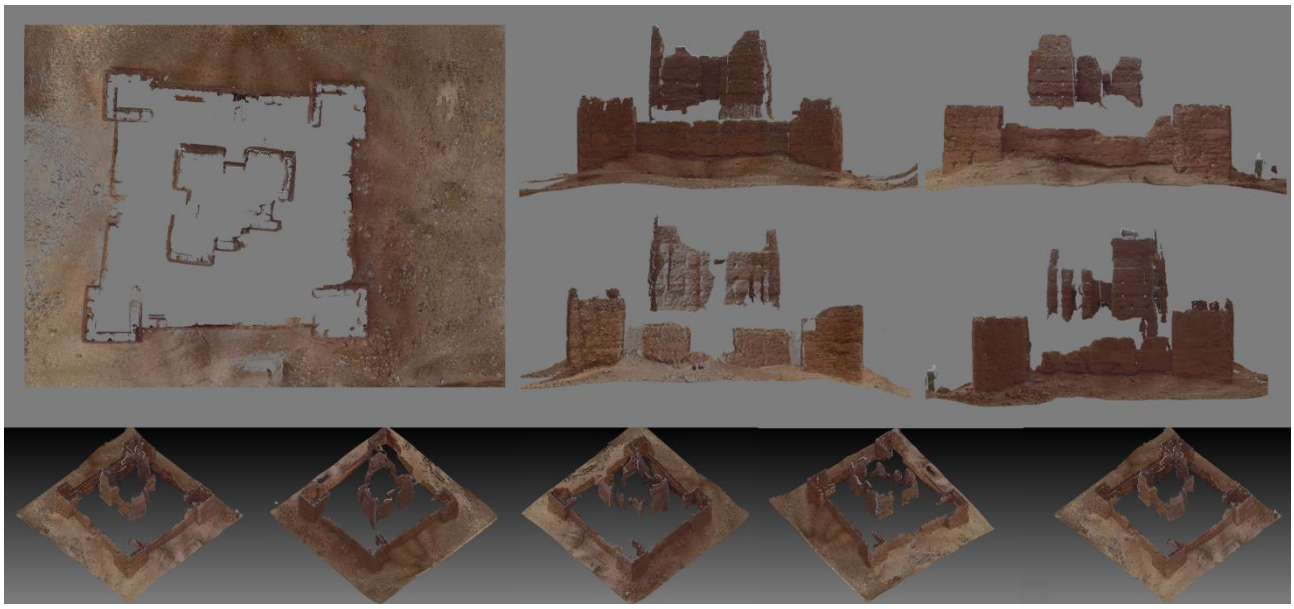


Fig. 8 Aguddim 13_Tisguine

fortified farm, often located within the oasis, or in the immediate vicinity. The large tighremt, often an expression of the power of the Cadi, supported by the colonial power, and placed on the high ground to dominate the territory and to demonstrate its strength and power. In other instances the tighremt are the so-called "dominant homes " placed within a ksar [3]. The tighremt, in fact, has high walls, up to five levels, and rises among the houses that make up the urban fabric of the ksar. In this regard we must make a small clarification. (Fig.5) The isolated tighremt are often the basis for the formation of ksour, in fact they constitute the first core. Around this architecture there are other tighremt, one or two, and then the more modest homes, "taddart" [4], which have one or two levels with small courts often covered. All of them are enclosed by boundary walls interspersed with defensive and structural turrets. It is important to note that all around the tighremt enclosure walls are often made to define the area of relevance and which, at a later date, are filled by other homes. The internal distribution of the tighremt has at ground floor level the rooms for storing grain, “ahano”, stables, and of course, the stairs leading to the upper floors. The first level revolves around the court, usually covered and very small. Around the court are small rooms for family life during the hot summer days. Upstairs there is the terrace and other rooms utilized during the winter months. The central court, for its

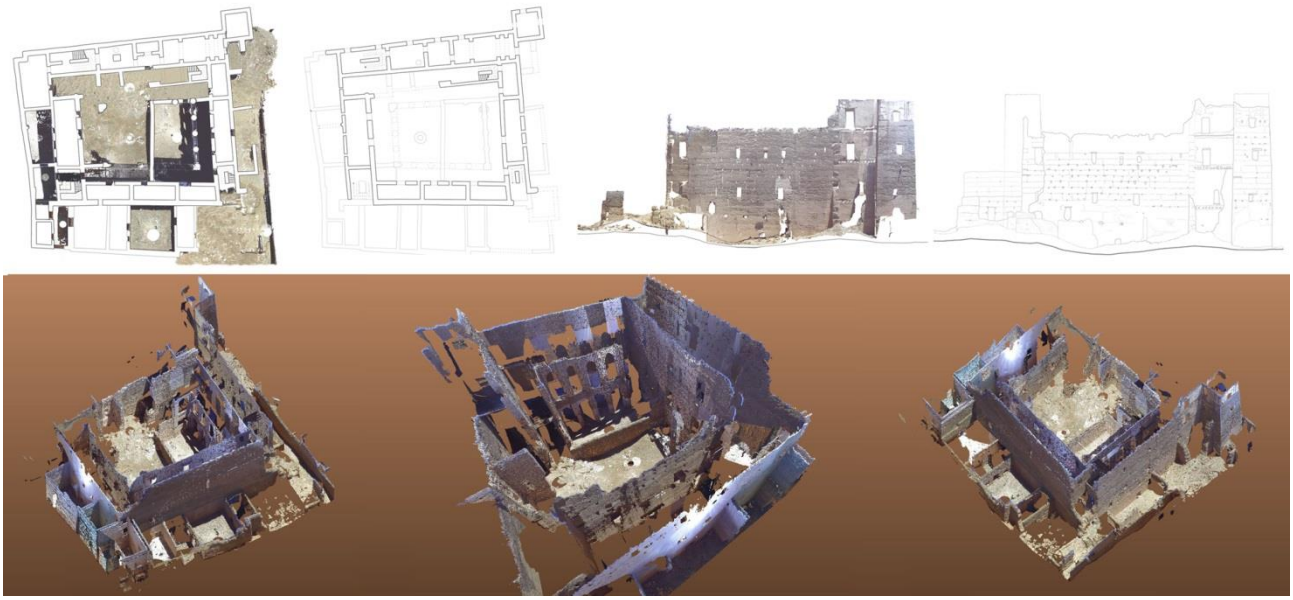


Fig. 9 Tighremt 01_Aslim

size and for the coverage, often elevated above the floor of the terrace, serves as a fireplace. It is capable of eliminating the hot air and cooling the entire home. The terrace is surrounded by a perimeter wall, 1.8 m high, which protects the privacy of the residents and gives access to the rooms situated on the top level and to the corner turrets. As we said before, the structure of the tighremt can be summed up in a few elements where the squared shape is predominant. The court, “taddawārīt” in fact is usually squared and very small in the isolated tighremt and those which are placed inside the ksour. The court appears long in the great tighremt belonging to local Cadi. The dimension of the court is confirmed by the size of the turrets that are on average 3/4 meters wide. The perimeter walls, “agadir”, reaffirm the morphology of the court and stand apart from this 2/3 metres as much as is allowed from the thin wooden structure that forms the attics. The rooms themselves are positioned against the perimeter walls that are often completely closed on the lower floors and only show some openings on the second or third level.
The technique of construction, actually very simple, includes the use of pisè, “llōh”, for the realization of the first levels with blocks equal to 1.2 m wide, 0.8 m high and 0.6 m depth. The blocks are made of pisè work and dictate the dimension of the construction. The arrangement of the blocks and their overlap often generates small rectangular windows, “isirr”, useful for ventilation, while the size and structure of the blocks is well visible because of the holes left by the ribs in wood. The top of the perimeter wall is built with bricks of raw earth, “ottob”, which often create geometric designs, “lasserift”. These are real emblems of the Tamazight culture. In fact they seem to follow the geometrical decorations present in all Berber art that Gabriel Camps dates back to the Carthaginian culture.
The internal tighremt decoration, is concentrated on the upper floors it is decorated with horseshoe shaped arches. The arches in the Maghreb often have no structural function as has been pointed out many times by Titus Burckhardt, in his book *The Art of Islam*, in fact, arch type and materials make them unsuitable for a structural function. The arches have a rather formal and aesthetic value. They are often interrupted by a wooden element that acts as a chain, and also the characteristic protruding shape of the arch is due to the arrangement of the wooden supporting structures.
The structure within the court is entrusted to the wooden beams of palm and a small wooden boards arranged so as to form small projections on which the bricks that form the decorations are arranged. The wooden structure, within the court is hidden by plaster, “tamassalt”, which covers and protects it from rainwater.

6. Aguddim Taliwin

The guard towers, along the Draa Valley, are located on the borders of the oases, where the valley narrows and allows the construction of the barrage, which control the flow of water. The Berbers call these buildings "Aguddim". The structure of Taliwin, and its location, shown the role that this plays in the territory. Indeed, we can define this tighremt as a real guard tower built to protect the barrage of the same name. Its perched position allows you to see the landscape, the slots on the two turrets, which are on the mountain side, confirm the defensive purposes of this architecture. The building is very small. Built on a square base of 14 meters, has four corner towers of regular shape. Its morphology confirm that the turret is the constructive form of the entire structure. In fact, each turret measure 3.5 meters and the wall that separates them is 7 meters long, the distance between one turret and the other is equal to two modules. The towers are also still intact, they rise on the upstream side to 10 m while, on the side facing towards the Draa Valley, they are supported by extensive ramparts. The towers are also attached to the wall structure with small wooden beams, arranged obliquely. The survey, carried out with the laser scanner, measure the deformations that the entire structure has suffered as a result of washout and subsidence of the land.
Furthermore it has been verified that the outer walls have a variable section, which passes from 90 cm at the base, to 55 cm for the body of the wall, up to 25 cm at the conclusion. The court, now partially collapsed, is slightly rectangular shaped, 5.3 to 6 meters wide, has three bays on each side, originally decorated with pointed arches. The main entrance, which faces on a small square, is located approximately 1.5 metres from ground level, and is protected by a brattice, a small projecting compartment, arranged on axis with the doorway. The decoration is partially visible on the south side of the building where the typical small narrow windows are decorated with letters of Tifinagh. (Fig.5,6,7,8)

7. Tighremt Aslim

The Tighremt Aslim, rises on the border of the Mezguita Oasis, closer to the small centre of Aslim than to the newest one of Agdz. The Tighremt is protected from view by a little centre; this latter is made up of small houses built on rammed earth that lie close to the street that leads to the Draa Gorges. The Tighremt is placed near the edge of the oasis like the great kasbah which is built very close, just a few metres to the north, and also the one of Cadì Alì in Aslim. Near Agdz the Draa makes a loop flowing around Djebel Kissane where the palm grove grows on one side drawing radial paths through the street to the river. This tighremt has a typical squared plan with four corner turrets. The impressive exterior walls, very high, are

surrounded by many lower small rooms. The north façade confines with a little garden which divides it from mosque.
Only one turret remains complete and it maintains the north-east corner of the kasbah; while the south-east turret has completely collapsed and the last two are barely visible. The building develops around a courtyard with concentric thick walls, of about 70 cm. The distance between the axis of the columns and the innermost wall is about 2 metres, but this last is detached from the outermost wall by 2.5 metres. Only the north facade has an extra wall which generates two big rooms and a staircase. Observing from the outside it is possible to note that, probably, all the exterior walls were decorated with the characteristic triangular acroteria. Those last were placed on the top of the wall to fix the stratum of canes which makes a sort of cornice. On the North, East and West facades, five windows have been opened while the South side is completely closed. The perimetric walls have no signs of decors, except for the “skifa” one, and they show the constructive patterns lot made by cubes of rammed earth and by the holes of scaffolding.
The access to the kasbah is placed on the South side along the street that goes to the oasis. This kind of entrance, called “skifa” in Tamazight language, does not allows you to see the interior of the house from the door and originally it was decorated by one lancet arch now destroyed. The interior floors are almost absent and it is possible to individuate only the location of the staircases which are behind the turrets in the four corners of the plan. The inside of the kasbah, despite many collapses, still allows a good understanding of the plan and of the typologies. In fact it is possible to evaluate the shape of the courtyard, a rectangle 12.5 metres long and 8.7 metres wide, and the decorative apparatus: the court has four arcades on the short side and five on the long one. The arches, placed on two levels, measure 5 metres on the ground floor and 4,5 metres on the first level, while intercolumniation is 2,2 metres. The shape of the arches is still easy to perceive despite their deeply deformed appearance caused by ground subsidence and by the rammed earth instability. The lancet arcs have the typical structure of Maghreb ones and are enclosed by a rectangular frame. Every arch, which has a clear span of about 1,4 metres, is interrupted at the impost by a little rafter of wood which was useful to sustain the scaffolding. Similar arches have been surveyed in the in the Cadì Alì kasbah in Tamnougalt, a few kilometer from this site. The courtyard, which appears divided in two parts by a wall added recently, is wider than the others and this fact, combined with the presence of two wells, indicate the richness of the kasbah. This survey is part of a broader research, which contains the cataloging of more than forty ksour, tighremt and kasbah and the survey of twenty exempla performed with manual measurement and 3D laser scanner techniques. (Fig. 9)

8. Conclusion

In the region of the Draa Valley we surveyed more than ten tighremt, and a first cataloguing of the findings is shown. The importance of these buildings has enabled a thorough reflection on the quality of this architecture and on the conservation status of a very fragile heritage. Many of the tighremt detected, in fact, have partially collapsed, in some cases the tighremt are still inhabited but the continuous restoration that these buildings require tend to change the appearance, and to cancel out all the decorative elements which are the very delicate, and at the same time the most characteristic, of these buildings. Some texts such as “Manuel de conservation du patrimoine architectural en terre des Vallées présahariennes du Maroc”, published by CERKAS in 2005, with the support of UNESCO suggest not replacing the decorations with simpler ones during restoration. It asks you to use reliable graphic sources. The instrumental surveys of these buildings allows users to record, with absolute precision, a moment in their development. It allows you to pass on the nature and morphology of the facades, the decorations and the moldings. It allows you to read the deformations that the buildings suffer due to water seepage or landslides of the sandy ground. They are therefore, essential documents for appropriate restoration so as to pass on the quality of the architecture. Furthermore the measurements have allowed new reflections on the morphology and geometry of the buildings. The study, still in progress, has tried to verify some assumptions such as the structure of the corner turrets and the courts.

The morphology of the towers and the courtyards has been compared and figure 10 shows tighremt, aguddim, and kasbah, wide isolated tighremt, and points out the system of the court and the turrets. The figure shows the schematic dimensions of the analysed elements, so the dimensional and morphological comparison is more direct.

In the drawings the correlation between the size of the tower and the court is clear. In fact the typology of the aguddim, like Taakilte, Tisguine, Taliwin and some guard turrets, do not have a common dimension, while the dimension of the tighremt, Domougni Tamekasselt, Tansik, Ouled Othmane and Moquaddem, have the court the same size as the tower, the module fluctuates around 4 metres. The courts of the more modest homes, "taddart", which are inside the ksour have one or two levels and they are 1.5 metres long and 1.3 wide as in the case of ksour Ait Hammousaid. When the size of tighremt increases, as is the case of Aslim, Tamnoulgalt and Tinzouline, the court widens but the dimension are comparable, a square of about 12 metres. These courtyards have in fact 5/6 arches on each side, and maintain, in the plan, the square shape of the smaller ones. (Fig. 10)

The dimensions of the plan of the turrets are very similar. They are about 4 metres long and wide, while the height could be very different. In fact some turrets are very high, about 12 metres, and others are shorter,7-8 metres. The dimension of the turrets often depends on the location. In some cases, in fact, when the ground is steep, the turrets are utilised as buttresses and are higher.

Bibliographical References

[1] See the voice Dra in RISER J. *Encyclopédie Berère*, XVII, Aix-en-Provence, Edisud, 1996

[2] ARENA M., RAFFA P., *Ksour della regione di Tataouine*, Roma Kappa, 2007; ARENA M., RAFFA P., *Ksour di Jelidet, disegni e rilievi*, Roma, Kappa 2012

[3] Some ksour, which Jean-Louis Michon defines ksours 'dispersed', are actually combinations tighremt. See in this regard: MICHON Louis, *Un patrimoine en danger: les architectures en terre du sud Marocain*, in Icomos Information, Napoli, Edizioni Scientifiche Italiane, 1985

[4] All the Tamazight words used in this research are referred to the Glossary French/Tamazight in the text of JACQUES-MEUNIE' D., *Architectures et habitats du Dadès, Maroc présaharien*, Paris, Librairie Klincksieck, 1962

[5] MAJORELLE J., *Les kasbahs de l'Atlas*, Paris, Meyniel 1930

[6] MONTAGNE Robert*, Villages et kasbas berbères*, Paris Félix, Alcan 1930

[7] TERRASSE Henri, *Kasbas berères*, Paris, Editions des horizons de France 1938

[8] HENESENS Jean, *Habitat rural traditionnel des oasis présahariennes: Le qsar- Problèmes de Rénovation*, B.E.S.M n°114, 1969

[9] BURCKHARDT Titus, *L'arte dell'Islam*, Ascondita 2002, I ed., L'art de l'Islam, Actes Sud 1985

[10] CAMPS Gabriel, *Les Berbères*, Edisud, Aix-en-Provence 1996

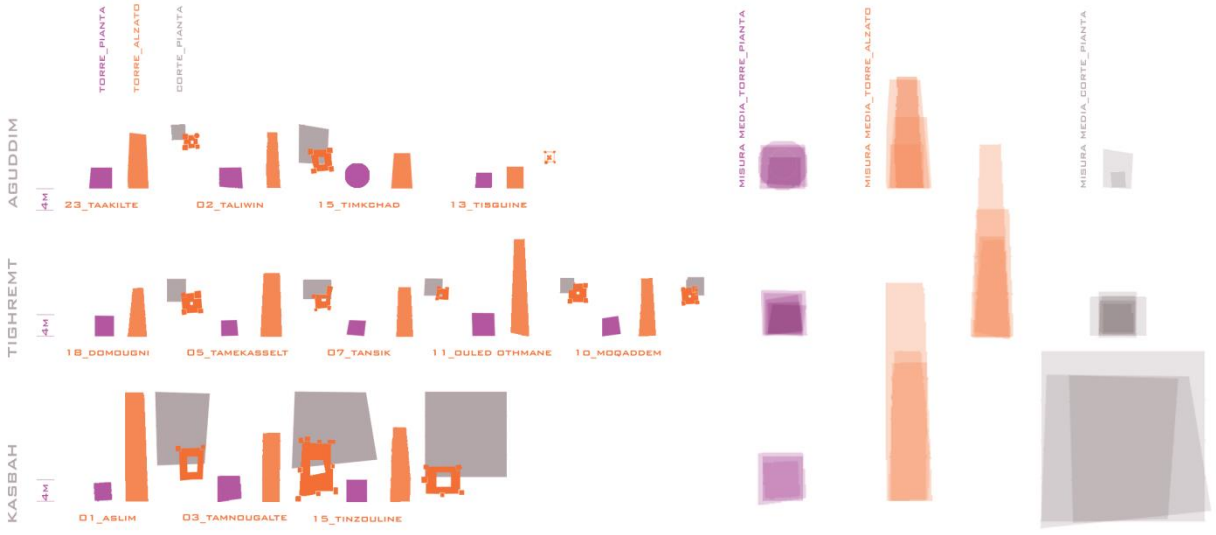


Fig. 10 Dimensional analysis of aguddim, tighremt and kasbah in the Draa valley

HERITAGE and TECHNOLOGY
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The management of prívate properties with heritage values

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Abstract
Heritage is a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. Albania has many places and buildings with heritage value, a large number of which are privately owned. Private ownership on a property entitles the enjoyment and free disposition of property within the limits prescribed by law. Heritage is about cultural or historical values and not about economics. A conservation restriction may prevent the property from being developed to its "highest and best use"; the owner of the property, while retaining the majority of his interests in the property, might be obligated to maintain his property in a certain manner or be restricted from developing it in some respect and, consequently, may decrease the property's market value.
This paper proposes several ways of managing the heritage value properties in private ownership in order to preserve the heritage value but also to ensure the best market value. As a case study, this paper addresses the rehabilitation of a historic site - Old Bazaar of Korca City, Albania.

Keywords: heritage value, market value, management.

1. Introduction
Real estate is most commonly defined as land and any improvements made to or on the land, including fixed structures and infrastructure components. It represents one of the most valuable assets for the state and individuals. The value of an interest in property is determined by the market value of that interest. Market value is the estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion [1] [2].
Property is always valued on the basis of its highest and best use, which may or may not be its present use. Highest and best use is defined as the reasonably probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value. A conservation restriction, that comes from being a cultural, historical or architectural heritage, may prevent the property from being developed or used to its "highest and best use" and, consequently, may decrease the property's market value.
Such a thing is obviously contrary to the interests of the owner, who is interested only in economic benefits from his property. It is the duty of property specialist to give its recommendations on the most efficient management of heritage properties in private ownership, in order to to preserve the heritage value and at the same time to ensure the best market value.

2. Heritage value of property

2.1 What is heritage?
Heritage is the full range of our inherited traditions, monuments, objects, and culture. Heritage is what we inherit, but more specifically what we retain of this inheritance. The heritage value of a place is also known as its cultural significance which means its aesthetic, historic, scientific, social or spiritual value for past, present or future generations [3]. As it is defined in UNESCO Convent, the "cultural heritage" are

monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science; **groups of buildings:** groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science; **sites:** works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view [4].
Cultural heritage is a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time [5].

2.2 Heritage values

Today cultural heritage is seen as an integral component of sustainable development together with three other components, economy, society and environment. A heritage protected and valued can bring numerous social and economic benefits. Heritage has economic value generated by its use for the purposes of tourism, recreation, which are a source of income generation. Heritage has socio-cultural values that are expressed in strong spiritual connection of people with their country, their identity in local and national context. Heritage has scientific and educational values that are expressed in their transmission from one generation to another in order to understand the cultural level that characterizes the period of construction. Heritage has political values, which are expressed in the use of cultural heritage and its values for promotion of national values and national identity.
Heritage values must be seen in complex. Neville Agnew have said: "We all need to remember that the economic benefits of cultural heritage evaporate, if other cultural values social, its aesthetic, not respected or lose “.

3. The ownership`s rights on heritage properties

There are two things in an edifice: its use and its beauty. Its use belongs to its owner, its beauty to everyone” [6]. Private ownership on a property entitles the enjoyment and free disposition of property within the limits prescribed by law. The exercise of property rights deriving from the ownership on a property are limited by the action of regulators for cultural listed and registered buildings.
In Albania, In the first category objects can be performed restoration interventions in facade, but cannot be done changes to the interior, while in the protected area can be built, etc., but preserving old buildings volumes. Interventions in the first category monuments preserve the composition and original techniques as on the inside, as well as in external images. Courtyard walls surrounding the outer gate and auxiliary buildings are an organic part of the monument and, as such, are subject to the same treatment. In cases where a monument has suffered damage, transformations or missing, additional interventions can be undertaken according to the initial situation. Interventions in the second category monuments keep the original volume and the formulation of facade, while the inner changes can be made by applying various compositions according to requirements and contemporary techniques. [7]
Monuments are part of modern life. They can be used, at times, the functions for which they were built, or other functions, provided that these functions do not violate the values for which the monument is being protected [8].
Historic buildings are considered as multi atributed buildings, some of atributes belong to the collective interest and some to private interest. The atributes which concern the historical quality of the asset, its cultural characteristics, have to be shared.
The owners of buildings with heritage value should create the necessary conditions for the maintenance of these premises. For restorations, they are obliged to turn to specialized state institutions [8].
In the United States the owner can agree to transfer his property rights on a façade [9].
In France, protection offers tax deductions for building or repair work and for management or caretaker fees, and relief from inheritance taxes: real estate expenses are fully deductible for open monuments and half-deductible for non-open ones. Restoration costs are deductible also. Therefore and rather surprisingly, tax deductions are linked to the eligibility for a subsidy [9].
In several countries the division of property rights is materialized by a separation between the façade and the interiors of listed buildings. The façade is considered as the joint-property of private owners and the community, while the interior is the sole property of the private owner. From an economic point of view, this separation, called *façadism*, is an architectural strategy that deals with the economics of property rights as they relate to attributes and not entire assets. It is a compromise between economics and aesthetics, a very pragmatic and minimal solution for a very common problem concerning cultural goods [9].
Sharing property rights finds a concrete and visible illustration in *façadism*. Since the façade belongs to the community and the interior to the owner, conservation becomes purely a question of

appearance. Thus, *façadism* represents a compromise between two polar solutions: retaining the historical aspect of a listed or registered building in its integrity (with a risk of sterilizing important sites), and allowing changes behind the unchanged façade. It is also a compromise between preserving and destroying. On the one hand, the façade becomes a historical screen for a new construction, which breaks the unity between the interior and exterior [9].

4. Heritage in Albania

Cultural heritage is the foundation of the identity of a nation. Albania is ranked as the first countries not only in the Balkans, but also in Europe, in terms of number of monuments. It counts about 1350 monuments of the first category, monuments, both of which include various types of construction, they have archaeological constructions, engineering, construction Christian and Muslim religious centers and historical ensembles, urban and rural dwellings etc" [10].

Replacement of state property to private property, after the political changes of 1991 in Albania, was accompanied by damage in terms of preserving cultural monuments and archaeological wealth, on the one hand by the aggressiveness of private property, on the other hand, because the Albanian state not accompanied this policy change with legal preventive measures for their protection.

4.1 Korca Old Bazaar

Korça is a historic city with rich cultural values and fascinating buildings from the Otoman period. Korça is considered to be one of the cleanest cities in Albania. It is also known for the beautiful ladies, the serenades, the active bazaar, the carnivals and the deliciuous cooking. Korça is often called : The city of serenades, The city of art, The city of beer, The city of croquettes (kërnacka), The little Paris.

Korça has rich spiritual traditions like paintings, songs, festivals, historic monuments. The city is widely known for the songs called serenades, accompanied by guitars. It is also known for the biggest carnival festival in all of the country, which takes place each January the 6-th as a tradition of the albanian culture kept alive during the years.

The Bazaar of Korça is situated in the historical center of the city and is under state protection.

According to the law number 9048 dated 7.4.2003 for the cultural heritage, Korça Old Bazaar is an architectonic ensemble. In this ensemble, there are first and second category objects (Figure 1)



Fig. 1: Map of (a) first category objects; (b) historical ensemble and the protected area (IMK)

The Bazaar of Korça is a unique ensemble of functioning markets and workshops. It is placed at the most developed part of the city. It is composed of the following elements which define the functional and cultural value of the Bazaar (Figure 2):

- **The market "squares".** The square was the most vital part of the bazaar, especially in saturday, which was the shopping day. Squares were sorounded by shops, but often their space was filled with various trading activities, near the square, there were also placed the inns.
- Workshops/ stores. Shops were placed in group, according to crafts, or in series next to each other. Crafts that produced for a wider clientele were placed at the center, and they give name to the street. Shops are organized in two floors, the most common compositional scheme is with one unit per floor. The ground floor served for production and trade, it had major showcases for light and display of goods. The upper floor was used for storage, they are highter and have less lighting. The floors were connected with narrow wooden stairs
- Inns. Inns occupy an important part of the urban structure of the bazaar, they were located near marketplaces or near the roads that lead to bazaar. The most common scheme of inns is that with closed courtyard. The compositional unit of the inn, remain the small room. Inns volumes had a clear functional division, usually they were organised in two floors. Ground floor served for animals, while the firts floor for sleeping. Rooms were organised around a corridor that looked out of the yard. They were constructed with local materials.
- Clock tower. It was located near the bazaar and together with the minaret, they were the only vertical elements in the lying silhouette of bazaar.
All properties that constitute Korca Old Bazaar are privately owned , mainly in co-ownership.

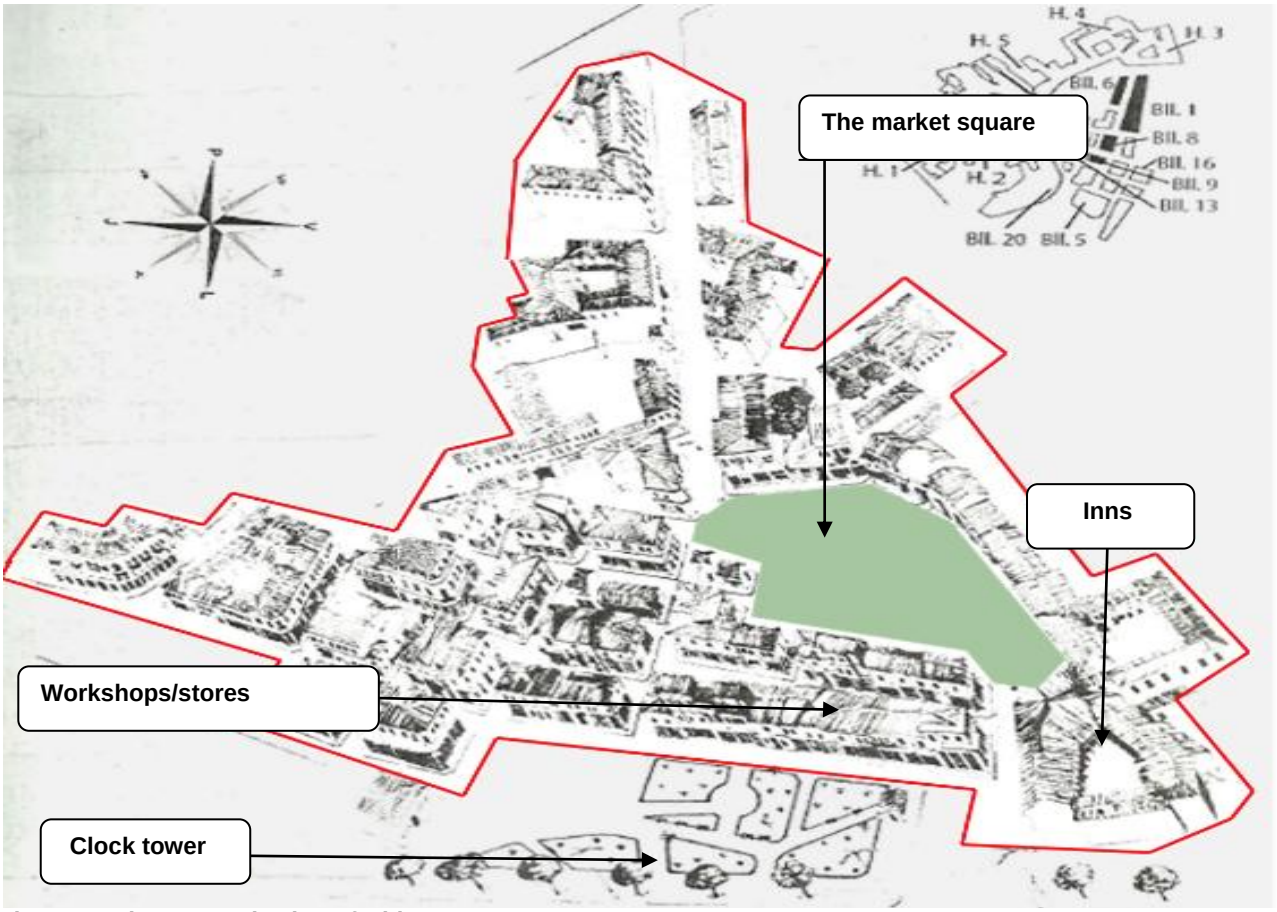

Fig. 2: Previous organization of Old Bazaar

The current situation of the Old Bazaar appears unattractive. From the analysis of the current situation resulting a number of gaps, like destructed buildings, lack of green space, issues of accessibility, bad conditions of the ground, lack of facilities and leisure park benches, noisy and polluted places etc.

4.2 Rehabilitation of Korca Old Bazaar

Bazaar nowadays is just a trading market. Stores are located in groups or in series one after another. As a part of real estate the shops are subject of renting. The current condition of the Bazaar and the state og conditions of the buildings , besides the market conditions, are the couses of low rents. Revitalization of Bazaar will consist on bringing back their former functions, will bring back native and tourist attention and interest on architectural heritage and also will develop artisans, craftsman, tourist articles, souvenirs,

traditional products. The increase of economic activity will arouse interest even for properties. They could be leased higher and therefore their value will increase.
According to the development control of the area the Bazaar will stay an Historical Area, meaning that in the future it won't succumb to any changes. The rehabilitation of the Old Bazaar of Korca relies on three important theoretical definitions of cultural heritage: Conservation, Restoration and Revitalization.
The rehabilitation has consist on:
1.Improving the situation of the urban bazaar aims at solving accessibility problems, endless space needed for parking and creating attractive urban spaces and lighting;
2. Internal organization of the bazaar aims in two directions: New proposal functions and a new functional zoning. Reorganization of the sites and areas.
The Bazaar has a high capacity for usage in different functions. Nowadays these spaces are being used for retail selling and their conditions are plain and not at all tourist attractive. Is proposed a new concept for the functions which these spaces will have, by keeping some of them as they were and by proposing new ones. The proposed functions are in full agreement with the tradition, like shops and handicraft stores, but at the same time they bring a new spirit for the historic zone, like auditoriums, educational centers, movie theaters, offices, art galleries, lofts etc. the proposed functions of the objects in the Bazaar are illustrated by the maps below (Figure 3). New proposed functions also affect property values
3. Rehabilitation of buildings

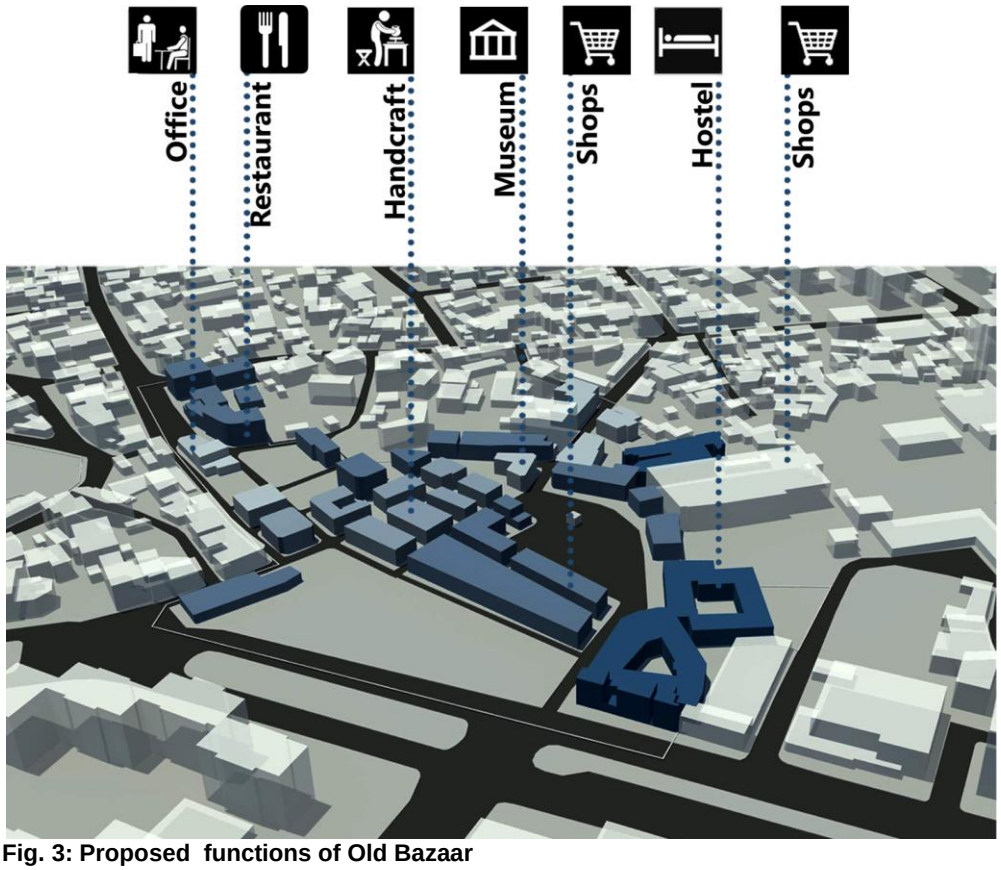

Fig. 3: Proposed functions of Old Bazaar

4.3 Buildings rehabilitation

General problematics in the buildings of the Bazaar are structural and material. Some structural problems has to do with Irregular schemes in height (Soft storey effect) , flexible or completely deteriorated horizontal slabs, cracks on the walls, the cracks above the architraves, intervention on the roofs, rebuilding of the stairs.
Some materials problems are moisture in the façade, damaging the plaster, damaging the decorative elements, the deterioration of wood elements, damaging the metal, the problem of moisture and vegetation on the facades, partial or full damage of the stone elements, etc.
A general view of the state of the buildings and the problems detected on the objects in the Bazaar are given in the maps below. (Figure 4 and Figure 5).
The buildings can be classified as completely deteriorated, averagley deteriorated and slightly deteriorated.



Fig. 4: View of general state of buildings

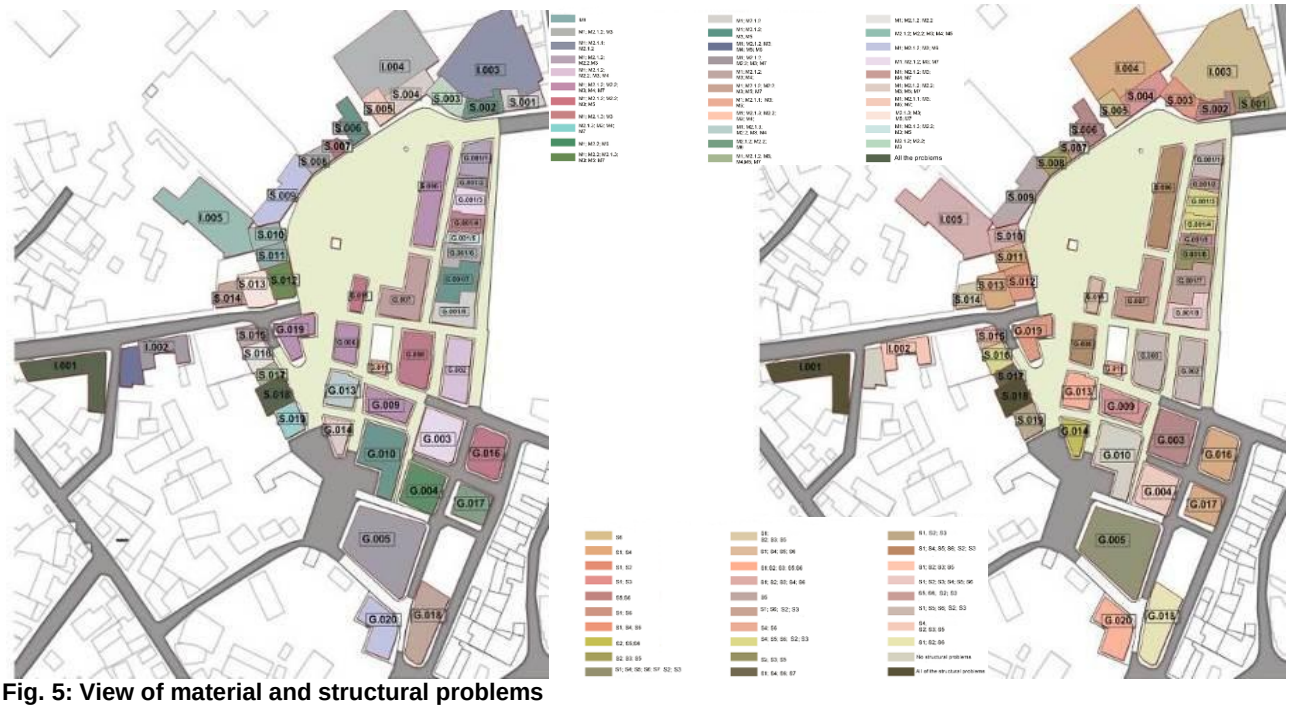

Fig. 5: View of material and structural problems

Some techniques for structural restoration are reinforcement with steel jackets, Reinforcement using FRP, Composite slabs, Wood slabs, Masonry repairs, Intervention in the foundations, Avoid rising damps
A restorating intervention usually follows a multidisciplinary approach and is divided in different phases which can be established from the process of preconsolidation, cleaning, consolidating and protecting, which is preceded by a preliminary phase, in which after careful evaluation of the objects , the “surgery” techniques and methods are established.

4.3 Benefit and cost evaluation

For the restauration of the objects of the Bazaar is done a classification according to their actual state, where are determined three different categories

- Severely damaged objects – objects which present both structural and material problems
- Avaragely damaged objects– objects which present more material problems than structural ones
- Slightly damaged objects – objects in which the degree of intervention is minimal, only little repairs

This classification is done for an objective, to establish a intervention cost for each category. The evaluation has been done in accordance with the prices from the Restoration Manual, designed by the Monuments Institute.

Is taken in consideration Rako's shop as the severely degraded structure (Figure 6)



S1- Slender columns in the ground floor
S2- Flexible or destroyed horizontal diaphragms
S3- Absence of stairs
S5- Falling of the roof or need for reinforcement
S6- Damages in the masonry
M1- Problems with humidity
M2.1.2- Partial falling of the plaster
M3- Damages of the wood doors and windows
M4- Damaging of the stone
M5- Damaging of the decoration

Fig. 6: View of material and structural problems

Is taken in consideration Block 6 as the average deteriorated structure (Figure 7)



S1- Slender columns in the ground floor
S4- Problems with gaps
S5- The fallen roof
S6- Damages in the masonry
M2.2- Changes of color as a result of plastered parts
M2.1.2- Partial falling of the plaster
M1- Problems with humidity in the facade
M3- Damage of the wooden doors and windows
M4- Damage of the stone in the facade
M7- Damage of the metallic elements

Fig. 7: View of material and structural problems

Is taken in consideration Block 4 as the slightly degraded structure (Figure 8)



S4- The problem of gaps
M2.2- The change of colour as a result of plastered parts
M1- Problem of humidity in the facade
M6- Problem of vegetation in the facade

Fig. 8: View of material and structural problems

Have been determined for each property (building) the actual possible lease, referred composition, conditions, surfaces, location ,etc. and referring the new shops in the area (shopping center ....) and the proposed functions, the future possible rents after the rehabilitation of buildings.
The following table gives a summary of the total costs of the interventions based on three categories of buildings and rent increase after rehabilitation (Table 1).

Category	Interior Cost (EUR)	External Cost (EUR)	Total Cost (EUR)	Rent Today	Rent after rehabilitation	Rent increase
Completely Deteriorated	285388	718033	1003421	3621	11701	3.23
Averageley Deteriorated	180789	780387	961176	3578.6	12000	3.35
Slightly Deteriorated	45140	256397	301537	1242	5000	4.03

Table 1. Cost and rent evaluation

5. Conclusions

The calculations carried out show that the external costs are several times higher than the internal costs.
The rents of the premises are expected to increase after the rehabilitation of buildings about 3 times compared with current rents. Such an increase of the rent is in favor of the owners, who are interested in the rehabilitation of buildings, beyond the fact that they are bound by the law, according to which " Individuals and legal entities that own objects of cultural heritage values, movable and immovable property registered, are obliged to create the necessary conditions for the maintenance of these facilities".
Rehabilitation of buildings is an effective way to enable the preservation of historical and cultural values, but simultaneously has interest and for owners. They have to pay just for interior parts because refering to the law number 9048 dated 7.4.2003 " For the cultural heritage", "On monuments of the categories I and II, property of non-state entities, the state bears all the costs for maintaining the historical-artistic values, which are not related to the sustainability of the facility. Other works of restoration of these monuments are covered to the extent:
a) 60 percent of the state and 40 percent by the owner, for the monuments of first category;
b) 30 percent of the state and 70 percent by the owner for the monuments of second category ".
The payback time of internal cost is from 0.6 to 5 years.

6. Recomandations

Rehabilitation of buildings should be made not only based on the principles of conservation of cultural and architectural heritage, on revitalization that consist on bringing back their former functions, but at the same time to enable the creation of a new face of buildings, giving them new functions in the light of the highest and best use, that will result in favor of the owner. This will be a good attempt to converge the individual and collective interest.

In order to enable the provision of necessary funds for rehabilitation or restauration primarily should be used all the instruments the law recognises, such as financing of external works from the state and interior works partly by the state and partly by owner; intervention at financial institutions to ensure for the owners long-term soft loans, the loan interest payments from the state.

In the present conditions that passes the country, finding funds to enable the rehabilitation project, is a very difficult task for the individual as well as for the state. In these conditions has to be proposed and found new schemes for management of the rehabilitation project.

So, one proposal can be the interior cost can be covered by the city hall , which will then gather all the rents, or half of them until the costs have been settled, or it doesn't take the rents but sets taxes instead.

Cultural heritage preservation is a partnership endeavor, requiring the support and participation of large numbers of interested parties, including governments, donor organizations, and the surrounding population. Proper maintenance and management of the region's cultural heritage assets can positively affect the quality of life through a wealth of channels-economic, cultural, spiritual, and educational [11]. A third party, investor or private construction firm, undertakes work and gathers the leases to the full extent or partially until the debt without interests is repaid, while in turn the investor receives from the state facilities in the exercise of the activity, within the legal framework.

Bibliographical References

[1] Europian Valuation Standards, Seventh Edition, TEGoVA, 2012

[2] International Valuation Standards Committee, August 2007, IVC

[3] The Allen Consulting Group 2005, *Valuing the Priceless: The Value of Heritage Protection in Australia*, Research Report 2, Heritage Chairs and Officials of Australia and New Zealand, Sydney.

[4] Convention concerning the Protection of the World Cultural and Natural Heritage 1972 http://portal.unesco.org/en/ev.php-URL_ID=13055&URL_DO=DO_TOPIC&URL_SECTION=201.html

[5] Council of Europe Framework Convention on the Value of Cultural Heritage for Society http://conventions.coe.int/Treaty/en/Treaties/Html/199.htm

[6] Hugo, Victor, *"Guerre aux démolisseurs!"*, in Littérature et Philosophie mêlées, Paris: Laffont, 2001 [1834], p.188.

[7] Decision of the C M no.238 dated 23.03.2011, "Civil Code of the Republic of Albania", Official Journal of the Republic of Albania No. 53, 7 May 2011, edition of the National Assembly

[8] Law no. 9048 dated 07.04.2003, "Civil Code of the Republic of Albania", Official Journal of the Republic of Albania No. 33, May 2003, edition of the National Assembly

[9] ftp://samos.univ-paris1.fr/pub/mse/cahiers2003/R03102.pdf

[10] http://www.panorama.com.al/thomo-monumentet-restaurimet-behen-nga-joprofesioniste/

[11] World Bank. 2001. Cultural Heritage and Development : A Framework for Action in the Middle East and North Africa. Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/13908 License: CC BY 3.0 IGO.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Pompeii - World Heritage Site: the buffer zone, urban structures and spaces of collective interest

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In 1997 UNESCO declared Pompeii World Heritage Site "considering that the impressive remains of the town, buried by the eruption of Vesuvius in AD 79, provide a complete e vivid picture of society and daily life at a specific moment in the past that is without parallel anywhere in the world". The archaeological site of Pompeii is a very fragile site, its integrity is threatened constantly by natural and anthropogenic risks, as demonstrated by the state of conservation of many of its monuments. The biggest challenge in the new millennium is not only to protect and enhance the archaeological site of Pompeii, but also improve the overall enjoyment. This means making the World-Heritage as a heritage of the city of Pompeii and its inhabitants. The protection of the site from the processes of urbanization of the area, the preservation and enhancement of its relationship with the landscape will be possible through the creation of a complex "buffer zone" capable of preserving the archaeological site and its historical and cultural value, and at the same time able to serve as a ecological connecting element of the environment system and as an urban public space with services and functions for its citizens and visitors.

Keywords: pompeii, world heritage site, buffer zones, urban public space

1. Pompeii: ancient city and modern town. Territorial analysis and development opportunities

In 1997 UNESCO declared Pompeii World Heritage Site "considering that the impressive remains of the town, buried by the eruption of Vesuvius in AD 79, provide a complete e vivid picture of society and daily life at a specific moment in the past that is without parallel anywhere in the world".

The archaeological site of Pompeii is a very fragile site, its integrity is constantly threatened by natural and anthropogenic risks, as demonstrated by the state of conservation of many of its monuments. The large surface exposed area, tourist pressure, the inadequate supervision and the inherent structural weakness of the site exacerbate the harmful effects of the risks from natural sources such as volcanic risk, seismic risk, hydro-geological and meteorological risk. During the last five years, in the archaeological area, there have been numerous collapses because of water infiltration caused by bad weather combined with poor maintenance of structures. In 2010, along *Abundance Way*, the *Schola Armaturarum* is totally collapsed upsetting the international community and forcing the European Union to fund a massive project for the conservation and management of archeological site. After the famous school of gladiators many other monuments have been damaged, although less severely, like *Villa* of *Loreio Tiburtino*, *Villa* of the *Mysteries*, *House* of *Venus* in the *Shell, House* of the *Moralist, House* of the *Small Fountain, Tomb of Lucius Publicius Syneros* and *the Temple of Venus.* It is, therefore, of fundamental importance that are started restoration projects aimed at halting the degradation of buildings, both in terms of architectural and decorative, combined with mitigation of landslide risk through new systems for water drainage.

However the biggest challenge in the new millennium is not only to protect and enhance the archaeological site of Pompeii, but also improve the overall enjoyment. This means making the World-Heritage as a heritage of the city of Pompeii and its inhabitants.



Fig. 1: Archaeological site of Pompeii: damages from 2010 to 2014

World Heritage Site

Buffer zone Unesco

Entrances

Damaged monuments

1. Schola Armaturarum - 6/11/2010
2. House of the Moralist - 30/11/2010
3. Villa of Loreio Tiburtino - 21/12/2011
4. House of Venus in the Shell - 27/2/2012
5. Villa of the Mysteries - 8/9/2012
6. House of the Small Fountain - 2/12/2013
7. Temple of Venus - 3/3/2014
8. Tomb of Lucius Publicius Syneros - 3/3/2014

The territory of the Municipality of Pompeii, unique in the world for its cultural, archeological, architectural, naturalistic and landscape richness, was strongly affected by phenomena of conurbation associated with illegal housing and high population density. This settlement density and the land consumption associated has saturated the area actually blocking the socio-economic development. The area seems a chaotic mosaic in which different "town" (industrial and agricultural areas, residential areas, areas of high historical and environmental value) coexist without an apparent urban planning rule. It therefore seems necessary to control the development of the areas around the archaeological site, in order to protect the cultural heritage of Pompeii, but it is also essential to maintain the visual relationship between the ancient city and the Vesuvius. We need to enhance the environment and the landscape that characterized the ancient Pompeii to protect the cultural values of the territorial system of modern Pompeii.

The protection of the site from the processes of urbanization of the area, the preservation and enhancement of its relationship with the landscape will be possible through the creation of a complex "buffer zone" capable of preserving the archaeological site and its historical and cultural value, and at the same time able to serve as a ecological connecting element of the environment system and as an urban public space with services and functions for its citizens and visitors. Urban structures and spaces of collective interest, that will develop along the new buffer zone, must meet appropriate performance characteristics and be equally accessible to all citizens and users of the city, so that the needs of individuals are fulfilled and the primary objective of safeguarding World Heritage Site for transmission to future generations is achieved.

The involvement of local communities in decision-making will be fundamental for the protection, conservation, enhancement and sustainable development of the territory. Through the active participation of citizenship is possible to improve the sense of belonging of the local population in the cultural values of the area and eliminate the condition of "marginalization and isolation" of the archaeological site from the urban center.

The realization of a new buffer zones will also allow a better fruition of the site for the visitors. The interventions in the outside area the archaeological site will concern primarily the redevelopment of the entrances, which will represent the "City Gates" on the site, and the creation of a system of paths that can effectively accommodate the flow of tourists. The equipments, which will be hosted by the new buffer zone, will have to be achieved with lightweight structures, removable and environmentally friendly in such a way that they can be replaced in the future for a change of use of the area. These structures should not only be at the service of tourists (picnic areas, rest areas, bookshop, info-point and so on), there also will be public spaces that contribute to promote social networks between citizens of Pompeii and strengthen their relationship with the archaeological site.

To make stronger the link between the archaeological heritage and the city it's also necessary to create a "visual contact" with each other. Through the paths that will develop along the buffer zone, tourists and citizens can see the ruins of Pompeii, so symbolically the new town embraces the ancient city recognizing it as part of itself.

Now unfortunately many visual barriers surround the archaeological site, contributing, together with the urban problematic situations described previously, to its isolation from the urban context.

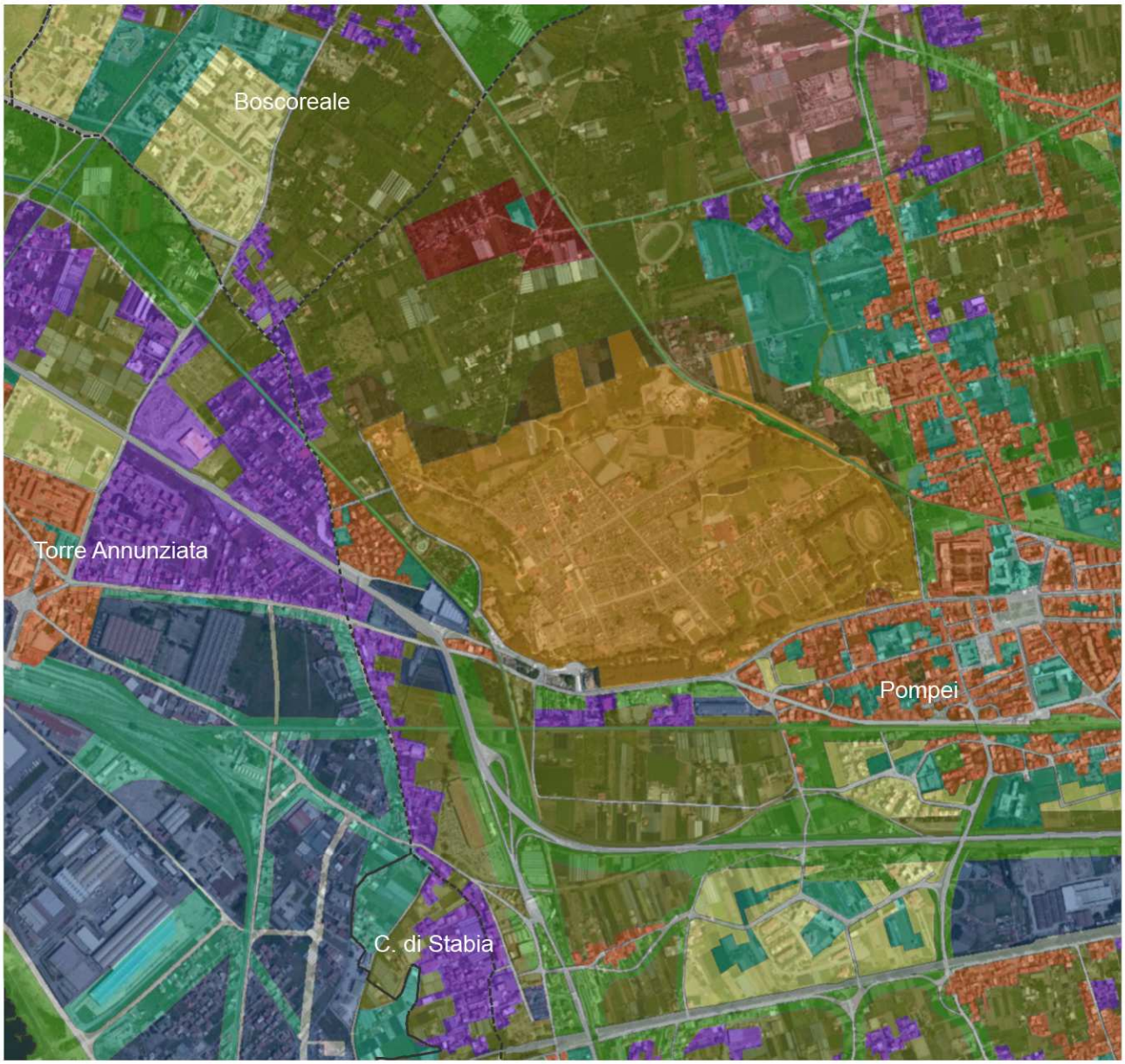


Fig. 2: Municipal Planning (P.R.G.), zoning_1:20.000

- Municipal limits
- Urban center
- Completion zone
- Expansion zone
- Industrial and commercial zone
- Agricultural zone
- Urban functions
- Agricultural zone of archaeological respect
- Archaeological area of Pompeii
- Widespread building
- Urban green spaces
- Cemetery area
- Roads

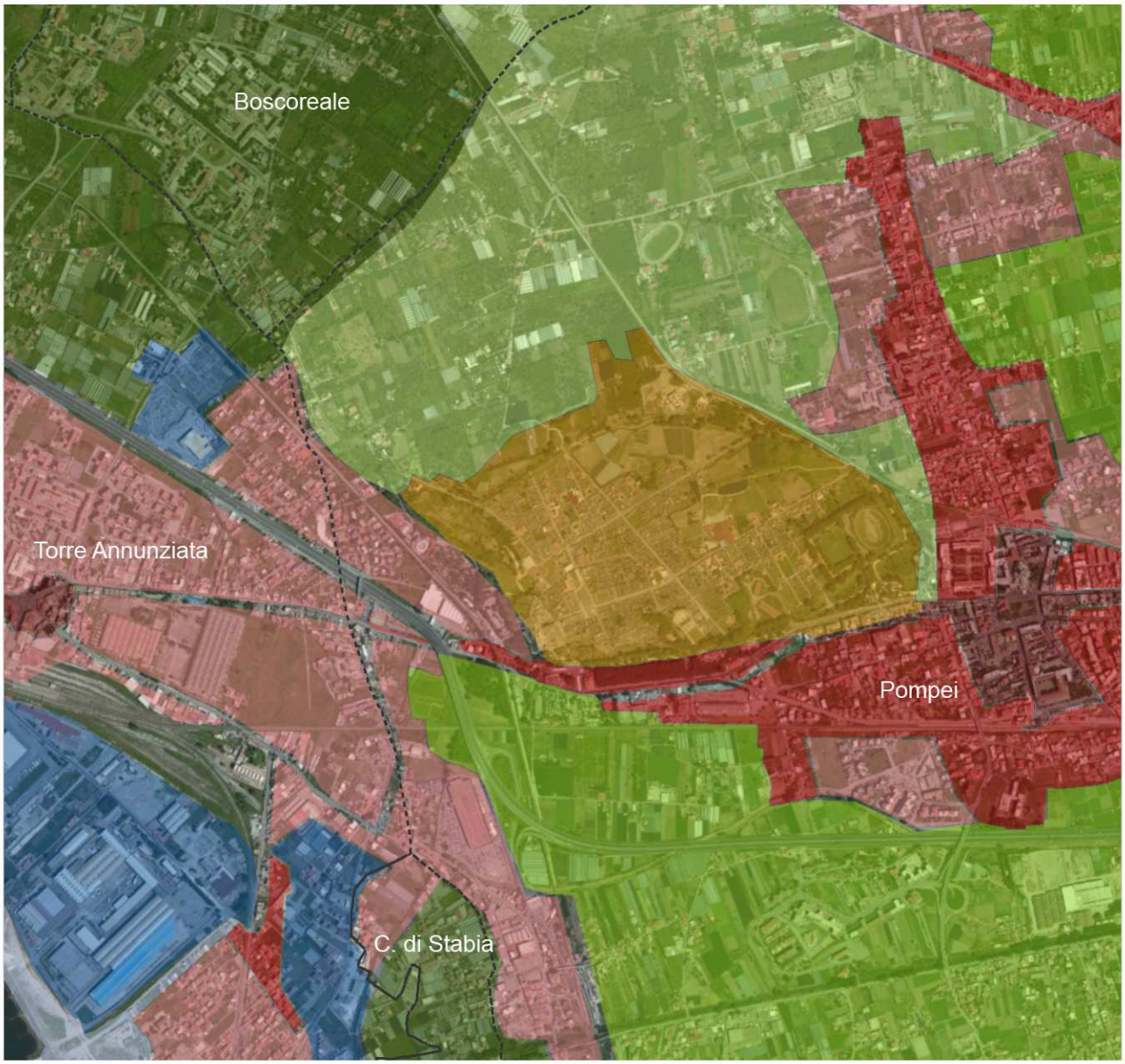


Fig. 3: Regional Planning (P.T.C.P.), zoning_1:20.000

- Municipal limits
- Historical centers
- Consolidated urban settlements
- Urban and environmental consolidation areas
- Archaeological area of Pompeii
- Productive settlements
- Ordinary agricultural areas
- Peri-urban agricultural areas
- Areas of special landscape
- Special landscape areas to requalify



Fig. 4: Urban areas close to archaeological site of Pompeii

2. The buffer zone as a new ecological system of public space

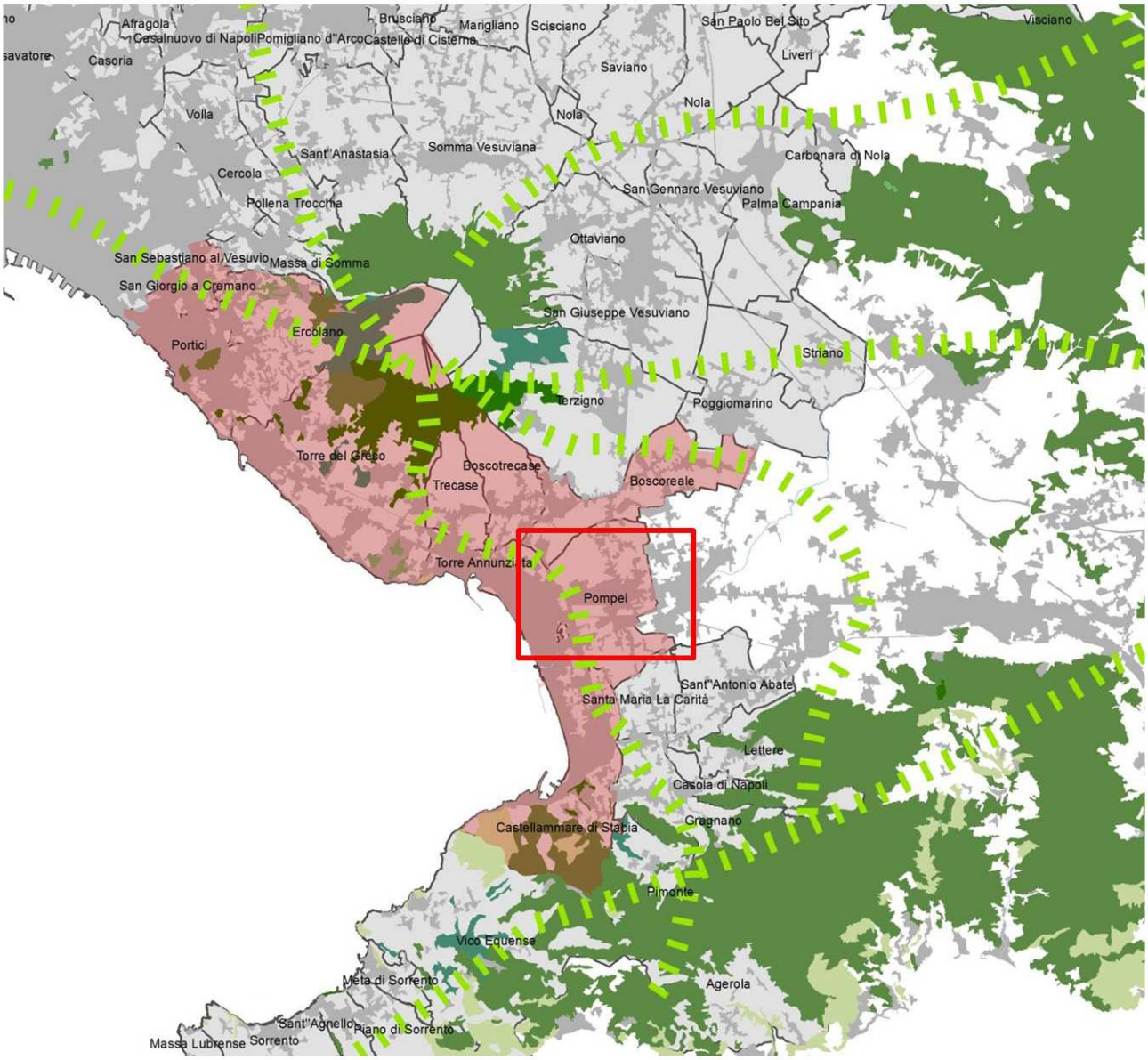
The environmental issue is now on the agenda of municipalities. The idea of a innovative buffer zone, which is not a mere obligation for safeguarding the archaeological site but that will enhance its importance, its centrality, it could allow to experiment on a part of the urban area the ideas, the technologies and urban development processes that promote environmental sustainability.

The archaeological site of Pompeii does not currently provide for a real buffer zone, with the exception of the site of the Villa of the Mysteries, leaving the site in a state of apparent calm that comes out from the logic and processes involving the city. An active buffer zone, functional to urban life, in the service of citizens and visitors but also capable of "mending" the fractures present in the system of ecological networks. A "continuous" and "adaptive" public space able to accommodate functions that are currently lacking in the city. Temporary functions compatible with the nature and the space of places. The city regains its configuration, its identity and its attractive power in the public space. The city of the future has to start, becoming creative and global, from the redesign and rethinking of these spaces. The buffer zone, understood as a new public space for the city and citizens, is the site of the new urban design, assuming a central importance in the dynamics of development of the city. The "zero volume architectures" [1] are the lifeblood of the new urban project, based on the enhancement of landscapes and ecological dynamics that characterize them, which opens to a new season and new design scenarios. The urban ecosystem is shaped and formed, it is enhanced by biodiversity, social life and new urbanity in these places and in their rediscovery.

A crucial process of development and "mending" based on green and blue infrastructure, on the system and the efficiency of a "red" infrastructural network [2] that enhances public transport, on creating a functional "mixité" able to regenerate the sites. The complex system of green or blue ecological networks becomes the material of the project "for" the soil. It becomes basic tool on which to focus the guidelines which outline the choices on which shape the future. An "ecological - landscape" approach allows to develop concretely what has been enshrined in the European Landscape Convention, in which the landscape is defined as an essential component of the context of life of the people, an expression of the diversity of their shared cultural and natural heritage and foundation of their identity. The transition to an eco-design is not just a "greening" of our model of today's society but is a new model of economic and social development to renew our ways to consume, produce, work and live together. This transition leads to a rational and efficient use of all land resources in response to industrial, environmental and climatic risks.

The objective is to integrate, innovate, make urban design a tool capable of transforming territories. A tool capable of increasing their capabilities of attractions, the intrinsic potential. Being able to operate at multiple levels, multiple scales where the improvement of quality of life and enhancement of the landscape remain the central objectives. In this way the buffer zone is no longer a constraint but an opportunity for transformation and development; the basis of an integrated urban design, with an eye to many and different scenarios, that exceed simplistic paradigms of zoning. Thinking on this logic, the possibility is to make the buffer zone a place with its own identity but at the same time be able to relate the city, its shapes, its material and immaterial networks, with its historical and cultural heritage.

The city of the future needs new tools so that it can be a reality. The case study is an emblem of a thought linked to do urban planning and not just to imagine it. Environmental issues, to which we give more and more a character of random disasters, are the target on which to focus the choices of development and urban planning, an renovated urban planning. This is the key for opening up new perspectives of social, economic and ecological development of the territories.



Ecological corridors

Urban areas

Blue infrastructure

Green infrastructure
Core Areas

Renaturalized areas

Areas with vegetation sclerofila

Areas with vegetation sclerofila

Coniferous forests

Deciduos forests

Mixed forest
(great value of biodiversity)

Fig. 5: Strategic scheme of ecological connections on project areas of Pompeii

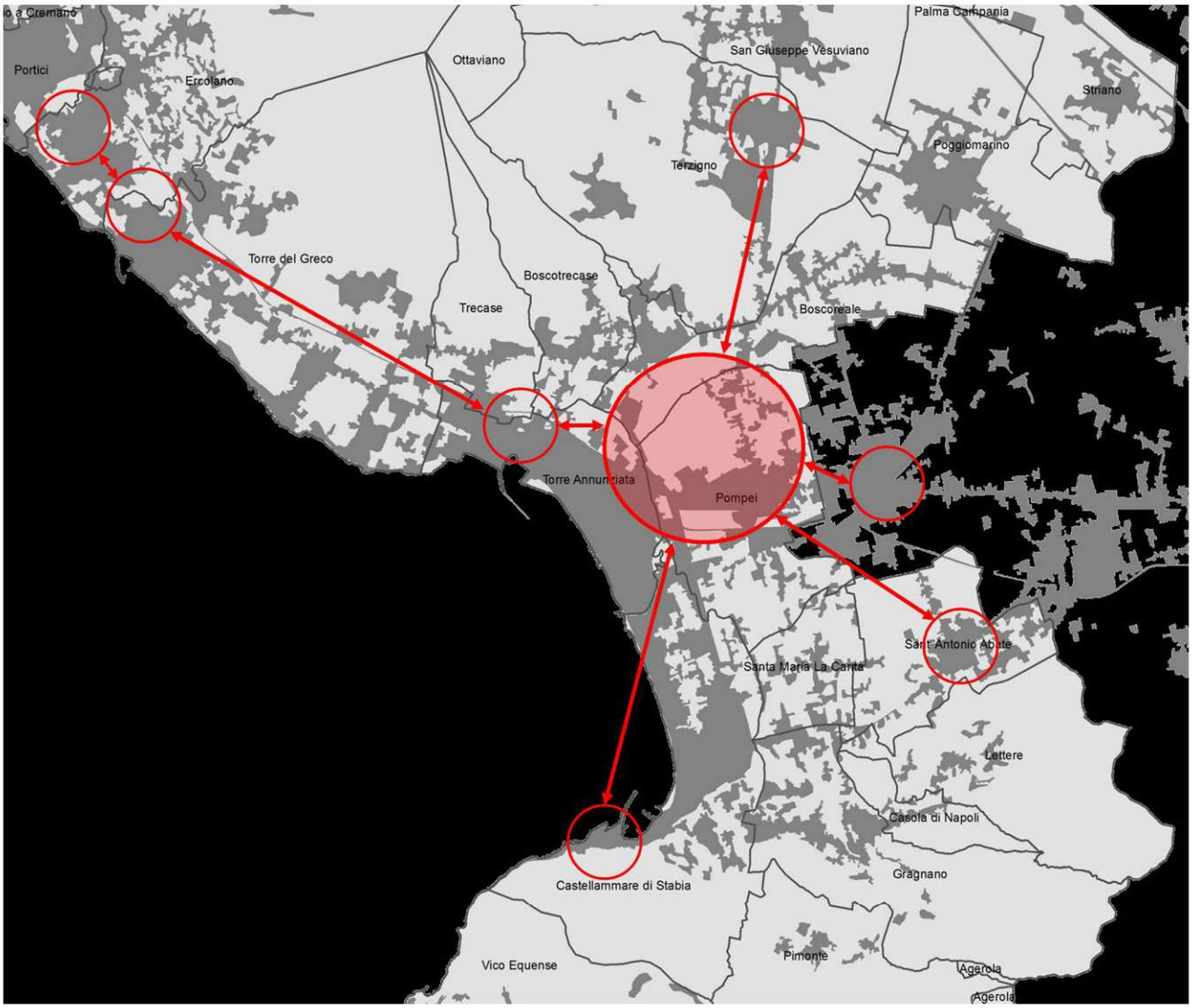
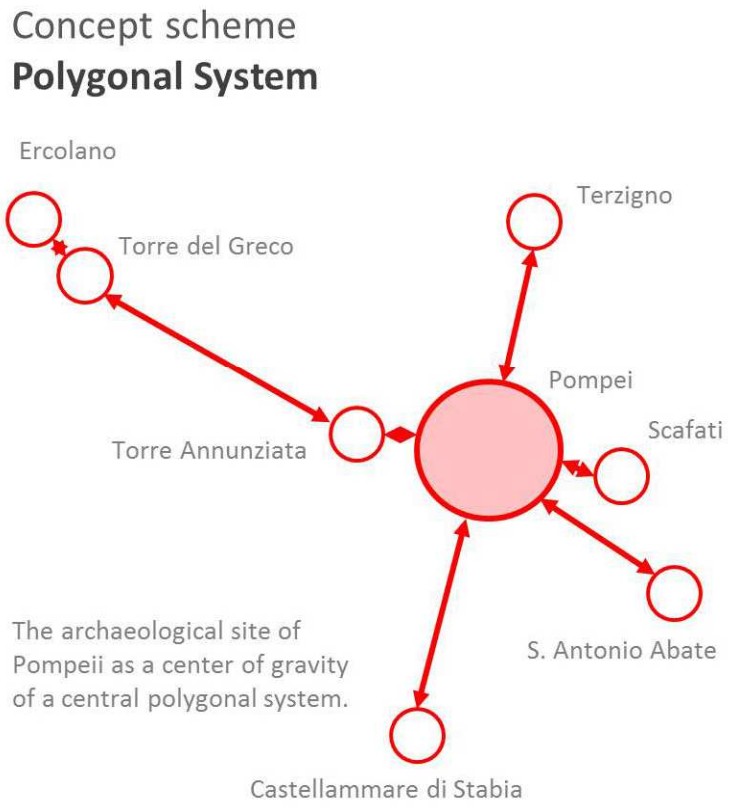


Fig. 6: Concept scheme of the urban system with the "new gravity center" of buffer zone in Pompeii



Notes:

[1] Aldo Aymonino, Valerio Paolo Mosco (2006), *Spazi pubblici contemporanei. Architettura a volume zero,* Skira, Milano

[2] The term "red infrastructures" comes from research paper "Ecological dimension. A research on new materials of the urban project" and it identifies the infrastructural system created by man (highways, roads, railways, airport hubs, ports, transport and energy production infrastructure) that follow, in the processes of territorial transformation, different trajectories from green and blue infrastructure, not-integrating and leading to environmental very serious imbalances. The term "red" strives to emphasize their importance and their close link to the green and blue networks for the territorial planning.

Bibliographical References

AA.VV. *The landscape urbanism reader.* New York: Princeton Architectural Press, 2006. 295 p. ISBN 9781568984391

AA.VV. Atlante dei paesaggi riciclati. Milano: Skira, 2014. 336 p. Architettura. Dossier. ISBN 885721148

AA.VV*. Progettare paesaggio. Landscape as infrastructure. A studio research report of the harvard graduate school of design*. Roma: Gangemi Editore, 2011. 224 p. ISBN 9788849221848

AA.VV*. Landscape. Between conservation and transformation*. Roma: Gangemi Editore, 2013. 128 p. Architettura, Urbanistica, Ambiente. ISBN 9788849227826

AA.VV*. Paesaggi culturali. Rappresentazioni, esperienze, prospettive-Cultural landscape*. Roma: Gangemi Editore, 2008. 271 p. Architettura, Urbanistica, Ambiente. ISBN 9788849214918

CARTA, Maurizio. *Ripensare l'urbanistica-Reimagining urbanism.* Roma: List, 2014. Babel. ISBN 9788898774197

FRANCESCHINI, Alessandro. *Sulla città futura*. *Verso un progetto ecologico*. Roma: List, 2015. 112 p. Tempi e Temi. ISBN 9788898774104

GAMBARDELLA, Carmine. *Atlante di Pompei*. Napoli: La scuola di Pitagora editrice, 2012. 592 p. La fabbrica della conoscenza. ISBN 9788865421710

GASPARRINI, Carlo. *In the city. On the cities.* Roma: List, 2015. 391 p. Babel. ISBN 9788898774357

JAKOB, Michael. *Il paesaggio*. (Translated by GHERSI). Bologna: Il Mulino, 2009. 142 p. Universale Paperbacks il Mulino. ISBN 9788815130495

MARINONI, Giuseppe. *Urban landscapes strategies*. Milano: Studio Marinoni Own Publishing, 2012. 192 p. European Practice. ISBN 9788890777318

MOSTAFAVI Mohsen. DOHERTY Gareth. *Ecological urbanism*. Zurich: Lars Muller Publishers, 2010. 656 p. ISBN 9783037781890

RICCI, Mosè. *Nuovi paradigmi.* Roma: List, 2012. 224 p. ISBN 9788895623641

VIGANO', Paola. *La città elementare*. Milano: Skira, 2002. 208 p. Biblioteca di architettura. ISBN 9788881186426

VIGANO', Paola. *Territorio dell'urbanistica. Il progetto come produttore di conoscenza.* Roma: Officina Edizioni, 2010. 398 p. Architettura/Urbanistica. ISBN 9788860490773

Referring Web Pages Web: http://www.beniculturali.it

http://www.ilmattino.it

http://pompeiiinpictures.com

http://www.landscapeandurbanism.com

http://www.urbanisten.nl

http://ecologicalurbanism.gsd.harvard.edu

http://www.isprambiente.gov.it/

HERITAGE and TECHNOLOGY
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Building techniques in the Umbrian Middle Ages: from history to conservation

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Abstract
Umbria has a great, widely known, art and architectural heritage. Throughout the entirety of the Middle Ages, the unique geography and strategic location of this region promoted the development of a prolific architectural culture while the succession of various sovereignties left behind compelling civil, military and religious buildings.
Systematic scientific investigation into the building techniques of Umbria in the Middle Ages has never been conducted despite the extensive studies focused on the monuments of this area.
The aim of the present research is to identify successive techniques within the evolution of the building methods along the *via Flaminia*, in particular in the Umbrian region in XII and XIII centuries. The results are based on surveying and analyzing the masonry from the Middle Ages starting from the examination of the building materials used to their modifications and typologies.
The current study is focused on architectural conservation and restoration and intends to extend the life of Umbrian architectural heritage while facilitating the understating of said patrimony through the promotion of its authenticity. Quintessential factors of this study, therefore, are the recognition and conservation of the building material. To this end, the analysis of the masonry becomes a fundamental instrument in the understanding of the subject itself and is a necessary element in the preservation of the entire architectural discovery.

Keywords: Building tecniques, Middle Ages architecture, Umbria, masonry, conservation

1. Boundaries of present research
In Umbrian building people can observe the homogeneous materials, among which the pink or white carbonate rocks, named by geologists as “Scaglia Bianca and Scaglia Rossa Units”, are the most utilized. The Scaglia Units outcrop largely in the Umbrian Apennine chain were used because it is very workable and generally the thickness of the single calcareous bed is adequate to create medium size ashlars.[22]
The use of Scaglia Units limestones, cut according to the needs, represented the easiest way to build external walls; moreover the natural fracturing of Scaglia into fragments (from decimeter to centimeter in size) provided the raw material to be included inside of the walls, as early as Roman times and then continued until the whole Middle Ages.
The above rock was cut into reasonably regular blocks and it was probably used as a facing for stone work throughout the Middle Ages, starting from the late ancient masonry of the northern way that leads to the Otricolean Collegiata coming to the full gothic buildings of S. Francesco in Assisi and in Gubbio.
The building technique that continues the traditional Roman methods shows three-section raised walls, in turn made of barriers of more or less squared blocks and an internal *nucleus*.
This is a preliminary work, that is part of a the larger research I started with my PhD. Present exposition is not intended to be complete or exhaustive, but it can give preliminary results oriented to obtaining the interpretation of styles of Umbrian architecture and characterized by the Medieval building phases. This topic is undoubtedly intriguing and rich in interest; it has not been systematically studied in Umbria, despite the intensive studies performed in other Italian regions.

In order to circumscribe the field of interest of the present study from a historical and territorial point of view, I will describe the temporal and spatial influence of the above cited technique of masonry with scaglia rocks.



Fig.1: Evolution of the building techniques from the XII to the XV century. St. James's church masonries, in Foligno (PG)

1.2 Umbrian history

The orography and its central position in the Italian peninsula give Umbria a strong dualism.
In the pre-Roman period we can recognize the first evidence of the double identity of this territory. The river Tiber historically splits it into two areas: the right one is the Etrurian part, that gives close contacts with Tuscany and the Tyrrhenian sea and on left we find a territory in which the Umbrian people are isolated and with limited trading and cultural exchanges with neighboring people. Augustus also decided to split this territory into at least three parts and identified the name of Umbria with an area larger than that at present called Umbria. The *Regio IV* Augustea consists of two sub regions separated from each other by the Apennines to the west of the Umbrian mountains. Perugia was located in Etruria – *Regio VII*- and Norcia was put into Sannio – *Regio IV* - and the Umbrian *Regio VI* extended its territory to Otricoli and the Cosentino; to the east the *Regio VI* reached up to the so called "*ager gallicus*" including Rimini and Ancona. In the III century, the administrative re-organization made by Diocleziano caused the loss of administrative unity in the region. The name itself of Umbria disappeared in the XV century.
The decline of agriculture, the crisis of the urban structures existing along the major connecting roads due to the barbaric invasions of the Visigoths and the Ostrogoths coming in quick succession, as well as the Byzantine and Longobardic conquest, which further fragmented the the forementioned territory during the V and VI centuries. The Longobardic invasion also caused divisions: the Spoletian dukedom belonged to the Longobardic dominion, whereas a narrow belt of territory was created and defended by the Byzantine Esarcatos in order to connect Rome with Ravenna. Thus Perugia, Gubbio, Orvieto, Narni, Amelia and Todi, that were in the above cited belt, belonged to the eastern Roman Empire.
This is why, during the entire Middle Age, the ancient name of this region, which indentified the territory of the Umbrian people and which in the Augustean age was the *Regio VI*, disappeared. The ancient name reappeared only at the end of XV century thanks to the humanist Flavio Biondo, who describes " the region named Umbria by ancient people and the dukedom of Spoleto by modern people".[13]
Umbria thus became an administrative and regulatory unit only in rather recent times. This region maintained a deep cultural division that is still visible through the evidencies coming to us from the historical heritage. This fragmentation is attested by both structure and typology of our findings.

1.2 Territory

The use of similar building techniques during the whole Middle Ages, which are based on similar structures and materials of the masonries, is closely connected to the presence of the *via Flaminia*.
The layout of this consular road connects Rome to northern Italy around 220 B.C. in obedience to Caius Flaminius. This road was built by readjusting and joining several pre-existing segments in the Veian, Capenian and Falerian districts.[9]
The Flaminia way started from the Servian walls, directed to the north-east and going up to the Tiber.
The first segment joined the city of Rome with very important towns such as *Faleri Veteres* (Civita Castellana), *Ocriculum* (Otricoli) e *Narnia* (Narni). From *Narnia* to *Forum Flamini*, *via Flamina* had two branches: the 1st branch went on towards *Interamna* (Terni), reaching *Forum Flamini* through *Spoletium* (Spoleto) and *Fulginium* (Foligno). The second branch followed the old layout, passing through the towns of

Carsulae (San Gemini), *Vicusad Martis* (Massa Martana) e *Mevania* (Bevagna) to arrive in *Forum Flaminii* (San Giovanni Profiamma).
After *Forum Flamini* and *Ponte Centesimo via Flaminia* reached *Nuceria Camellaria* (Nocera Umbra), *Tadinum* (Gualdo Tadino), *Helvillum* (Fossato di Vico) and crossed the Appennines at *Ensem* (Scheggia). After *Ensem*, the road descended towards the Adriatic cost along the Metauro valley passing through *Luceolis* (Cantiano), *Vicus Cale* (Cagli) and *Forum Sempronii* (Fossombrone) arriving at *Fanum Fortunae* (Fano) and *Pisaurum* (Pesaro). *Via Flaminia* was prolonged to *Ariminium* (Rimini), finishing at the Augustean arch.[11, 20]
In the Middle Ages *via Flaminia* was also named *via Ravegnana* because it connected Rome with the properties of the catholic church in Latium, Umbria, Marche and Romagna.
This road allowed continue exchange of knowledge and the survival of material culture, even during times of deep crisis.

3. Umbrian masonries continue the Roman techniques

In order to study the Medieval building techniques, it is worth studying and analysing the Roman methods from which the Middle Ages techniques derive.
The Roman building technique is the basis of the techniques developed during the Middle Ages and also after the Middle Ages. This is true in the majority of territories, which were part of the empire. The case of Umbria is particular. In Umbria the link between Roman and Middle Age techniques is particularly strong, hence it is often difficult to establish when an old - roman- technique finishes and when a new method starts by the unique means of the sole direct analysis as we can see in the instance described by Maria Romana Picuti: masonry done as an *opus vittatum* with facade of small blocks of white limestone coming from I century B.C., found in the archaeological site of Cancelli in Foligno.[18]
The above architectural affinity, structural as well as formal, is particularly clear when we compare the *opus vittatum* of the roman defensive walls, still visible in Spello, Bevagna, Gubbio, Assisi, Spoleto and Todi, to the Medieval block facing masonries. Actually the Middle Ages methods resume the structure of the Roman walls, with rubble masonries with thick cross section and blocks and horizontal recurrence for facing.
The earliest examples of Roman masonries can be found in the defensive walls of Amelia, Spoleto, Perugia, Todi, Cesi, Narni and Trevi, done with a poligonal plant, successively with a square work in *opus siliceum* and subsequently from the structures in *opus quadratum*. The cited structures are anyway present only in the territories of Etruscan origin. The similarity between Roman and Middle Ages buildings, that sometimes can only be due to the use of same materials, may however be only apparent, because of the internal structure of the wall that is totally different. Roman masonry are made with poligonal or squared stony blocks joined without mortar, whereas the Medieval buildings show more complex cross-sections.
The affinities between the Middle Ages methods and the Roman technique of *opus reticolatum*, the major examples of which we can see in the towns of Gubbio, Otricoli, Assisi e Todi, are more intriguing than the apparent affinities that can be found in the territories of Etruscan origin.[12]
Besides the formal differences due to the materials of blocks, its positioning and dimensions, we can recognize important internal similarities due to a complex cross section of the walls, formed by an internal cement core and external faces. These characters were assessed in the mansonry of romanic age which appeared during the archaeological excavation undertaken in 2014 in the Abbey of Sassovivo.

4. Building techniques in the Umbrian Middle Ages

4.1 The study method

The method of our analysis is meticolous, it does not destroy the objects submitted to analysis and is centered on the material appareance of the buildings, by reading the physical marks left on the masonry.
To this end we sometimes made use of stratigraphic analysis, a method we can adopt without limits of time, even when the building has no artistic value but the value of this building remains as a document of the social, civil, economic and cultural historical environment from which it comes to us.
Stratigraphic reading actually allows the interpretation of the evolution which the cultured architecture and the construction engineering of ancient buildings underwent. It is worth noting that modern architecture, too, shows an evolutionary trend, when it is characterised by a succession of building phases and interventions.
The stratigraphic method, when employed to analyse the front masonry, takes advantage of the analytical techniques developed by the archaeological research in order to achieve a careful examination of the subsoil layers, following the Harris principles.[10] This researcher actually developed stratigraphic sequencing and the related diagrams - also called matrix - that are now often used by researchers.
In order to attain the required purposes, the present study is structured in four sequential sections, each preceded by a punctual check of the study status.
Phase 1 - Determine the monuments of major interest to provide documentary evidence about the various Middle Age building types in Umbria, through the analysis of written and iconographic sources.
Phase 2 - Reconnaissance and study of part of the facades of the selected monuments, by means of

surveying and photographic pictures of 1x1 mt. If necessary, in order to make further examinations, the analysis of material sources includes sampling of mortar for related analysis. In phase 2 it is necessary to perform all the direct studies such as the architectural and stratigraphic evaluations, the measurement of single elements for metrologic analysis, the investigation of nature, colour, consistency of materials, the evaluation of eventual degradation or corrosion. The latter evaluation is important if linked to the nature of the studied building.
Phase 3 - Selection of more important samples and synthesis of types of materials to be conserved and catalogued. A cognitive synthesis will be carried out, to arrive at the final cataloguing of at least one sample of each detected building technique, based on the analysis of all the materials, found during surveys. Criteria for detecting the continuity gaps among the various masonries will be the change of technical/technological characteristics relevant to materials and building methods, and also of the physical and chemical character of the ground. To this end we must take into account the regional history, the production methods and cycles and the empirical knowledge.
Phase 4 – drawing up the records of the masonry samples and mapping of the homogeneous masonry, with chronological order of samples. The chronological categorization can be obtained by comparison of the direct and indirect studies.

4.2 Characters of Umbrian stones
The Umbria stones, designed as building materials and specifically of limestone rocks, include a variety of lithotypes belonging to what geologists call "*Successione stratigrafica Umbro-Marchigiana*".[9]
As briefly reported in cap.1 the geological structure of the Umbria region, characterized from the vicinity of the carbonatic Apennine Chain to the east, offered great opportunities for opening of quarries and or exploitation of natural outcrops of limestone rocks, where it was possible to extract the raw material to be used in construction.
The carbonate materials exploitable in the Umbria region belong to types of rocks that have been formed in a temporal space between the Jurassic and Eocene (from about 190 to 35 million years ago) as accumulation of small sedimentary particles in marine environments.
The rocks formed during this geological period are mainly composed of calcium carbonate, and rich in fossils remains (micro- and macrofossils) as evidence of organisms that inhabited the ancient marine environments.
The largely used lithotypes are the Scaglia Bianca and Scaglia Rossa limestones, followed by the Calcare Massiccio, Corniola, Rosso Ammonitico, Maiolica, and Calcari Diasprigni.
The petrographic characters of the aforementioned lithotype are briefly illustrated with particular attention to the features for thickness of the strata, color, compactness and ease of cutting.
Calcare Massiccio: white limestone with common fossil fragments, massive strata variable in thickness from 1 to 3 m. Difficult to dig that to work, its use is rare but documented in some monumental works of the Via Flaminia[25] (Ponte San Giovanni de Butris, Acquasparta, TR; Ponte Grosso di Ponte Riccioli, Cantiano, PU).
Corniola: light grey to light brown limestone with common fossil fragments, compact strata with thickness variable from 1 to 0.50 cm; in some outcrops of Corniola are present also light pink strata rich in fossil fragments. The Corniola limestones contain nodules of gray chert, very useful for the field recognition of this lithotype. This lithology was utilized commonly together with the Calcare Massiccio for the building of bridges, severages and viaducts along the Flaminia Road, in both the Umbrian and Marchean stretchs. A large use of Corniola for ashlars of various sizes is recognizable in Roman and medieval buildings. The light colour, the compactness, the absence of porosity, and the good workability made this lithotype very attractive.
The Calcare Massiccio and the Corniola Units constitute the central ridge of the Umbria-Marche Apennines.
Rosso Ammonitico: red nodular limestones, with some thin layers of red clays; the thickness of strata is of about 5-20 cm. Utilized for building of severages along the Flaminia Road and for plate and long architectural elements (pavements, thresholds and steps) during Roman and medieval ages.
Calcari Diasprigni: lithotype characterized by limestone rich in siliceous microfossils and common lens of gray-green chert. The thickness of strata is variable from 5 to 10 cm and because of the reduced thickness this lithotype was rarely used. This material is quite fragile and tends to fracture into fragments of a few centimeters that have found their use as material for filling of masonry. This lithotype has rarely been used as elements in view of the masonry.
Maiolica: white limestones, strata of 30-40 cm in thickness, presence of dark grey cherty nodules; this lithotype thanks to its compactness and its colour has been widely used for bridges of Flaminia (Ponte Spiano, Sigillo, PG and Ponte San Giovanni, Fossato di Vico, PG).[25] Also in Middle Ages the Maiolica ashlars were largely utilized for external masonry.
Scaglia Bianca: Thin to medium (30 to 50 cm) white to grayish limestones with bands and layers of black chert;
Scaglia Rossa: pink and red limestones, regularly bedded with strata of 10-15 cm thick separated by marly interbeds and with red chert listes and nodules. This lithotype is the most used in Umbria and characterizes

the historic buildings of the city centers. In the town of Assisi exists an architectural constraint which requires the construction of new and the renovation of old buildings exclusively with the Scaglia Rossa.

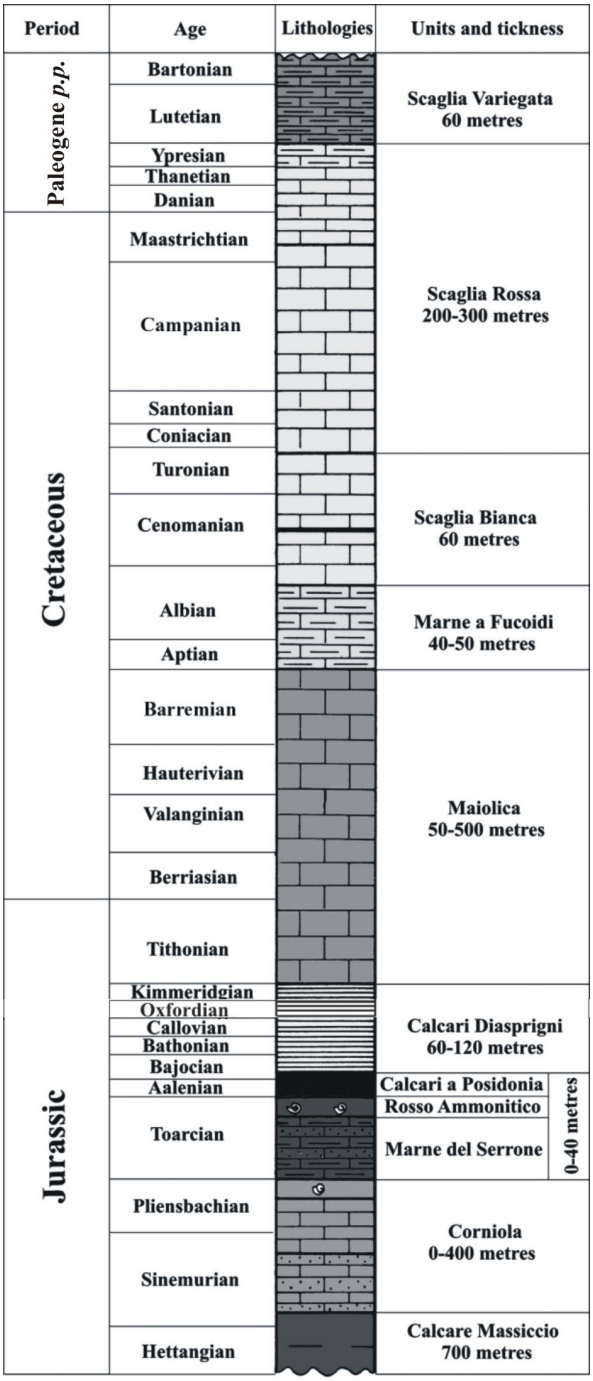

Fig. 2: Schematic column of the lithotypes constituting the Umbria-Marche Stratigraphyc succession.[24]

4.3 The peculiar case of the Sassovivo abbey

The abbey of S.Croce in Sassovivo, founded by benedictine hermit friars in AD 1080 , lies up at about 6 km from Foligno, on the slopes of Serrone Mountain. It is an architectural complex of particular interest and usefulness for the study of building techniques because it is erected on a pre-existing fort and shows a number of building phases that have changed its external aspect and typology several times.

Some of the presented results are part of a much larger research work directed by Prof. Lia Barelli - Dept. of History, Drawing and Conservation, Sapienza University of Rome - and her team. The above studies started on 2012 and are still going on, brought to identification of the supposed extension site of the Middle Ages church; this result was in turn possible because of the archaeological excavation made on spring 2014 directed by the postgraduate School in Monument Conservation under supervision of Maria Romana Picuti and Raffaele Pugliese.

The church is today visible in its eighteenth century shape. Owing the studies carried out by the mentioned teams, it was possible to recognize and set a date to traces of Middle Ages building phases of the church, by combining the research on masonry with the study of archived documents.
The results of Roberta Loreti's analysis coming from the stratigraphic reading of the south west front of the churchyard where traces left by typological changes of the church plan, permit good reconstruction of building phases, from the ancient Romanic structure to the XX century restorations, when related to the masonry coming to light from the archaeological excavation made in spring 2014, thanks to the analysis of structures present above the ground combined with the recently excavated walls.[15]



Fig. 3: The south west churchyard front of the Sassovivo abbey.

The front taken into is made up of masonries that can be interpreted as successive building faces of the Medieval church, the existence of which was verified in 2003 due to the recovery of the ruins of the apse beneath the present choir and confirmed by the recovery of the facade wall in 2014. This wall is made up of blocks of white Scaglia showing different heights with horizontal and parallel rows, it is 1.13 mt. thick at the base; its thickness decreases to 0.88 at the height of 6.85 mt. from the basement. Its original maximal height was 9.70 mt and probably corresponds to the inferior boundary of a plaster layer that luckily remained *in situ*.
The masonry that probably corresponded to the internal nave and is placed on left of the facade imprint, is made of blocks of white and pink Scaglia in almost horizontal rows, formed by lines of variable heights, moreover the horizontal and vertical joints sealing survives.
Differences between the two walls of the same building phase are probably due to difficulties of methods of supplying and working the material.
The Romanic church was prolonged in the XIII century, this can be verified today thanks to the imprints left on the south-western facade. The masonry face of this extension is probably made up of little blocks of white Scaglia with parallel rows; however it is difficult to read, because it is particularly ruined by successive changes. On the bottom we observe several additions due to the restoring done in 1966-68; on top the original wall is completely lost owing to an important intervention made in XVIII century, that is verified by the year 1737 engraved on a brick inserted on the facade. Over the basement of the facade we can still observe a narrow embrasure, the conch shell of which enlarges inwards. This disposition allows us to affirm that this part of the wall was pointed towards an open space placed in front of the church in the XIII century.
Hereafter the Church of the Sassovivo Abbey had an anterior body built on two levels. The perimetral walls of north-west and north-east came to light during the excavation made in 2014. The south western side is, on the contrary, absorbed into wall of the churchyard, where the outline of the added facade remains well visible. These masonry faces are built with blocks of Scaglia, as all the abbey complex is, but with more regular rows.
The use of Sponga stone as a new building material helps us to identify the last change of the Middle Ages that was probably made in the XIV century, when the church had a codification change and some typical elements of the gothic style were adopted. The pre-existing parts were connected giving place to a single nave, which was sustained by arch-diaphragm. We can still observe the divisions because these arches were placed on blocks of Sponga stone, which are still the unique and well identifiable Sponga rocks in all

the building. The use of this peculiar rock was probably due to various reasons: the Sponga rock is extremely workable, so this stone can be used without previous work, the great aptitude of the plaster to stick onto this stone and possibly the proximity of quarries to the abbey.



Fig. 4: Detail of the structure of Romanic masonry from the archaeological excavation made on spring 2014 in Sassovivo abbey.

5. Problems arising from incorrect restoring

The study of the building facades is developed in the setting of conservation and architectural restoration. The aim of this is to prolong the existence and to facilitate the comprehension of the building heritage and to promote the maintenance of its authenticity.

Reading the facade masonry is the main philological pillar for the study of architecture. In the case of minor architecture, which is rarely documented by indirect sources, the analysis of masonry and the examination of every mark imprinted on the building material is the sole tool for reading the text of building codes, thus recognizing and understanding the successive phases of construction engineering.

Often people do not pay the necessary attention to the analysis of layers. This analysis, of which the masonry facades are documents, is however mandatory for the historical, artistic and technical study of architectural products. When the layer analysis is not properly undertaken, the small traces may be ignored or disregarded, thus causing the loss of the informative potential carried by all building material. Hence we lose our history. The analysis of architectural matter becomes an important action aimed at understanding and studying: within the results of the research we find a hidden perspective of restoration and conservation. Elements of peculiar artistic value and evident monumental importance may have a completely different fate in spite of a facade of the same age and with the same history even within the same building, but with less touristic or artistic value.

As Prof. Carbonara states, conservation has to be planned with an accurate study of the original opera and has to be based on solid theoretical and methodological foundation and correct disciplinary principles. It also needs a solid technical and operative capability. The absence of the above prerequisites means submitting the studied object which we wish to conserve to considerable risks.[1]

These statements are relevant in every restoring action, even when the study is limited to apparently minor aspects, as the undressed walls often are considered. As a result of disregarding the apparently minor aspects, we can often miss the documentary material thanks to the addition of new layers of mortar or to the mimetic substitution of entire parts of the wall. To forget history by overwriting on the surface that is the object of conservation, the aim of restoration is to conserve without producing arbitrary changes to the

materials of the historical building. Every action must follow the primary needs of the monument and the guidelines of modern restoring: minimal action, the possibility of distinguishing the recent from the original work, the physic-chemical compatibility of new with old materials, the potential reversibility of the conservation intervention, so that this intervention can be removed or ameliorated in the future.
To isolate the last theme from a larger consideration or restoring is also not correct, because it leads to imagine that “restoring” and “architectural restoring” are two different and distinct subjects. So the architectural restoration seems to be less analytical and to need less care in spite of conservational restoring, the architecture being important for its aesthetic form, but not for building details, when the latter is not decorated.
The practice of restoring and conserving ancient architectural surfaces is disappointing, this is not true only in Umbria. The interventions are often rough and also wrong, even when we only observe the technical action; sometimes the action is too vast and heavy. In the majority of these actions, following the prudential recommendations of the chart of conservation edited in 1972, it would be sufficient to maintain, reinforce, patch the existing surfaces, protect them with glazing without restoring the plaster and the related colors and completely losing the finish (e.g. layers of plaster).[5]
The best solution, which respects the nature of the object and prolongation of its life, even when we consider the smallest details, is to establish a maintenance plan which does not foresee replacement of materials. On the contrary, resorting to strong polishing, new glazing heavy remaking of plasters and important re-painting, has no positive effect. The heaviest damage is not due to a generic erosion, or consumption of the surface because of rain, but to loss of protection such as covers or malfunction of the water discharge at the basement of the building or below ground level.
No trace can be neglected when doing historical study. Historical architecture can be studied not only through the shapes but also by the interpretation of the architectural techniques of single parts of the building through the history that characterizes their development and change over the time.
A punctual historic analysis can help the creation of the diffuse awareness, at least among the researchers, on which it is based the knowledge of the objects in study, their protection and the decisions devoted to its careful conservation.

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Bibliographical References

[1] BARELLI, Lia, CARBONARA, Giovanni, *Il valore documentale delle finiture e l'importanza della loro conservazione: l’imitazione del passato nella falsa cortina laterizia dipinta a Roma nel medioevo*, in *Il potere dell’arte nel Medioevo. Studi in onore di Mario D’Onofrio*, GIANANDREA, Manuela, Francesco, CANGEMI, COSTANTINI, Carlo (a cura di), in c.di s;

[2] BENAZZI, Giordana, CARBONARA, Giovanni, *Cattedrale di Spoleto. Storia, arte, conservazione*, Milano, 2002, ISBN 88-7179-322-6;

[3] CAPPONI, Gisella, D’ANGELO, Carla, SANTAMARIA, Ulderico, *Nuove acquisizioni sulle finiture architettoniche,* in CARBONARA, Giovanni, *Restauro architettonico e impianti,* vol. XI, Torino, 2008, ISBN 978-88-5980-342-3;

[4] DOGLIONI, Francesco, TORSELLO, Paolo B., *Stratigrafia e restauro. Tra conoscenza e conservazione dell'architettura*, Trieste, 1997, ISBN 978-88-8190-018-3;

[5] DOGLIONI, Francesco, *Conseguenze del restauro sulla stratificazione e contributi della stratigrafia al restauro architettonico, in «Archeologia dell'Architettura»*, II, 1997, ISSN 1127-2155, pp. 207-213;

[6] P. FONTAINE, 2008, Mura, arte fortificatoria e città in Etruria. Riflessioni sui dati archeologici,dans La città murata in Etruria in Atti XXV Convegno di Studi Etruschi e Italici (Chianciano Terme-Sarteano- Chiusi, 2005), Pisa-Roma, ISBN 978-88-6227-024-3, pp. 203-220;

[7] GIGLIOZZI, Maria Teresa, *Architettura romanica in Umbria*, Roma, 2000, ISBN 88-7890-361-2;

[8] GIGLIOZZI, Maria Teresa, *Romanico in Umbria. Architettura sacra nel contesto*, Roma, 2000, ISBN 88-6514-200-6;

[9] *GUIDE GEOLOGICHE REGIONALI: Appenino Umbro-Marchigiano, 15 itinerari*, A cura della Società Geologica italiana, BE-MA editrice, 7 (1994) 1-301;

[10] HARRIS, Edward C., *Principles of Archaeological Stratigraphy*, London, 1979, ISBN 978-14-8329-585-5;

[11] *L'antica via Flaminia in Umbria*, PINESCHI, Ignazio (a cura di), Roma, 1997, ISBN 8870603636;

[12] LUGLI, Giuseppe, *La tecnica edilizia romana*, vol. I, Roma, 1968, ISBN 978-03-8434-180-7;

[13] MAIRE VIGUEUR, Jean-Claude, *Comuni e signorie in Umbria, Marche e Lazio,* Torino, 1987, ISBN 978-88-7750-140-0;

[14] MARTELLI, Gisberto, 1966, Le più antiche cripte dell'Umbria, in Aspetti dell'Umbria dall'inizio dell'VIII alla fine del secolo XI. Atti del III Convegno di Studi Umbri, Gubbio, 23-27 maggio 1965, Perugia;

[15] *Oltre le Carte. L'abbazia di S. Croce di Sassovivo presso Foligno e la sua realtà materiale*, BARELLI, Lia, LORETI, Roberta, PICUTI, Maria Romana, TADDEI, Roberta (a cura di), Perugia, 2014, ISBN 978-88-6778042-6;

[16] PARDI, Renzo, *Ricerche di architettura religiosa medievale in Umbria: integrazioni ed inediti*, Perugia, 1972;

[17] PARDI, Renzo, *Architettura religiosa medievale in Umbria*, Spoleto, 2000, ISBN 88-7988-950-8;

[18] PICUTI, Maria Romana, *Scavi a Cancelli (ovvero l'archeologia al tempo della crisi), in ArcheoFoligno, Notiziario bimestrale di cultura dell'ArcheoClub Foligno*, nn. 3-4, maggio-ottobre (2012), pp. 12-14;

[19] PRANDI, Adriano, CHIERICI, Sandro, TAMANTI, Giulia, CADEI, Francesco, *L'Umbria* in *Italia Romanica*, vol.3, 1979, Milano;

[20] SCHMIEDT, *Contributo della fotointerprerazione alla conoscenza della rete stradale dell'Umbria nell'Alto Medio Evo,* in «Aspetti dell'Umbria dall'inizio del secolo VIII alla fine del secolo XI», Atti del III Convegno di studi umbri, Gubbio, 23-27 maggio 1965, 1966, Gubbio, pp. 177-210;

[21] SPERANDIO, Bernardino, *Chiese romaniche in Umbria*,Perugia, 2001, ISBN 88-8596-256-4;

[22] SPERANDIO, Bernardino, *Delle pietre dell'Umbria: da costruzione e ornamentali,* Perugia, 2004, ISBN 88-8596-262-9;

[23] SPERANDIO, Bernardino, *Le pietre ornamentali e da costruzione nelle chiese romaniche dell'Umbria e il loro impiego nei restauri moderni, in Umbria e Marche in età romanica. Arti e tecniche a confronto tra XI e XII secolo. Testi e contesti. Arti e tecniche a confronto in Umbria e nelle Marche in età romanica*, Atti del convegno (Perugia, Facoltà di Lettere dell'Università, 13-14 giugno 2012), E. NERI LUSANNA (a cura di), Todi, 2013, pp. 45-60;

[24] VANTAGGI, Mirco, BALDANZA, Angela, RENZULLI, Alberto, SANTI, Patrizia, LUI, Mario, BONOMI, Laura, *Archaeometric and geological constraints for the provenance of carbonatic breccias used in monumental works along the Flaminia Consular Road (Umbia-Marche, Central Italy), Journal of Cultural Heritage*, 8 (2007) pp. 434 – 444;

[25] VANTAGGI, Mirco, *Archeometria delle pietre utilizzate in opere monumentali della Via Consolare Flaminia*, Tesi di Dottorato dell'Università degli Studi di Urbino, (2006) 1-90.

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Development of a GIS environment for archaeological multipurpose applications: the Fano historic centre.

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Abstract
In this paper we present a methodological workflow developed within the "ArcheoFano" project, improving collection, organization and management of a GIS data structure for the urban-archaeological Roman centre of Fano town. In this context, the proposed methodology is aimed to build up an integrated and multipurpose system. The starting point is data collection by means of archival (for documentation purposes) and high-resolution survey techniques (for metrical purposes); afterwards, a conceptual data model organizes archaeological data and realizes an easily updating solution that automatically produce short reports to share with the users. The open source QGIS is used to develop the spatial extension with the aim to manage 2D/3D numerical cartography and detailed 3D model (using open tools such as Virtual Terrain and Enviro). The final geo-database contains all the useful information to support urban planners decision-making. The ability to structure data in a maintainable way helps to ensure cross-disciplinary cooperation in the management and protection of heritage resources. Lastly, an Augmented Reality (AR) experience is carried out. Linked directly to the geo-database, AR allows a quick real time visualization of GIS layers and 3D models, showing the way forward smart tourism and virtual museum applications. This technology is needful when the archaeological findings must be conceived due to conservation issues.

Keywords: Archaeology, GIS, DBMS, 3D Visualization, Augmented Reality

1. Introduction
The rapid development of geo-spatial and digital technologies makes the application of information technology unavoidable, also in archaeology [11]. The achievement of good practices and sustainable workflows to manage heterogeneous data for archaeology has been made possible thanks to the exponential growth of digital tools for data registration, acquisition and management, mandatory at each level and essential to preserve and protect cultural heritage [3].
During the last decade, different approaches have been experienced for the digital documentation of excavation, providing interesting solutions on computerization flow especially for Geographical Information Systems (GIS) [13], [16].
Although the delivered functionalities are gradually improving, a real integration between digital methods in the archaeological pipeline is still broadly missing. Further, it is well known that archaeological activities give in output a huge amount of data that are very difficult to be stored into a complex structure because of their heterogeneities in terms of source information, chronological parameters dissimilarity and findings classification [2]. Therefore, it is paramount to find a "common language" representing the key for integration [10]. Furthermore, there is the necessity to satisfy both internal (cataloguing, documentation, preservation, management of archaeological heritage) and external (communication through the web portal) purposes, a good interpretation suggested in [4]. The approach described in this paper faces these issues and try to outline a method to avoid the drawbacks arising from the aforementioned inconsistency. More in deep, we

propose a complete workflow realized within the framework of "Archeofano Project" (described in the following section) ranging from data gathering toward a tidy management system with the aim of providing information for different kind of users, from insiders/public administration, dealing with technical information, to the wide public and advanced tourism.
With this aim, we put our efforts in dealing with the following key aspects:

1. Definition of the database structure and selection/definition of the archaeological entities
2. Development of a spatial database management system for the collected archaeological data (Geo-DBMS)
3. Spatial data handling into an open source GIS environment
4. 3D Visualization and virtual reality experience, both for desktop and mobile applications

Main features of this model are flexibility scalability, in order to create good practice in the national archaeological panorama.
The aim of this work is also to develop a simple data structure allowing users to easily access the information and contribute to their enrichment.
The project's first phase starts with data collection and ends with the generation of an archaeological plan, representing a complex document with the list of findings and enclosed their geographical position. The advantage of this phase is that, starting from inconsistent data, it is possible to re-produce an updated situation of the findings' state of the art.
The second phase is the GIS management of this set of information. Despite the limitations of GIS in handling complex textured 3D models, this project proves how the systematic integration of 3D information in the framework of a 3D GIS platform can open up more efficient data structuring and archaeological interpretation solutions.
GIS-based archaeology is becoming a guideline over the world for cultural resource management and academic research with several successful cases in which scientists are mostly engaged [8], [19], [20].
Many advantages arise from the GIS approach: firstly, merging alphanumerical, multimedia and spatial data it allows welding the relationships between real elements and, secondly, it provides an easy and intuitive access to the information for non-expert users.
The paper is organized as follow: after this introduction, Section 2 explains the general framework, Section 3 illustrates the data management approach while Section 4 shows the main features of the Geo-Database inside the GIS environment. Last, in Section 5 a 3D model visualization case study is presented. Concluding remarks are reported in Section 6.

2. Case settings

The workflow described in this paper has been developed within a wider project called *ArcheoFano*[1], mainly aimed at designing the Fanum Fortunae Roman forum, present-day Fano, that was a colony dating to Emperor Augustus's reign and standing at the Adriatic end of the famous via Flaminia. It departed from Rome and ended exactly at the entrance of the Augustus Arch.
Underneath the urban-archaeological historic centre of today, long corridors hide beautifully preserved remnants of the Roman city of over 2000 years ago. Archaeologists have discerned dwellings, palaces, narrow streets, baths and complex water and refuse systems for a great number of archaeological sites, all along studied but never organized in a detailed 2D archaeological map.
It is a key outline of the ArcheoFano project using a GIS environment and its strengths to turn all the documentary data into an additional archaeological "layer" to be integrated into the existing Fano municipality GIS, already built for administrative and planning purposes and now migrating towards open source solutions.
No price is too high for deepening and digging up the lost Vitruvian Basilica ruins, which is still a matter of conjecture, although various attempts have been made to visualize it.

2.1. Data Gathering

The starting project context is characterized by handy and not structured archaeological documents/drawings collected by different institutions (Fano municipality, Superintendence for the Archaeological Heritage of Marche, Province of Pesaro and Urbino and Centro Studi Vitruviani) working independently of each other for a long time. The project, regulated by an agreement among the four above mentioned Bodies together with Università Politecnica della Marche, first focuses and puts a lot of efforts in cataloguing several archaeological structures localized in the wide historic forum. The main source of data documentary was mainly made up of notes, bibliographical and archival material, in both printed and digital format. Alongside, other documents were available such as graphic and photographic archival, stored thanks to private citizens. In addition, there were also available information simply passed orally from generation to

[1] Agreement between Provincia di Pesaro-Urbino, Soprintendenza ai Beni archeologici della Regione Marche, Comune di Fano, Centro Studi Vistruviani. Scientific Director prof. Paolo Clini

generation. In summary, the majority of the information comes from diverse sources such as bibliographic notes, consultations of photos, consultations of reporting.
From these sources, the types of data most commonly encountered were:

- Bibliographic material, such as text, documents and oral information.
- Picture material, including photos of the era of discovery or recent photos
- Plants and elevations of reliefs, for the most part in paper format and only rarely digitized.
- Reports of geological investigations or excavations.

In this context, the chance is taken to enrich the archaeological dataset using state of the art 3D survey technologies such as 3D laser scanner and Ground Penetration Radar (GPR). The wide range of digital topographic data, part of the ArcheoFano dataset, are collected at two different scales (historical centre and localized archaeological sites) and described in Table 1 in terms of data type, main acquisition and processing methods.
All the data were acquired/digitized and processed prior to the start of the fieldwork to form the underlying GIS data structure, implementing the spatial extension of the archaeological database.

Data type	Extent	Format	Acquisition and processing methods
3D cartography	historic centre	3D vector	GIS data handling
Traversing	mostly historic centre	3D vector	Land surveying by total station and GPS
TIN	historic centre	raster	Generation from 3D cartography (scale 1:500) and spot heights
Orthophoto	historic centre	raster	Scanning and georeferencing
3D model	4 archaeological complexes/monuments	3D mesh	3D Laser scanner acquisitions, point cloud processing and 3D model construction
GPR prospections and tomographic maps	4 archaeological complexes	2D raster	GPR investigations and post-processing
Data documentary	63 archaeological complexes and 48 monuments	2D vector and raster	Typing, scanning, manual digitizing and digital image processing

Table 1: Archaeological dataset from diverse sources

3. A relational Data Base for Archaeological data management

Nowadays, for archaeological purposes, modelling a database to manage objects of different nature is mandatory, this is demonstrated by many examples [17]; this is true especially because a large set of objects are available, as well as concepts and actions that shall be related in a wide variety of ways [14], [15].
During the investigation, relations and object definitions require a continuous refining to facilitate the creation and management of non-static archives. Besides, urban constraints and uncertainty about chronological issues, often triggered by the nature of findings or documentation, make the definition of archaeological units a hard task.
Despite these limitations, we decided to adopt a simplified conceptual model of cataloguing, strictly related to the one implemented by “Istituto Centrale per il Catalogo e la Documentazione” (ICCD), which enhance the development of data information process in a more structured analytical and semantic domain. According to this adopted conceptual model, a spatial database management system (Geo-DBMS) was designed to handle and give weight to all the heterogeneous and gradually collected data.

3.1. Definition of the conceptual model of ArcheoFano

Due to the huge amount of information as well as due to the site complexity, it has been fundamental to implement a relational model. In this phase, we adopted a specific data classification defining attributes element by element.
As discussed in the previous section, in order to establish a clear relation between the elements, we adopted the national standard from the ICCD. This cataloguing system facilitated the description of the huge variety of archaeological data, provided interoperability and gave the researchers the chance to enhance their work accessing integrated archives.
It is one of the seven Central Institutes of the MiBAC, whose main goal is to create a centralized national catalogue of the Italian cultural heritage. A more deepen and comprehensive description about this cataloguing system can be found in [1], [10]. From the archaeological point of view the available version for categorization is 3.00, which presents a series of tool that can be found in [21].
After a deep analysis of the ICCD system, we agreed on choosing SA, MA and CA schemas and, for completeness, we report them hereafter.

- **SA Schema** - Archaeological Site: used as “container” to describe and document an archaeological site; in our case it identifies the historic centre of Roman époque.
- **CA Schema** - Archaeological Complexes: used for the documentation of archaeological properties, easy to be identified, within which each archaeological presence of the same period can be catalogued.

- **MA Schema** - Archaeological Monuments: used for the recording of archaeological properties, it consists of a single identifiable building unit with a unique function (e.g. towers, a domus, a temples, etc.) It can belong to only one (CA).

The model well fits with the ArcheoFano case setting and gives a structure to all its entities.
Considerably helpful was the data structuring and analysis as explained below.
As a first step of this complex and lengthy process, we built up a general list of all the objects, regardless their scale and dimension, pursuing the aim of relating findings with all available information (e.g., bibliographic, archives, reports, pictures, plans). For a more reliable positioning and zoning of these entities, we referred to the so called "Piano Particolareggiato", as shown in Figure 1A. Thanks to this system, it has been possible to map these objects into graphical entities, constituting the base for the Archaeological Chart and the Geo-DB (Figure 1B) inside the GIS environment. A deep explanation is reported in Section 4.
The adoption of this cartographical reference helped us to relate the archaeological findings at an urban scale. With this partition we pointed out, up to now, a list of 63 Complexes and 48 Monuments, organized as entities within (CA) table and (MA) table.



Fig. 1: The "Piano Particolareggiato" plan. A: the identification of urban blocks and buildings. B: The subdivision of the Historical Centre into Archaeological Complexes

3.2. Entities, attributes and relations

Once the structure of the DB was defined and the process of collection, analysis and formalization of the data ended, it was necessary to move on the real implementation of the Geo-DB.
We started from the most closely descriptive attributes and added technical ones, such as digital/media, photographs, three-dimensional representations, GPR surveys, etc. while, for the geographical part, we had available vector maps, orto-photos and digital terrain models (DTM). Entities belonging to a specific class have an immutable identifier (ID), while other features change.
Archaeological features have different attributes like:

- **Indexing** attributes, to have a unique identifier and exploit the relational feature of the DB. In particular, in order to allow indexing and search of information is necessary to define for each entity a unique identification code (SA, CA or MA) followed by a sequential number. This code is also fundamental for the definition of the relationship between objects in the database.
- **Spatial** attributes, to manage 3D data inside GIS environment. Furthermore, we have a number of attributes of spatial nature, which link to the map data, vector or orto-photos, which will be used explicitly by the management software of GIS.

Despite each table is related to a specific entity, a logical connection with the other tables have been implemented. Thanks to them the user can also create forms, queries and reports.
Another important issue was distinguishing among assigning specific information to the single monuments or, conversely, assigning more general information to the complex entities. Deeply, some of them could be common to many complexes while others could be univocally assigned. To avoid the problem of redundancy of information, we exploited the concept of inheriting of the relational model.
Figure 2 can clarify this concept showing the relationship from (SA) to (CA) and between (CA) and (MA). This relational model of the data structure allows to recover all the information for each (MA) belonging relatively to its (CA) within the hosting (SA). Primary keys (ID_MA, ID_CA, ID_SA) are used to relate tables

and are necessary because they allow much more rapid execution of many operations and an easier data retrieval due to their uniqueness.
These associations are considered as “one to many”, so that we can have several (MA) inside a (CA), but the first could belongs to at least one (CA) (see Figure 3). However, despite the stiffness of such a structure, it can be simply manipulated and other entity can be added without damaging the initial concept and leaving the possibility to store new complexes without the presence of archaeological monuments inside.
Surveys, documentation and all the other collected data (see section 2) are enclosed within tables and related to the (MA) table, by means of ID_MA identifier (Figure 3 is self explanatory). Table MA can connect to the related GEO table through ID_MA; the latter in turn connects to the related table EXCAVATION (SCAVI) via the SURVEY (RILIEVO) field.

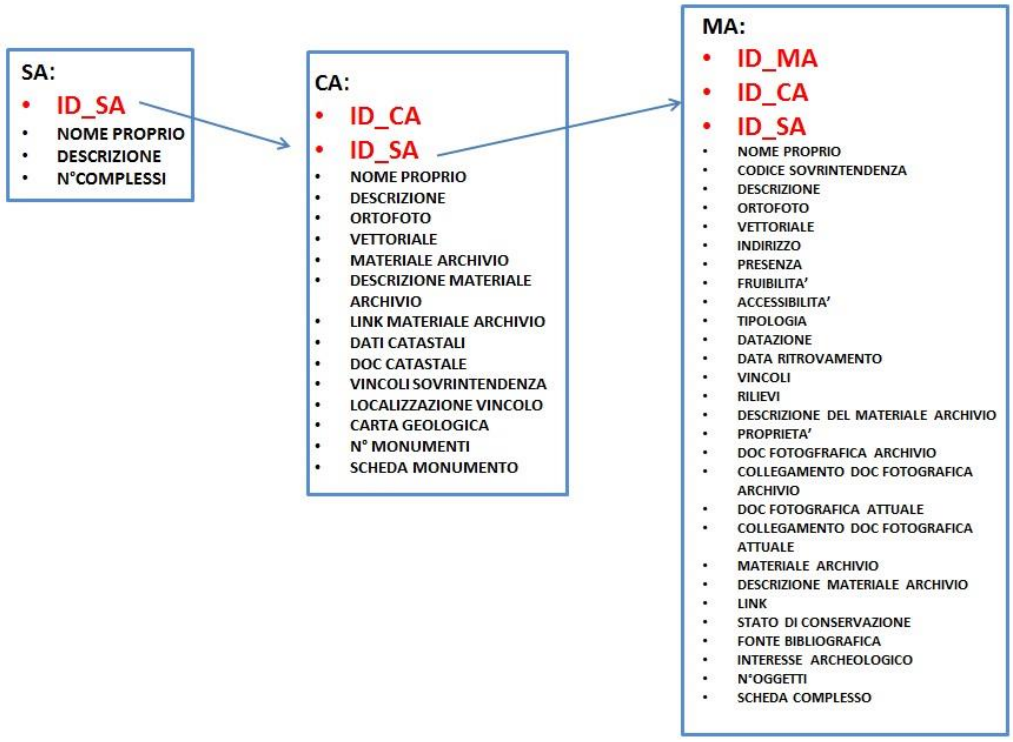

Fig. 2: Relations between tables, representing SA, CA and MA entities.

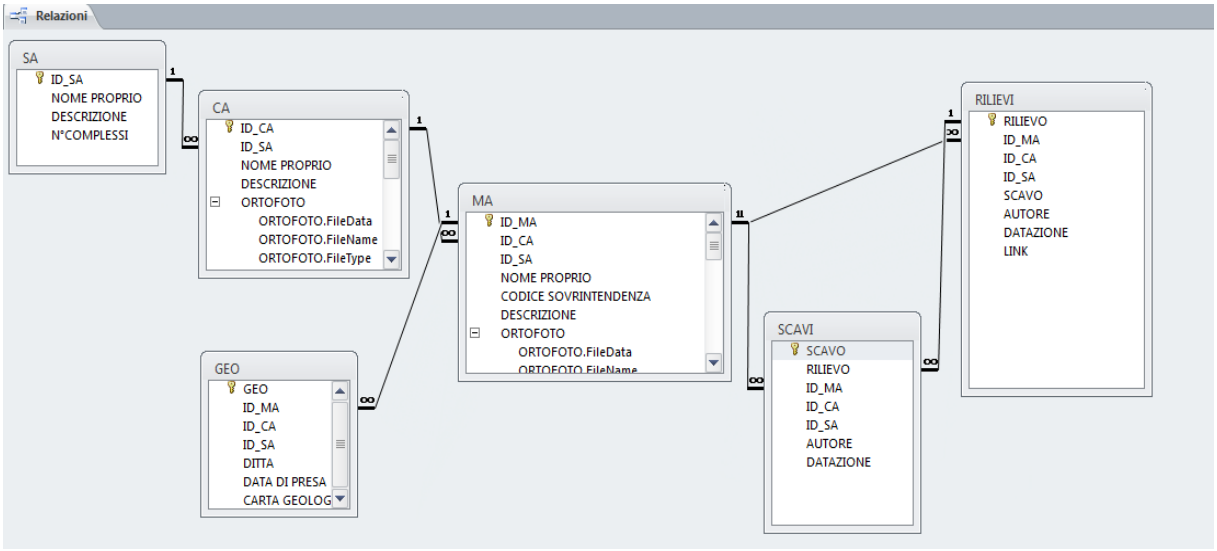

Fig. 3: Screen shot of the relational model, implemented with Microsoft Office

For the physical implementation of tables, fields, relations and queries we used Microsoft Access 2010.
The implemented system automatically produces short reports (pdf format) to share with the users. (see Figure 4).



ID_MA	CODICE SOVRINTENDENZA	NOME PROPRIO	INDIRIZZO	N°OGGETTI
MA_08_01		Teatro Romano		
MA_08_02		Resti tardo-antichi Teatro Rom		
MA_08_03		Tombe tardo-antiche Teatro R		
MA_08_04		Resti murari cd. Basilica di Vitr		
MA_08_05		Resti lato Via Nolfi		
MA_08_06		Resti murari Filanda Bosone		

Fig.4: Summary sheet about archaeological complex "Ex Filanda Bosone" .(CA_08)

4. The Geodatabase into Open Source GIS environment

The Geodatabase is a collection of spatial data of various kinds, such as the municipal mapping, orto-photos, DTM and vector files arising from topographic surveys, laser scanners and performed for this project, as well as the entities associated to the relational database created in Access environment. The archaeological site and complexes are instantiated as entities and represented by polygons, while points represent monuments.
Due to development and research issues we have choose an open source GIS platform (i.e. QuantumGIS). The organization of information is structured into layers of points, polylines and polygons allowing elaborations and spatial analysis of the data.
Managing the attributes in the database and the archaeological plan, we extrapolated different classifications, useful for specific studies or for promoting tourism. A list of possible classifications is here proposed:

- Complexes' classification according to the number of the monuments contained;
- Inserting labels to localize monuments by type (door, tower, theatre, macellum);
- Other classification depending on the selected attributes (dating, ownership, etc)

Figure 5 shows two examples of classification, using also the overlaying mapping. The same management of the reliefs in the layers can be designed to visualize data at different scales of representation. The opportunity to organize data into a tidy layer organization, overlapped and independent, allows viewing contextually archival data together with data from the recent excavations, acquired through new technologies.
In the next section will be discussed the GIS three-dimensional reconstructions of monuments and archaeological stratigraphy, using ad case study the survey of the Roman Theatre.

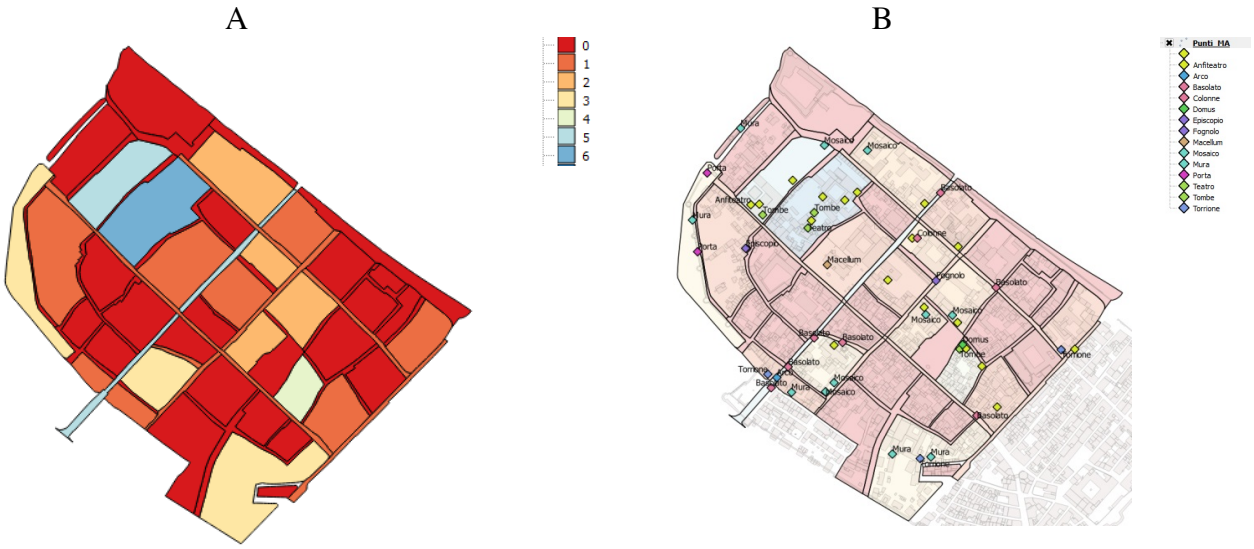

Fig.5: Examples of classification. A: According to the quantity of Archaeological Monuments within the Archaeological Complexes B: In this case we divided monuments according to their typology

5. 3D Visualization of the Roman Theater of Fano

3D reconstruction technologies, as well as and virtual reality are becoming a common practice and are gaining significance also in archaeology for documentation and restoration purposes. Many aspects of this approach are clearly summarized in [18]. The final part of this work objective to demonstrate that potentialities of GIS could exploited in conjunction with 3D technology in order to set a well-grounded basis for good and reliable analysis [5], [7], [9].

Furthermore, the availability to use advanced 3D visualization techniques for heritage, opens a wide spectrum of further applications not only for insiders (who's needs are, studies, interpretations, conservation policies as well as digital preservation and restoration) but also for non-experts citizens who want to deepen its knowledge.

Thus, virtual heritages should be more and more frequently used for both archaeological purposes [12] and new forms of advanced tourism. In the following are reported two kind of 3D visualization, and the respective pipeline to achieve them, which could open new boundaries in the hard role of preserving and spreading the cultural heritage.

5.1. 3D GIS using Virtual Terrain Project

In this sub section we will describe the procedure to insert and visualize the 3D survey of the Roman Theatre of Fano within GIS environment, in order to obtain an unique Digital Terrain Model (DTM). The key aspect of this approach is the possibility to recognize 3D objects, within the GIS environment, as single archaeological units which implies a unique correspondence between records in the database and an object . The visualization of these elements in a GIS environment and their manipulation o possible through a range of existing and generally available tools; for this purpose, we used the open source package "Virtual Terrain Project" [22]. These tools enable the user to browse through the data, contextualizing objects and highlighting mistakes that occurred during fieldwork. For this phase of the work, the input data are:

- DTM of the city of Fano, ASCII format
- Local survey of the Roman Theatre, XYZ format.

Although the 3D reconstruction is not part of this paper, we'll provide details about the acquisition campaign, carried out through a scanner laser Leica C10 with the following features

- scanner laser TOF,
- 50.000 point/sec
- maximum range300m
- maximum resolution 1mm x 1mm
- accuracy 6mm@50m
- Camera resolution 5Mpx

Taking advantage of the geodatabase described in the previous sections, it has been possible to manage the 3D model of the Theatre into GIS Environment, as explained in Figure 6.

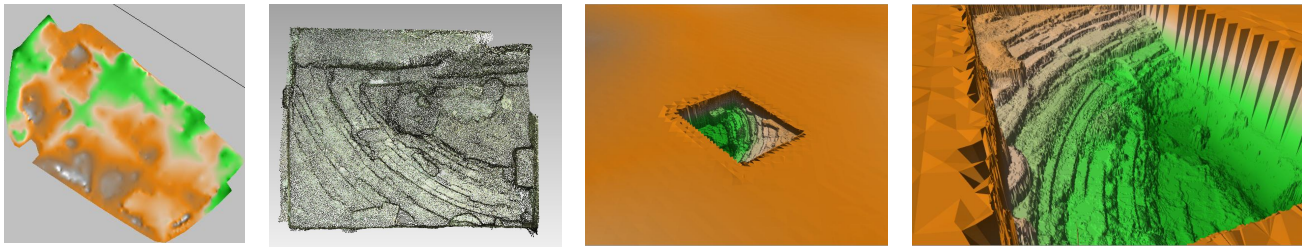

Fig.6: Pipeline for managing 3D model and Geo-referencing into QGIS. From the left: DTM of Fano Historical Centre, 3D model of the Roman Theatre, inclusion of the model in the correct position.

5.2. Augmented Reality

Augmented Reality (AR) is a growing technology in the field of Computer Vision. It is particularly suitable for many kinds of applications such as gaming, entertainment or museums applications [6].
Nowadays, the use of AR in for Archaeological applications is still broadly missing; although there are several examples of projects with this aim, there is the necessity to introduce such a technology to drive people towards a new concept of archaeological tourism.
Our attempt is to cope with the lack of widespread interactive solutions to serve both archaeologist and tourists. Augmented reality allow to discover in an alternative way monuments or rests by simply scanning the surrounding environment, loading contents from a remote repository and visualizing them as virtual objects. The most important feature is the possibility to visualize findings, also when they are covered. It is well known that, due to conservation reasons, once the rests, monument or graves are discovered, if there is not the possibility to store and safe them, they are covered again. AR allows the visualization of rests, also where they are invisible. In our case, the Roman Theatre constitutes the Point of Interest (POI) to be visualized.
To develop our solution the following steps were conducted: starting from the point clouds, a 3D mesh of the Theatre was generated into MeshLab [24], open source software for the processing and editing of unstructured 3D triangular meshes. Then it was exported as ".obj", because of its capability to maintain the original file object and the possibility of being edited.
This file was conveniently managed within an Augmented Reality framework [23] (Layar) until the definition of a geo-layer, ready for being uploaded to a web-server. In the database we built a table that contains data regarding the POI, geometrical transformation, description and link to external resources. More in deep, we stored the POI within the database table linked to the application created specifically to contain them; in particular, about each POI, is essential to store latitude and longitude (to correctly register geo-location), title, description and other information of interest for the user. The parameters to correct locate the model above the screen are: latitude, longitude and a radius of influence. Within the circle of specified radius, the application seeks for relevant POIs, starting from user's location. Figure 7 shows the AR visualization of the 3D model.



Fig.7: Augmented Reality visualization of the Roman Theatre in the correct location

6. Discussion and conclusions

The aim of this work is to provide good practices to be used as guideline to manage heterogeneous data. The integrated application of DBMS, GIS and 3D visualization allowed very detailed identification, localization, and mapping of various types of archaeological features. The main contribution of this paper is the definition of some guidelines for the implementation of a pipeline, which starts from sparse archaeological data until a possible virtual exhibition, in which, systems can be created quickly and with reduced costs. In this way, experts as well as non-expert user could contribute to the population of cultural heritage and benefit of it. The "ArcheoFano " project assures the safeguard of the rests, monitoring them and spreading historical knowledge for specialists and general/touristic purposes. The ability to structure data in a maintainable way, such as employing a geo-database, helps to ensure cross-disciplinary cooperation in the management and protection of heritage resources. The final geo-database contains all the useful information to analyze historical/archaeological interpretations, validate theories about ancient buildings and ruins and support decisions dealing with the planning of the town. It is moreover ready to be integrated as additional archaeological “layer” into the existing Fano municipality GIS, already built for administrative and planning purposes and now migrating towards open source solutions. This paper described also the realization of an integrated virtual exhibition system, that combines the most advanced 3D technologies applied to the reconstruction of archaeological finds with an portable and versatile visualization system. With a relatively low budget, it is possible to recreate and show a rich archaeological collection in an appealing way. Another important solution with AR is the possibility to enhance the way finding inside an archaeological site. As a matter of fact, every device is able to geo-localize the user and the superimposing of contents could be used, as well as to inform and to drive him with a sort of augmented route guidance.

Bibliographical References

[1] AIELLO, A., et. al. An ontological interpretation of the ICCD recommendation. *established by: Mauro Cristofani and Riccardo Francovich*, 2007.

[2] ANICHINI F, et al. A database for archaeological data recording and analysis. MapPapers 1en-II, 2012, pp.21-38

[3] ANICHINI F., et.al. MAPPA Project. Methodologies Applied to Archaeological Potential Predictivity, in MapPapers 1en-I, 2011, pp.23-43

[4] APOLLONIO, Fabrizio I., et al. Construction, Management and Visualization of 3D Models of Large Archaeological and Architectural Sites for E-Heritage GIS Systems. 2011. In: XXIIIrd International CIPA Symposium, September 12 - 16, 2011, Prague, Czech Republic.

[5] BRUNO, Fabio, et al. From 3D reconstruction to virtual reality: A complete methodology for digital archaeological exhibition. *Journal of Cultural Heritage*, 2010, 11.1: 42-49.

[6] CLINI, Paolo, et al. Augmented Reality Experience: From High-Resolution Acquisition to Real Time Augmented Contents. *Advances in Multimedia*, 2014, 2014.

[7] COLOSI, Francesca., et al. Discovering Chan Chan: modern technologies for urban and architectural analysis. Archeologia e Calcolatori, 2013, 24: 187-207.

[8] COLOSI Francesca. et al., “Strategies and technologies for the knowledge, conservation and enhancement of a great historical settlement: Chan Chan, Perù”, Proceedings of Conference Built Heritage 2013 “Monitoring Conservation and Management”, Milano, 18-20 November 2013, Editor in chief M. Boriani, edited by R. Gabaglio, D. Gulotta, ISBN 978-88-908961-0-1, pagg. 56-64.

[9] DELL'UNTO, Nicolò., et al. Experiencing Ancient Buildings from a 3D GIS Perspective: a Case Drawn from the Swedish Pompeii Project. *Journal of archaeological method and theory*, 2015.

[10] FELICETTI, Achille., et al. Mapping ICCD Archaeological Data to CIDOC-CRM: the RA Schema. Vladimir Alexiev, Vladimir Ivanov, Maurice Grinberg (eds.): Practical Experiences with CIDOC CRM and its Extensions (CRMEX 2013) Workshop, 17th International Conference on Theory and Practice of Digital Libraries (TPDL 2013), Valetta, Malta, September 26, 2013, CEUR-WS.org/Vol-1117, pp 11-22, urn:nbn:de:0074-1117-1

[11] FRONZA, Vittorio, et. al. An integrated information system for archaeological data management: latest developments. *CAA2002 (Heraklion, Crete 2002)*, 2002.

[12] GARSTKI, Kevin, et. al. Reconstituting community: 3D visualization and early Iron Age social organization in the Heuneburg mortuary landscape. *Journal of Archaeological Science*, 2015, 54: 23-30.

[13] GUGNALI, S., et al. Design and implementation of an open source GIS platform for management of anthropological data. *Journal of Biological Research-Bollettino della Società Italiana di Biologia Sperimentale*, 2012, 85.1.

[14] KATSIANIS, Markos, et al. Integrating excavation recording, data management and object representation through GIS. In: *CD Proceedings International Congress "Cultural Heritage and New Technologies*. 2005.

[15] KATSIANIS, Markos, et al. A 3D digital workflow for archaeological intra-site research using GIS. *Journal of Archaeological Science*, 2008, 35.3: 655-667.

[16] KHOUMERI, El Hadi. H., et. al. GIS in Archaeology. In: *First international Symposium on Environment Identities and Mediterranean Area, 2006. ISEIMA'06.* IEEE, 2006. p. pp. 441-446.

[17] LUO, Lei, et al. Integrated RS, GIS and GPS approaches to archaeological prospecting in the Hexi Corridor, NW China: A case study of the royal road to ancient Dunhuang. *Journal of Archaeological Science*, 2014, 50: 178-190.

[18]NIKNAMI, Kamal Aldin., et. al. 3D Tools for Scientific Visualization and Documentation of Archaeological Heritage Case Study: A Sassanid Shrine of Daregaz, Northeastern Iran.

[19] http://mappaproject.arch.unipi.it

[20] http://pompejiprojektet.se

[21] http://www.iccd.beniculturali.it/index.php?it/473/standard-catalografici

[22] http://vterrain.org

[23] https://www.layar.com

[24] http://meshlab.sourceforge.net

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
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HISTORY BUILDS, SURVEYING RE-BUILDS: conservation work of a medieval building through the representation of its (most likely) construction history

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Abstract
A private medieval building in an Apulian town, outside the ancient walled city, in a not-historical urban context which had been strongly modified in the mid-twentieth century. On it, every potential transformation (including demolition) would have been allowed by building regulations; a building without an official or documented history has been investigated by means of architectural surveying and representation. The accurate surveying of its state of preservation allowed to formulate some hypotheses on some construction events that had affected it; this scientific speculation reaches the "re-building" of some stories (the most likely ones), not the history, of the building itself.
In a first stage, this method has permitted to draw attention to the building as a historical testimony on the territory, including it among listed buildings with historical and architectural importance; it has been preserved from every potential disrespectful transformation.
Working for protection and transmission of the cultural heritage imposed by this constraint, a new history started for the building, concerning the conservation project. Under the guide of the evidences that surveying had read, this project has operated with continuous rebounds among most likely hypotheses and the physical characteristics of the monument. Sometimes it confirmed, sometimes it disproved what the graphical representation suggested; sometimes it revealed new elements, hidden under the layers of time.

Keywords: surveying, architectural analysis, virtual re-building, conservation project

1. The preservation of the building
The study of the building started from the will to recognize and ascribe it as one of the few architectural and urban testimony, which is still readable and almost completely preserved outside of the ancient walled city in Putignano, in the province of Bari, Apulia region, Italy. This is an emblematic case for which the tools of architectural surveying and graphical reconstruction are the essential means for knowledge, preservation and conservation of the building when there is not an official history, there is not any written document, differently from more important (but not more worthy of attention) urban contexts.
Most of the ancient buildings within the walled town is still substantially unaltered, since the most significant modifications on it go back to historical and relevant building periods and were respectful of the age-old built background. Whereas “torre Marcualdo”, together with its very small, surviving private garden and the surviving portion of the homonymous road are isolated traces of an urban environment that was so heavily transformed in the second half of the last century, that the image of the historical city outside its ancient walls does not exist anymore.
Local regulations provide preservation and conservation measures on the historical areas, so called "A" zones of the city for the traditional general town planning; both buildings within the ancient walled city and the early twentieth century expansions outside it are considered as “A” zones. The building in question is located in a dense completion area (so called "B zone"), together with the adjacent twentieth century multi-story buildings; therefore, when this study began, even reconstruction projects (through demolition) were potentially approvable. In this case, the initial phase of accurate description and analysis of the status of the building was particularly important; its objective are: to achieve the knowledge and a first partial definition of

its constructive history and especially the (collective) acknowledgement of its historical and documentary value through the declaration of cultural interest provided for architectural heritage by the current Code.

1.1 Preliminary notes for the history of the building

Its location is outside the historical centre surrounded by walls but anyway undoubtedly significant: the small road, named Marcualdo Street, bordering the building, appears nowadays as a fragment of the ancient road connecting the cities of Putignano, Noci and Conversano.

In fact, with a closer look, the still used remains of this ancient road seems to be in perfect continuity with the current country roads, demonstrating that it was the ancient roadway linking the three cities. Along the same street, there was a big convent outside the city walls consecrated to St. Anthony, surely less ancient than the tower and now destroyed, showing the importance of this road in the history of the city. More specifically, the tower is located at the intersection between this ancient Marcualdo Street and another important urban road, along which there is the main front of the building: its name, Cappuccini Street, derives from the presence of St. Francis Convent of the Order of Friars Minor Capuchin, situated at its end, northwest. Therefore an absolutely strategic position, as the first cartographic representations of the town confirm (The Cabrei of the Order of Malta) always depicting a small building a short distance between the two convents, in a very similar position to the real location of torre Marcualdo.

It is conceivable that the original environment of the tower had a triangular shape, with the vertex at the intersection of the ancient Marcualdo Street and the street now called Roma Street (formerly Sant'Antonio Street). In fact, the city blocks between these two streets are quite recent as well as their roads, all dating back to the period of expansion of the city outside its walls between the end of the nineteenth century and early twentieth century; it is likely that once the entire land between the two streets belonged to the tower without any interruption, as the historical maps represented, although in an ideographic way.



Fig. 1: Historical eighteenth century map on the left and present aerophotogrammetry of the city of Putignano on the right: in blue there are three convents, in red there is a small building situated on the cross between the road in orange (probably Marcualdo Street) and the road to St. Anthony convent (now called Roma Street). In yellow on the aerophotogrammetry there is the original historical city center at the time in which torre Marcualdo was built.

Local literature associates the name of the building with that one of the Chancellor of Bohemond of Hauteville, Marcualdo, historically placing its presence between the late eleventh and early twelfth century. Riccardo Marascelli, a scholar of the history of Putignano, cites the house at no. 37, Cappuccini Street as the "villa usually dwelt by Marcualdo, chancellor of Bohemond, Prince of Taranto and Mottola [the Norman nobleman Robert Guiscard's, Duke of Apulia and Calabria, eldest son]".
Local history tells that once Bohemond had left for the Crusades, Marcualdo became his regent and imposed heavy taxes on Bohemond's possessions. Marcualdo cruelly repressed the rebellion of its inhabitants of Mottola, one of those possessions, in 1102. The news about its siege and destruction is confirmed by several sources. [1,2]
Torre Marcualdo has a trapezoidal plan and two storys: the ground floor has three rooms anciently connected one another, with access on the main road (Cappuccini Street) and connections with the rear garden. The second floor has four rooms; only three of these ones are accessible through the footpace and one room directly communicates only with the two adjacent rooms.
The singularity of the building consists of a large staircase linking the two levels; its dimensions are not usual and typical of a house but, rather, they can be attributed to the original use of the building as a garrison for territorial defence with a probably different spatial configuration, even with the presence of uncovered spaces, as well as perhaps the staircase itself. Other evidences of a defensive use of the building concern: the presence of short, almost impassable and hardly visible "interspaces" seeming safe hiding places in case of attack; the system of visual control post represented by a fine angular loggia with three archways having the dual function of looking out towards the territory and of looking towards the staircase, that is the only access way to the first floor.
The loggia also contains the only dated inscription of the entire building: it is into a herald and tells about the restoration taking place in 1668 thanks to a member of the owner family at that time. The other decorative element of torre Marcualdo is the entrance portal characterized by a large pointed arch on pillars with capitals shaped like cordons (typical medieval reinterpretation of classical traditional theme); the keystone is decorated by another noble herald, different from that one on the loggia.

1.2 Surveying as a tool to read the (more likely) history of the building

The building and its now reduced 150-square-metre garden are located outside the city historical centre. At the time of its construction the urban centre had the dimensions of its inner core, surrounded by more ancient walls, still evident today in the shape of its plan (see Fig.1) and probably it was under the jurisdiction of St. Stephen Benedictine Abbey in Monopoli by Hauteville family's will.
Surveying developed by several stages: the first one was suitable for general description of the features of the building and of its overall state of preservation, and allowed some initial hypothesis about its history and dating with the primary objective of achieving the recognition of its value and the secondary objective of elaborating a conservation project.
Other "periodic" surveying operations associated with the different phases of conservation works allowed the implementation of the information about construction phases of the building and the course of the successive conservation works.
The building has a plan with trapezoid shape, about 12 metre long, and two storeys, totally 10,50 metre high.
The ground floor was composed of three "autonomous" rooms; one (named room "A" in Fig.2) was accessible through the large arched portal on Cappuccini Street, another (room "B") through a smaller door near the portal on the same street and the third one (room "C") through the garden behind. Room "A" is rather unusual: its shape is like "L" and it is characterized by the succession of a barrel vault with a lunette on a large niche and of an irregular star vault; this part of the room is connected with the garden behind through three steps. The two rooms named "B" and "C" were not connected each other and with room "A" at the time when surveying began but traces of a walled door between them was visible. Room "B" is accessible through Cappuccini Street and is covered by a barrel vault supported by the wall of the main front and the parallel internal one; room "C" is connected only with the garden and is covered by a cross vault. The acute angle of the two roads (Cappuccini Street and Marcualdo Street) generated irregularities of the angles among walls, especially those ones composing room "A" and room "B", while room "C" has a more regular plan.
The staircase connecting the two storys of the tower has four stairways with variable length surrounding the space under the star vault remembering a sort of big hollow wall; surveying showed a discontinuity in masonry just at the junction between the barrel vault and the star vault of room "A", that has been considered a proof of the not simultaneous construction of the two covering systems of this room. The staircase is supported by a thick arch at the opposite of the portal and by another arch close to the star vault; the first stairway was surely altered in fairly recent time or added to link the first footpace with the floor level of room "A". That hypothesis implied that probably the original access of the staircase was directly through outside, since traces of a walled door were visible on the wall of the first footpace. The peculiarity of the staircase is also the covering solution by means of a series of monolithic architraves (120 cm long and 15 cm thick) side

by side, supported by a continuous cornice with ovolo profile on each of the two walls of the staircase (25 and 35 cm thick).
On the first floor the angle between Marcualdo Street and Cappuccini Street is built by a large rectangular room, named “F” in Fig.2, covered by the combination of two sail vaults, the bigger one with square plan and the smaller one with rectangular plan; the other room overlooking Cappuccini Street (named “G”) is covered by a cloister vault about 4 metre by 4 metre and is accessible only through the adjacent rooms, “F” and “H”.
Each of the two rooms overlooking Cappuccini Street has a window with balcony consisting of thin steel plate supported by steel beams or by stone shelves under steel beams. The presence of this material suggested that the pre-existing balconies were replaced or that the original windowsills were removed to widen the windows and to add balconies.
Furthermore, in the balcony of room “G” the overhanging stone shelves supporting steel beams seem recent while the stone moulded shelves with carved leaves below seem ancient, probably coeval with the construction of the building.
The last footpace connected other two rooms: room “I” overlooking Marcualdo Street and room “H” on the opposite side, both covered by sail vault; the perimetric wall of room “H” is occupied by a corner loggia with three round arches on columns with capitals consisting of abacus and echinus surmounting acanthus leaves of clear Medieval feature; columns rest on a breast with a moulded cornice.
The loggia was originally connected even with the adjacent room “G” through a walled door, and overlooked both the garden outside through the archways and the staircase below through a window, denoting its likely initial function as a structure to control possible enemy penetrations on the first floor of the tower; this defensive function is further evident if we consider that above the window overlooking the staircase another one leads into a very short “interspace” (about 90 cm high), deeply extended for the entire length of the staircase, which almost certainly was a refuge in case of invasion, once enemies had reached the first floor of the tower. The loggia is covered by a system of monolithic stone architraves side by side, likewise the staircase. This significant architectural system had, unfortunately, suffered significant deterioration since it was transformed into a closed room: the two arches of the longer side of the loggia had been closed with frames (one of them was transformed into a window with steel balcony cutting the torus cornice of the breast); the single arch of the shorter side of the loggia, overlooking the garden, was walled with masonry.
The room overlooking Marcualdo Street, covered by a sail vault, has an higher floor level than the other three rooms and has a trapdoor in the floor near the entrance, connecting with another "interspace” (between the ground floor and the first floor of the tower); next to it there was another interspace that was accessible through the penultimate footpace of the staircase. The sail vault of room “I” has a square plan while the room has a rectangular plan, so the vault is connected to the perimetric wall by means of an arch with a lunette linking to a staircase to reach the terrace level. This stairway is closed by a door, and the first step is about 1.5 metre higher than the room floor; a wooden removable staircase was used to overtake this difference in level to easily remove it in case of enemy attack and to retreat on the terrace. Further evidence of the defensive origin of the building is given by the presence, in all windows and doors, of massive stone hinges, which ensured a stronger resistance of the original frames, particularly if we suppose that the doors having them overlooked external parts of the building.
On the terrace, the first phase of surveying detected some chimneys of the original fireplaces now demolished.
The building shows, with some of its elements, several significant chronological and historical clues: first, the only written date on the herald above the corner loggia tells us about a restoration that take place in 1668 and cites its author and promoter, Ioannes Maria.
The complete inscription is IOANNES MARIA MINUO(?) RESTAURAVIT AD 1668.
The two heralds on the façades of the building are different, presumably dating from different periods: the herald on the portal seems the older one and is embedded in the keystone of the pointed arch; only during the conservation works the elements carved on this herald became visible again: they consist of a shield inside which there are a castle with three towers and arched doors, an upright moon and three stars above; on the shield there is a barred helmet with a torse above and mantling sideways; below the herald, the keystone is decorated by an acanthus leaf.
The same stylistic feature characterizes the two shelves with mouldings and leaves under the balcony of room “G” and probably originally differently placed.
The herald above the corner loggia is inserted inside the stone with inscription indicating the author of the seventeenth century transformation interventions and is vertically divided: the right side of the emblem has two horizontal strips and three roses, while in the left portion there is a wolf with the head toward a comet. All the elements in both the heralds are quite typical and widespread and, on the other hand, no systematic study of local families’ heraldic symbols yet exists and a research about this theme is furtherly complicated by the presence, in Putignano, of the Knights of Malta from 1317 to 1806.
There are other important details, though less explicit and less "exact" in terms of their precise chronological dating: the use, for the entrance, of a pointed arch could denounce the Gothic origin, as well as the capitals with cordon decoration supporting the pointed arch or the leafy capitals of the columns in the corner loggia.

The profile of this arch on the main portal has a particular shape: its thickness is variable because the extrados is a pointed arch while the intrados is a round arch, so that the maximum thickness corresponds with the keystone and gradually it decreases towards the springing line; a sort of “static contradiction” that could be explained, on the one hand, with the simpler building of the frame closing the portal, on the other hand, with the will to visually enhance pressures affecting the keystone and how these were quickly led on the vertical abutments (thinning the arch at its springing lines).
Two preliminary observations endorse the hypothesis that the building lived different construction phases: the presence of different alignments of walls indicates points of constructive discontinuity, and successive transformations. Furthermore, some doors of the first floor rooms have embrasure, a typical device to better convey light from outside into interior spaces, as well as the presence of stone hinges of windows and doors, a defensive measure to protect the interior from external intrusions, suggests that some parts of the building were uncovered.

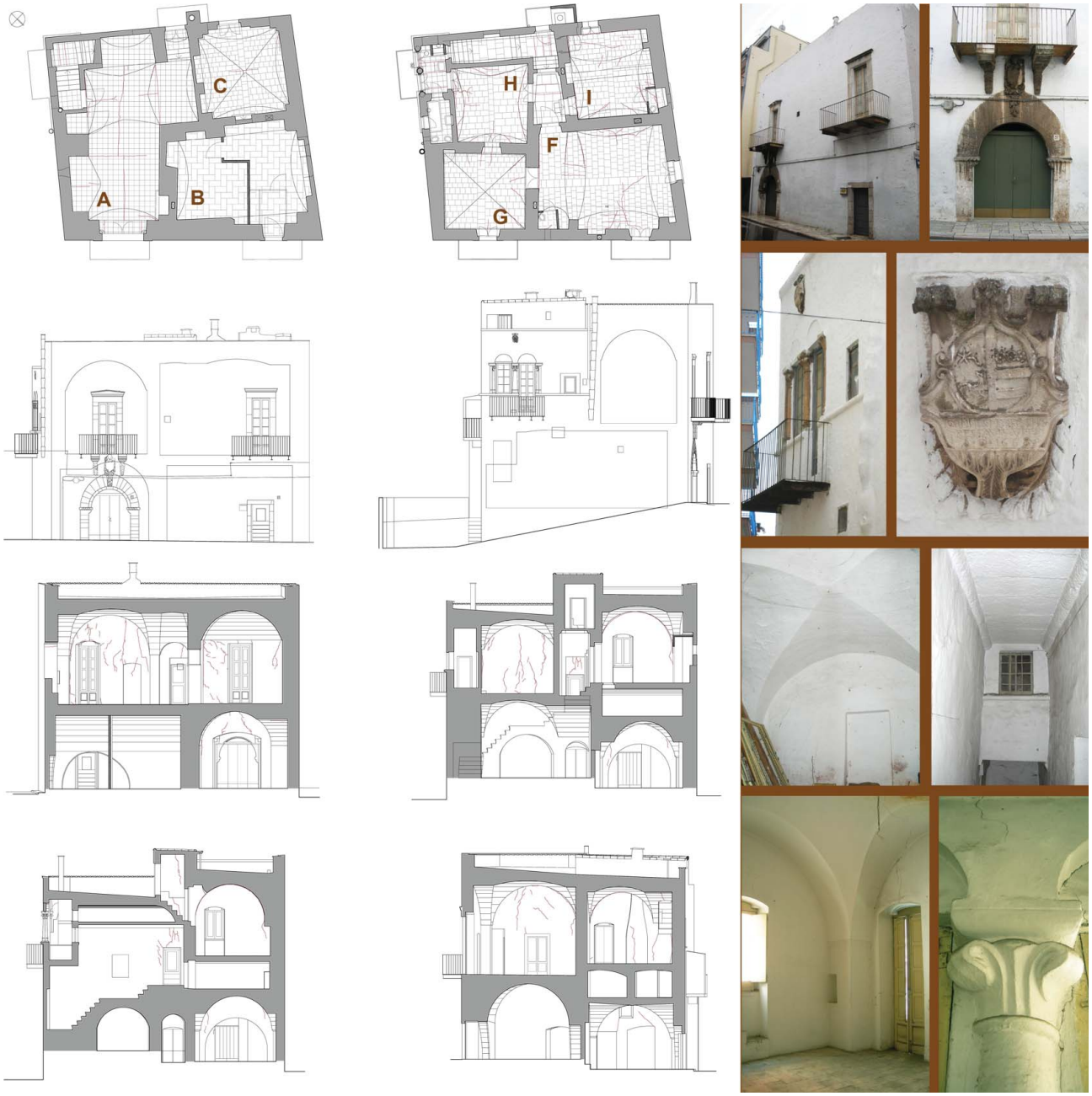

Fig.2 The first surveying phases. Drawings from top to bottom and from left to right: ground floor plan, first floor plan, main façade on Cappuccini Street, façade with the corner loggia, sections of the building. Photographs of the external façades and of the inside rooms.

The initial hypothesis on the construction history of the building identified a first phase in which the portion of the room “A” covered by the star vault did not exist and was a sort of internal open courtyard accessible through the barrel vaulted room (so through the main portal); that room was probably without any other room on the upper level. The shape of the wall between room “C” and room “A” could confirm this hypothesis: on it, there are a walled door flanked by a large arch, above which a walled window is visible. The room “C” was probably completely open towards the garden outside with a large arch in the external face of the wall overlooking the garden shows. The system of the corner loggia appears with all its importance in this hypothesis. Maybe the most significant changes of the building happened during its functional transformation from a garrison for temporary rests into a proper house and were done in the occasion of the “restoration” cited in the herald above the corner loggia.

2. The integration of surveying during the conservation works and the subsequent revision of the initial hypotheses

The description of the building through its surveying was essential, first, to obtain recognition of its documentary value by the Soprintendenza per i Beni Architettonici e per il Paesaggio for the province of Bari, safeguarding it, as well, from any possible improper intervention and, secondly, to develop a conservation project of the building that could take account of its construction history, considering even what more recent transformation interventions had concealed and guessed, in some cases, in embryo by surveying.

The first operations when the work of preservation started, such as the removal of superfetations and improper materials, introduced in the early decades of the last century, the removal of wall plaster and the essays and investigation below the paving of the two storys, revealed very significant data on the transformation of the building and on the stratification of centuries.

The removal of the external plaster highlighted the posthumous construction of the facade overlooking the garden that was juxtaposed to the original one, probably when heavier stone vaults substituted the original wooden roofs: traces of pre-existing pitches emerged on the inner faces of the breasts on the terrace floor. This wall closed the arch, which originally connected room “C” with the garden, while it continued the round arch of room “A” bearing the staircase. On the internal facade (on which the loggia is built), the original entrance door of the staircase was identified, confirming the initial hypothesis about the recent modification of the first stairway; on the main facade overlooking Cappuccini Street another arched portal flanked the main one, having rather similar height and width. Its height is incompatible with the current level of the springing line of the barrel vault supported by the main facade; probably this arch gave access to room “B” in place of the actual little door built when the covering system changed.

On the same facade, a visible window on the top of room “G” at a much higher level than the inner springing line of the cloister vault, suggests the presence of an ancient mezzanine dating back to a phases in which the covering system was wooden; this theory is suggested by the traces of pitches on the breast of the terrace and by wall reinforcements due to the substitution of the original wooden covering structures with vaulted thrusting ones, to ensure a greater resistance to the existing walls.

The phases of investigation and essays during the conservation works denoted the removal of the original windowsills to build steel balconies, as the vertical extension of the doorposts using similar ashlars demonstrates; during this transformation, the original windowsill above the main portal was disassembled and disappeared. As well as in other buildings in the historical centre of the city, it could consist of an overhanging cornice supported by the two shelves with acanthus leaves, then moved down under the steel balcony, altering relation and distances among the arch of the main portal, the herald and the original windowsill above it.

In the middle of the facade overlooking Marcualdo Street, a masonry angle has been identified between rooms “B” and “C” on the ground floor and rooms “I” and “F” on the first floor, which denotes the addition of the rooms “C” and “I” in successive phases.

The gradual removal of filling materials under the paving of the ground floor has allowed the identification of the original level, attested by traces of plaster on walls under the actual floor level, and by the finding of circular stone waterproofed basins under the original floor level, probably used for the hardening of hot forged iron artefacts (as also confirmed by the traces of a furnace close to them and the existence of a high door between rooms “A” and “B”, probably used for the passage of horses).

In room “C”, the only one with a stone paving, removing a strip of it for the installation of the technical plants another circular stone basin and a piece of an ancient stone paving under the actual one were found.

The removal of plaster from interior wall of room “A” showed that the thick walls delimiting it, on which some doubts emerged during the initial surveying are indeed couples of walls covered by monolithic architraves side by side; the angle below the first footpace of the staircase, apparently full, is occupied by a small room, completely hidden and walled before. The walls of room “A” were also connoted by the presence of a torus cornice all around the perimeter, emphasizing the springing line of the barrel vault, almost totally demolished during the recent transformations of the building.

The conservation works established with certainty that the construction of the star vault on a part of room “A” covered a pre-existing open courtyard, surrounded by the staircase on three sides; the courtyard was directly connected with the garden; the windows and doors overlooking the courtyard belonged to room “C” and to a small room under the loggia, with three arches on columns quadrangular, now intercepted and partly hidden by the star vault; on the first floor the walls of the courtyard corresponded to room “G”, to the gallery with monolithic architraves connecting room “G” with the loggia and to the entire staircase.
The removal of plaster inside the first floor also highlighted the heavy recasting of the wall separating the two rooms overlooking Cappuccini Street (“F” and “G”), which clearly shows the removal of the original architectural elements, probably two or three arches with pillars, to substitute them with one door; of those arches, only a pillar and a portion of an arch are still visible inside the modified wall.
A portion of another arch is incorporated into the access wall of the loggia through room “H”. A base of a column of this arch, similar to those ones of the loggia, was successively re-used as ashlar in the equipment of the doorpost connecting room “H” with the last footpace of the staircase; probably, room “H” was built covering the existing courtyard. Even the vaults of the other rooms on the first floor were built in later times than the original configuration of the tower: this is evidenced not only by the traces of wooden pitches on the

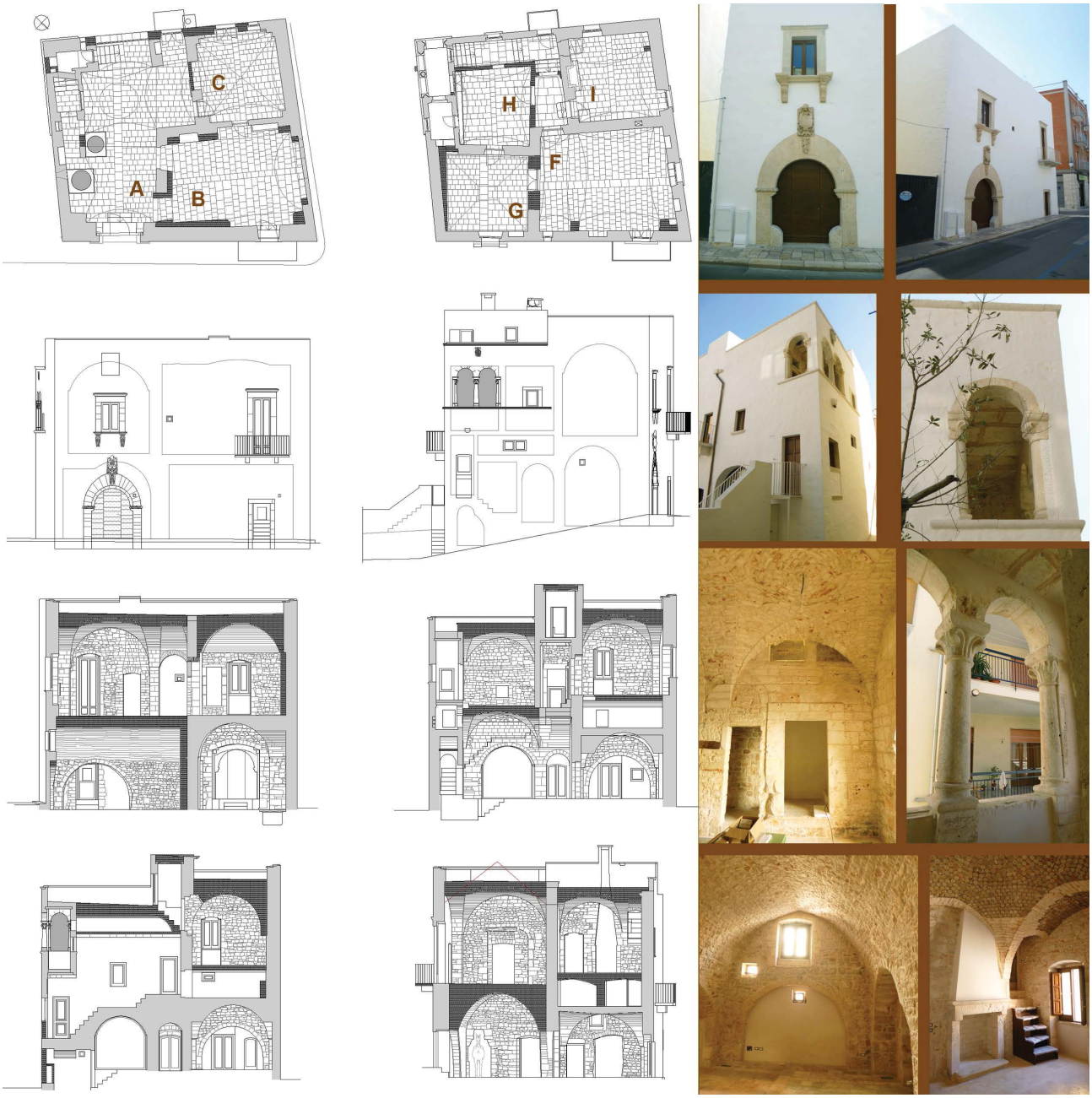

Fig.3 The implemented surveying during conservation works.

breast of the terrace, but also by planimetric regularization and reinforcement of masonry to better support new vault thrusts. Even the choice of more modern types of vault than the traditional barrel vaults or cross vaults demonstrates the successive building of those vaults: they are stone made for the lower part and brick made for the upper part up to keystone (in order to avoid excessive pressures on pre-existing walls built to support lighter wooden roofs).

3. Final (?) constructive history of the building

The data obtained from the stages of critical surveying and direct investigation on the monument have established that, from an original nucleus, the building developed and grew through both effective additions and successive structural reinforcements to give the original walls a sufficient load bearing capacity in order to accommodate new systems of vaulted roofs replacing wooden ones, since their traces were found on the building.

With a good approximation, the oldest nucleus has been identified with the part of room “A” which is covered by a barrel vault, with access through the pointed portal surmounted by the noble herald; this space was probably enclosed by a couple of parallel walls with a staircase inside and was connected with the garden by means of a large arch. This original staircase was probably uncovered. Later, two rooms (“B” and “C”) were added on the ground floor: room “B” is now covered by a barrel vault replacing the original wooden roof, as



Fig.4 The final (?) hypothesis on constructive phases with plans. A “virtual” drawing of the façade of room “A” overlooking the internal courtyard as it could appear originally.

evidenced by the subsequent reinforcement of the perimetric walls and the original higher arched entrance (similar to the main one), successively walled because it was higher than the springing line of the new vault. Even room “C” overlooked the garden by means of a big round arch; it was probably originally uncovered (as suggested by the piece of an ancient kind of stone paving, typical of courtyards or stables) and a cross vault was added only at a later phase.
On the first floor, there would be only one room (“G”) with a wooden roof and a mezzanine floor, overlooking the courtyard below and which was linked to the terrace on the wooden roof of room “B” by means of double or triple archways on columns. Subsequently, the two walls of the staircase were heightened and the staircase was covered, obtaining, on the first floor, the corner loggia overlooking the courtyard and the staircase itself; under the loggia, a small room covered by monolithic architraves side by side on an overhanging cornice, overlooked the courtyard with three arches on quadrangular columns: its current reduced height suggests that in a first phase it was an uncovered loggia with a different paving level (maybe the level of the first footpace of the staircase). The presence of dovecotes confirms that even this space was originally an open element overlooking the internal courtyard. Even the short “interspace” above the staircase and accessible through the loggia was probably built at that phase.
The last substantial constructive phase consisted of the replacement of wooden roofs with vaults; the oldest is cloister stone vault on room “G”, thrusting directly along the four walls of its perimeter; in a successive period vaulted coverings were added on rooms “F” and “I”: those ones were stone and brick made sail vaults, supported by four angular piers added to the original walls. All the rooms of the first floor continued to overlook the courtyard that was later covered with a star stone vault on the ground floor and a sail stone vault on the first floor; this caused the extension of the original room “A” and the addition of a further room (“H”) on the first floor.
Finally, on the occasion of those changes, which gave the building in its current shape, the archways, connecting the original room “G” with the terrace of room “B” and, then, with the adjacent room “F”, were walled and substituted by a single door. The most recent transformations happened throughout the nineteenth century, consisting of the construction of external buildings with the probable function of blacksmith shops, successively demolished.
Presumably between the thirties and the fifties of the last century functional transformations were done, such as the introduction of technical plants, the elevations of the ground floor paving at the level of Cappuccini Street, the introduction of new paving, the introduction of the overhanging steel balconies and the consequent demolition of the windowsills with the moving down of the couple of leafy shelves. [3]

Bibliographical References

[1] MARASCELLI, Riccardo. *Guida storica di Putignano*. 1ª ed. Putignano: Tipografia De Robertis, 1959.

[2] PEROGALLI, Carlo, ICHINO, M. Paola, BAZZI, Silvana. *Castelli italiani: con un repertorio di oltre 4000 architetture fortificate.* 1ª ed. Milano: Bibliografica Ed., 1979. On p.232 the book quotes: "Putignano (Bari): fortified remains of 11th century residence, Marcualdo Chancellor of Bohemond of Hauteville".

[3] A special thanks goes to Mr Pietro Chiarolla and his wife, owners of this monument: their love for art and history addressed this long-lasting work and allowed the rebirth of such an interesting architectural testimony from the past.

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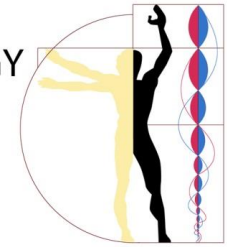

Design + Nursing: From Laboratories to Users, the Transformation of Concussion Prevention

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Abstract
In April of 2013 University of Cincinnati's president and his staff publically supported a university wide research initiative focusing on concussion prevention. To address this, our six-year Design+Nursing collaboration between Industrial Design and Community Health Nursing transformed its focus and made concussion prevention its sole objective. While our University's president's initiative was to focus on the "student athlete", we expanded the scope to find out who were our most vulnerable to mild traumatic brain injuries (TBI) (concussions). We conducted this research and development in a studio setting where industrial designers were grouped with college of nursing students to solve problems surrounding concussion prevention. This conceptual studio focused on the three areas of prevention; primary, secondary, and tertiary. Our goals were to transform clinical research, data, and lab testing fixtures into user centered products and services that addressed groups who are at high-risk of TBIs. We worked closely with patients, doctors, caregivers, and therapists to fully understand the conditions, nuances and how best to design prevention strategies. These strategies included physical wearable product solutions, virtual awareness systems, and even education systems. This paper outlines our process for success, challenges of collaboration, and studio outcomes.

Keywords: collaboration, wellness, concussion, industrial design, nursing

1. Introduction
A concussion is a mild type of traumatic brain injury (TBI). In a concussion, microscopic bruising of the brain without structural defect is detected in brain imaging studies. The mechanism of injury is usually blunt trauma from an acceleration/deceleration force or a direct blow to the head. With a concussion, there may or may not be a loss of consciousness. If there is a loss of consciousness, it usually lasts less than six hours, and the person experiencing a concussion may have posttraumatic amnesia. There are no structural signs of injury to the brain. Duration of unconsciousness is an indicator of the severity of the concussion, with the longer the patient has experienced a loss of consciousness, the more severe the concussion. Recovery may appear complete, but the patient may develop long-term sequelae, also known as post-concussion syndrome.

National TBI statistics indicate that at least 1.7 million TBIs occur annually in the United States, and TBIs contribute to 31% of all injury-related deaths in the USA. Of these, approximately 75% of TBI's are concussions. Those who are most likely to sustain a TBI include children age 0-4 years, teenagers ages 15-19 years, and adults ages 65 years and older. In addition, for every age group, concussion rates are higher for males than for females [1].

Concussion prevention is based upon the principles of health promotion, which includes three levels of prevention: primary, secondary, and tertiary prevention [2]. Primary prevention is focused on well populations and is implemented before disease occurs. This type of prevention, used first when possible in the medical field, results in the goal of health promotion and health protection from disease [3]. Secondary prevention is used to facilitate detection of disease and treating health problems early in the course of disease in an attempt to cure or slow its' progression. Tertiary prevention is implemented after disease occurs and is used to restore an individual or population to an optimal level of function. In the medical field, this includes rehabilitation to return an individual to his or her baseline state. Based upon the above statistics and the lasting effects a concussion can have upon an individual, projects were developed to address each level of prevention.

2. The Design Plus Nursing (D+N) Collaborative

2.1. Evolution of the collaborative course

The D+N Collaboration is a spin-off of The Live Well Collaborative (LWC), a 2007 non-profit joint venture formed by the University of Cincinnati (UC) and the Proctor and Gamble Corporation of Cincinnati, Ohio [4]. The purpose of the LWC is to specialize in research and development of products and services for living well across the lifespan. With this unique academic-industry innovation center, organizations are able to collaborate with top ranked faculty and experts in a major research academic center as with the colleges of Design Architecture, Art, and Planning (DAAP), Business, Engineering, Nursing and Medicine among many others. A 14 week design thinking model of innovation and translational research is used that fits into the university semester system as well as flexible scheduling as needed. It forms a unique academic-industry innovation center in which products and services can be designed to meet the needs of consumers.

The D+N Collaborative was established in 2009 by the UC Colleges of Design, Architecture, Art, and Planning (DAAP) and the College of Nursing (CoN). The initial D+N Collaboration was funded through the Live Well with a $50,000 intramural research grant for DAAP industrial design and CoN students to collaborate in a studio on an assisted mobility device project. The focus of this collaborative was on devices such as canes and walkers and stretched across the lifespan.

Following this initial experience, we found we were able to synchronize the student courses. This created the D+N Collaborative as non-funded model to generate innovative solutions to health problem issues and the next sessions moved on to issues in rehabilitation for community based long-term health issues.



Fig. 1: Role-playing exercises evokes student empathy

2.2. Focusing on community health issues

When initially establishing the D+N Collaborative, we focused on the CoN's identification of "high priority" opportunities in community health [5]. Based on research findings and personal experiences in healthcare settings, the CoN identified projects that required a product or service component that could have a significant impact on communities. Faculty and advisors from the CoN and DAAP prepared a project description and required course deliverables. These descriptions and deliverables varied greatly between the two disciplines as the nursing and design students were enrolled in separate classes and graded according to the criteria set by their respective faculty members. Classes consisted of as many as 10 nursing students and 26 design students.

For the first four years the D+N Collaborative projects were purposefully broad in scope. Examples include redefining space and surface to develop a functional solution for healthcare and home and redesigning assistive mobility devices, such as canes, crutches and walkers to cover the life span (e.g., child with a birth disorder, stroke victim, frail older adult) and in various environments (e.g., community-dwelling residents, long-term-care patients). By keeping the scope directed but open we gave students the ability to select the areas they had a passion for while still staying in the realm of the original research. Once a topic was presented and design students select an area of interest, nursing and design student groups were formed. These groups help to unify students with similar interests and enable nursing students to see what groups coincide with their expertise.

For 2010-2011, the D+N course moved to improving head protection such as motorcycle and bike helmets, fire helmets, and medical head protection devices. This was an especially rich innovative session, moving the collaboration into its present focus on Concussion Prevention.

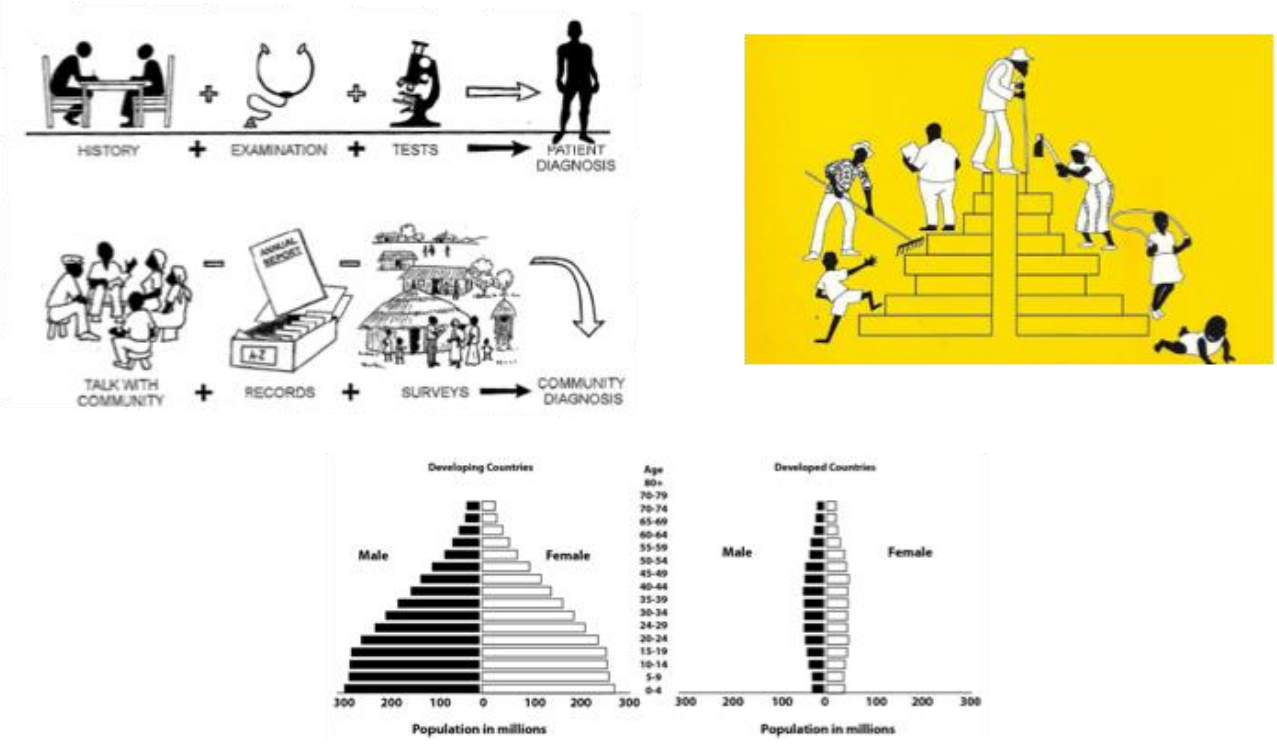

Fig. 2: Community health population pyramids determine prime areas for intervention

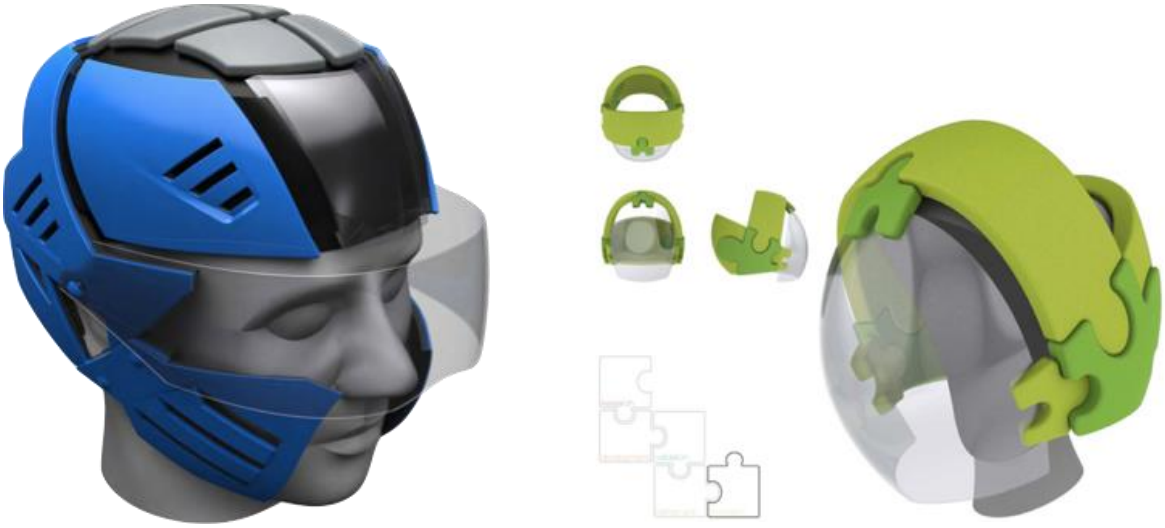

Fig. 3: Field sports and Autism head protection. (Students: Daniel Wodarski and Laura Reasoner)

2.3. Why the focus on concussion prevention

UC is classified by the Carnegie Foundation as a university with "very high" research activity and fosters world-changing innovation, scholarship and entrepreneurship. In 2012 several academic medical faculty within the UC College of Medicine (COM) developed a Sports Neuroscience Initiative with the goal of bringing innovative, collaborative university research teams to work together towards one goal – *To improve the health of student-athletes and enhance their safe participation in high-level athletic programs without a risk of life-long repercussions*. Within the University, there were experts within multiple disciplines with expertise, practical applications and a similar passion for sports. Capturing the institutional talents and bringing them together to create a cross-disciplinary initiative was a critical first step towards the achievement of placing the health and performance of UC student-athletes at the highest levels [6].

DAAP joined the sport neuroscience initiative in 2013 and began to interact with concussion researchers from the Colleges of Medicine, Engineering, Allied Health, Nursing and several others. This initiative played directly into the collaborative's main goal and research and development strengths. As a team the D+N Collaborative decided to focus their efforts on those individuals at highest risk of concussion and the communities where they thrive.

In fall of 2013 the first D+N concussion-focused class was started and several of the concussion researchers gave presentations at the beginning of the course – providing basic education about concussion plus informed the students about several research initiatives that were underway at UC. This initiative allowed students to work directly with some of the world's foremost experts in the physiological aspects of concussion, cutting edge assessment techniques, and rehabilitation procedures. Never before had the team had access to such knowledge and resources.

After students determined their focus area and began to narrow in the project scope they again met with several of the UC concussions researchers for brainstorming, input or feedback. The result of several of these interactions was that the D+N took a current research concept or theory and developed a project that incorporated ideas of the researchers.

In addition to UC researchers efforts were made to work with local high school teams and reinforced their insistence that multi-disciplinary teams must gain an understanding of all the stakeholders when solving for concussion. It was apparent from the beginning that the athlete was only one person affected by this affliction. There were also parents/families, coaches, trainers, and teammates and considerations for the surrounding community environment. A sports program that is well funded is very different from one that is not and in the later cases an athlete must rely more on his or her community to assess, treat, and rehabilitate. These circumstances became an interesting challenge for students because each discipline has been taught to focus on different aspects of problem solving. In class, reinforcement the notion that every field involved has expertise and value to bring to the effort. The professors emphasized that combining expertise and trusting knowledge is the gateway to successful results.

3. Concussions: *Designed Prevention*. Collaborative Studios Fall 2013 and 2014

The structure of the studios followed a traditional five-phase process: 1) research and assessment, 2) concept development, 3) validation, 4) refinement, and 5) finalization. The design students conducted user and trend based research/assessment documentation, and advanced product conceptualization in the form of 2D sketching and 3D sketch modeling. They went back to their users and conducted user based concept validation techniques, and then constructed full-scale semi-functional prototypes and presentation posters of final concepts. The nursing students had the opportunity to apply community/public health competencies in the design and delivery of evidence-based interventions to promote community health through the product and service concepts. This embedded clinical experience allowed for direct application of concepts in various community settings.

Objectives for designers and nurses were similar yet different. This collaboration unified two courses in separate curriculums and required each student population to have unique objectives in order to comply with their curriculums. Students were also required to adhere to the collaborations over-reaching objectives that focus on our multi-disciplinary course structure. Designer course objectives included demonstration the ability to conduct user-centered research and assessment and the ability to translate facts into tangible products or service concepts. Designers were to effectively construct various levels of conceptual iterations in both 2D and 3D mediums and develop presentation materials that outlined key findings and solutions. Nursing's objectives included analysis of individual, family, and community factors that affect population-based health and the application of the nursing process to plan evidence-based interventions and evaluate outcomes for culturally diverse and/or vulnerable populations within the community. The students were required to implement evidence-based interventions for populations at risk for poor physical/mental health due to diseases, environmental hazards, of disaster events using advanced communication, collaborative, and technological strategies and apply the legal, ethical, and professional standards of community/public health nursing in community-focused care. Collaboration with community members to coordinate risk reduction and health promotion interventions for individuals and populations within the community was required.

The overall objective of the collaboration was more overreaching and less specific on disciplinary details and stressed class environment and user interactions.

- Leave your egos at the door.
- Learn empathy for those you are solving problems for.
- Listen to your collaborative partners. You WILL learn something.
- The better the team relationship, the better the results.

Upon completion of the objectives from Design, Nursing and the collaboration, students left this experience with an accelerated understanding of multi-disciplinary problem solving, peer to peer learning, and how good it feels to solve a problem for community populations that really need assistance.

3.1. How we realized data: guiding students

When developing the course, the D+N faculty worked together to develop a presentation outline in which the design schedule matched that of nursing. As the semester progressed, students had to present their work on three different occasions, individually and then together (design and nursing student), gradually building up to the final project. Individual student presentations were incorporated into the course as this was necessary to meet specific course outcomes; however the group presentations facilitated project completion. Throughout the presentations, the faculty provided constructive feedback to the students, which was necessary in assisting students to achieve course outcomes. At the beginning of the semester, one of the common themes recognized in many of the groups was the need to increase communication between the design and nursing students in order to advance the progress toward completion of projects. Once this communication increased, we observed a transformation among many of the student groups. For example, one of the projects that did not seem realistic or feasible at the beginning of the semester resulted in being one of the best projects developed to facilitate detecting the presence of a concussion.

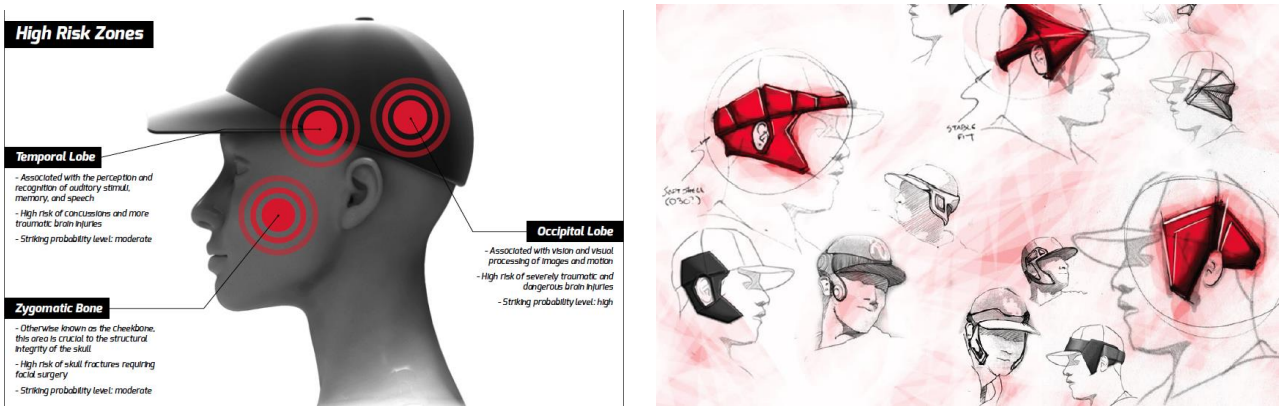

Fig. 4: Baseball fielders helmet (Students: Alex Hart and Corey Salyer)



Fig. 5: Baseline rehabilitation system using topical sensing and smart-phone tracking application (Students: Hailey Cook, Madeleine Huey, Eliot Reshetar-Jost, Sam Newman)

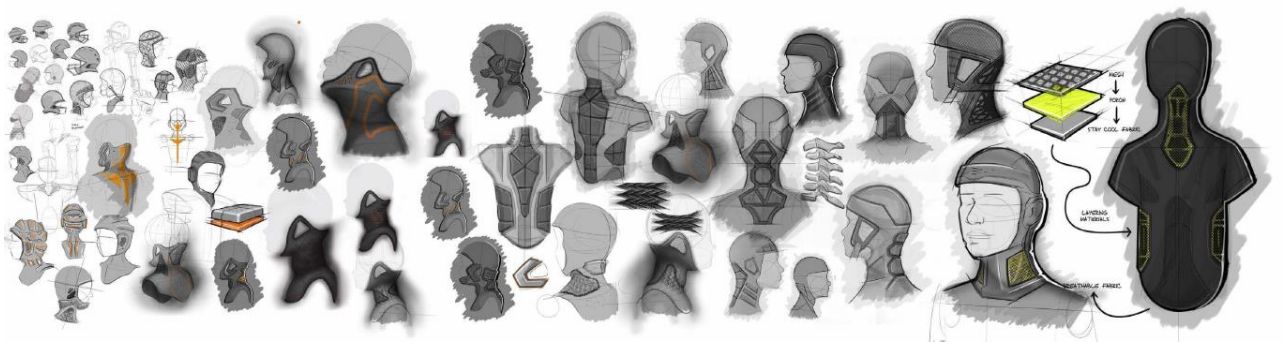

Fig. 6: Youth football Whiplash protection system (Students: Laura Sebastian and Kevin Gibboney)



Fig. 7: Blood vessel pressure system (Students: Katja Riley and Adam Voegel)

4. Discussion

With respect to the importance and significance of the D+N projects and the research efforts at UC, the projects were essentially translational research projects, taking clinical research observations or discoveries generated in a medical laboratories, clinical settings, or field applications, and translating them into innovative products, novel improvements for better health outcomes and effective educational programs. The project teams executed the design thinking process that involves three main steps, which include in-depth user focused research, ideation of products and services, and concept refinement to "translate" some of the novel research concepts developed within UC to innovative solutions across the three tiers of sports concussion initiatives – prevention, diagnosis and treatment. The collaborative work has resulted in integral advancements of clinical research at a major research university in addition to possibly impacting the health of student-athletes by means of a product or education tool.

4.1. Lessons learned

In the D+N's new focus area, concussions have proven to be a fruitful area of research and development. But just because topics and resources are exceptional it does not guarantee successful results. Collaborative problem solving is difficult. Non-design students find the studio setting unfamiliar and when assessing creative problem-solving evaluation can be difficult to understand. Design students must use evidence-based research to guide their designs and not pure intuition. Learning a disciplines vocabulary can be challenging as well. If a design student tries to present clinical data without understanding correct terminology, outcomes can be disastrous. And finally in an age of digital dominated communication, students find the early stages of this collaborative awkward. Once these obstacles are overcome, most students find this experience one that is beneficial far beyond the initial experience and into their professional careers.

From a faculty perspective, collaborations take much more organization than a typical class setting. It becomes apparent early that an agreement on course content and milestone objectives are critical to

successful cross discipline endeavors. There also needs to be an understanding that every group of students are different and team building strategies that work one group cannot be expected to work on another. The faculty for D+N Collaborative has learned that flexibility is key to student success. Along with pedagogical adaptations, new relationships and research opportunities can develop out of collaborative efforts. This collaborative has produced several publications and presentations. Now that the focus has pivoted to concussions faculty are finding new relationships with faculty engaged in various types of cutting edge research that opens opportunities for other collaborative activities.

4.2. Our future

As the D+N Collaborative continues its activities in the area of concussion, its faculty plan to refine their pedagogy and broaden their field of collaborative partners with the end goal of seeing their innovations reach those who need them most. The Collaboration has always envisioned their products and services reaching a commercial state. With its new focus students have move, with their ideas, out of the classroom and into the field for further development of their products. To date the collaborative has seen one student project written into an NSF grant and one student project considered for early stage development by a major athletic equipment corporation. Two products in two years, the collaboration believes this will be a continued trend as it gains more notoriety and more researchers understand the outstanding results being accomplished in the D+N Collaborative.



Fig. 8: Final presentation

Bibliographical References

[1] Institute of Medicine and National Research Council. 2014. *Sports-related concussions in youth: Improving the science, changing the culture*. Washington, DC: The National Academies Press.
[2] Designing the healthcare provider of the future: Chad Priest at TEDxIndianapolis. Accessed 3/23/2015. http://www.youtube.com/watch?v=DZr3JiiKEQA
[3] Bradley EH, Taylor LA. American Health Care: Too Much, Too Late? The New Yorker. November 13, 2013. Accessed 3/23/2015. http://www.newyorker.com/online/blogs/currency/2013/11/american-health-care-prevention-treatment-cost-problems.html
[4] The Live Well Collaborative. Cincinnati, Ohio. http://livewellcollaborative.org/.
[5] Concussion Public Health Evaluation. Accessed 3/23/2015. https://www.youtube.com/watch?v=QlN3MLOOr78
[6] Blue AV, Mitcham M, Smith T, Raymond J, Greenberg R. Changing the future of health professions: embedding interprofessional education within an academic health center. Academic Medicine. 85(8):1290-1295, August 2010. doi: 10.1097/ACM.0b013e3181e53e07.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
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OSCAR NIEMEYER, THE ARCHITECT OF THE CURVED SURFACES
The freehand relief as tool for investigation of modern Brazilian architecture

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Abstract
These brief remarks concern to the use and the importance of the survey in sight for the analysis and a meditated observation on the modern Brazilian architecture.
In September of 1956, a few months after his proclamation, President Juscelino Kubitschek calls for a meeting Niemeyer, announcing: "Oscar, we will build the capital of Brazil. A modern capital. The most beautiful capital of the world."
The modern project of Brasilia was the symbol of an age of great changes in the country. Made in three years and seven months on the basis of the pilot plan of Lùcio Costa, it still remains the prime example of modern architecture in South America.
The buildings examined are of great value, the sites near the Eixo Monumental, the main artery of Brasilia, which form the core of the city.
The aim and the purpose of this research are focused on the utility of the survey in sight as a tool for knowledge and understanding of some buildings like the *Palàcio do Planalto*, the *Palàcio da Alvorada*, the *Supremo Tribunal Federal*, the *Museu da Cidade*, and finally the complex of the *Congresso Nacional*.

Keywords: Modern architecture, Niemeyer, Brasilia, survey

O Poema da curva. *"Não é o angulo reto que me atrai. Nem a linha reta, dura, inflexível, criada pelo homem. O que me atrai é a curva livre e sensual. A curva que encontro nas montanhas do meu país, no curso sinuoso dos seus rios, nas nuvens do céu, no corpo da mulher amada. De curvas é feito todo o Universo".* **O.N.**

1. "Arquitetura Contemporânea no Brasil"
The intense building production that involved Brazil from the thirties of the twentieth century till the second postwar period, and from the economic development to the post-industrial phase, was on the one hand associated with a widespread phenomena of abusiveness and speculation and on the other hand left a building heritage of great architectural and urban value. Immediately after World War II, the civil architecture definitely made a qualitative leap, also thanks to young emerging designers, with great idealistic talents. The creation of an innovative heritage is owed to them. This innovative heritage consisted in infrastructure, service equipment, housing, public spaces, which contributed to the modernization of the country and profoundly transformed the image of Brazil.
Affonso Eduardo Reidy, considered the pioneer of Modernist architecture in Brazil, was the creator of architectural structures conceived with original aesthetic intentions and authentic modern design criteria. Architects as Gregori Warchavchik, Marcelo and Milton Roberto (MMRoberto) the team of Carlos Leao, Jorge Moreira, Ernani Visconcellos, and then in the '50s Oswaldo Arthur Bratke and Rino Levi, Joao Batista Vilanova Artigas, Carlos Cascaldi and Carlos Millan also realized projects strongly characterized from the typological perspective, but structurally fragile, like the entire modern architecture built in that period.
Cultural exchanges and links between the Brazilian architects and their European and American colleagues were particularly significant. This fact was crucial for the diffusion of a modern architectural culture in Brazil, which certainly developed in the '50s and '60s its own self-identity. This line of thinking is relatively recent,

because the Brazilian architectural historiography was mainly based on the unique contribution of the Western avant-gardes, overlooking other references. Before that period the idea of a "*Brazilian Modern Architecture*", completely subordinated to the European and American cultural education, prevailed. Actually this architectural production deserved other considerations from the experts and above all from the Brazilian architects and designers [1].
Many of these Brazilian scholars have always considered this architecture as an unoriginal production and even marginal, compared to the "International Style". Since the eighties, there was a review of this position by a part of the new generation of Brazilian critics and architects. A reassessment of the history of modern Brazilian architecture was made by the French historian and critic Yves Bruand, in his essay "Arquitetura Contemporânea no Brasil" published in 1981. In this book the work of Lúcio Costa becomes fundamental and probably "the source" of Brazilian city-planning. He was a Brazilian architect and modern town planner. Attentive to Le Corbusier teachings Lúcio Costa was one of the most influential exponents of Brazilian architecture, together with O. Niemeyer. His name is undeniably linked to the planning of Brasilia. Lúcio Costa, visionary and utopian, imposed to Brazil his ambitious idea of a new science of town-planning and involved Oscar Niemeyer in his ideal project.

1.1 Oscar Niemeyer

After graduating from the Escola de Belas Artes, as engineer architect in 1934, he spent the first years of his professional education in the architecture studio of Lúcio Costa and Carlos Leão. Costa promoted Niemeyer as the official image of Brazilian architecture. He became the icon of the twentieth century's Brazilian architecture, and he has faced the challenges of his time working until his last days. He is remembered as a great artist, not only for the quantity but also for the relevance of his works: there are more than five hundred projects all around the world. The IPHAN, Instituto do Patrimônio Histórico e Artístico Nacional, has listed thirty-five of his projects that have been realized.
From 1940 the mayor of Belo Horizonte, capital of the Minas Gerais, Juscelino Kubitschek de Oliveira, summoned Oscar Niemeyer for a meeting. From that conversation they established a very long and fruitful collaboration. At that first meeting the major already commissioned to the architect the design of the Casino, the first building of an articulated complex that had to be built in a new district in the north of the city, called Pampulha. However, his first building was actually the church of St. Francis of Assisi, in 1943, widely recognized as the first modernist monument in Brazil, and because of that signed by controversial events [2].

1.2 Brasilia

Twenty years later, Niemeyer concluded the most of his architectural achievements, and most of the public buildings in Brasilia. In September 1956, shortly after being elected president of Brazil, Juscelino Kubitschek decided to build a new capital, moving it from Rio de Janeiro to a central location of the Brazilian territory. The location indicated by Kubitschek was on an upland with low vegetation, and it was an intuition with few precedents in history. But his utopian vision was to encourage the national industry, integrating distant areas of the country, and so to populate inhospitable regions.
Drawing the pilot plan of the new capital, there were Niemeyer and his mentor Lùcio Costa, while the task of landscape designer was entrusted to Roberto Burle Marx.
Taking as reference the ancient cities, Lùcio Costa represented the graphic composition of the plant of



Fig. 1: Brasilia. Eixo Monumental. Photography.

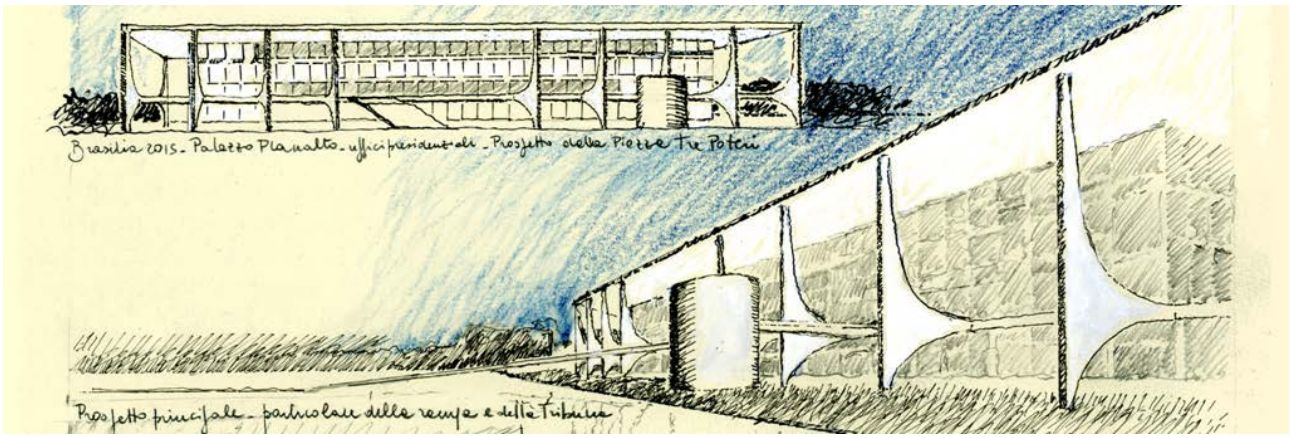

Fig. 2: Brasilia. Palácio do Planalto. Architectural perspective in gesture. Analysis of order and proportion of the facades. Ink and pencil on vellum. Author.

Brasilia as a bent but tense (as a wing) line, dividing the plan in two symmetrical wings connected by a transverse articulated axis [3].
The transverse axis called Eixo Monumental, is the main artery of Brasilia, it forms the core of the city. All the symbolic buildings of the capital are gathered in this place, as in the classical cities, responding to those requirements of rationalization and organization of social life. Oscar Niemeyer suggested to Lúcio Costa a recovery of a classic model for the foundation of the city, which could provide the instrumental support for a renewed desire of order and rationality. This system, legitimized by tradition, was reinterpreted in the light of the Modernist culture, generating a new idea of beauty. Vertically to the transverse axis, a main longitudinal axis was developed. The latter was outfitted with several parallel and continuous secondary axes, disposed symmetrically on both sides, to serve the residences[4] that were arranged in large residential blocks called *quadras*.The analyzed buildings near the Eixo Monumental are of great value. Here these buildings were considered in their specific functional roles and in both their different aspects: typological and morphological.
The monumental axis is deliberately emphasized by the duality road/building, this order is accentuated by the contrast between the projected emptiness and the full, represented by the exceptional nature of the buildings.
An important example is given by the Cathedral which is characterized by the unmistakable Hyperboloid structure and it's proximity to the Complexo Cultural da República (Cultural Center of the Republic). The center is formed by the Biblioteca Nacional de Brasília, beautiful building for the National Library and the Museu Nacional da República. This one is very articulated with its 14,500 square meters exhibition spaces that are arranged in multiple layers under a cement hemisphere.
The Eixo Monumental is bordered to the East by the famous "Square of the Three Powers": a high terrace, overlooking the planted land below, that reach the artificial lake Paranoá Lake, realized as a reserve to increase the amount of water availability for the region.

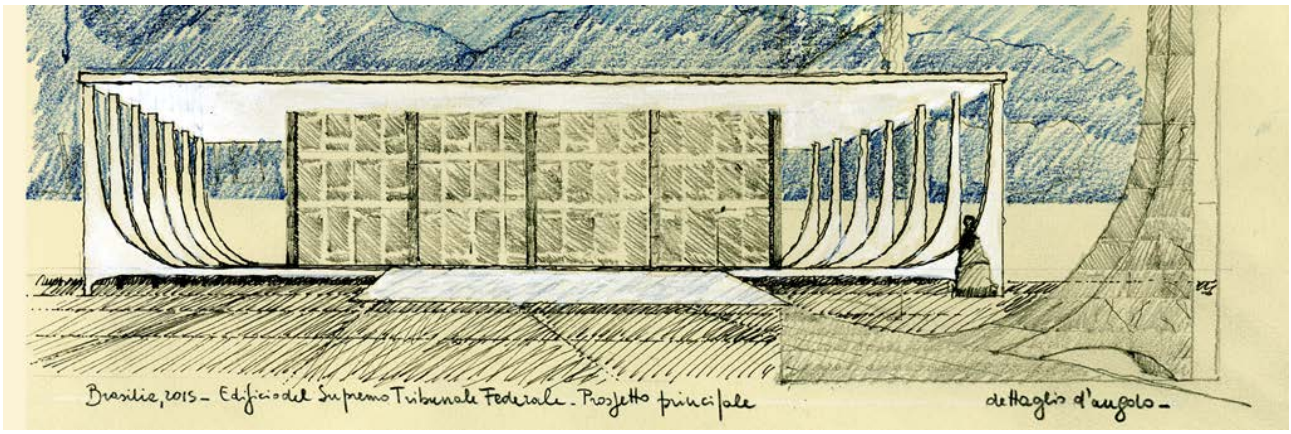

Fig. 3: Brasilia. Supremo Tribunal Federal. Architectural perspective in gesture. Sketch of the modules of the facades with light construction lines. Construction detail of the pillar. Ink and pencil on vellum. Author.

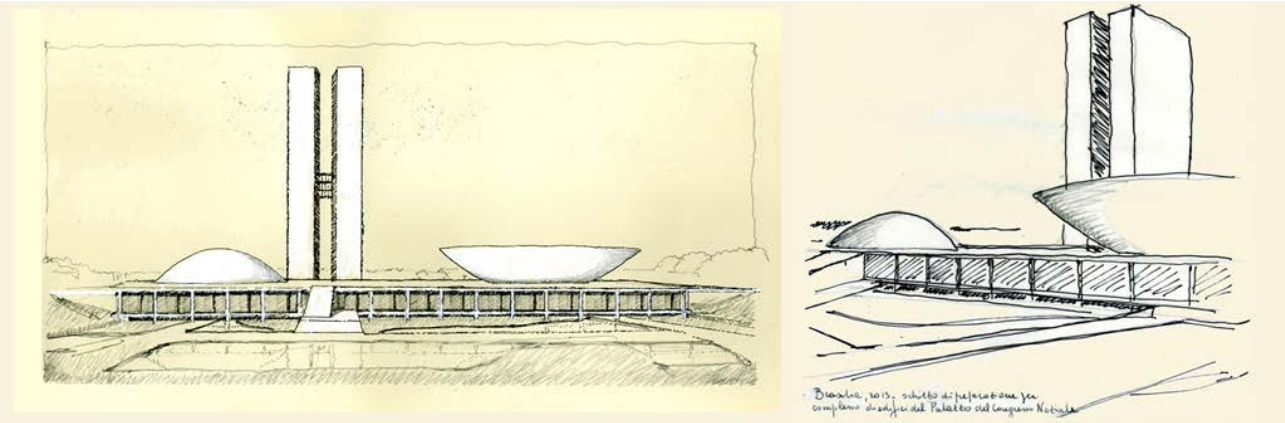

Fig. 4: Brasilia. Palácio do Congresso Nacional. Architectural perspective. Rapid freehand perspective gesture. Ink and pencil on vellum. Author.

The Praça dos Três Poderes is the square of Brasilia. It is the Symbolic center, which name comes from the comparison of the three federal branches around the square: the executive, represented by the Palácio do Planalto (presidential office), the judicial branch, represented by the Supremo Tribunal Federal (Federal Court) and the legislative branch, represented by the complex of buildings of the Congresso Nacional (National Congress).
Palácio do Planalto is the Presidential Palace, designed by Oscar Niemeyer. The work was completed on April 21 1960, with the inauguration by the then President Juscelino Kubitschek. The inauguration was a solemn ceremony because it definitively introduced Brasilia as the new capital. In 2010, after several years of abandonment, the building has undergone a radical internal restructuring and a remake of the structures and the external facade fixtures. Now with the opposite building, the Supreme Federal Tribunal, Palácio do Planalto can be considered among the most significant achievements of Modernist architecture in the world.
It is the very icon of modernity, designed as a glass box with a superstructure punctuated by slender external pillars, shaped with perpendicular curves to the body of the building, and capable of holding a heavily protruding thin cover. On the main prospectus we find other elements of considerable plastic -formal value, such as the building ramp and the presidential grandstand facing the square. The building is four floors high aboveground, and it is surrounded by a stretch of water, made for aesthetic and climatic reasons.
Also the perimeter surfaces of the Supreme Federal Tribunal building are made of wide glass windows. It is a transparent volume slightly raised from the pavement, with thin shaped exterior pillars, which support a cantilevered projecting roof. The great buildings of public institutions that are aligned perpendicularly to the main axis of the cross are all characterized by a monumental emptiness.
Moreover the National Congress complex, consists of a large basic building which forms a horizontal platform. Here two complementary volumes are arranged: the dome of the Senate and, upside down, the dome of the House of Representatives[5]. In front of the building rise a couple of twin towers. Several representatives of global avant-gardes were invited to give their critical contribution especially on the construction of Brasilia and the new vision of architecture in Brazil

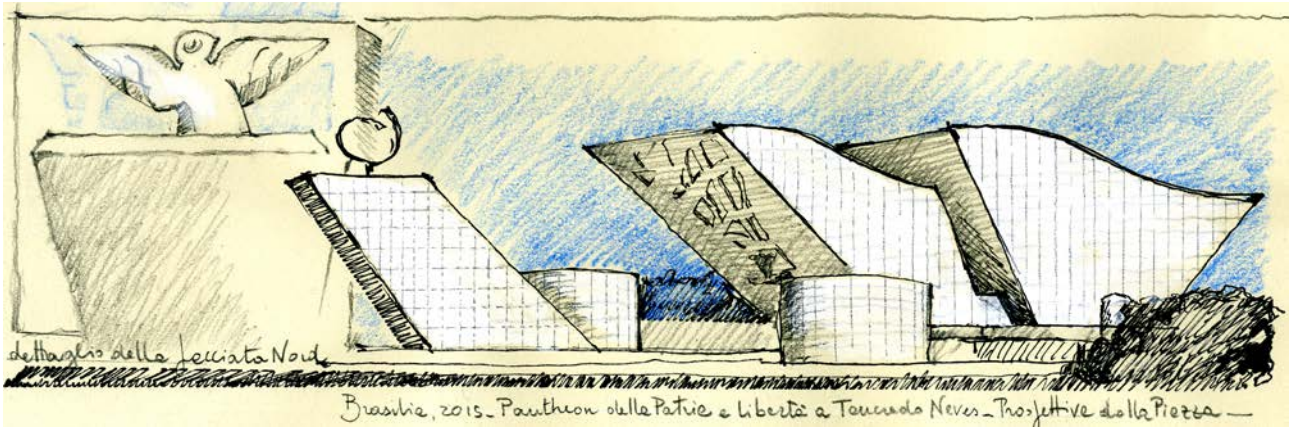

Fig. 5: Brasilia. Panteão da Pátria e da Liberdade Tancredo Neves. Architectural perspective in gesture. Ink and pencil on vellum. Author.

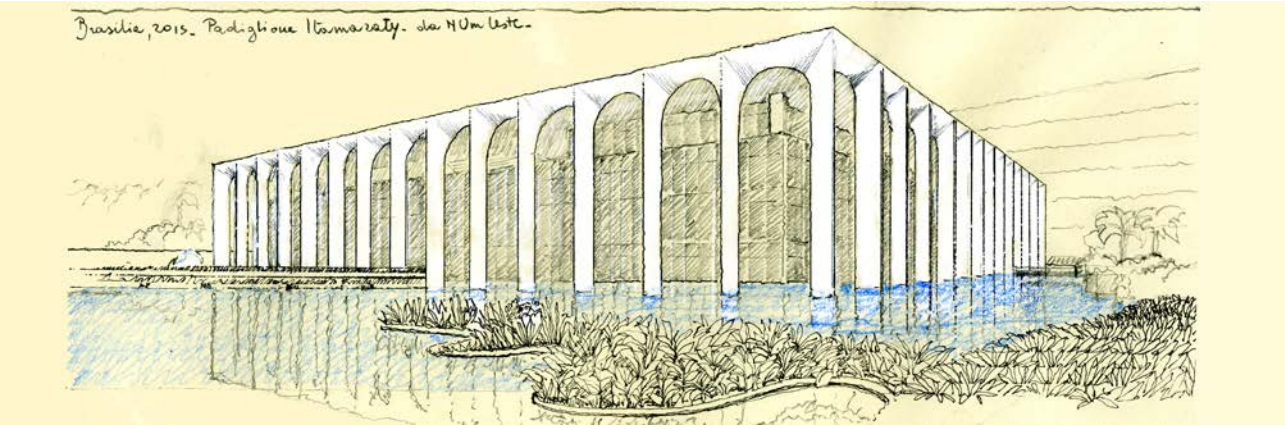

Fig. 6: Brasilia. Palácio Itamaraty. Architectural perspective in gesture that underlines the facade arches. Ink and pencil on vellum. Author.

The ground is designed with small palms rows wanted by the landscape architect Roberto Burle Marx. Of great interest, regarding the landscapes, are the large bodies of water. A sloping and wide empty but drawn lawn characterises the posterior prospectus. It is deliberately lacking of planting.
Concluding the square between the Supremo Tribunal Federal and the Presidential Office of the Palácio do Planalto, there are the Panteão by Patria and Tancredo Neves da Liberdade. The small Pantheon of the Fatherland and Freedom with his dismantled profile, also designed by Oscar Niemeyer and opened in 1986, is still an authentically modernist architecture[6]. With its three floors above ground, it is a remarkably daring architecture structurally speaking. Here the cement creates with glass a surprisingly simple and elegant architectural monument that arouses surprise and interest, as a secret place.

A particular aspect of Niemeyer, on which we should dwell for a while, is the constant use of cement and glass in its architecture. The concrete was frequently used to realize large curved surfaces. We can understand the reasons why he was so fascinated by the use of glass by reading some of his speeches in which the modernity of this material was emphasized. The glass becomes therefore, in his architecture, the expression of the possibility of a marriage between a tendency to accuracy and the willingness of creating suggestions. The modernist culture of Niemeyer developed and reinterpreted new construction techniques in the light of functional requirements.
Of great interest are two large rectangular-plan buildings that overlook the space westbound the National Congress building. On the S Um Leste Street, there is the Palácio Itamaraty, and across the N Um Leste Street, we can see the Palácio da Justiça, with the other buildings of the Department of Justice.
The Palácio Itamaraty is the headquarters of the Ministry of Foreign Affairs of Brazil. The architectural project (1960) is by Oscar Niemeyer, while the bold structural project is owed to the engineer Joaquim Cardoso[7].
This extraordinary architecture has three floors.

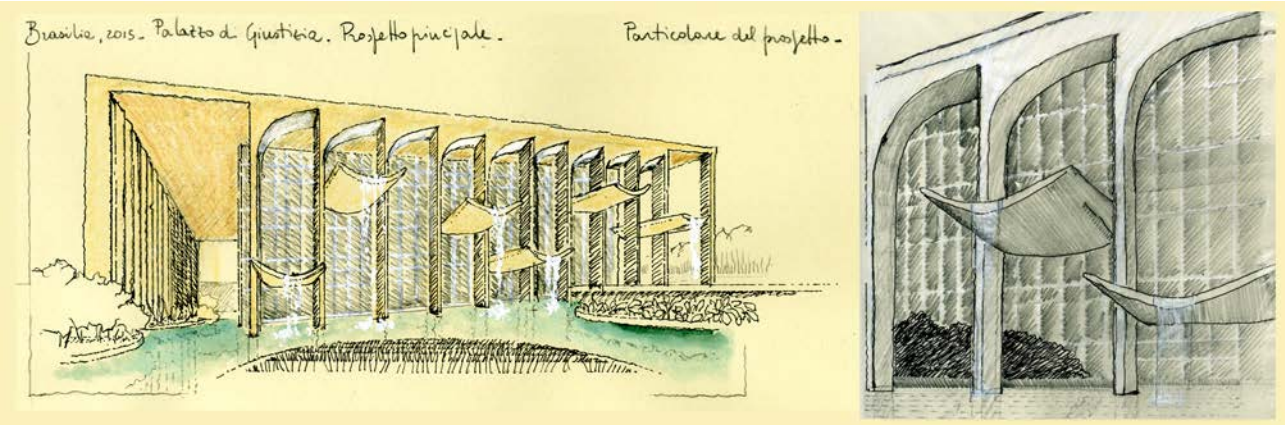

Fig. 7: Brasilia. Palácio da Justiça. Architectural perspective in gesture. Detail of the protruding elements from the facade. Ink, pencil and watercolor wash on vellum. Author.



Fig. 8: Brasilia. Panteão da Pátria e da Liberdade Tancredo Neves, (1985). Photographic gallery realized by the author.

The large prospectus below with wide glass walls is protected by a deep portico supported by a succession of round arches that are splayed outward, in a giant tier, all made of exposed concrete. The interior installation, with works of great artistic value, is by Roberto Burle Marx, as well as the design of the exterior, with water pools and themed gardens. The building was completed in 1970.

The Palácio da Justiça is the Palace of Justice. It was designed by Niemeyer in 1957 and placed in front of the Department of Foreign Affairs, whose setting of composition is very similar. With its exposed concrete and steel structure, it is a five-storey pavilion with an area of 23,000 square meters. The deep portico is drawn on the facade by half arches supported by pillars in a giant tier.
These pillars hold among each other protruding curved corbels, capable of overthrowing cascades of water in the pools below. The idea was to remember the moorland of Amazon. The facade below is made of large glass surfaces. The building has undergone many renovations of the interior because of its different distribution. The first was in 1985 and the second in 2003 when the marble slabs not provided by the designer were removed. This building, more than the others, recalls the work of Le Corbusier in Chandigarh, India.

1.3 International Congress of Art Critics in Brasilia, Sao Paulo and Rio de Janeiro, Brazil, 1959.
In 1959, the year before the inauguration of Brasilia, Juscelino Kubitschek wanted to organize a special International Congress, inviting the main critics in Art and Architecture fields, architects and designers to Brazil, to discuss the future of the cities of the twentieth century and the future relevance of Brasilia.
The Congress was organized between Sao Paulo and Rio de Janeiro and included a three-day visit to Brasilia. The program was based primarily on the debate of modern urban planning, as part of the 5th International Biennial of Contemporary Art in Sao Paulo.
With an ambitious program, the conference was organized by the art critic Mario Pedrosa and the president Giulio Carlo Argan.



Fig. 9: Brasilia. Palácio da Justiça, (1957). Photographic gallery realized by the author.



Fig. 10: Brasilia. Palácio do Congresso Nacional, (1960). Photographic gallery realized by the author.

The debate was attended by representatives of culture, architecture and art of Latin America, Europe and the United States.Despite the hard availability of the documents of the Fifth Biennial, we know that architects and researchers of international prestige attended the Congress.This was supposed to represent the materialization of a utopia.
But Brasilia was still under construction, in a turning point, so when these personalities were invited to visit the future capital, almost nothing was completed, everything was still under construction. Regarding the Congress Palace, one of the most significant buildings, only the concrete structure of the twin towers 28 floor high was visible, while the concrete structure of the domes of the coverage of the convention center was still shored up with the scaffolding.
After a three-day visit of the wide construction yard of Brasilia, the prestigious visitors were unable to formulate any consideration about what they had seen. In general it was reiterated that if the Modern Movement had failed, and it was by now dead in Europe and in the United States, it could not be considered the same in Brazil (Bruno Zevi), where the architectural production was considerable. They focused on one important aspect: the construction of the new capital permanently transformed the awareness of architecture in Brazil from a first utopian condition to the realization.

The participants outlined the "post- Brasilia condition" (*"condição pós-Brasília").*The debate, even then paid attention to the matter of conservation, aroses the low efficiency and the energetic unsuitableness. Surely, several maintenance interventions would have been required shortly to protect and to hand down this heritage to the future. The technological aspect was linked to the ideological aspect.
So it was clear that, with the prevalent use of certain materials for the realization of these architectures, there would have been an inevitable and real physical degradation, until the technological obsolescence, risking an alteration of structural and morphological peculiarities.
They paid attention to the identity (as modernist architecture) of buildings to consider and to appreciate their historical and cultural value, protecting them through the documentation and the architectural survey.



Fig. 11: Brasilia. Palácio do Planalto, (1960). Photographic gallery realized by the author.

1.4 The freehand relief as an essential tool for the survey of the Modern architecture

The perception of the built identifies and involves the visitor in the urban space defined by the features of this complex and variable city. The freehand relief becomes an essential and basic tool to understand and later to realize the metric survey of the modern. This kind of survey is a style of hand drawing, and so becomes the first “forms decoder” tool in the architecture field. It is an effective instrument to investigate the formal values of a specific building and state the environmental connections.

It becomes the essential moment of meditation for a heritage in need of protection, it becomes a critical survey.

Especially for Modern architecture, the freehand survey represents an important exercise that allows us to acquire skills in observation and it is the fundamental technique to graphically record what we see.

It involves the creation of a rapid perspective gesture: the sketch that implicates a complex process of abstraction on a critical plane and on the level of application.

The freehand survey involves a direct presence of the asset to be documented, and tends to define the building, in its constructive peculiarities, according to a graphic simplification performed manually. With the addition of meticulous details it allows us to recognize the techniques and the technology.

Often thanks to these drawings, performed by hand, it is easier to identify the different phases of the transformation process of the object to be recovered, allowing to easily reaching the identification of the original work.

To conclude, it is through the freehand drawing that is possible to highlight those general challenges of modern architecture, and here in particular of the architectural heritage of Brasilia, from which you can draw theoretical approaches and methodologies oriented to the maintenance of the architectural heritage recovery.

Bibliographical References

[1] Some essays about this topic are: *Arquitetura Moderna Brasileira* (2004) by E. Andreoli, A. Forty; *História Do Modernismo Brasileiro* (1982) by M. Da Silva Brito; *Depoimento De Uma Geração Arquitetura Moderna Brasileira* (1987) by Alberto Xavier; *Arquitetura e Estado no Brasil (1987)* by C.A.F. MARTINS.

[2] In 1943 this building received an international acclamation during the exhibition of "Brasilian Buildings" at the MoMA, but the conservative authorities of the church in Minas Gerais refused to consecrate it until 1959, one-sidely for its unorthodox form and for mural painting of the altar, painted by Candido Portinari. The wall painting depicted Christ as the saviour of mad, poor and heretics.

[3] The graphic plant, in the collective imagination, originated the popular idea that the design was suggested by the shape of an airplane, a privileged mean of access to the city.

[4] The residences are built in tall buildings with a reasonably rigorous and rational design, mainly with typologies of row houses with pilotis ground floor

[5] This architectural composition recalls clearly the shape wanted by Le Corbusier for the United Nations Building in New York in 1947, and which certainly had also the contribution of Niemeyer.

[6] With highly symbolic aspects it represents the flight of a dove. Inspired by the ideals of freedom and democracy of President Tancredo Neves.

[7] This pavilion is 13 meters high, the floor plan square measures 84 x 84 meters. It includes a wide room with an area of 2800 square meters, without central pillars.

Drawings were realized on site and then completed in laboratory with liquid techniques.
Thank for the logistic collaboration Paula Kamogawa and Fabio Zonno.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Survey on the landscape and morphological singularities of the Cliff of Aci Castello

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Abstract
Our territory is rich in locations of indisputable charm, whose wealth is the enviable result of the century old work carried out by nature, as well as that carried out by man that at times has been both interfering as well as interacting. This involves stratified palimpsests whose interpretation is complicated by the superposition of several semantic layers, each corresponding to different elements of quality and, often times, elements of fragility.
A study aimed at protecting and enhancing the value of these sites can not be separated from the development of a targeted strategy which has a strong interdisciplinary vocation and is also closely linked to the areas of archeology, history, survey, landscape reading, morphology of the territory and geology. It must no longer be managed as autonomous cognitive elements - differing in scale, setting and language codes - but within a single comprehensive analytical model of interpretation.
A cognitive survey of the costal area of the *Riviera dei Ciclopi* was developed using this methodological approach. The survey focused primarily on the Cliff and the Castle of Aci, which are of high landscape value and interconnected to the historical events of the Etna volcano. It is a place full of unusual geological, natural, human and cultural features that have been praised over the centuries through the descriptions by both artists and travelers.
The aim of the integration of various survey technologies - 3D laser scanning and mobile mapping systems - is to obtain a dynamic understanding, which is both punctual and comprehensive. It is a necessary step in order to initiate a counter-action against the geomorphological risk that is linked to a strong anthropization and which has taken place because of the inadequate understanding and knowledge of the location's value and intrinsic fragility.

Keywords: Aci Castello, Morphological Complexity, Mobile Mapping, 3d Laser Scanning, Virtual Modelling

1. Investigate to uncover a natural–architectural *unicum* *(M. Liuzzo)*
Our lands are rich in places of undoubted charm, whose value is the wonderful result of the millenary work of nature; as well as of the work, sometimes interacting or sometimes interfering, of man. The interpretation of these stratified palimpsests is complicated by the superposition of several semantic layers, corresponding to different elements of quality, but often, of fragility as well.
To provide answers that are consistently more suitable, in terms of understanding, protection and valorisation, is the most current challenge that our research activity can accept. All the while acknowledging the innate privilege and duty of the acceptance of this responsibility towards such an extensive heritage.
This challenge is made even more arduous by the awareness that only a targeted strategy with a strong interdisciplinary calling, closely linked to the areas of archeology, history, survey, reading of landscape, landscape morphology, and geology; that is no longer an independent cognitive tile - different in scale, setting and language code - but one that is a part of a single analytical interpretive model, can allow for the finalising of an efficient fact-finding survey capable of safe-guarding and valorising every site in its singularity.
For this reason, the role of scientific research becomes fundamental with respect toward the world production of technological innovation in order to direct the rampant advancement of technology towards well-focused objectives and areas of applicability.



Fig. 1: The *Riviera dei Ciclopi* and the survey campaign with mobile mapping technology

With the objective of creating a strategic convergence between the requests of the territory and technological innovations, an experimental investigative activity has begun in the costal area of the *Riviera dei Ciclopi* and, in particular, in the area of the cliff and of the Castle of Aci. This is a wealthy area for the singularity of its geological, natural, human and cultural features that risk disappearing in time if a substantial and delicate job of strengthening and securing the rocky coastline; which has at present been classified, according to the Hydrogeological Structure Plan of the Sicilian Region, as an area of high risk and danger.
Furthermore, adding to the hydrogeological risk is that which is produced by the consistent human presence along the coastline as well as that of the seaside tourism that is not adequately informed on the value and intrinsic frailty of the area.
The near complete lack of documentation, of a thorough and reliable survey of the area, which is an essential and necessary condition in order to proceed towards any action of understanding and conservation, is certainly ascribable to multiple factors: the undeniable problem in the geometric – spatial control of the lava front bluff rising sharply from the sea, high, morphologically structured and of extremely low reflectivity matter, the scarceness of adequate space in front where to set up an ideal instrumental survey, the unavailability of direct access to large parts of the rocky coast, which is perceivable only from the sea.
The location consequently seemed to be the ideal testing ground in which to launch our campaign for experimental testing on the new possibilities of survey offered by the mobile mapping technology mounted on a boat, as well as on a car, and able to reach areas of the rocky coast line and the Norman castle otherwise immeasurable.

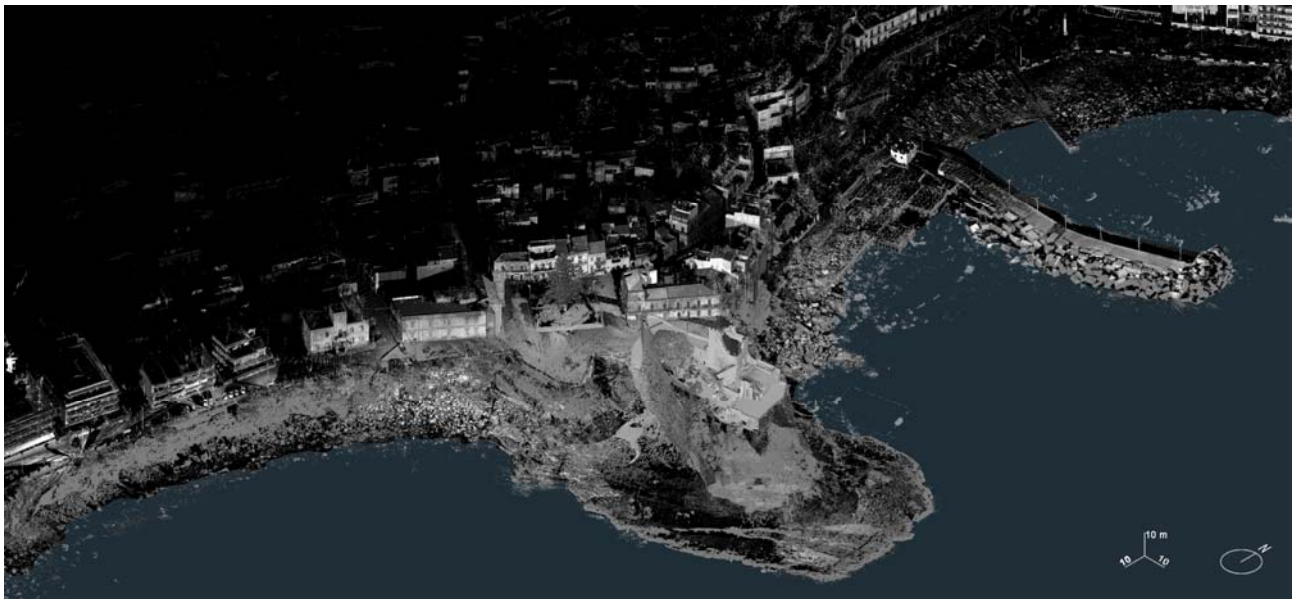

Fig. 2: The overall point cloud of the investigated area

The realisation of this interesting experiment, which was made possible by the generous availability of several important producers of the surveying system[1] and by the merging of interests by the municipality of Aci Castello and the University of Enna “Kore” was the first fundamental step, of a study in which this paper reports several of the significant findings.
The realisation of a three dimensional model of the investigated area by means of the delicate integration between the data from the mobile mapping and that obtained from the terrestrial 3D laser scanning with GPS positioning, was fundamental. This last survey campaign had the dual purpose of testing the precise limits of the technology in movement and to integrate the data through parts of the survey of the areas of the castle and of the areas not reached by the scans in movement.[2]
The purpose is to create a single analytical- interpretive model of the area, which complies with the scientific technology requirements and is immediately communicative. Such that it can be attributed with the value of a unique instrument, powerful and flexible, in support of a wide range of efforts to protect and valorise, aware of the site and of its various singularities.
The site of the *Riviera dei Ciclopi*, prolongation of the northern catanese coast, is an ancient location of rare beauty, that unites in a physical-environmental *unicum,* naturalistic, geologic, historic, mythological, archeological, and architectonic value.
From the geomorphologic point of view, the Riviera is formed, in the section south of the Aci castle, by high basaltic cliffs. Part of which jut out towards the sea, and in part protected by sections of beach of varying expanse, formed by large blocks that have been rounded by the continuous motion of the waves, often called “*cuti lisci*”. In the section north of the castle, the coast line is instead formed by low cliffs with sections of beaches that seem almost sculptured and strips of lava flow.

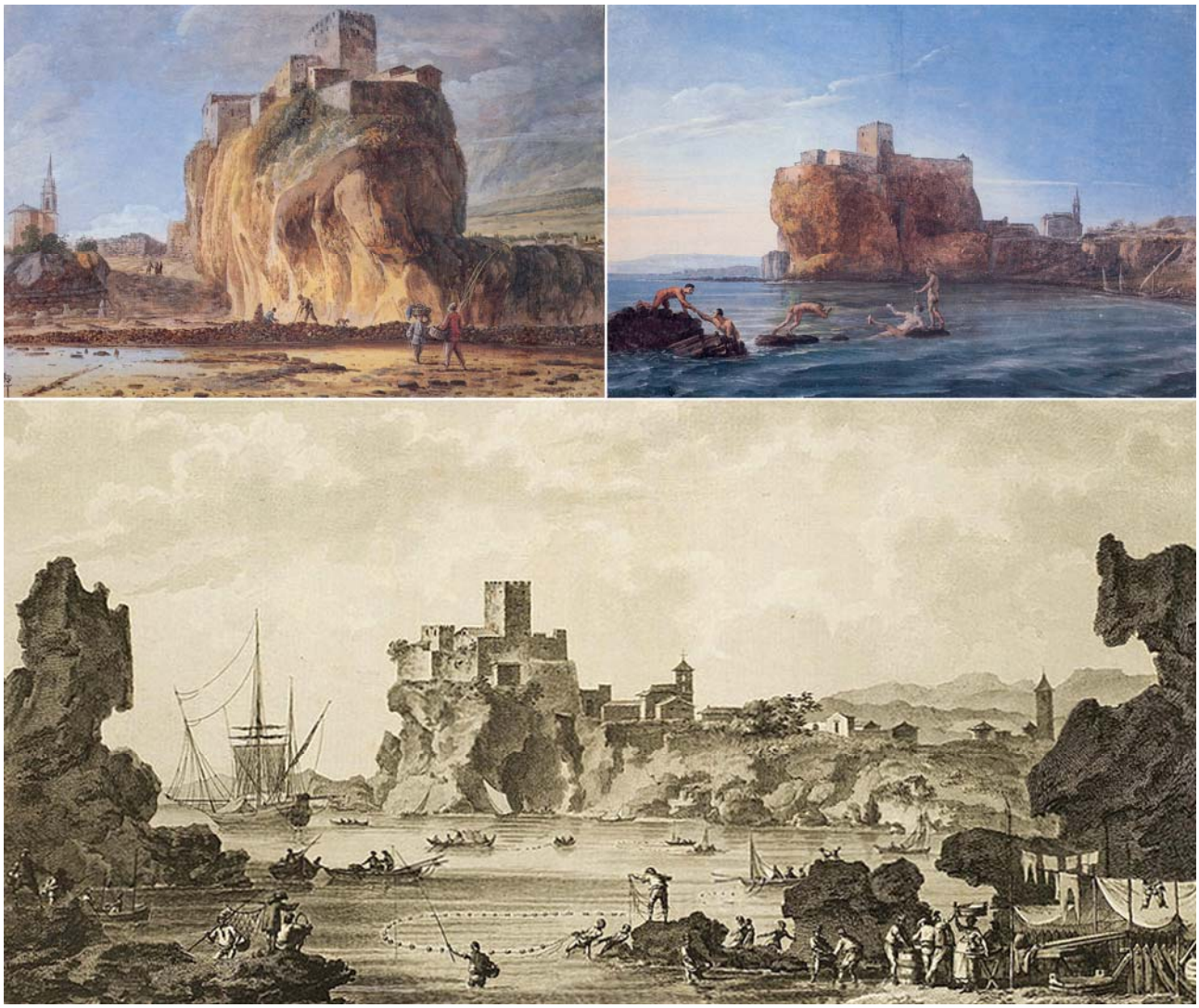

Fig. 3: Images of the rare scenery depicted in XVIII century by travellers from the *Gran Tour*. Above, the landscape views of Jean Houel; below, the etching published by Abbé de Saint-Non

This mainly involves underwater magmatic rocks, which effused during the first phases of activity from Etna (circa 500 - 600,000 years ago), currently admirable above sea level, because of the constant rising that in the last hundreds of thousands of years has affected the lower south-west Etnian side. Such a process has brought about the gradual emergence, among others, of the bluffs of Acicastello's castle and the nearby Sea Stacks of Acitrezza. They are impressive for their group mass, but extremely interesting from a close up view because of their peculiar sculptured structures of single magmatic masses that gradually cooled.
Precisely above a monumental rock composed in this manner, held up by a single natural platform that barely emerges from the water, known as "*praca*", seems to stand out, strategically in regards to the surrounding masses, the *castrum Jacii,* of the same lava rock from which the rocky coastline seems to emanate geometrical - material with an extraordinary naturalness.
From uncertain origins and complex stratification[3], the Castle "*gives the impression of a colossal ship, whose bow has run ashore amongst the bluffs of an immense lava flow, a ship which has come from the mythical, unknown shores. … If the visitor should then bring their gaze to the right of the gigantic bow of the castle, the open sea presents itself ahead, boundless, a sea of the purest blue, with turquoise reflections, often praised by poets".* [4]
It is this image of rare landscape beauty that must have enchanted the cultured travellers from the *Gran Tour* that, driven by natural curiosity, left written testimonies and depictions of the site, that still today remain among the most complete and significant. Among these, the landscape views of Jean Houel, in Sicily twice between 1770 and 1779, the etchings published by the French editor Abbé de Saint-Non (1781-1786), and the drawing by landscape artist Christoph Heinrich Kniep, together with J.W. Goethe during an excursion to Aci Castello May 6, 1787.
These representations, along with the subsequent ones and all the way to the photographic, cinematographic, literary, and pictorial images attributable to the second half of the last century, refer to a majestic landscape. One that is wild, barely contaminated by anthropic actions; a very different image from the current one, strongly characterised by the massive urbanisation that has irreversibly modified the *facies* of this costal setting.

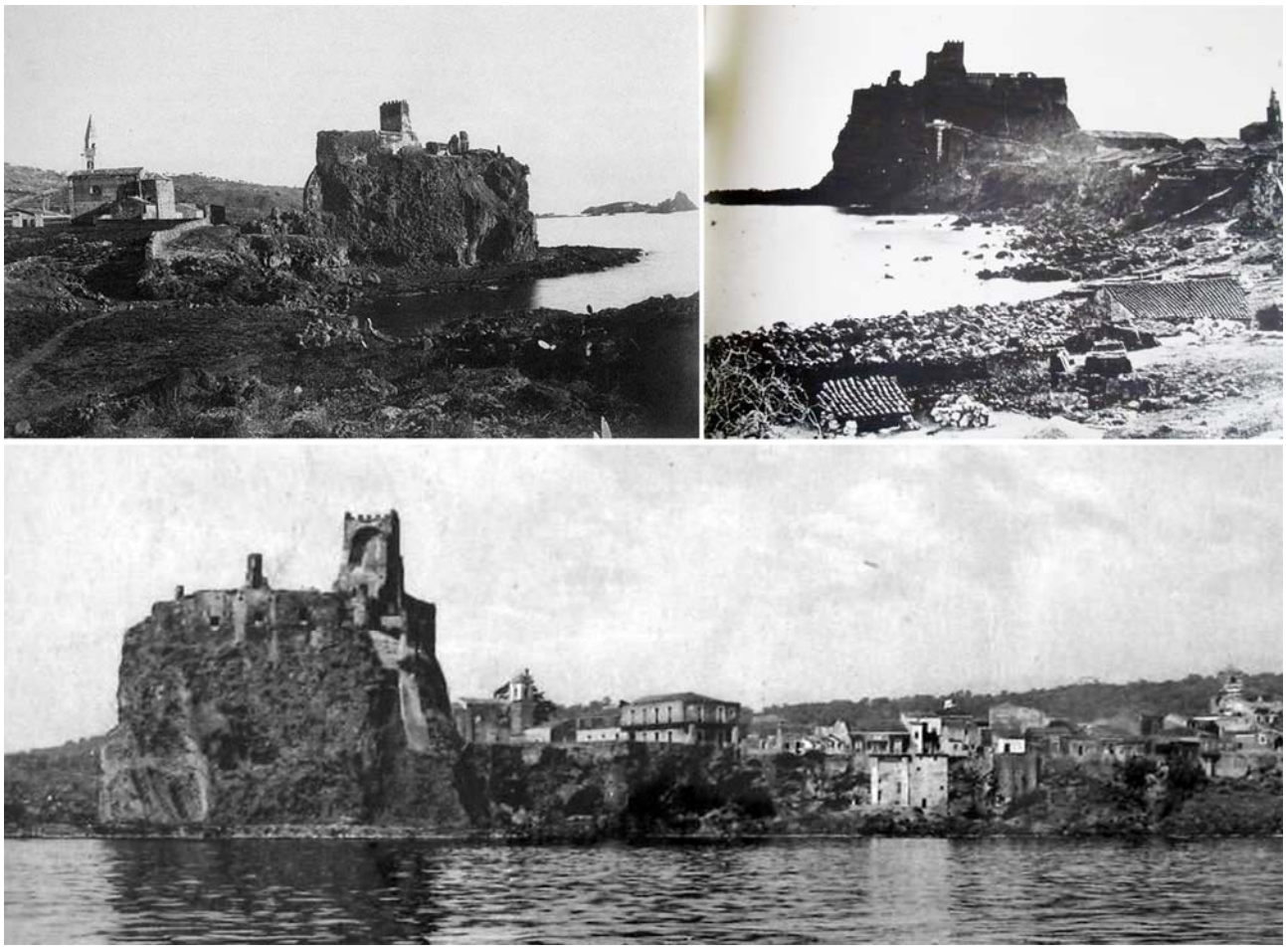

Fig. 4: The majestic landscape in photographic images attributable to the last century

2. The integrated survey campaign *(S. Savarino)*

A vast array of survey instruments and procedures have been made available on the market because of the noteworthy developments of the last decade. They are suitable for managing data to a topographic scale as well as to a detailed one, versatile and often equipped with high performance software for the acquisition, management and elaboration of data.

The study conducted on the cliff and castle of Aci has allowed for the use of such *in combination* techniques, opportunely integrating terrestrial 3D laser scanning technology[5] and mobile mapping[6], according to the range and optimal precision of each individual sensor.

Such activity has made it necessary to program in detail a precise operating protocol, relative to methods, timing, precision range and the choice of control points. It has also progressively made it necessary to find the best way to overcome the ensuing operant conditioning: on one hand, instrumentation and commercial software, almost never projected to facilitate the exchange and integration of data originating for other technology; on the other, open-source software, much more flexible in its use, but not capable of managing such a bulk of data, note-worthy in its dimensions and complex in its structure.

In particular, the union of the bulk of data gathered inside a single system of reference was guaranteed by the input of common geographic coordinates, through a global GPS positioning system.

Such anchoring to a geographic element, fundamental for the environmental survey and in mobile mapping mode, but often disregarded in urban or monumental surveys, assured the possibility of always integrating, on the basis of absolute coordinates, even in different times, ulterior portions of survey inside a single general georeferencing model.

Starting from such a point cloud general model, obtained in conclusion to a delicate multi-step experimental process of union and elaboration of data, it was possible to carry out a series of dynamic analyses and inspections on the model, at various scales of approach, and to extract several two and three dimensional graphic representations that comply with precise technical requirements, interpretive and educational, tied also to the need to provide basic documentation to support ulterior multidisciplinary investigations[7].

It was then possible, among others, to return the orthoprojection of the front of the cliff and of the castle overlooking the sea; in a metrically controlled manner, to once again propose, a view only perceptible when approaching from the sea.

The possibility of sectioning the model with opportune secant planes consented, furthermore, to hypothesise the logic of several reciprocal relationships, not evident from an overall external observation, between the geometrical clarity of the external configuration and the unexpected articulation of the internal spaces, which are distinguished by their natural morphology and architectural choices, between the internal spatiality attributable to human influence and natural cavities created by the magmatic nature of the cliff.



Fig. 5: The orthoprojection of the front of the cliff and of the castle overlooking the sea

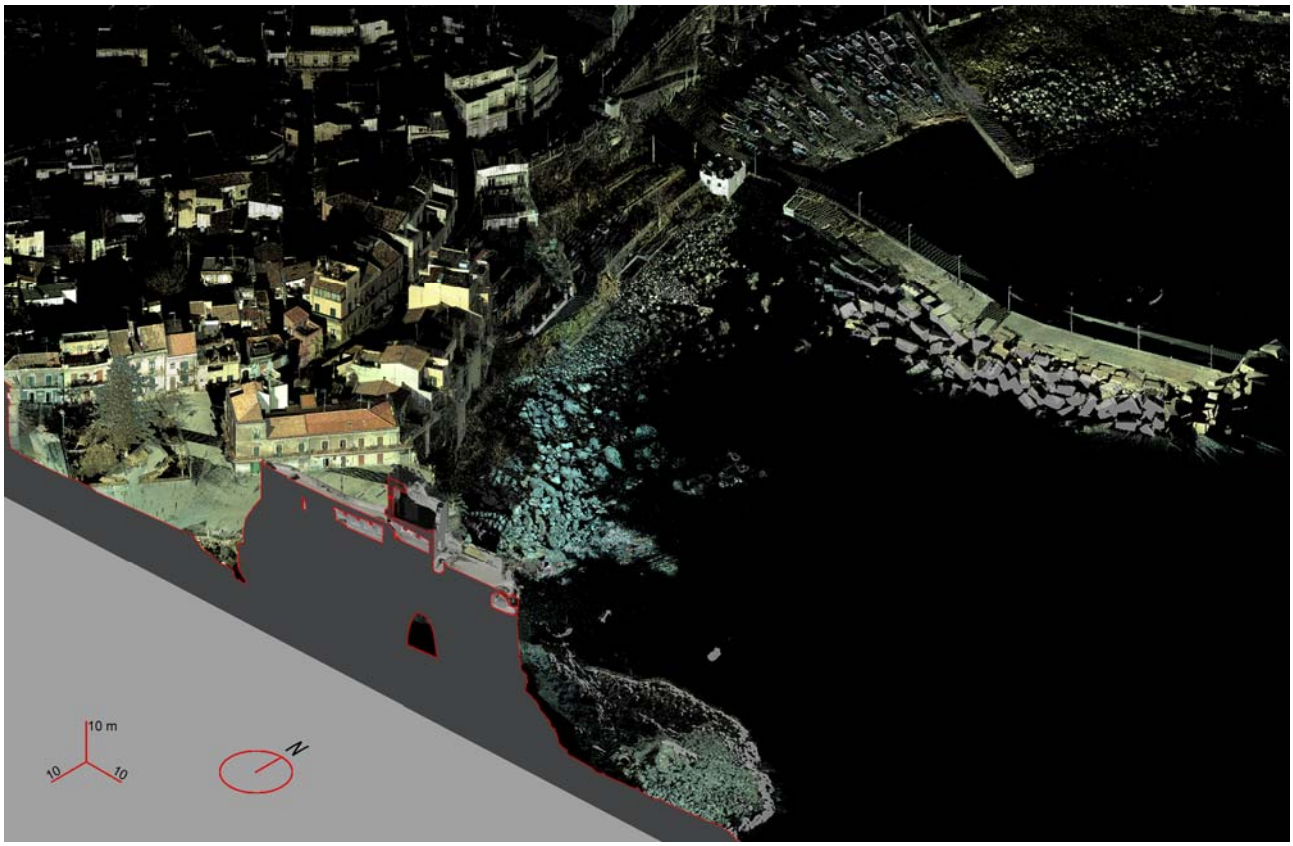

Fig. 6: Analytical axonometric view of the sectioned model, to reveal the logic of any reciprocal spatial-morphological relationship

3. An implementable modelling system *(S. Giuliano)*

Immediately emerging from among the bulk of the data that originated from the survey, is the particular morphological complexity of the castle, nestling itself within the basaltic rocks that characterise the bluffs.
The desired outcome of the research is to manage the scanning and decomposing of these phenomena of considerable territorial value, analysing the respective relationships between rock and architecture, between natural construction and anthropic construction.
The objective is to protect these enchanting sceneries by way of active monitoring, that emphasises the critical factors, unfortunately intrinsic in the passing of time.
With this aim, the research presents the instruments of survey and representation as the main actors capable of effectively triggering this monitoring process.
Furthermore, virtual modelling makes it possible to utilise the survey data for point clouds in two or three dimensional synthesis models; easily managed by technical users that are not in close contact with the study of representation, or by a public interested its virtual use for tourism or cultural reasons. For this reason, due to the large complexity of the object represented, virtual modelling becomes a winning weapon, obtaining in a precise and rapid manner the most suitable form of representation for the sought after purpose, whether it be scientific or of cultural dissemination.
Given the complexity of the surface of the rocky walls, the modelling process that is carried out in the creation of the triangular mesh surfaces adequately meld onto the point clouds measured. This allows one to base themselves not on the processes of simplifying the real morphology of the accepted structure but, in fact, on the virtual reproduction of the fractal complexities that connote the natural-architectonic object.
The main critical points of this modelling method are essentially tied to the managing of the files of such notable dimensions, directly proportional to the complexity and expanse of the amorphous surface as well as to the level of precision that the model is set to obtain.
Such difficulty has prompted the breaking down of the model of the investigated area into two systems; the irregular one of the rock and the geometrically regular one of the architectonic system, attributable to different layers on which to set the parameters, in a focused manner, for the reduction of the detail in the forms.

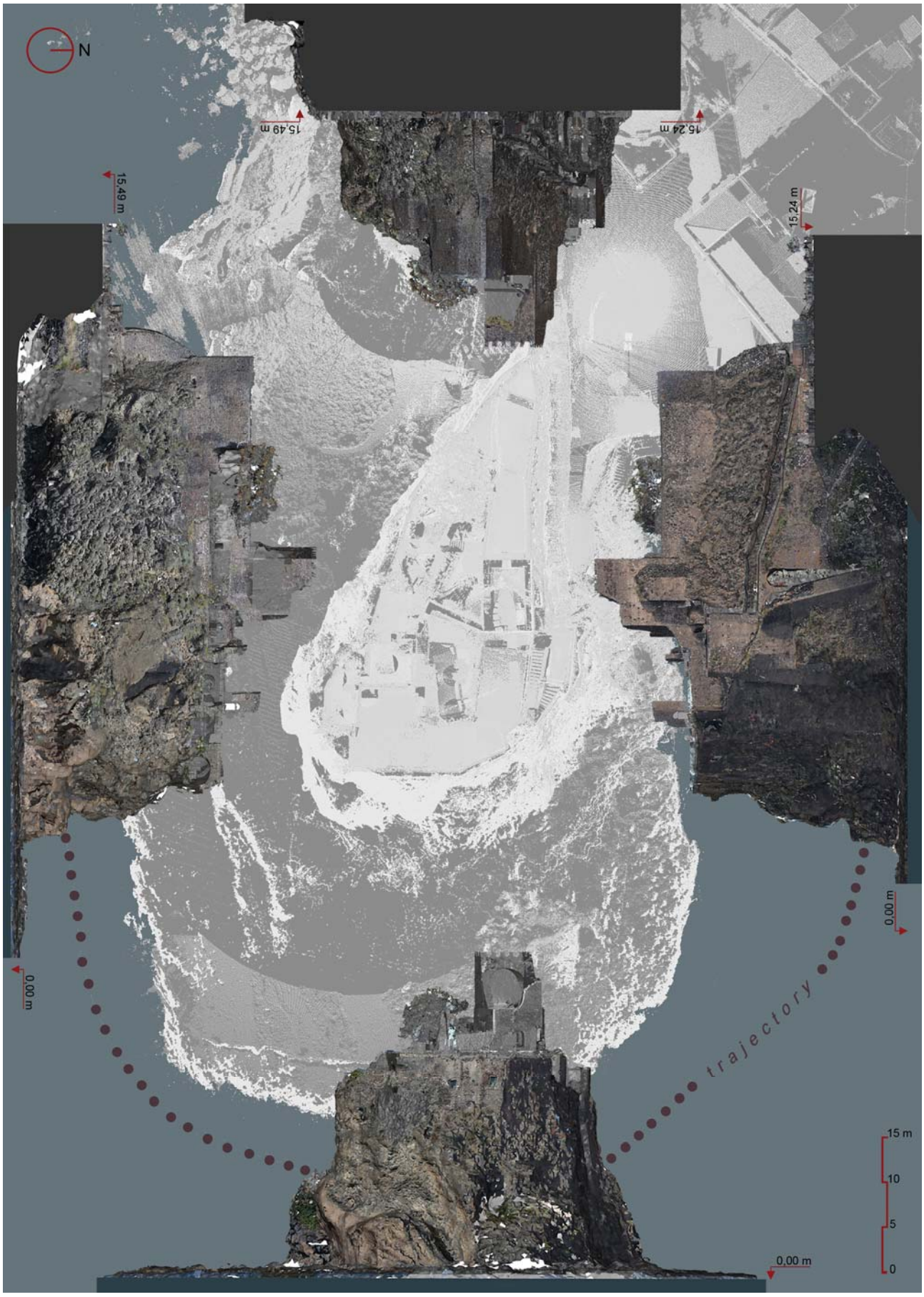

Fig. 7: The overall textured mesh model, dynamically “navigated” from various points of view

Even more extensively detailed, in consideration of the fact that in the survey phase with laser scanning technology, both environmental and detail scans had already be opportunely programmed with high-precision on the emerging singularities; with the same criteria the three dimensional mesh was divided into various levels on which to operate both autonomous and dynamic choices, with evident advantages in terms of the managing of the produced files.
Specifically, considering that the resolution portion of mesh is closely related to the starting point cloud resolution and that one degree of greater detail leads to greater difficulty in the managing of the overall file, it is a fundamental result to be able to decide if and in which part of the investigated system to implement the morphologic definition, varying, simplified and in a reversible manner, suitable form reduction parameters.[8]
The following step in the detailed and integrated modelling of the two systems, rocky and architectonic, was the necessary enrichment of the mesh surfaces with the chromatic data gathered during the photographic survey campaign.
A careful positioning phase, achieved by the individualisation of corresponding points visible on the three dimensional model and on the single photograms, permitted the photographic mapping of the entire investigated object, significantly contributing to the reading of the complex architectural detail system. The breaking up of the superficial model into homogenous parts was further emphasised and simultaneously justified, by the photographic element, that it significantly characterised the dichotomy between nature and architecture, between half-formed rocks and building material, between fractal surfaces and regular surfaces.
Furthermore, the representation system thus obtained, drastically reduced the difference between the technical model that required a certain amount of scientifically obtained information, and the artistic model that, specifically for its subjective character attributed to the artists' inspiration, is capable of seizing the essence and soul of the investigated site, including the rhythmic variations in the chromatic aspects of the location.

Bibliographical References

[1] AA.VV. *Castelli medievali di Sicilia. Guida agli itinerari castellani dell'isola.* Regione Siciliana Centro Regionale per l'Inventario, la Catalogazione e la Documentazione dei Beni Culturali e Architettonici. Palermo: Arti grafiche Renna, 2001. p. 154. SBN Pal0182068.

[2] ADAMI, Andrea, BALLETTI, Caterina, GUERRA, Francesco, ORLANDINI, Simone, VERNIER, Paolo. Mobile laser scanning lungo i fronti veneziani del Canal Grande. In Atti *15ª Conferenza Nazionale ASITA*, Reggia di Colorno, Parma 15-18 novembre 2011, pp. 3-12. ISBN 978-88-903132-6-4

[3] AMICO, Vito. *Dizionario topografico della Sicilia*. (Translated by DI MARZO, Gioacchino). Palermo: 1855-86. Vol. I, pp. 43-44

[4] FAZZINA, Sebastiano, LA FICO GUZZO, Franco. *Basalti colonnari. Geositi testimoni del tempo*. Regione Siciliana, Assessorato dei Beni Culturali e dell'Identità Siciliana. Catania: 2010, 47 pp.

[5] GAMBARDELLA, Carmine, ZERLENGA, Ornella, PISACANE, Nicola, ARGENZIANO, Pasquale, AVELLA, Alessandra, CIOFFI, Gianluca, EMANUELE, Gianluca. Il biodisegno per la conoscenza e la rigenerazione dei territori compromessi. In GIANDEBIAGGI, Paolo, VERNIZZI, Chiara (a cura di). *Italian survey & international experience*, atti 36° Convegno Internazionale U.I.D., Parma 18-20 settembre 2014. Roma: Gangemi Editore, 2014, pp. 853-862. ISBN 978-88-492-2915-8.

[6] MUSCARÀ, Paolo. *Il Castello di Aci nella leggenda e nella storia.* Catania: Tipo-Lito La Celere, 1982. 122 pp.

[7] MAINENTI, Fernando. La Sicilia dei Castelli (III). Il Castello di Aci: architettura, storia, miti e leggende popolari. In *AGORÀ. Periodico di cultura siciliana* N.51 (1/2015). Catania: gennaio-marzo 2015, pp. 78-83. ISSN 2280-4196.

[8] PLATANIA, Francesco. *Viaggiatori nelle terre di Ulisse. Acicastello-Acireale-Catania-Etna-Taormina.* Acireale-Roma: Bonanno editore, 2008. 202 pp. ISBN 887796503-7.

[9] TRIMARCHI, Rosario, PRIVITERA, Sandro. Pressione antropica e degrado ambientale nelle aree costiere siciliane. La dispersione del patrimonio paesaggistico della riviera dei Ciclopi. In *Annali della Facoltà di Scienze della Formazione. Università degli Studi di Catania*. Catania: C.U.E.C.M., 2007, pp. 187-247. ISSN 2038-1328.

[1] The experimental tests were done during the period from June-September 2013, in order to exploit the most suitable meteorological conditions relative to the sea and wind. The following systems were tested on the same portion of the territory: Leica Pegasus SM70,with a phase shift scanner, HDS7000 model, for car or boat; Riegl MLSVZ400, integrated with a long range time of flight sensor, VZ400 model, for car and boat; TOPCON IP-S2, for car. We thank the managers and technicians from Leica, MicroGeo and TOPCON for having made this task possible.

[2] The survey was carried out by the authors of this study in the field of activity conducted by the Laboratory of "Survey and Representation of the Territory and of the Environment" of the University of Enna "Kore".

[3] If the initial information relative to a possible encastellation in the vicinity of the area where today rises Acicastello refers to an arabic era, many scholars tend to attribute the construction to 1071-1081. But, the lack of documentation and of well defined building language elements leaves ample margin of doubt. As Giuseppe Agnello has highlighted, along with others, the creation should in fact be attributed to the Federiciana construction activity. Various transformations, destructions and reconstructions, have in the following centuries, profoundly transformed the fortified system, not easily legible today, a stratified palimpsest.

[4] Paolo Muscarà, *Il Castello d'Aci nella leggenda e nella storia*, Tipolito "La Celere", Catania, 1982, pp. 9-10. The *Riviera dei Ciclopi* is still noted for the mythological happenings brought to us by the great ancient poets, Homer, Virgil, and even Euripides and Theocritus, who localised the myth of Ulysses and Polyphemus and that of Aci e Galatea. In more recent eras, others have taken place in the same location, among them the novel "I Malavoglia" by Giovanni Verga and the film "The Earth Trembles" by Luchino Visconti.

[5] A time of flight range laser scanner, Leica ScanStation C10 model, that, measuring objects up to a maximum distance of 300 m, with a 4-6 mm precision, has offered the best compromise between the request for range and detail requested by the site. The topographic survey was carried out with the GNNS system, Leica Viva GS15 model, in Real Time Kinematic setting, integrated in real time with laser scanner data. The survey campaign, carried out in January 2014, was developed in 6 working days and had the expectation of 54 different station points (19 scans from the surrounding urban environment to measure portions of the rocky coast and the environmental context; 6 scans of internal-external connection, from the Castle's access staircase; 29 detailed laser scans to measure the spaces, both open and closed, in which the Castle develops itself at the peak of the bluff).

[6] The mobil mapping measurement permitted the acquisition of broad data on the rocky coastline on the part of the 3D laser scanner sensors, on moving vehicles, automobiles and boats, adequately paired with GPS positioning systems and an inertial platform, for the control of balance and trajectory of the vehicle utilised.

[7] The elaborations were carried out with software owners Leica Cyclone and CloudWorx that, during the experimental intermediate test phase, answered in the most appropriate manner to the need to manage a significant bulk of data structured with topographic information (that is with point coordinates represented by very high numbers).

[8] The 3D Reshaper software was used, capable of creating and modifying mesh, even with photographic texture, and to generate metric orthophotos, starting from acquired point clouds even from different laser scanner sensors.

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The use of external claddings in the functional recovery of disused industrial buildings.

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Abstract

Since the second half of the last century, disused industrial areas and buildings are studied in the context of "Industrial Archeology", the aim of which is the conservation and the enhancement of the industrial heritage. The industrial Archeology has now reached a recognized level of maturity and autonomy, not only in Britain, where it was born, but also in the rest of the world.
The decay which can be observed in the disused industrial areas and buildings is both exterior and structural, so that a performance reduction of these buildings is unavoidable. As a consequence, the industrial archeology buildings are objects of several studies aimed to their functional recovery and performance retrofitting.
This paper is focused on the use of claddings in the regeneration of external walls. In particular, a specific terracotta tile dry fixed by means of anchor bolts is proposed in order to obtain two types of claddings: the first consists of a direct fixed cladding on the existing wall; the latter takes into account the use of particular device to achieve a ventilated façade system. This new technology has been subjected to experimental tests in- and out-of-plane of the wall, in order to investigate its security level and the response to seismic events.
The comparison between the two systems is proposed in the application to a case study, which is a building of the former Falck steel production plant, located in the town of Sesto San Giovanni, Milan (Italy).

Keywords: Disused industrial buildings, retrofitting, cladding.

1. Introduction

In the last years many primary industrial activities, as the iron, mining and chemical industry, moved from the most developed countries, like Europe and North America, to developing countries [1]. This phenomenon began in the seventies of the last century from the areas of most ancient industrialization like the mining basins of central Europe, United Kingdom and Atlantic and central regions of the United States. Then it reached also the industrial areas of the Mediterranean and southern Europe. Among the causes that generated this move, which can be interpreted, for the involved countries, as a transition from the industrial society model to the post-industrial society, there are the increased attention paid in the most developed countries to the environmental preservation, the sustainable usage of the natural resources, the globalization of the markets and the attraction from those countries where the production costs are lower. This process made available a great amount of former industrial areas, that are commonly referred to as brownfields, along with the disused industrial buildings, which belonged to the abandoned industrial plants. The recovery of these buildings is a problem of great interest and importance, because of the obvious impact on the related economic and social opportunities and as it represents an unavoidable challenge for the sustainability of the urban development.
A pioneering and well known example of recovery of former industrial buildings took place in the region of Ruhr, in Germany. There, in slightly more than 20 years, foundries, coal washing plants and blast furnaces, have been converted into museums and exhibition areas, maintaining the original structure [2].
In the present paper the problem of the functional recovery of disused industrial building is addressed with reference to a case study. The attention is focused on the use of innovative cladding in the regeneration of external walls.

2. The retrofitting of the external cladding

The retrofitting and reusing of disused industrial structures are still today a crucial task for both the local administration and the scientific community. The importance of the building history and the memory retention, are often in disagreement with the new structural conception and the codes which regulate the conformity of a building.

Within this context, this study is focused on the proposal of a new technology for the recovery of external walls. It is based on the use of dry fixed terracotta panels to build simple claddings or ventilated façade. Both solutions and in particular the ventilated façade, lead to the enhancement of the building sustainability by providing energy savings and low maintenance costs, thus improving the overall building performance.

2.1. A new type of façade built using dry fixed terracotta tiles

2.1.1. Organization of the system

A new type of fixing technology may be used to speed up and simplify the installation of the cladding.

The system consists of specific tiles [3] which have dimensions 500×250×40 mm and a weight of about 57 N. Each tile has, at the top, three holes with a diameter of 10 mm, to host three steel screws that are fastened to the wall by means of suitable expansion plugs. A snap-fit profile at its bottom allows the insertion into the corresponding profile of the lower tile, in order to warrant the out-of-plane stability.

The creation of an interspace between the wall and the cladding can be simply obtained by inserting the rods inside suitable flanged tubes (Figure 1). In this case a ventilated façade can easily been built.

Panels of insulating material may be interposed between the cladding and the existing wall to improve the thermal properties of the wall.

The system has been tested to investigate the reliability of the anchorage (both of the anchor bolts and of the snap-fit profile) under out-of-plane loads and under in-plane loads.

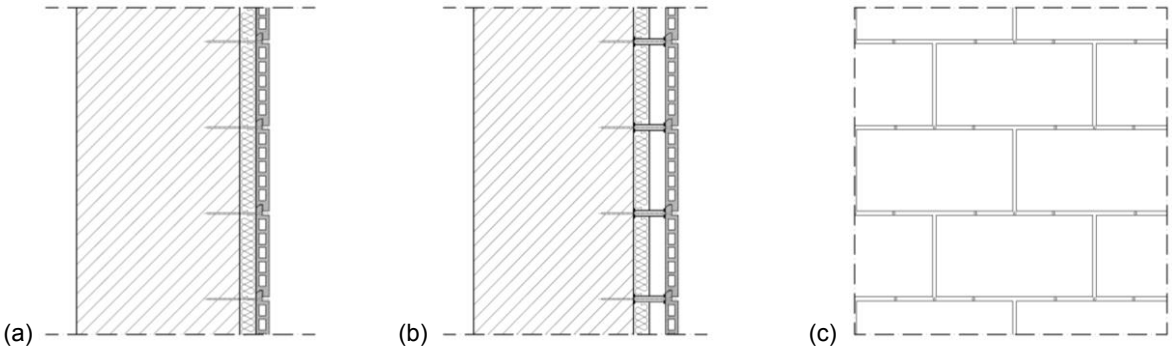


Fig. 1: Dry fixed terracotta façades: (a) section of the simple cladding, (b) section of the ventilated façade, (c) front view.

2.1.2. Experimental out-of-plane tests

2.1.2.1. Experimental setup

The tests were performed on a couple of tiles by means of a steel reaction frame which the tiles have been anchored to. A hydraulic actuator and a load cell have been placed between the wall and the upper tile. The actuator pushes over a timber beam that distributes the load on the upper tile. An increasing force is applied to the upper tile until an out-of-plane failure occurs. The lower tile is tied to the frame by a nylon band in order to prevent out-of-plane movements (Figure 2).

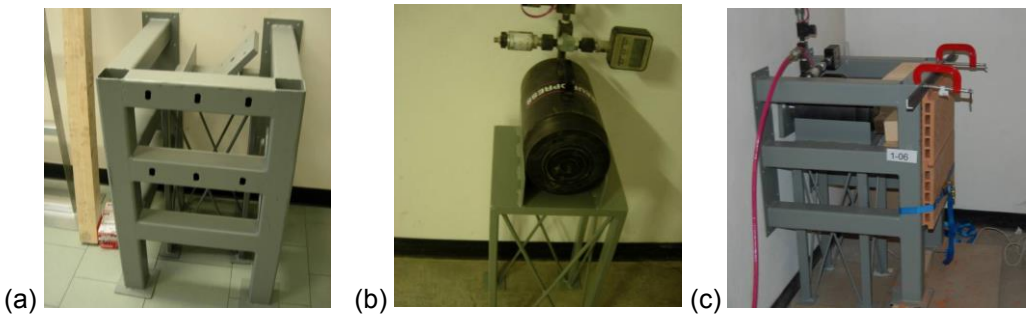


Fig. 2: (a) Steel reaction frame, (b) hydraulic actuator, experimental setup: (c) lateral view, (d) front view.

2.1.2.2. Experimental results

The tests were carried out on 20 specimens, in order to evaluate the statistical spread of the results.
The Figure 3 shows the results of the test over one of the specimen. It can be observed that the weakest part is the snap-fit section, whose collapse occurs with a widespread crack scenario. Figure 3(b) shows the time history of the applied load. It can be seen that in this case, a maximum out-of-plane load of about 3,12 kN has been reached.

(a) 

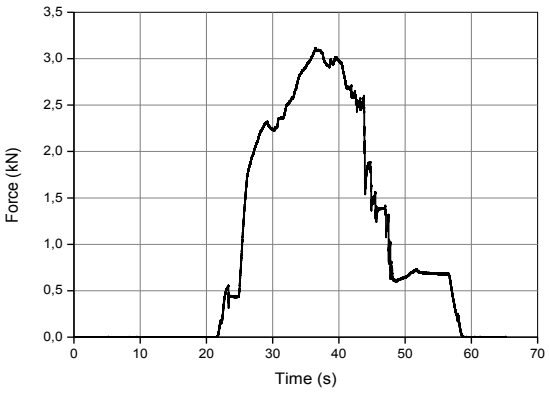
(b) 

Fig. 3: Out-of-plane test no. 1-06: (a) test setup at failure, (b) time history of the applied load.

In table 1 the results of all the tests are synthesized. The statistical analysis of the results shows that the mean value of the strength is 2,91 KN, while the standard deviation is 0,95 KN and the characteristic strength is 1,07 KN. As the weight of a tile is 57 N only, its strength is sufficient for the tile to withstand the worst seismic event.
Assuming the load as uniformly distributed over the tile surface (A=0,125 m^2), the characteristic strength, in terms of pressure, is 8,56 kN/m^2.

Specimen	F_{max} *(kN)*	p_{max} *(kN/m^2)*
01-01	2,21	17,68
01-02	2,48	19,84
01-03	3,19	25,52
01-04	3,19	25,52
01-05	3,60	28,80
01-06	3,12	24,96
01-07	3,68	29,44
01-08	2,08	16,64
01-09	1,75	14,00
01-10	1,51	12,08
01-11	1,58	12,64
01-12	3,85	30,80
01-13	4,47	35,76
01-14	1,37	10,96
01-15	2,52	20,16
01-16	2,40	19,20
01-17	3,17	25,36
01-18	3,36	26,88
01-19	3,93	31,44
01-20	3,94	31,52

Tab. 1: Results of the out-of-plane tests.

2.1.3. Experimental in-plane tests

2.1.3.1. Experimental setup

The in-plane behavior of the new cladding system has been investigated by means of a cyclic shear test.
The tiles are fixed to a masonry wall having dimensions 1800×1800×150 mm. The specimen has been pre-stressed by means of four tie rods anchored to a steel beam placed over it. This load simulates the vertical load due to the self-weight of the structure above and to the other vertical loads. An hydraulic actuator connected to the top of the specimen and to a reaction wall is used to give lateral loads (Figure 4). Among the actuator and the wall a load cell is interposed, while the displacements are measured by a LVDT.
The cladding system has been applied on both sides of the wall, with two different textures: the running bond and the stack bond. Moreover, panels of polystyrene (EPS) of 15 mm thickness have been interposed between the masonry specimen and the tiles to regularize the surface and to improve the thermal performance.
The aim of the experimental tests was to compare the response of the two different textures when subjected to large shear deformations.

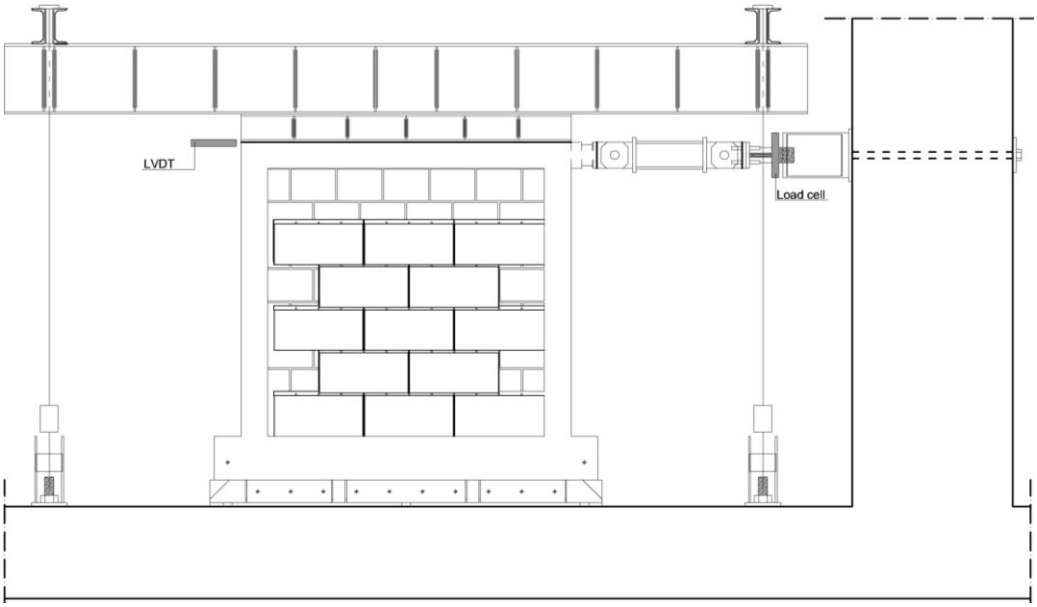


Fig. 4: Experimental set-up for the in-plane cyclic test of the new cladding system.

2.1.3.2. Experimental results

A cyclic history of displacement has been imposed at the top of the specimen through a hydraulic actuator. The masonry specimen was previously subjected to cyclic shear test, so its state was just severely damaged at the beginning of the cladding test. This condition allowed to investigate the behavior of the cladding system when the support wall is subjected to large deformations.
In Figure 5 the applied force-displacement time history can be seen.

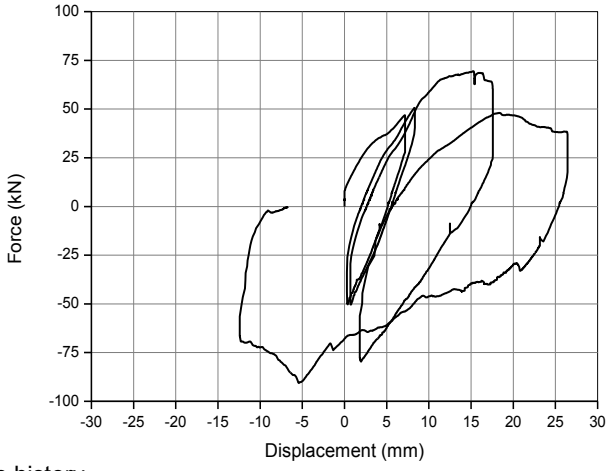


Fig. 5: Force-displacement time history.

In Figure 6(a-b) and 6(c-d) the effect of the cyclic deformations of the wall on the two claddings are shown respectively. It should be noted that the texture could affect the presence of stress concentrations which cause the tile fracture. In particular, in the running bond texture some fractures occurred, while in the stack bond texture only sliding between the tiles has been observed. Nevertheless, the snap-fit profile of the cladding has prevented the expulsion of some broken parts.
It should further be noted that each cladding is fixed by means of three anchor bolts, so that the cladding is connected to the existing wall through an amount of anchors of about 24 per square meter. This widespread availability of anchor points allows to avoid stress concentrations on the existing wall, by favoring a structurally sustainable architectural retrofitting of the building.

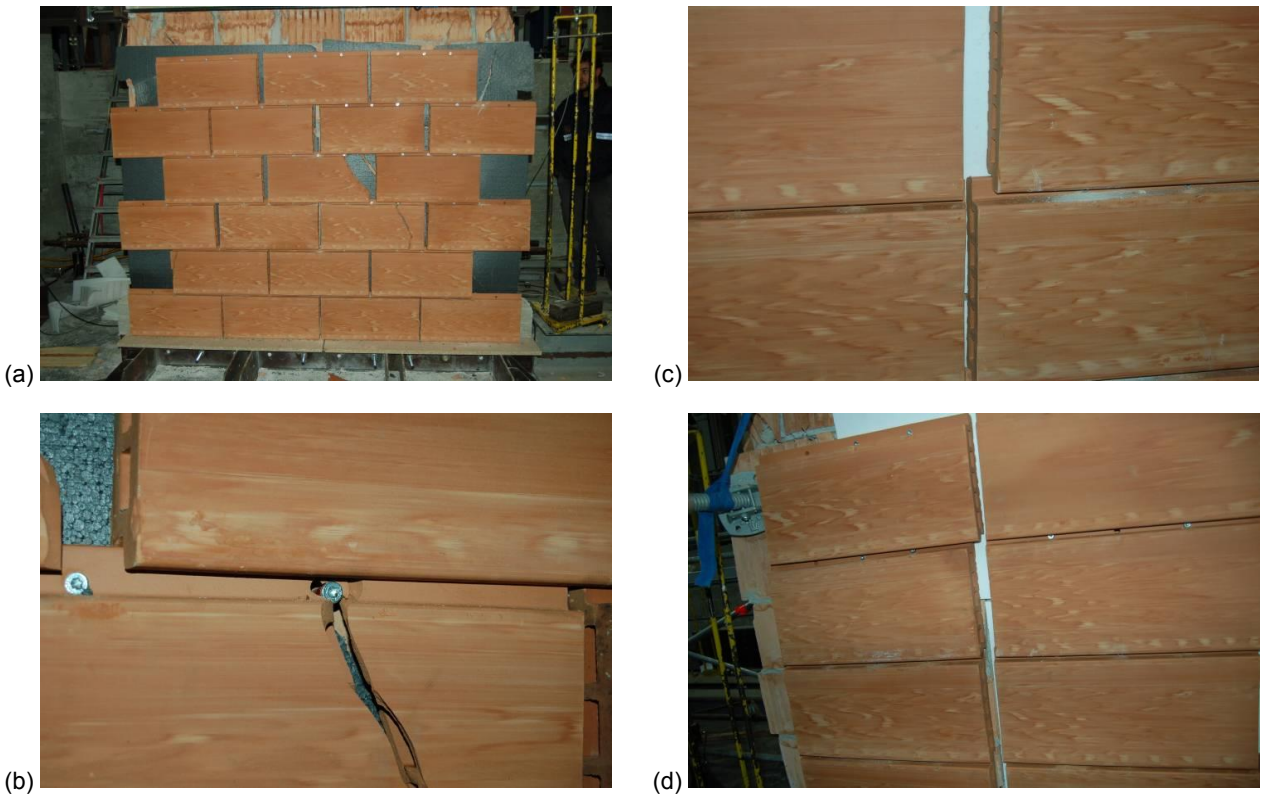


Fig. 6: Experimental set-up for the in-plane cyclic test of the new cladding system.

3. The case study

The former Falck steelworks were chosen as a case study to test two systems for refurbishing the external walls. The site, located in the urban area of the town of Sesto San Giovanni, near Milan, covers an area of 143 hectares and falls within one of the 39 sites of national interest, considered by the National Institute for Protection and Environmental Research (ISPRA).
Inside the former industrial area are located 16 industrial disused buildings [4]. One of them is used for the application of the proposed approaches.
The selected building, is located in the so-called Union division [5], and is called Mechanical Workshop and Construction, whose acronym in the Italian language is OMEC.
The OMEC building employed about 300 highly qualified people and was equipped with modern machines and tools that could work pieces of solid steel up to 80 tons in weight.
The OMEC building, which rises to a height of about 15 meters, has a rectangular plan, which extends for 280 meters in the longitudinal direction and for 16 meters in the transverse direction (Figure 7).
Its longitudinal development corresponds to two stages of implementation with two different technologies.
The part “A” of the building, that is 160 meters long (Figure 7b) was built using steelwork, while the part “B” of about 120 meters in length (Figure 7c) was built using reinforced concrete. The reinforced concrete part was the first one to be built, around 1900. Then the building was completed around the 30ies using steelwork.
Figure 8 shows the reinforced concrete and the steelwork building during their activity.
Anyway in both parts of the building the shape of the external openings remains the same.

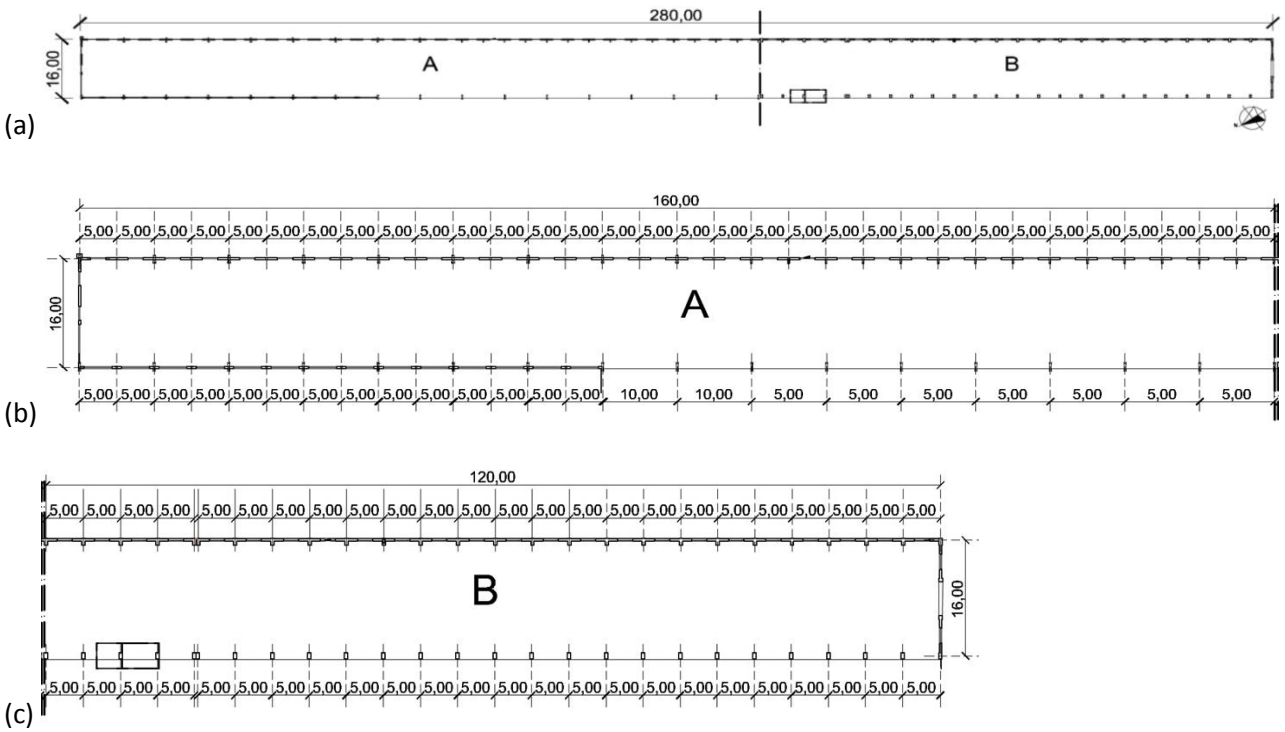


Fig. 7: Plan of the OMEC building: (a) keyplan, (b) part made with steelwork, (c) part built using reinforced concrete (courtesy of STS S.p.A. Bologna, Italy).

According to available data, its development in length reflected an absolutely innovative organization of production based on the use of modern machine tools that could operate in sequence as in an assembly line.
The reinforced concrete building is composed of transversal frames, placed at a distance of 5 meters and connected by longitudinal beams (Figure 9a).
The columns of the frames support reinforced concrete Vierendeel beams which, in turn, bear a roof having shed openings.
The structure made of steelwork is composed of transverse frames placed at a distance of 5 meters and composed of steel columns e beams. Also this part of the building is covered by a shed top closure that, in this case, is made of steel.

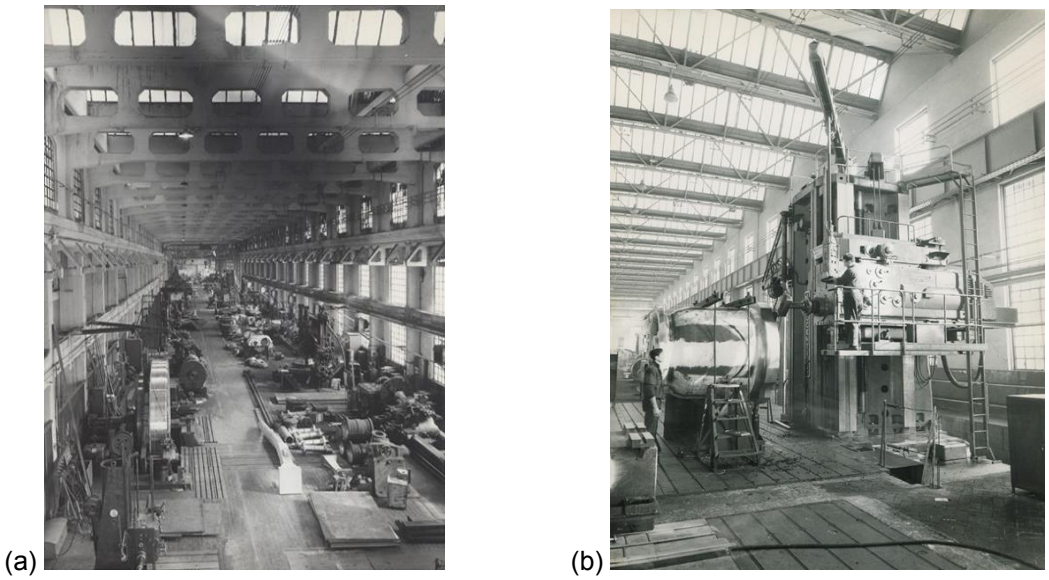


Fig. 8: The reinforced concrete (a) and the steelwork (b) buildings during their activity.

The roofing of the building made of Marseilles tiles, sheet metal and fiber-cement panels, is nowadays in conditions of severe decay.
The façades of the building are simple but different. What distinguishes them is the technological system used for the vertical structures, which can be seen from outside the building.
The North façade, that closes the steelwork building, is divided vertically by steel elements that recall the steel structure that lays behind. The façade is filled by vertical window frames of different sizes and by a vertical closure in solid bricks, plastered and protected by a finishing layer of yellow color. Near to the lower level of windows it is placed the main access to the building, which is highlighted by the acronym OMEC (Figure 9b).
The South façade is perhaps the best known of the OMEC building (Figure 9c).

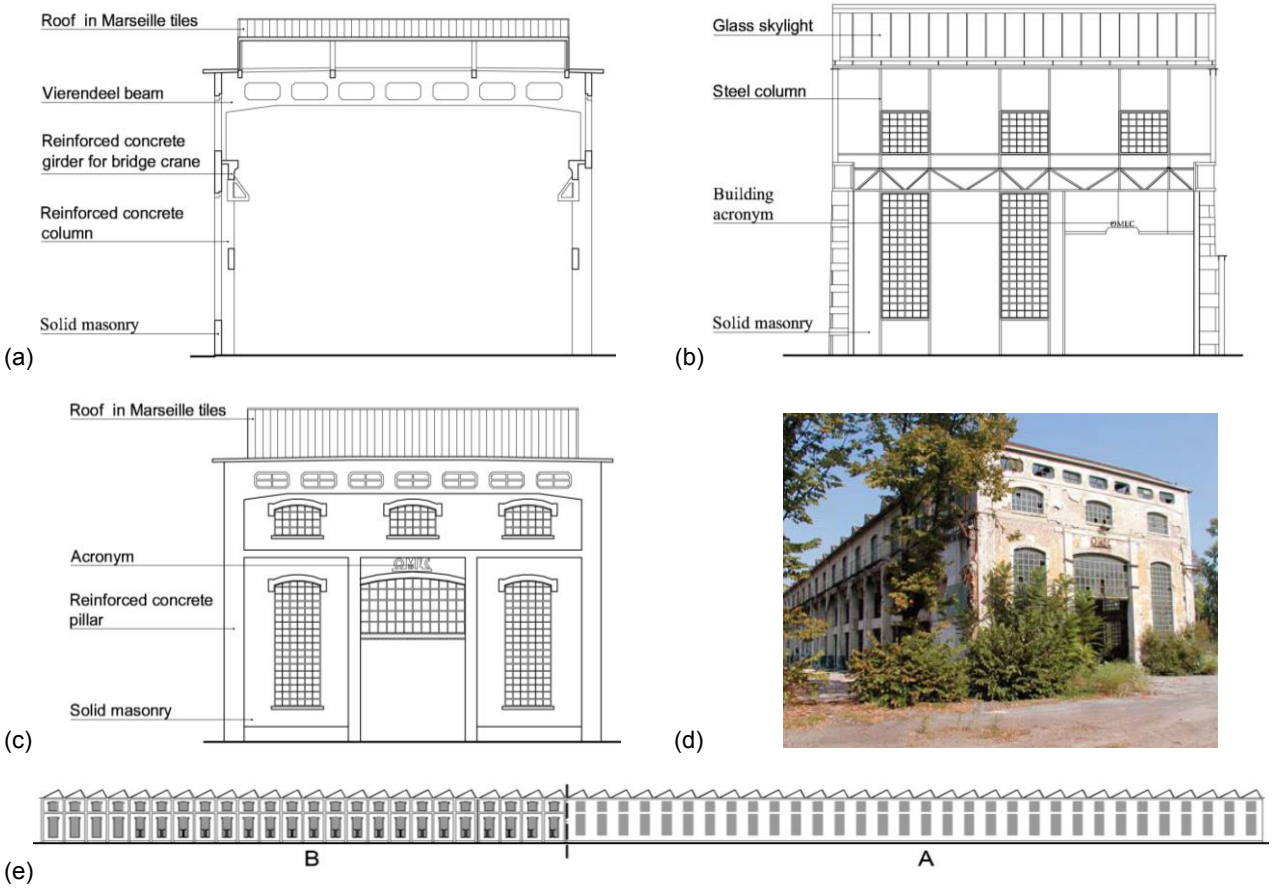


Fig. 9: Drawings of the OMEC: (a) vertical section of the reinforced concrete building, (b) north façade, (c) south façade, (e) east façade. (d) Photo of the south façade (courtesy of STS S.p.A.).

From the outside it is recognizable the inner frame in reinforced concrete, which was plastered and painted in a yellow color. Non-structural parts are filled by a solid brick masonry, plastered and painted with the same color of the structure.
Inside the walls vertical windows are made of iron and a single glasses, of various sizes, arranged in 3 rows and enclosed by decorative concrete. The lower windows are two and each one of them has a surface of 10 m^2. Between the windows there is the entrance to the building. The second row of windows, located at 8,64 meters above the ground contains three openings of approximately 2,50 m^2. Finally, the third row of windows, which lays inside the first Vierendeel beam, is composed of seven openings to retrieve the echo of the structure from the outside of the building.
The original pavement was done in blocks of solid wood, in order to damp the vibrations produced by the machines, anchored to the ground.
The OMEC interior spaces are evenly enlightened thanks to the double row of windows that runs through the building for all its length, both in the area built with steel structure and in that built with reinforced concrete.
The oldest inner portion of building still retains traces of the organization of the activities that took place there. In fact the concrete beam carrying the rails for an overhead travelling crane can still be seen.

4. Application to the case study

The proposed technology has been applied to the case study in order to improve the thermal behavior of the building. On the outer surfaces of the external walls ventilated façades have been applied, as showed in figure 10.

Some special pieces of terracotta tiles will be needed near the windows and the sills. At the ends of the facads sheet metal profiles will be used.

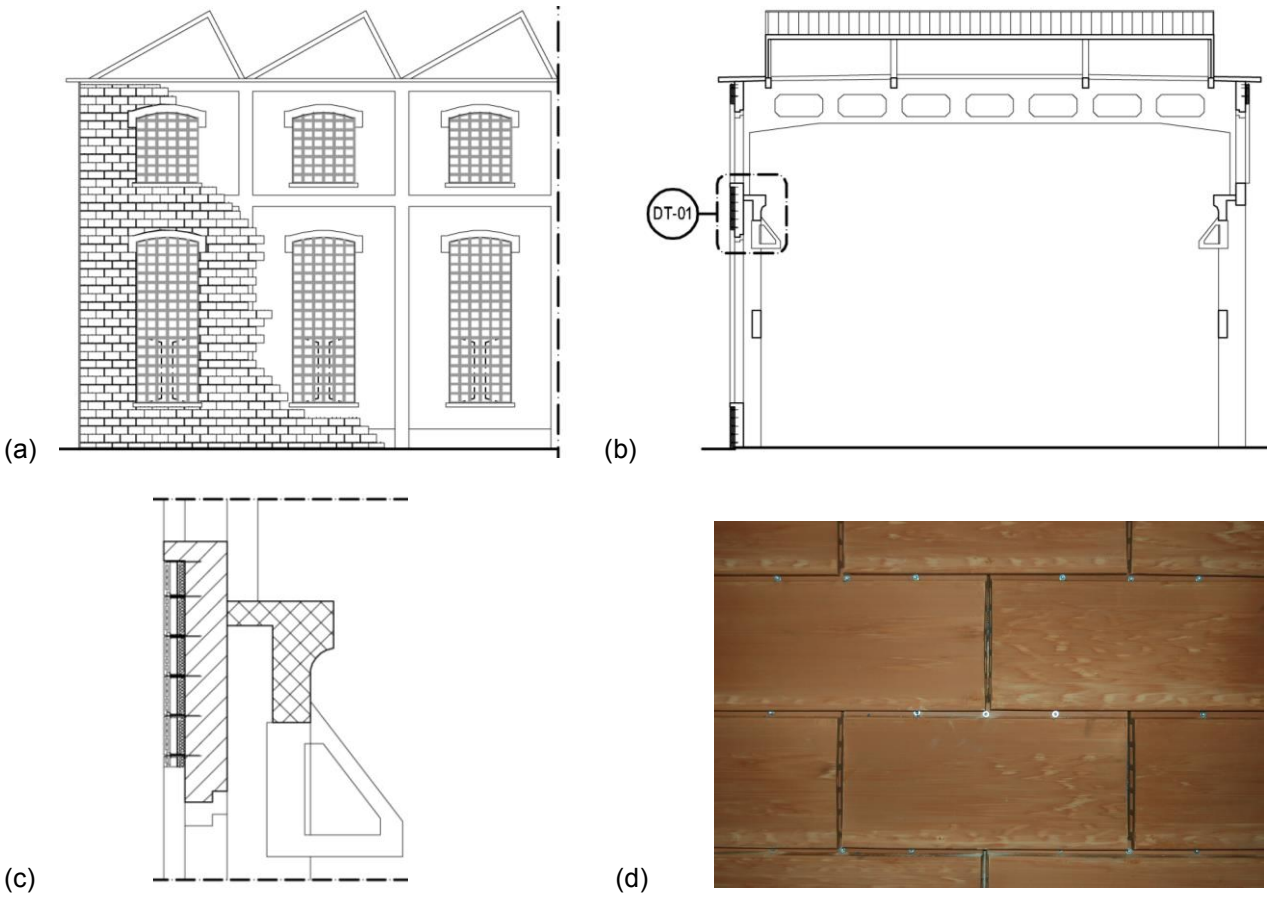


Fig. 10: Application of ventilated façades to the external walls of the OMEC building: (a) east façade, (b) vertical section of the reinforced concrete, (c) detail DT-01 of the new façade, (d) rendering of the new façade.

5. Conclusions

In this paper the issue of the functional recovery of disused industrial buildings was addressed with special reference to the relevant problem of the thermal efficiency and the energy sustainability .

For this purpose it has been proposed the use of an innovative technology for the realization of coatings and ventilated façades using brick elements anchored to the walls by means of mechanical fixings.

Within the experimental tests carried out, this technology has shown a good response, both under out-of-plane loads and in-plane large deformations. In this way, the tests has demonstrated its safety and reliability even in seismic areas.

Finally it has been studied its application to a case study, that is the OMEC building belonging to the former Falck steelworks, in the town of Sesto San Giovanni, Milan.

Provided that an additional and more detailed research program is necessary, with a focus on different restraints and ventilated façade solution, the obtained results allowed to highlight the promising aspects of the new technology proposed.

6. Acknowledgments

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Bibliographical References

[1] APAT. Proposal of guidelines for the environmental recovery and economic exploitation of brownfields (In Italian). Rome: I.G.E.R. srl, 2006, 322 p., ISBN 88-448-0219-8.

[2] VINKEN, Frank, ZUURING, Lilliane, MÄMPEL, Wulf. *Zollverein. Welterbe. Von Der Kohle Zur Kultur*. Beleke, 2009.

[3] Referring Web Pages: http://www.fbm.it/prodotti/tavelle-e-tavelloni/tavex.html and http://www.briziarelli.com/sch3d3/tavex.pdf

[4] MATERAZZI, Giulia. Methodology for the refurbishment of the disused industrial areas. A system of indicators as support to the analysis (In Italian). Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in “Retraining and recovery urban heritage”. Rome, July 2014.

[5] Referring Web Pages: http://www.sestosg.net/sportelli/falck/

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Structure and stone cladding in building constructions in L'Aquila, Abruzzo, Italy, from the 12th to the 18th century: methods used for the analysis and indexing of masonry categories and related performances in response to seismic activities

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Abstract
The research project, theme of the PhD study in History, Representation and Architectural Conservation XVII cycle, co-ordinated by professor Claudio Varagnoli, University 'G. d'Annunzio', Chieti-Pescara, aims at defining a general framework of the present state of the traditional buildings in Abruzzo and the action of the structures in response to the seismic activities based on the cataloguing of the architectural heritage recently discovered in L'Aquila during the earthquake in 2009. The study has been carried out through the analysis of urban fabric and individual architectural emergency works on the buildings in the historic centre (as San Giuseppe dei Minimi and San Sisto) providing a revision of techniques and traditional anti-seismic devices which are firmly embedded in the territory within the building and trial procedures. The architectural heritage of L'Aquila appears to have a vast repertoire of various types of anti-seismic devices that deserve to be examined evaluating the reinstatement or its use as a preliminary operative model favouring it over other technologies that appear to be less appropriate and inefficiently tested. The research and sampling of the varieties of masonry in the "crater", the mechanisms to identify the damages the building suffered from and the proper reinforcement systems are valid instruments of knowledge, management and prevention of the historical architectural heritage in Abruzzo necessary for the future processes of reconstruction.

Keywords: masonry, earthquake, building techniques, traditional anti-seiscmic systems

Masonry wall in L'Aquila, first outcomes and outlooks of the research
The theme of the seismic impact on historical buildings and the structural response of the traditional buildings requires a complex study of the architectural heritage that approaches several research settings analyzing in particular the knowledge of the literary and archival sources, the typological analyses of the instabilities, the identification of the anti-seismic devices and the evolution of the building techniques. The historical buildings in L'Aquila, which were analyzed through sampling of the masonry wall and the historical-critical study of religious and residential emergencies, reveal the variety and overlapping of the modalities and building expedients that rarely reach static and anti-seismic completeness and effectiveness. The good quality of some facings and wall structures, related to most of the religious buildings and in few cases to residential constructions [1], disperses among the numerous variants of irregular methods of built performed after the mid-fourteenth century. The identification and mapping of the masonry, conducted through the photographic survey of the samples gathered in the historical centre after the removal of the superficial layers of plaster, evidence the predominance of the heterogeneous methods of built. These usually come from the assembly of the material of the ruins and difficult to lead back to the classification according to the parameters such as dimension, shape, making and method of assembly of the components of the core and façade giving information for most of the studies in the sector. Therefore, the only relevant invariant detected is in the masonry wall, in the small regular stone blocks arranged in even rows with vertical half-bond

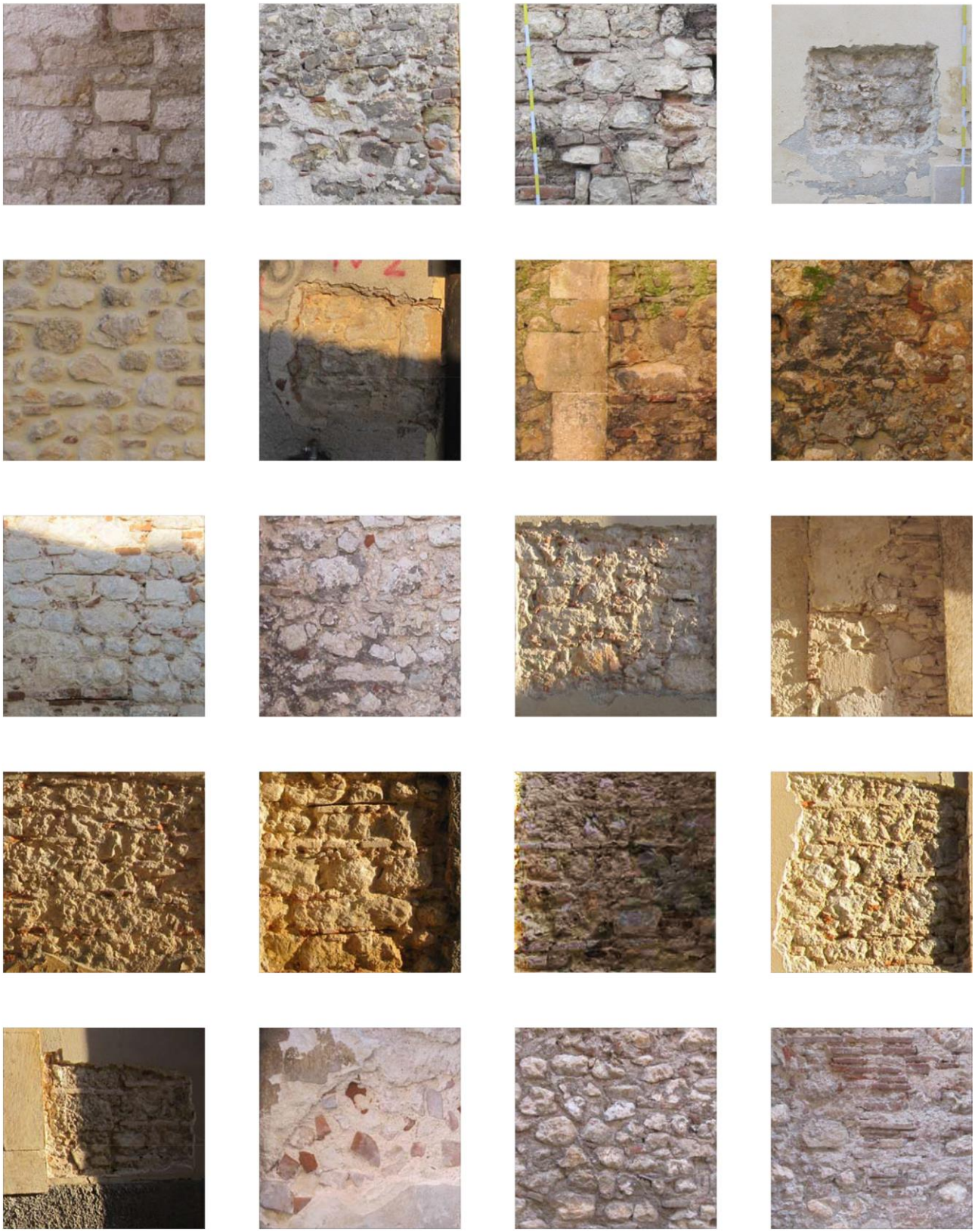

Fig. 1: mapping extract of the masonry wall in the historical centre of L'Aquila

patterns that Gavini identifies as ‘apparecchio aquilano’ [2]; a building method which represents an ideal model able to reach the formal and structural synthesis in accordance to the medieval concept of *bonum operis* [3] and it finds similarities with a popular method common in the Roman area called ‘a tufelli’. While the latter method clearly derives from the Roman building tradition, engaged and innovated through the

standardization of the low medieval productive system [4] and widespread use in every typology of buildings in the Roman area, the '*apparecchio aquilano'*, instead, was almost exclusively used in the construction of religious buildings, and it follows a complex identification of its origins and diffusion in the *Comitatus Aquilanus*, originated in the mid-thirteenth century from the merger of several administrative and territorial realities [5].

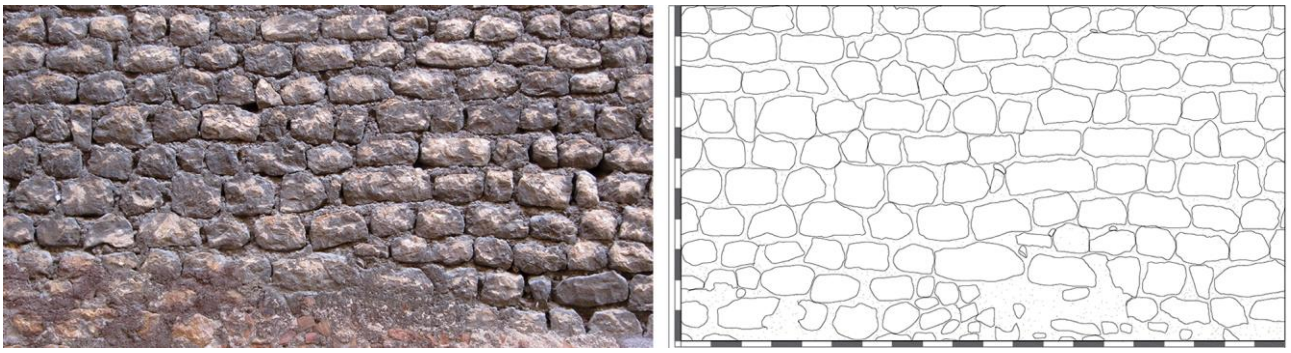

Fig. 2: 'apparecchio aquilano', photo and drawing of the church of San Flaviano

The varieties of methods and different building approaches are also observable in building measures adopted during the medieval era, such as scarp walls, toothing and good quality built angle bars, supported by anti-seismic systems and perfected during the Renaissance - ligaments and wooden encircling, metal chains, trusses, light vaults - largely used until a relatively recent period. These methods, however, do not find the correct grade of homogeneity in the masonry walls of the fifteenth-sixteenth century and later needed to collaborate in the seismic resistant structure.



Fig. 3: 'apparecchio aquilano', photo of the church of Santa Croce

The contingencies related to the restorations following the numerous earthquakes, with reference to the proportions and effects on the architectural historical heritage, can be reported to the earthquake on 6th April 2009 and previous ones (January 1915, February 1703, November 1461, September 1349 and December 1315) and to the typological and formal adjustments imposed by the social and economic dynamics resulting in the Spanish infeudation during the XVI century and to the advent of the Bourbon reign in the XVIII century,

lead to a progressive degeneration of the wall set. The supporting elements lack in terms of monolithic due to the installation and workmanship of the stone elements and of the recasting of the medieval and Renaissance construction cells in buildings extremely heterogeneous and complex. Setting aside the ideal model, the '*apparecchio aquilano*', in favour of irregular frame possibly executed and realized with elements of recovery or grafting wood and brick not properly designed, characterizes the 'façade architecture' of most of the historical centers in the administrative centre of Abruzzo. Workmanship is mainly directed towards the elements in the details – windows, angle bars, portals and cornices – to the detriment of the load bearing structure. The masonry wall curtains are related to the after-earthquake restorations operated in the XV century revealing an architectural attention towards the religious buildings characterized with skilled interventions by good quality stone units [6], and not present in the residential buildings.



Fig. 4: drawing of the main façade of Palazzo Pascali

The façade of Palazzo Pascali, at present a ruin on Via Roma [7], for example, represents a still-standing piece of fifteenth-century architecture useful to understand the particularities of the leading structures in the late medieval L'Aquila. The character of the composition highlights the contraposition between the method of implementation, decoration and assembly of jambs and window cornices and '*durazzesco*' portal and the method of realization of the masonry walls made in irregular stone bosses and recovery elements arranged without a clear architectural logic. The insufficient quality of these juttings in rough sizes, defined in literature as '*del muratore*' and addressed, in the case of L'Aquila, to a following plasterwork, denounces, in the heterogeneity of the building elements and in the complete lack of supports, the loss of building expedients that belong to the method called '*a cantiere'*, wrongly defined as poor mastery, it reveals in the preselection of the irregular stone elements, a structural complexity aiming at the statically efficient implementation [8].Palazzo Pascali is an example of the association of these modest structural abilities, and the geometry slenderness of the masonry walls represents the high quality of seismic vulnerability of the late medieval residential buildings. In the XIV and XV century the aristocratic buildings, which marked the transition between the typical shop-houses to the new urban typologies arranged around the internal courtyard, have undergone partial of total collapses of the uppers levels. Indeed, roof terraces, loggias and mullioned windows, typical of the upper section of the principle facades, were determined with formal and structural solutions and more perceivable to earthquakes, compared to the based blocks and lack of overhangs, and the prevalence of the full blocks over the empty ones resulting disappeared in most historical centres in Abruzzo repeatedly hit by earthquakes, such as L'Aquila and Sulmona [9]. The limited intrinsic resistance of the buildings in L'Aquila is not the only main cause of the multiple and relevant damages due to the earthquake on 6th April 2009; the partial or total collapse of the numerous stone buildings is related to the combination of factors of vulnerability due to the relentless changes and overlaps conducted on the architectural-historical heritage. These have altered the logical geometric and structural proportions rendering inefficient the numerous traditional anti-seismic systems substituted with elements dissimilar to the original historical making through incongruous interventions of consolidation following the technical and reconstruction line at the expense of a correct and constant maintenance. Traditional anti-seismic systems and methods, which are missing in Abruzzo and southern Italy, as well as a defined scientific theorization and norm, instead are strongly imbedded in the area at an experimental level and engineering practice [10].

The ‘local seismic culture’ of L’Aquila and smaller surrounding towns evidence a deep empiric knowledge of the most common mechanisms of damage and related solutions set in place with the technologies and local elements showing how, in the case where the preservation was predominant compared to the partial or total transformation of the architectural buildings according to the most recent models of structural analysis, the ancient buildings have withstood the earthquake. On the contrary, the complete elimination of few macro-elements, such as the replacement of the wooden roofs with the widespread use of cement mix, or further changes such as the tie beams or keystones, etc. have compromised the architectural-historical value of the buildings and, furthermore, have caused major damage and have largely influenced the outcome of the restorations. The operative stage of the research, carried out by means of participation in the restoration worksites, gives the opportunity to trace and deepen, through the study and enquiry of the damages of the historical-architectural heritage, the knowledge so far learnt about the historical, urban and architectural identity of the town. The typological analysis of the building on the built of the thirteenth century organized in districts reveals an urban structure responding to the depositions of the citizens statutes. The built set on gratings ‘*per fuochi di 4 canne per 8’*, represents the correct compromise between the cardus-decumanic model, the morphology of the site and the pre-existing traces to urbanization. The recurrent typology of both residential and religious buildings, defined by a prescriptive regulation concerning the urban and architectural aspects and the characteristic of the materials, compose a building fabric undergoing continuous operations of aggregation, fusion and modernization resulting from many important seismic events. The current architecture in L’Aquila, which advances on medieval structures and plans basically intact, is the result of pre-modern and modern reconstructions implemented roughly after the 1703 earthquake. This imposes a classical severe layout, the façades are organized into symmetries and alignments obtained through new openings that have been realized in breach, cladding, grafts and overlaps that compromise the homogeneity and solidity of the structures, restoring an apparent order of the fronts that the recent earthquake had revealed as weak.



Fig. 5: drawing of a building on via Fortebraccio

The post-earthquake collapses and the papers on the curtains of the historical centre reveal angles, facings and profiles pointed cross of doors and windows belonging to medieval masonry walls recovered and adapted as the foundation of the new buildings; the fall of the plaster shows the general use, starting from the XV century, of irregular systems called ‘*pezzame minuto’*, hardly processed and fastened with small quantity of malt. Testimonials of residential buildings belonging to the fourteenth and fifteenth century are also found in tower building fragments, remains of ancient terraced cells and decorative elements reused. Partial collapses, local structural failure and distortions denounce diastasis between buildings attached together but not properly clamped and empty structure due to the passage of chimneys and to the gaps of the accessory rooms and service channels related to the many stages of typological and formal adaptation of the building. Furred walls and terracotta linings commonly used from mid-fourteenth century for construction and repairs of the bearing structures appear to dissimulate fusions and grafts of the walls and to regularize external fronts and internal rooms of the buildings after the earthquake in 1703 concealing fusions and grafts of the masonry walls and regulating the façade and internal space of the constructions as in the wall samples of layered buildings such as *Palazzo Ardinghelli* and *Palazzo Cappa* in *piazza Santa Maria di Paganica* or *Palazzo Alfieri* on *via Fortebraccio*. The latter is a qualified building of complex structure events and its characteristic is given by the shape of the courtyard with ogival arches and roundarches and has undergone in 1911 an innovative restoration by Riccardo Biolchi to preserve the precious coffered wood ceilings [11]. The expedient of clay brick linings, found other buildings in Abruzzo [12], continues into the following century and it is today quite easy to find, mainly in the historical centre of the L’Aquila, bricks and clay tiles on plasters and old walls, arranged without a clear logic. The restoration in town throughout the XVIII century actually consisted in an intervention on the surface, in an adaptation and finishing of the building on the built through the project and reconfiguration of the façades and public settings. The spatial and representational

experimentations are finalized mainly to the recovery of the fifteenth-sixteenth century courtyards and to the building of new halls and staircases to access the floors above. The eighteenth-century worksite appears inadequate to define and correct the vulnerabilities discovered in the after-earthquake; the use of many anti-seismic systems, necessary to contrast the horizontal forces, reveal the awareness of the scarce tensile resistance of the walls.



Fig. 6: Furred wall and lining in brick works, photo and drawing; palazzo Alfieri

However, at the same time, we witness the recovery and elevations of spaces not adequately conform to the variety and mixture of structural and horizontal systems. The vaults made with conglomerate in lime mortar and pieces of stone and clay brick, which had already been experimented in L'Aquila, and those made in layers and recovered on wooden rib, introduced and widely used in the XVIII century, have often been revealed as inadequate to contrast the solicitations of the building, indeed in the collapse of the loggia, the staircase and some halls at *Palazzo Ardinghelli* and the chapels in front of the church of *Santa Maria di Paganica*. The wide use of bricks in the construction industry in L'Aquila is directly proportioned to the deterioration of the limestone. Between the fifteenth and seventeenth century, the use of ashlar are found in counterforts and corners, the stone elements included in the walls become, instead, heterogeneous and irregular for the size. Simultaneously, the first clay brick vaults are built, e.g. the convent of *Beata Antonia* (early XV century), *Santa Maria del Soccorso* (1469-1472), and the use of bricks mainly laid on edge, characterize the covering of the underground floors and rooms of few constructions built between the XV and XVI century. In largely stratified buildings, such as *Palazzo Ardighelli*, we can see various types of clay-bricks vaults: with lunettes on corbels with bricks arranged at cut file on the lower floors and cloister 'false vaults' made with bricks sheets with ribs on the upper levels; the texture of the elements generally follow the inclination of the crown, and using a different disposition, such as diagonal or herringbone pattern for more elegant representation. From the XVIII century the vertical structure started to be built in bricks, clay bricks result in several buildings such as *Palazzo Antinori*: the masonries of the halls on the ground floor are made of large tracts of bricks used on the upper floors to pad the doorways and consolidate the traversal walls inserted in the perimetral wall in stone; false vaults complete the large halls. Further use of clay bricks are found in many reconstructions, interventions of consolidation and 'modernization' of religious buildings. In the oratory of *San Giuseppe dei Minimi* curtains of bricks in wood embedding complete the walls of the apsidal area made with irregular stone elements and a complex system using clay bricks define the shape of the internal cornice supported and joined to the perimetral wall by overhangs in stone and grafting wood. In the churches of *Santi Marciano* and *Nicandro*, the double archivolts of bricks connecting the two original building units reveal, in the temporary cladding, a probable interruption of the works related to re-building during the XVIII century and never completed. This supports the imposing perimeter edging in concrete of the roof which causes deep vertical gaps along the summit gable of the main façade revealing the function of the stone linings overlaid on the original unit of the façade in square blocks during the restorations undertaken in the XX century. The churches in the historical centres, which have been rebuilt following the damages due to the earthquakes, are evidences of the different traditional techniques and anti-seismic measures; they summarize the construction sequences in L'Aquila: from the foundation worksites to the improper interventions of consolidation of the XX century. The plain finished façade, particularly vulnerable to earthquakes, combines most of the medieval and pre-Baroque constructions generally configured according to patterns with a single apse hall or to three naves with or without transept. Many façades today are the

result of partial reconstructions or significant restorations during the twentieth century, they are equipped with concrete or wooden anchoring exactly like in the oratory of *San Giuseppe dei Minimi* and in this case, as well, in an heterogeneous and irregular construction resulting mainly from hewn stone elements.



Fig. 7: San Giuseppe dei Minimi, summit cornice and wooden anchoring

These methods, likely brought from Lombard craftsmen [13] and whose use is documented in the area of L'Aquila from the XIII-XIV century [14], have prevented the overturn of the façade although the bad quality of the masonry wall used in the eighteenth-century restoration of the building, implemented through the elliptical scheme, used in the churches of *Sant'Agostino* and *Santa Caterina*. Additional interventions after the earthquake in 1703 confirm the perimeter of the previous buildings, form the main body of the church as in the churches of St. *Marciano* and St. *Nicandro*, or raise the local walls; this latter building expedient is found in the church of *San Sisto*, the drawing on the external fronts highlights the overlapping of at least three different sites. In particular, the west-side façade is formed by a base consisting of large stone ashlars of various different dimensions and materials reclaimed of the classic period which poses different enquiries concerning the unsolved question of the Roman origins of L'Aquila [15]; on the façade, a drafted masonry wall arranged in regular rows clamped angles in stone blocks. The following irregular rows in clay bricks define the base of the irregular face in stone ascribable to the changes in the XVIII century. Of great interest is the finishing of the face of the higher parts of the apsidal zone: this emerged during the restoration granted by the Superintendency for Architectural Treasures and Landscape in 2005 and carried out by Lorenza D'Alessandro and Giorgio Capriotti and the supervision of Biancamaria Colasacco. The sealing of joints of the walls is defined by a red straight line that recalls the false curtain painted on the pillars of the church of *Santa Maria in Valle Porclaneta* in *Rosciolo* (*AQ*.) were found following the removal of the Baroque plaster wanted by Umberto Chierici in the 1940s [16]. The research project carried out in the XXVII cycle in the PhD study in History, Representation and Architectural Conservation, co-ordinated by Professor Architect Claudio Varagnoli, represents a first approach to the complex reality in L'Aquila and to the many rises it gives by analysis and research. The study of the damages caused by the earthquake in April 2009 and the classification of the different types of stone walls in the historical centre are part of a preliminary and partial stage of the research that, thanks to the collaboration and support of the Superintendency for Architectural Treasures and Landscape, allows to examine the knowledge and acquisition through the direct observation and participation at restoration worksites.This operational phase, indispensable tool for the understanding and examination of the methods of investigation and intervention, has taken shape under the agreement between University 'G.d'Annunzio and the Ministry of Cultural Heritage and Environmental and Tourism, made possible by the attention and cooperation of the Superintendent BAP architect Alessandra Vittorini and the architects Gianfranco D'Alò, Patrizia Luciana Tomassetti, Claudio Ciofani and Aldo Giorgio Pezzi.

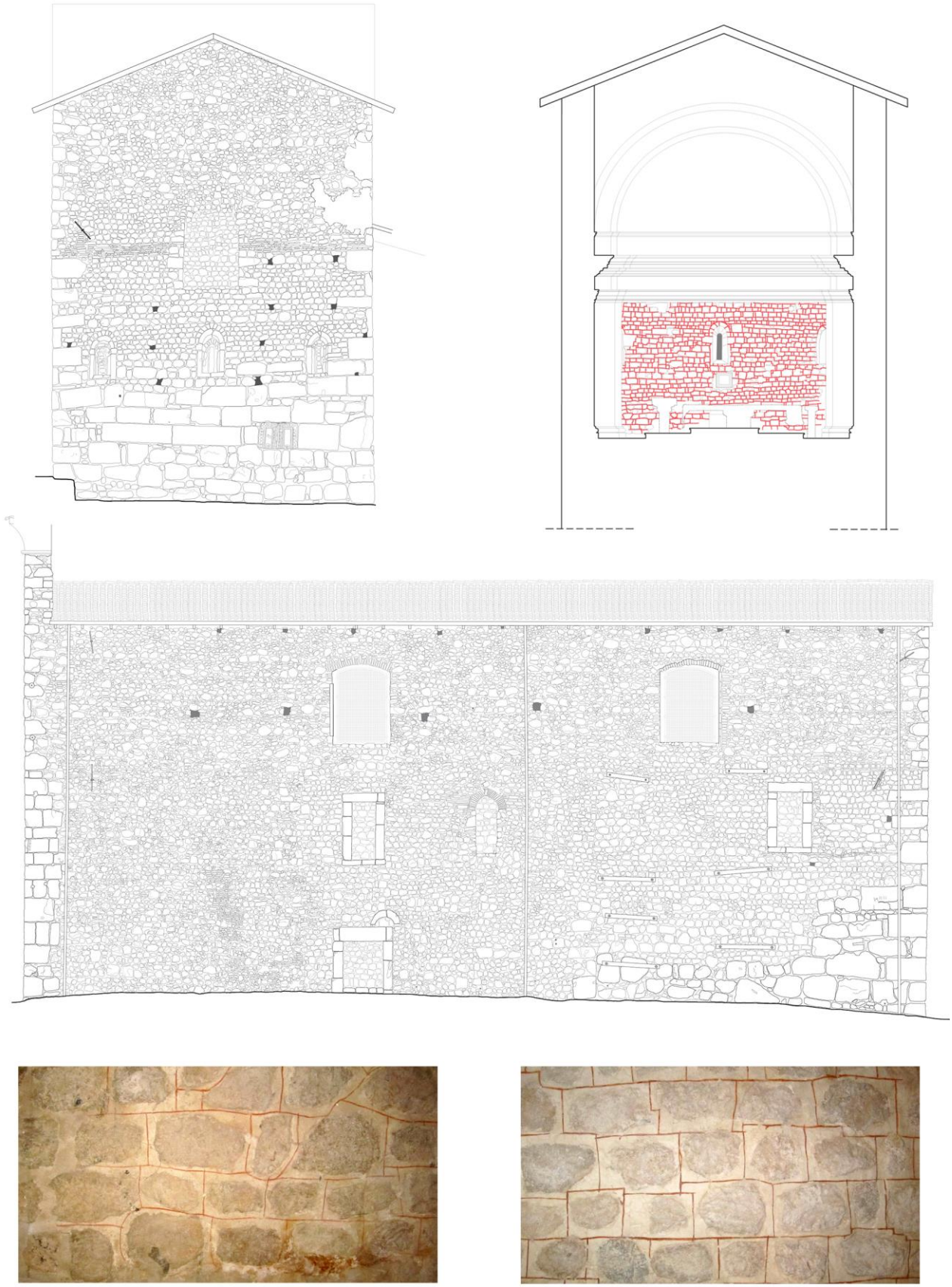

Fig. 7: Church of San Sisto, drawing and photos of the false curtain

Bibliographical References

[1] ZORDAN L., *Gli elementi costruttivi e le maestranze*, in CENTOFANTI M., COLAPIETRA R., CONFORTI C., PROPERZI P., ZORDAN L., (a cura di), *L'Aquila città di piazze*, Pescara, Carsa, 1992, p. 117, ISBN 88-85854-13-3

[2] GAVINI I.C., *Storia dell'Architettura in Abruzzo*, Avezzano, 1927, II, p.149

[3] ESPOSITO D., *Tecniche Costruttive Murarie Medievali. Murature 'a tufelli' in area romana*, Roma, L'Erma di Bretschneider, 1998, pp.42-43, ISBN 88-7062-982-1

[4] ESPOSITO D., *Tecniche Costruttive Murarie Medievali. Murature 'a tufelli' in area romana*, Roma, L'Erma di Bretschneider, 1998, p.35, ISBN 88-7062-982-1

[5] ANTONINI O., *Chiese dell'Aquila*, Pescara, Carsa, 2004, p.16, ISBN 88-501-0031-0

[6] DANIELE I.G., *L'Architettura sacra nell'Abruzzo dei Durazzo: un rinnovamento di facciata*, in PISTILLI P.F., MANZANI F., CURZI G., (a cura di), *Universitates e Baronie. Arte e Architettura in Abruzzo e nel Regno al tempo dei Durazzo*, Città di castello, Zip, 2008, II, p. 65, ISBN 88-901613-7-X

[7] MORETTI M., Dander M., *Architettura civile aquilana dal XIV al XIX secolo*, l'Aquila, Japadre, 1974

[8] D'APRILE M., *Murature tardomedievali in calcare di Terra di lavoro*, in FIENGO G., GUERRIERO L., (a cura di), *Atlante delle Tecniche Costruttive Tradizionali. Napoli, Terra di Lavoro (XVI-XIX)*, Napoli, Arte Tipografica, 2008, p. 59, ISBN 978-88-6419-007-5

[9] MADONNA A., *Edilizia civile a Sulmona nel Quattrocento: la fortuna del portale durazzesco*, in PISTILLI P.F., MANZANI F., CURZI G., (a cura di), *Universitates e Baronie. Arte e Architettura in Abruzzo e nel Regno al tempo dei Durazzo*, Città di castello, Zip, 2008, II, p. 141, ISBN 88-901613-7-X

[10] SERAFINI L., *Terremoti e Architetture in Abruzzo. Gli espedienti antisismici del cantiere tradizionale,* in VARAGNOLI C., (a cura di), *Muri Parlanti*, Città di castello, Alinea, 2009, p. 221, ISBN 978-88-6055-480-2

[11] PEZZI A.G., *Tutela e Restauro in Abruzzo. Dall'Unità alla Seconda Guerra Mondiale (1860-1940),* Roma, Gangemi, 2005, pp. 126-127, ISBN 88-492-0864-2

[12] VARAGNOLI C., Serafini L, *L'edilizia storica in Abruzzo: uso e cultura del laterizio in età moderna,* in VARAGNOLI C., (a cura di), *Terre Murate. Ricerche sul patrimonio architettonico in Abruzzo e Molise*, Roma, Gangemi, 2008, pp. 19-20, ISBN 88-492-1531-1

[13] VARAGNOLI C., *Tecniche e materiali nella costruzione delle volte in Abruzzo,* in VARAGNOLI C., (a cura di), *La costruzione tradizionale in Abruzzo. Fonti materiali e tecniche costruttive dalla fine del Medioevo all'Ottocento*, Roma, Gangemi, 2008, p. 62, ISBN 978-88-492-1521-2

[14] REDI F., *Materiali tecniche e cantieri: primi dati dal territorio aquilano,* in III CONGRESSO NAZIONALE DI ARCHEOLOGIA MEDIEVALE, Borgo San Lorenzo, All'insegna del giglio, 2012, p. 591, ISBN 978-88-7814-543-6

[15] ANTONINI O., *Chiese dell'Aquila*, Pescara, Carsa, 2004, p. 25, ISBN 88-501-0031-0

[16] MALANDRA B., Rosa S., *Le finiture delle chiese medievali in Abruzzo e in Italia Centrale; la ricognizione sul territorio,* in VARAGNOLI C., (a cura di), *Muri Parlanti*, Città di castello, Alinea, 2009, p. 161, ISBN 978-88-6055-480-2

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Structural calculations by horizontal and vertical interoperability for the redevelopment of existing buildings

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Abstract

By considering the importance of Italy which is cradle of civilization and has a rich architectural and cultural heritage, unfortunately, current attention of community is not paid as much as should be; at the same time the Italian real estate challenges contemporary designers in the field of heritage buildings care more than in the new constructions. Moreover, increasing awareness of problems related to seismic safety is also an important issue, especially as a result of dramatic seismic events of recent years.
The aim of this research is the integration of Structural analysis into Building Information Modeling (BIM) quickly using a methodology by which get data flows and information exchanges, with no data losses, between architectural software (as Revit Architecture and Archicad) and structural analysis software (as Axis VM) both static and seismic calculation.
For the process of exchanging data from Revit to other software was considered as an “intelligent interoperability” with good results passing through Industry Foundation Classes (IFC) format, analyzing problems and possible solutions by using Solibri Model Checker.
In this way, investigation of the possibilities of maintenance and structural stability analysis, in support to the comprehension of the behavior of elements within the whole building organism will be easier in achieving the connection between BIM and structural analysis for existing/historical buildings. The paper also elaborates risks and barriers to BIM implementation and future trends.

Keywords: BIM, intelligent interoperability, cultural heritage, seismic safety

1. Introduction

Seismic safety issues needs to be integrated in the existing building defining thus the preventive conservation a real necessity in everyday practice. A way to make this operation easier is to provide a unique design base on which both architectural and structural experts can share their analysis and modification proposals. Providing a shared design base is one of the BIM aims.
BIM has received much attention in recent years due to its ability to develop a new methodology for the design, construction and facility management based on the exchange of information. To implement the integrated design process with the issues of seismic safety is necessary to allow the exchange of information between the tools of each technical specialist involved in the design process. Specifically, it is essential to define a methodology to automatically switch the data flow between BIM software and structural calculation tools. This is designed in order to allow an iterative verification of the significance of the changes to the whole life cycle project aimed at pursuing a process of structural analysis through the database using the .ifc format.

The purpose of this study is to examine and describe the horizontal interoperability (between two architectural BIM software) and vertical (between architectural and structural software) and the opportunities offered by BIM process applied at existing buildings at Primo Liceo Artistico di Torino.

2. Methodology

This study focused on the use of BIM oriented software applied to existing asset with a deepening of the horizontal interoperability between Revit and Archicad (parametric software) and vertical interoperability with Axis VM (structural software). It was used the .ifc format and verified within Solibri Model Checker, with particular attention architectural and structural data. The research covered the following topics:

- 2.1 To use .ifc file which exports the model from Revit and imports it into ArchiCAD; subsequently exports it from ArchiCAD and imports it into Axis VM (horizontal-vertical interoperability);
- 2.2 To use .ifc file which exports the data from Revit and imports them into Axis VM (vertical interoperability);
- 2.3 To implement Static and seismic analysis and the verification of structural elements with possible modification of the geometry in Axis VM;
- 2.4 Exporting modified geometry from Axis VM and imports it into Revit (vertical interoperability);
- 2.5 Exporting modified geometry from Axis VM and imports it into Archicad; subsequently exports it from ArchiCAD and import it into Revit (vertical-horizontal interoperability).

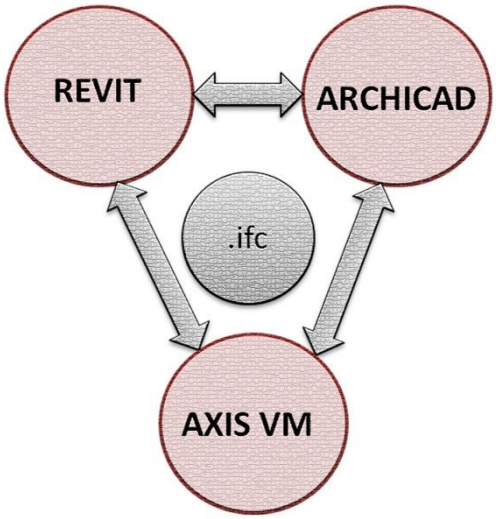

Fig. 1: Horizontal interoperability between Revit and Archicad (parametric software) and vertical interoperability with Axis VM (structural software)

2.1 To use .ifc file which exports the model from Revit and imports it into ArchiCAD, subsequently exports it from ArchiCAD and imports it into Axis VM

The first phase normally coincides with the consultation and the retrieval of archival material and contemporary photographic and metric survey both as a whole and in detail that characterize the structure and the architecture of the building.



Fig. 2: Photographic and metric survey

The structure was composed of precast elements such as columns and beams. The floor was made with TT beams, the plinths and the connecting beams were cast in situ.
Having available all these informations were possible to start the design phase of the parametric model, inserting all the required data for structural calculations and to process some hypotheses earthquake safety. For the modeling of the proposed study was used parametric software Autodesk Revit 2013.
Particular attention was paid to the definition of each element, starting from the standard families available in the software library, subsequently were customized to make the model to matches the existing building. First was created a structural grid, on which were placed the plinths, columns and beams. The structure itself was very regular although sometimes were found the differences between elements: for example, some columns were the presence of brackets of the beams while in others the section was reduced to allow a support plan.

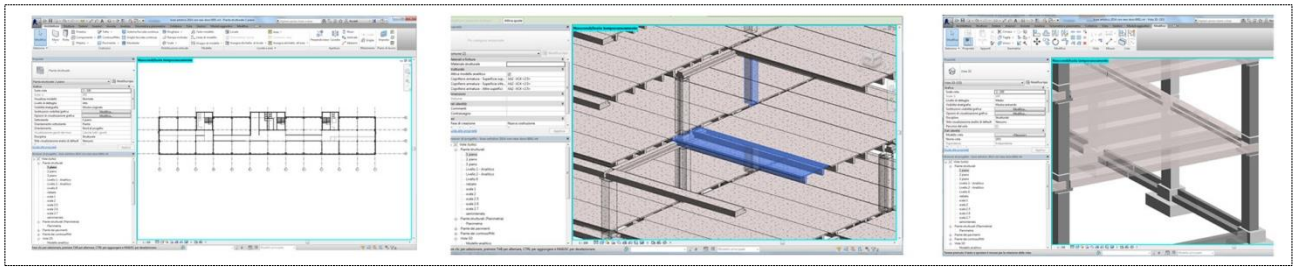

Fig. 3: Precast elements (columns, beams and floor was made with TT beams)

Once completed the model, the analysis focused on the exportation from Revit to ArchiCAD, occurring before the benefits of horizontal interoperability and then intelligent vertical through the "filtering" which was a selection of data to export, carried out by hiding unnecessary elements between ArchiCAD and Axis VM.
In this case study the first step (horizontal interoperability) was revealed a loss of data for complex elements - later it will be possible to see the example of columns. This phase was particularly useful to identify ways of modeling more efficient that able to increase interoperability both horizontal and vertical.

2.2 To use .ifc file which exports the data from Revit and imports them into Axis VM

The transmission of the data between Revit 2013 and Axis VM was carried out using IFC exchange format, the only currently recognized internationally by the IAI (International Alliance of Interoperability).
To optimize the export processes was possible to act on specific categories, filtering all the architectural elements to isolate the structural ones. So, under the same category, such as beam, there were different elements, it can be filtered the instance and selected only a specific type of item. So, it was possible to enter the menu and select *export* options. In this section there are 660 categories with related entities, a code that identifies the category. If this code is absent, it can be obtained from the website buildingsmart.it and ensure that the entities are supported by Autodesk.

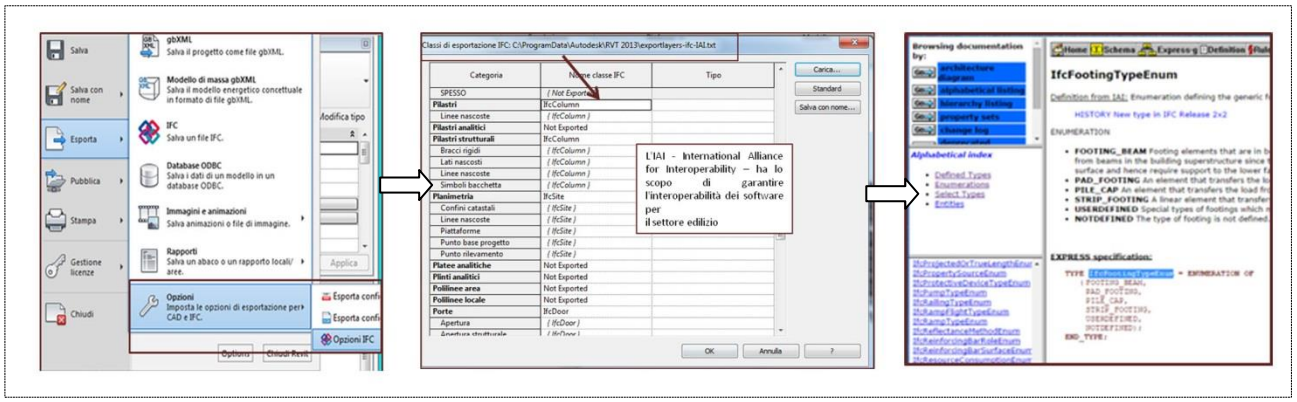

Fig. 4: Using IFC exchange format (Industry Foundation Classes)

Exporting the file in the traditional way, all the data of the model, including the hidden categories, can be transmitted to other software. In this case, it was necessary to isolate some specific data (like structural

element); moreovere, it is possible to install the plug-in IFC-EXPORTER, selecting the version IFC 2x3 GSA BIM Design Concept 2010, which was able to export only the visible categories.

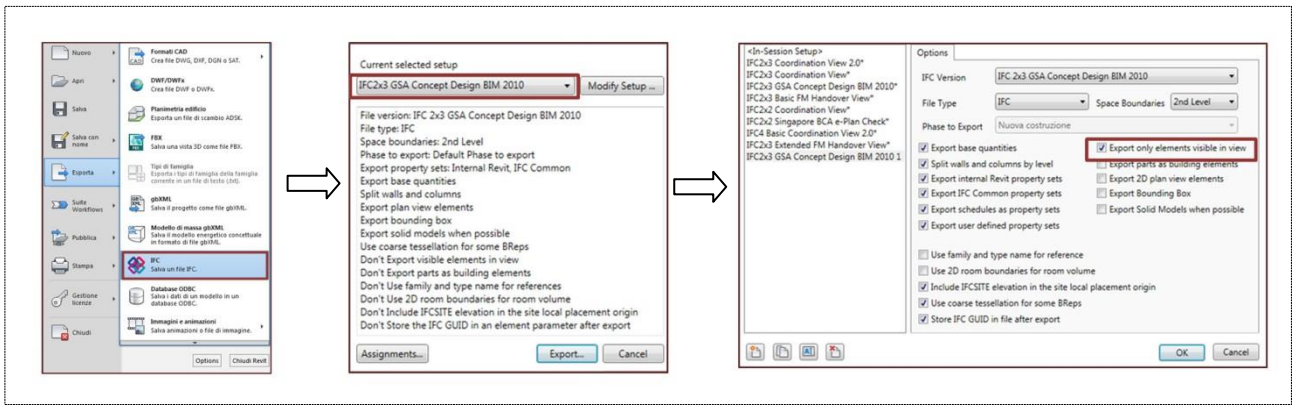

Fig. 5: Using Plug-in IFC-EXPORTER for the "filtering"

Completed filtering and exportation, the data were imported correctly in structural analysis software Axis VM to verify static and seismic calculations. At this step it was possible to verify the vertical intelligent interoperability, experiencing only minimal problems of reading data and the need to recalibrate the modeling elements to generate legible element from the target program easily.
The method used for such verification consists of reading the modeled elements by applying Solibri Model Checker, which identifies, isolates and allows reading individually all geometry created in Revit Architecture 2013, highlighting any problems of data loss.
To better understand the used methodology in this study can be referred to the recalibration of a vertical element (columns) of the school taken as a case study.
The columns in question, as well as other complex families in Revit can be modeled in two different ways: the *extrusion* for the architectural and the *adjustment analytical axes* for the structural elements.
Several problems have been found: (i) following the method of extrusion, the element was formed by a parallelepiped, constituting the load-bearing element, and by the relative shelf: in consequence, the section of the element was variable; (ii) the verification geometry creation, interpreting the element as a group of faces and not as an extrusion; finally, (iii) a further loss of information was about the size of the profile.

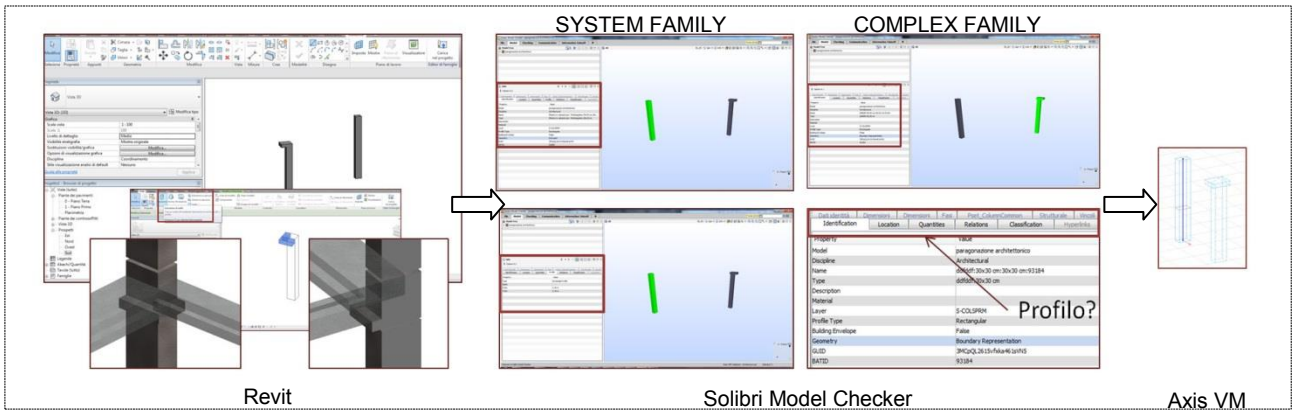

Fig. 6: Extrusion of architectural elements, the verification of them by Solibri Model Checker and import into Axis VM

In the procedure with the adjustment analytical of the axes, it was possible to align the analytical axes depending on the variation of the section. However, in Revit, going into IFC options, it can be noticed that the identity of the analytical column was not defined. Therefore, Axis VM lost the category and generated its axis on the center of gravity of analytical geometry.

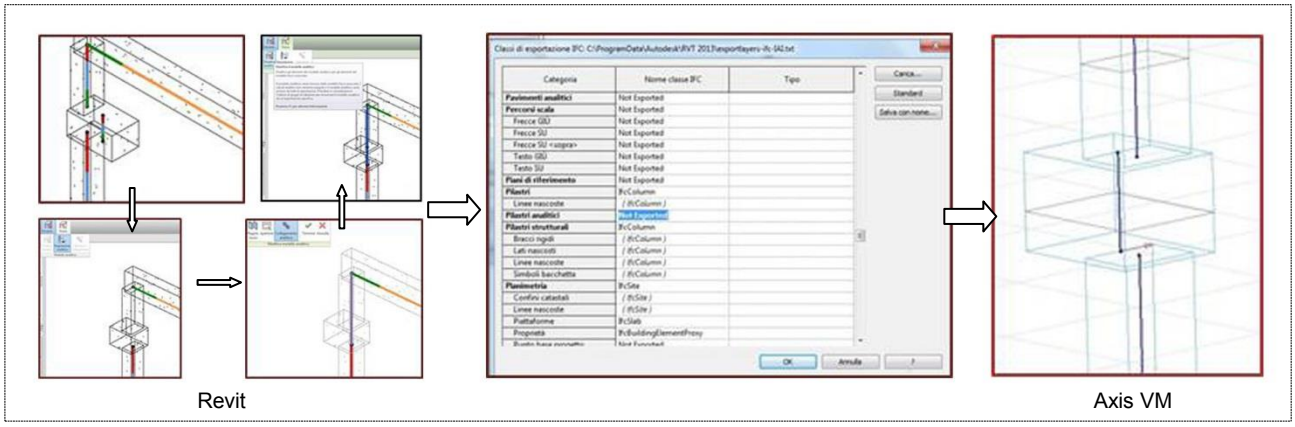

Fig. 7: *Adjustment analytical axes* for the structural elements and import into Axis VM

To overcome these problems, it was essential the calibration of the consisting model in a simplification of the element: for example, the column was decomposed into two simple elements with the aligned axes. Obviously, it was involved a difference between the geometric model and the actual situation. The important thing was to verify that this difference is irrelevant to the calculation.

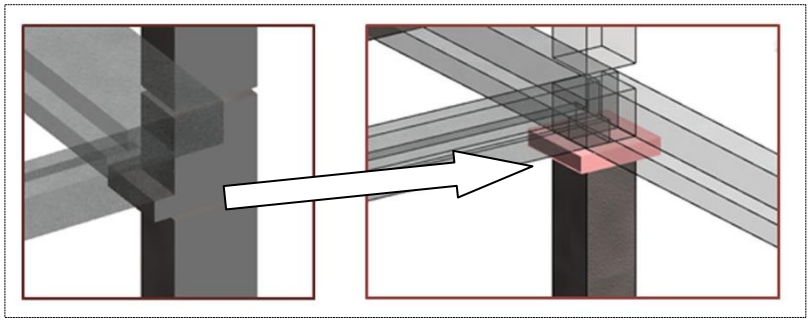

Fig. 8: Simplification of the element

2.3 To implement Static and seismic analysis and the verification of structural elements with possible modification of the geometry in Axis VM;

Fixed problems with reading of the desired element through the recalibration of the model, it was possible to perform calculations with Axis VM, which is a complete program for the finite element structural analysis of structures with each type of material.

The procedure of inserting analytical axes, joints and rigid surface in Axis VM was identical regardless of whether the file comes from Revit or Archicad. First, it was necessary to define the materials of columns and beams to set analytical axes on which were placed the loads. Subsequently, to specify the joints and rigid surface. After inserting the loads (permanent and variable), and applied linear analysis, results were obtained. These data were divided into the results of displacement and stress, and can be displayed in tables or graphs. Furthermore it was possible to perform the seismic analysis: in this case it was necessary to insert the loads (permanent and variable) to implement modal analysis, which was subsequently joined to the spectrum of project to obtain the seismic loads and the results of displacement and stress.

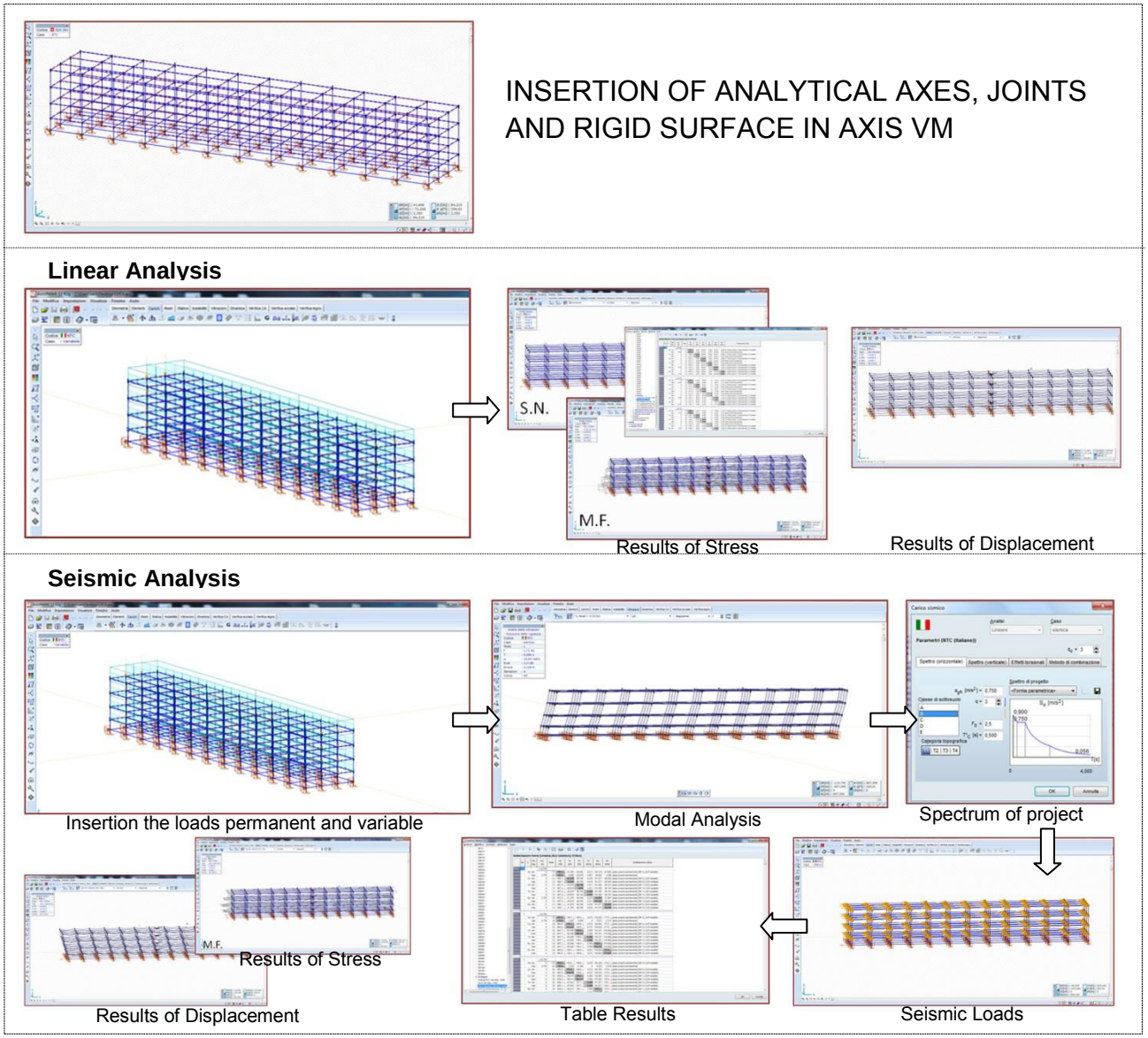

Fig. 9: Insertion of analytical axes, joints and rigid surface in axis vm, apply linear and seismic analysis

To verify the structural elements, in the Table Results was necessary to select the critical combinations among static and seismic ones to identify the element most stressed. For this element, it was proceed with the assignment of the resistance of materials values, with the placement of reinforcing bars (choosing diameter, number and position) and continue to verify. The interaction diagram of normal stress-moment was shown the domain of resistance element. All stress values (crosses) of static and seismic combinations should be included in that domain. Normally there were initially blue crosses (internal to the domain - checked) and red crosses (external to the domain - unverified). Based on these results it was necessary to modify the bar, the size of the section and the material until all combinations of stress values were within the domain of resistance (all blue crosses - checked)

The advantage of BIM interoperability is clear to all: it is not necessary search manually for the element and re-inserts the changes made by structural engineers, but the software automatically loads the calculated element in Axis VM and updates the possible choices, allowing the designer to choose between those that are more compatible with the project as a whole. Moreover, everyting starts from the 3D model that is much more than a simple 3D model because it is a digital representation of the project containing several data that can be exchanged thanks interoperability.

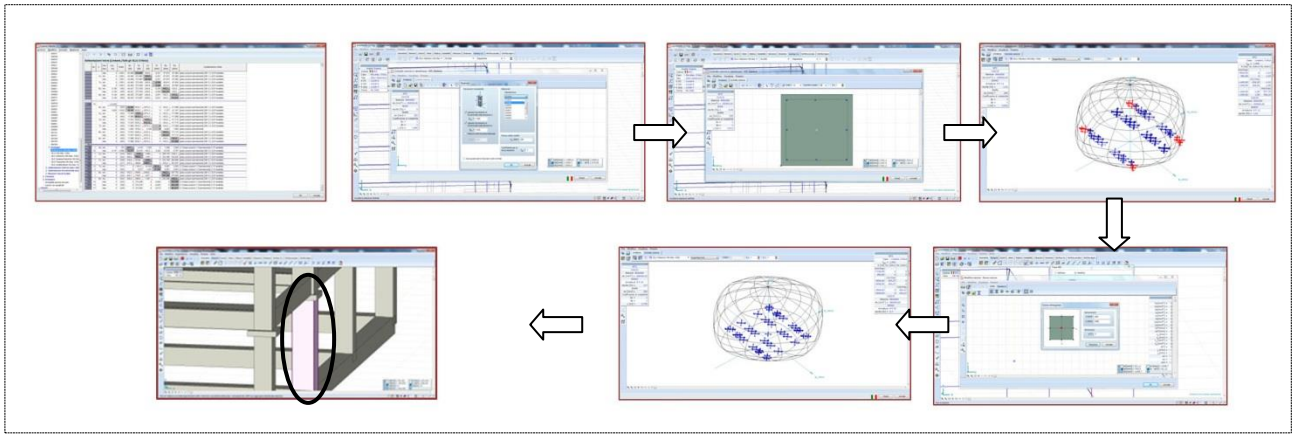

Fig. 10: Verification of structural element

2.4 Exporting modified geometry from Axis VM and imports it into Revit

Before importing the IFC file into Revit or ArchiCAD with the changes made in Axis VM,it was possible to verify with Solibri Model Checker that all information of the column were maintained, comparing the new IFC modified in calculation with those originally obtained from the parametric modeling software. In the case study described, of course, the check was performed with Solibri comparing old column information with those of the element being edited.

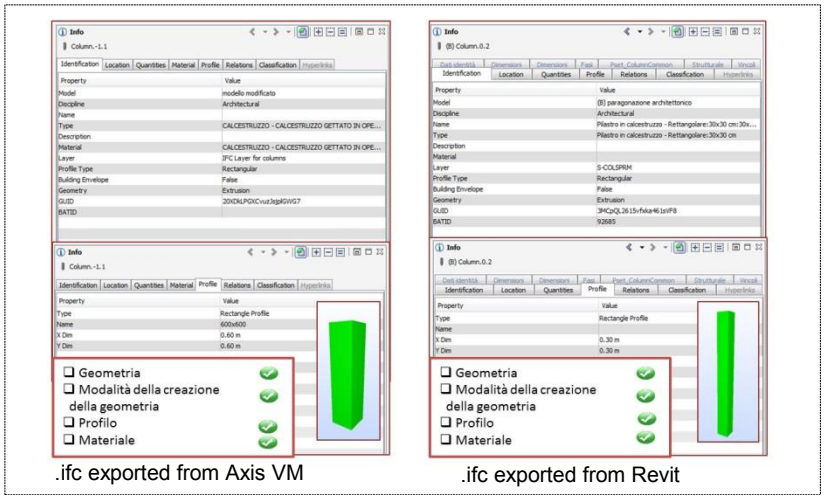

Fig. 11: Comparing the information of the original column with the modified one and verify with Solibri Model Checker

It must also verify that the information available in Solibri was maintained even in Revit and ArchiCAD. The structural element (in this specific case of the column) was imported into Revit with a *merge* of the single element on the original model. After this operation, frequently there was a loss of data taking into account the geometry, the profile and the material.

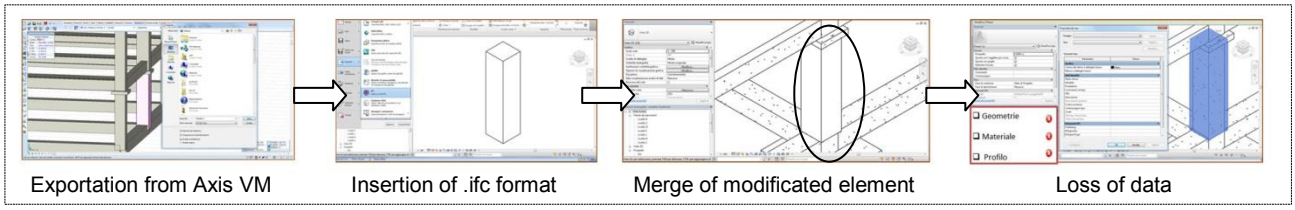

Fig. 12: Exportation from Axis VM and importation into Revit

2.5 Exporting modified geometry from Axis VM and imports it into Archicad, subsequently exports it from ArchiCAD and imports it into Revit

To ensure the maintenance of all the information it is essential to insert the element in the model. For example, it was possible to import the element from Axis VM in Archicad and, with the *detects changes IFC model* command to access the menu from which can be inserted the element with the section resized. At this point it was necessary to implement merge with the original model and check any data loss: Archicad displays in green all modified objects, while unchanged items remain blacks. Once, select *the changes into correction* command, the file is updated and all data can be checked simply by selecting the item.

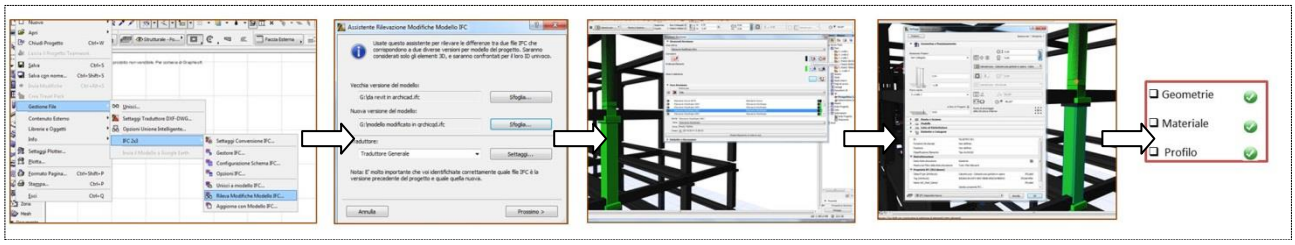

Fig. 13: Importation of the element from Axis VM into Archicad

The problems were found at the step by importing the element from Archicad in Revit using *the general translator* command. It was noticed that Revit couldn't t interpret some information of .ifc files. Despite the created and edited elements in another program were designed and positioned correctly, they couldn't be associated with a Revit family and therefore couldn't be changed. Instead, these elements in Archicad, in addition to being positioned and designed properly, could be also edited.

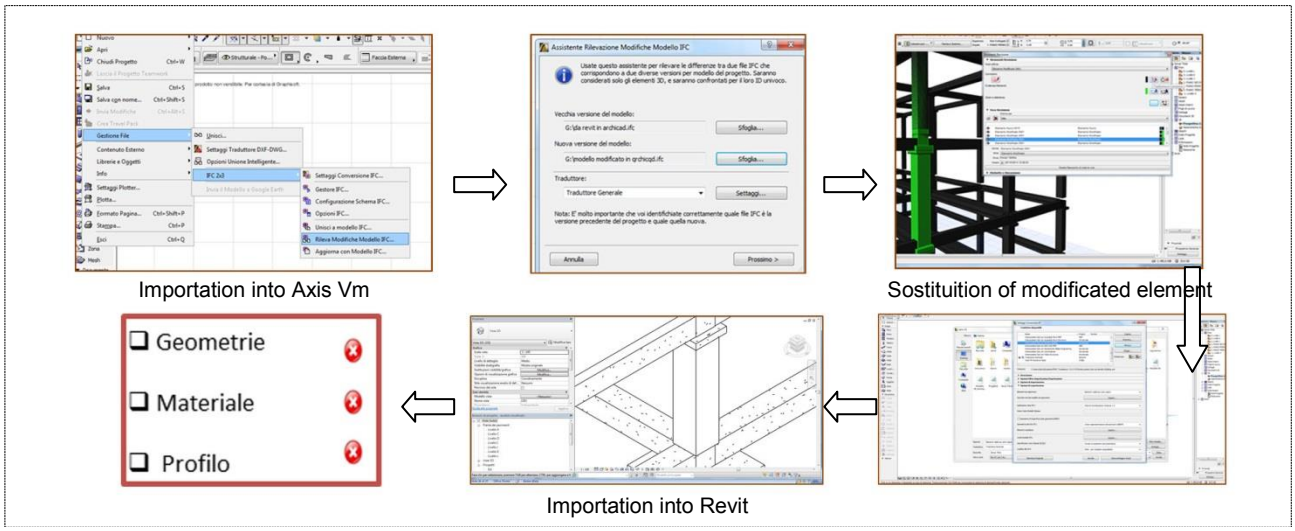

Fig. 14: Importation of the element from Archicad into Revit

This difference in behavior occurred because the IFC used a globally unique identifier (GUID) for all instances of objects. Solibri Model Checker reads exported elements from Axis VM through two GUIDs: Archicad GUID and IFC GUID. While Archicad was able to read both GUID, Revit had problems to read the GUID re-imported into the original model after effectual changes in Axis VM.

The problem can be overcome by developing an application that reads the data of the elements in the IFC file and converts them into Revit families system, thus improving the process of both vertical and horizontal interoperability.

3. Conclusion

As described above shows how the current state of interoperbaility would be very optimistic about the validity and potential of the method, although some steps have not yet automated in modeling, filtering and exporting information.
All of the problems detected by the current research, the most can be overcome with a good knowledge of the software for parametric modeling and the adoption of BIM workflow well defined from the beginning. In this way it is possible to identify in advance the necessary data for structural analysis and calibrate modeling through simplification schemes already known or easily deducible.
For other issues, particularly those relating to the GUID, the lack of analytical axes codes of Revit or loss of data due to the modeling of complex elements, Instead, it should be acooperative work of research and interdisciplinary development between developers, architectural designers and structural engineers.

Acknowledgments
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Bibliographical References

[1] EASTAM C., *Building Product Models: Computer Environments Supporting Design and Construction*, CRC Press, 1999.

[2] OSELLO A., *The Future of Drawing with BIM for Engineers and Architects*, Palermo, Dario Flaccovio Editore, 2012. ISBN 9788857901459.

[3] STABILE R., "*Il Building Information Modeling nella valutazione della sicurezza strutturale delle costruzioni in cemento armato esistenti: applicazioni ad un caso studio*", Master degree, Dept. Architecture, Università degli studi di Napoli "Federico II", Naples, IT.

[4] NUTI F., *Edilizia - Progetto/costruzione/ produzione*, Firenze, Edizioni Polistampa. 2010.

[5] SADEGHPOUR F., MOSELHI O., ALKASS S.T., *Computer Aided Site Layout Planning,* Journal of Construction Engineering and Management, 2005, vol. 132, No. 2, pp. 143-151.

[6] http://www.autodesk.co.uk/adsk/servlet/pc/index?siteID=452932&id=14645193

[7] http://www.buildingsmart-tech.org

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Cultural built heritage in cemeteries, between architecture and urban design. The Serramanna Cemetery Chapel

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Abstract
The birth of modern cemeteries marks a crucial moment in the history of urban planning in Sardinia, providing designers with the opportunity to express the tendency towards monumental architecture. In the regional scene of Sardinia, the cemetery of Serramanna is an interesting example of nineteenth-century cemetery. The discovery of some documents from the historical archives of Serramanna allowed to attribute the cemetery project to Enrico Pani, an engineer trained at the school of Gaetano Cima in Cagliari. Enrico Pani discussed his graduation thesis on October 13, 1864.
Gaetano Cima with his school sets the rules that characterize a good number of the architectural works in Sardinia in the nineteenth century. His students worked in different parts of the island, in an historical moment characterized by major transformations both architectural and urban. The combination of these positive conditions led to the proliferation of numerous interventions including the construction of new cemeteries outside the urban perimeters. The cemetery of Serramanna was initially set to a plan of quadrilateral shape divided into four parts by two orthogonal paths. At the intersection of the two axes is placed a monumental chapel. The chapel, inspired by the model of the Pantheon, has a central plan layout, with an octagonal shape set. The construction of the cemetery began in 1893 and ended in June 1897. Enrico Pani worked in the context of Sardinia in the second half of the nineteenth century, designing some valuable architectures like the covered washhouse in Villacidro (VS).

Keywords: 19th century cemeteries, Sardinia, Enrico Pani

1. The planning of the nineteenth-century cemetery in Sardinia
The birth of the modern cemeteries marks in the cities of Sardinia a crucial moment that triggered a wave of urban transformations involving the main centers of the island. In 1806 the edict of St.Cloud, issued in 1804 by Napoleon, is extended to Italy. Despite the *Décret Impérial sur les sepultures* did not concern legally Sardinia, also in the island began the construction of cemeteries outside the city walls.
The need for new ways to consider the public health is engaged in a substantial reconfiguration about the traditional approach to urban issues. Cemeteries planning plays a strategic role in the nineteenth-century processes of urban transformation. The layout of these infrastructures in urban outskirts derives from the need to provide simultaneously to the sanitary rules and to the need of a new management of the urban planning in its general reorganization. In addition to the urban aspect, the issues related to the design and construction of new cemeteries involves two different scales of design, such as the design of individual artifacts and the project of the new cemetery system. The type of the large square enclosure surrounded by porticos is indicated by Francesco Milizia as a reference model for the design of cemeteries.
The principles set out by Francesco Milizia in his "*I Principj di architettura civile*" [7] had already found application in the projects of Ferdinando Fuga for the cemeteries of Rome and Naples, the prototype of which is constituted by the Cemetery of Pisa [2]. The structure of the atrium Graveyard of Pisa, with an open space enclosed on all its four sides by arcades, is taken as a model by Ferdinando Fuga for the projects of the cemetery of the Holy Spirit in Rome (1745) and the cemetery of the "366 Fosse" in Naples (1762). Both set on a quadrilateral shape, these two cemeteries are bordered by a fence portico on three sides, at the entrance side, are placed the functional buildings (chapel, caretaker housing and morgue).



Fig. 1: The Serramanna cemetery: the entrance portal and the chapel

In his treatise of 1781 [7], Francesco Milizia inserts the paragraph on cemeteries in the chapter entitled: "Buildings for health and public needs". This choice already reveals how his cultural posture was aligned with the sanitary standards of the time [9]. However, this attitude does not stop him to pay close attention to the ideal of decorum and dignity expressed by the architectural ornament and by the monumentality of the architecture itself, considered unnecessary by Enlightenment meaning. Francesco Milizia assumes that each building must manifest the function they have through their features, highlighting the use of components, materials and finishes in keeping with the exaltation of the "funeral" appearance suited to cemeteries. He wrote: «*Sia un ampio recinto quadrato (...) circondato internamente da portici con archi scemi, e co' piedritti a bugne vermicolate; genere d'ornamento analogo alla corruzione de' corpi umani. (...) Il suolo dell'aia sia due o tre piedi al di sotto di quello de' portici, e questo sia meno elevato di quello delle strade che v'introducono. Questa inuguaglianza, unitamente coll'esteriore corrispondente all'interno, accresce l'immaginazione di un soggiorno terribile*» [7].
In Europe one of the first cemeteries with monumental structure is the *Santo Spirito* cemetery in Palermo [2], designed by Carlo Chenchi in 1782 in keeping with the principles set out by Francesco Milizia.
The cemeteries of the nineteenth century reveal and emphasize the spirit of the time of their foundation. The Enlightenment vision of cemeteries is opposed to the next romance, well expressed in 1821 by Shelley in the *Adonais* preface: «The cemetery is an open space among the ruins covered in winter with violets and daisies. It might make one in love with death, to think That One Should be buried in so sweet a place» [11].
Based on the principles of radical egalitarianism that leaves no room for the individual and the meditation, the rigid functional standards related to cemeteries light a strong debate in the Italian intellectual circles, in a period of transition between the extreme rationalization of the Enlightenment conception and the new sensitivity to religious values of Romanticism. In his work "*I sepolcri*", Ugo Foscolo reaffirms the usefulness of graves and funeral rites, the value of the bond between the living and the dead, and the value of maintaining the memory of the deeds of dead men. Foscolo's vision of the cemetery testifies the attitude in Italy at that time against the inadequacy of the Enlightenment conception of the cemeteries, he wrote: «*Pur nuova legge impone oggi i sepolcri fuor de' guardi pietosi, e il nome a' morti contende*».
The cemetery infrastructure go gradually detaching from the Enlightenment ideal of purely functional "devices", to regain possession of the formal traditional content of architecture. For designers of the 19th century, the construction of new cemeteries is an opportunity to demonstrate a tendency to monumentality of architecture typical of the time, providing a particular aesthetic care in the design of these architectures. Born as urban infrastructure, the 19th century cemetery becomes a complex monument, and the representative power of art and architecture becomes the focus of its design and construction. Furthermore, the richness and variety of styles present in the cemeteries, reflects the economic and cultural vitality of the city in the second half of the nineteenth century.
The cemetery area is generally defined by a wall within which the space is organized in a hierarchical structure that reflects the idea of the city at that time. These monuments, halfway between urban and architectural design, established a real urban infrastructure, whose construction is necessary in accordance with the radical reforms intended by the liberal climate of the Enlightenment era.
Representing a city, these cemeteries require a study that focuses on two different levels: the scale of the overall structure and the scale of individual monuments [9].

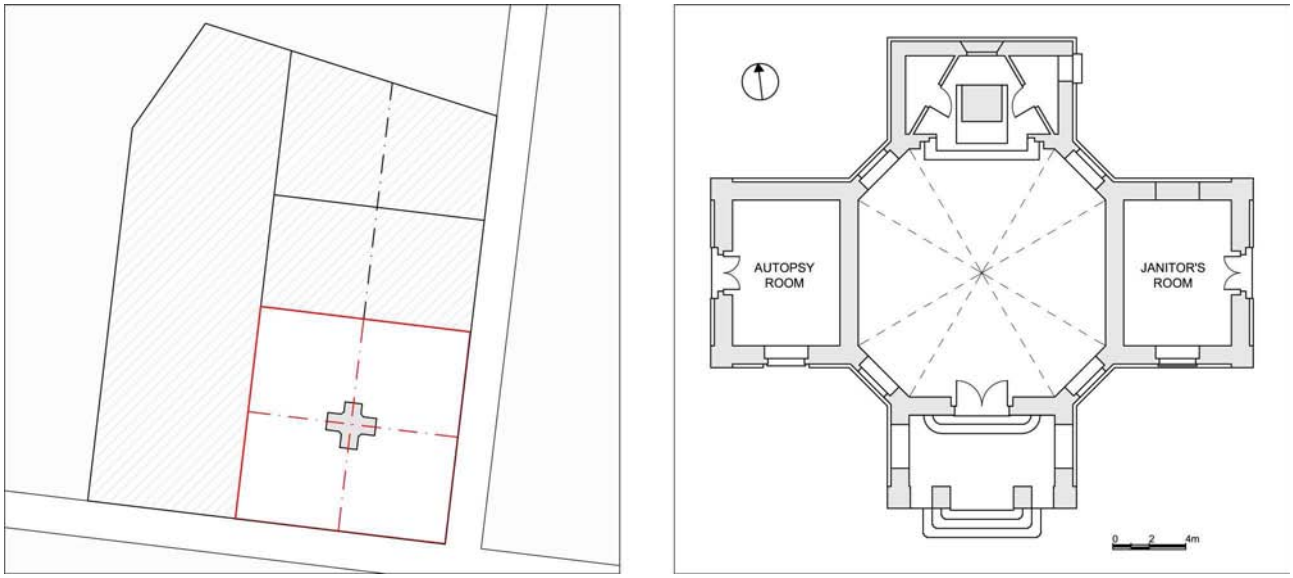

Fig. 2: The Serramanna cemetery plan with the three successive extensions by the original one. The first expansions of the cemetery have maintained the axis of symmetry defined by the chapel and from the portal of the main (longitudinal axis). On the right the survey of the cemetery chapel plan.

An example of this attitude is found in the work of the engineer Luigi Oberty: in his report entitled "*Cenno sui campisanti, e sulla loro influenza sulla morale e sulla civilizzazione"*, in 1818 he offers a first typological scheme that rejoins the civil function of the cemetery with human and religious sentiment disowned by Napoleonic decree [2]. Adhering to the literary model of Pindemonte, Oberty assumes that the tombs generate a positive action in human life. The graveyard designed by Oberty for the city of Avellino in 1818, is defined by a square with a church centrally located in a grid of tree-lined avenues that allows access to the areas of the burials. Below the chapel is set an ossuary and a series of chapels are placed along the perimeter walls. The monumental entrance of the cemetery is located on the line stretched out of the church. Compared to the cemeteries of the Enlightenment, the innovation introduced in the model proposed by Oberty, lies mainly in restoring the dignity of men as individuals: the graves are no longer collective but individual burials, there are spaces for walking and meditation and architectural ornament finds a monumental key in the neoclassical style [2].
In the Kingdom of Sardinia, in 1731 Carlo Emmanuele III di Savoia issues the first standards for the realization of some cemeteries outside the city limits. Vittorio Amadeo III di Savoia with the "*Manifesto senatorio con prescrizioni riguardo alle sepulture*" decreed a ban on the burial in areas within the city walls in 1776. In 1824, a circular from the Viceroy prohibits in Sardinia the burials in parish churches. Starting from 1824, many municipalities of Sardinia undertake projects and the construction of new cemeteries. In the following decade Cagliari, Sassari, Iglesias and other centers of the island build new cemeteries outside the city.
One of the early nineteenth-century cemeteries built in Sardinia was the Bonaria graveyard in the city of Cagliari. In 1816, a severe outbreak of cholera occurred in Cagliari: it imposed the identification of some areas near the city to use as a burial place. Until then in Cagliari, as everywhere, the burials took place inside churches and in areas adjacent to the churches. This often led to hygienic problems no longer tolerable. This precarious situation of the burials reinforced the need for a large city cemetery in Cagliari. Designed by the military engineer Luigi Damiano, the new cemetery was inaugurated January 1, 1829. It consisted of a rectangular plan divided into four parts. After just thirty years, the new graveyard needed an extension. The first expansion was designed by architect Gaetano Cima. The planimetric layout of the cemetery of Bonaria is one of the reference types used in the post-Enlightenment period in Sardinia and it became the model for some other cemeteries in Sardinia. The cemetery of Bonaria was used until the sixties of the twentieth century. Today the graveyard of Bonaria contains a wide variety of architectural styles used between the nineteenth and the twentieth centuries.

2. The Serramanna cemetery

During the thirties of the nineteenth century, Vittorio Angius in "*Dizionario geografico storico statistico commerciale degli stati di s. m. il re di Sardegna*" wrote that the Serramanna cemetery was adjacent to the church square. In 1859, in compliance with the provincial circular of 1850 which forbade burials inside the

town, the municipality of Serramanna identified an area located north-east of the town with the purpose of the construction of the new cemetery [1].
The new cemetery was designed in 1893 by Enrico Pani, an engineer trained at the school of Gaetano Cima in Cagliari [3]. A boundary wall, a building at the entrance and a funeral chapel represent a constant that characterizes a typology of nineteenth-century cemeteries. In the Serramanna cemetery we have the presence of two of these elements, missing the building at the gateway to the cemetery. The cemetery designed by Enrico Pani rises in place of a previous cemetery, evidently arisen in emergency conditions and not considered appropriate, which was demolished to make way for a new one [8].
The cemetery designed by Enrico Pani uses as typological matrix the framework of the fence, in accordance with the statement made by Francesco Milizia. In his treatise "*I Principj di architettura civile*", he proposed a large square enclosure, or any other curved or mixed-line shape, equipped with spaces for ossuaries and a chapel at the center in the shape of a pyramid or Pantheon. Francesco Milizia resumes ancient patterns drawn on a geometric basis and with symmetrical composition. In the project for the cemetery of Serramanna, Enrico Pani follows some of these principles.
Originally surrounded by a wall that defines a square spatial distribution, access to the new Serramanna cemetery is via a modest portal positioned centrally on a side of the nearly square plan. On each side of the entrance portal, two coupled cast stone pillars surmounted by stone pyramids. Aligned with the entrance portal a small domed chapel. The octagonal shape expresses the radial space and the multiple relationships established with the surroundings. The chapel is representative of the entire cemetery complex: it is built according to the model of centrally planned church, topped by an octagonal dome and preceded by a portico with a rectangular plan bounded by four pillars supporting a triangular pediment in the main front facing to the cemetery entrance portal. The architectural style of the cemetery chapel goes back to a neo-Palladian architectural language and the graveyard complete the project according to conventional typological references that realize a design in an urban language.
The cemetery chapel assumes an iconic value for its architectural forms and its location: it is the pivot of the geometric order of the cemetery. The cemetery plan is marked by two main axes hinged on the position of the chapel: ideally two lines depart from the axes of the chapel extending to the entire historic cemetery system. The quadripartite structure of the cemetery plan generates an orthogonal grid confined within a square perimeter whose center coincide with the chapel location: all the cemetery complex structure highlight the central position of the chapel. This same pattern also underlies the geometry of the cross that sanctifies the space. Obviously these assumptions are referred to the typological matrix of the fence of the historic core of the cemetery. Two subsequent "fences" have been added to the diagram of the historic cemetery and the space designed according these additions moves away from the original architectural and symbolic laws.
In the historical archives of Serramanna, are kept the "*Capitoli d'appalto*", containing the procurement criteria of the "Project for a new cemetery" [7]. Dated 1893, the contract, signed by Ing.Enrico Pani, designer and project manager of the work, is divided into six chapters.
The Chapter I art.I reads: «*L'appalto ha per oggetto l'eseguimento di tutte le opere e provviste occorrenti per la demolizione del vecchio cimitero e la costruzione in più ampie dimensioni di un nuovo, a seconda del progetto compilato dall'Ing.e E.Pani nel Comune di Serramanna e nella stessa località del vecchio*».

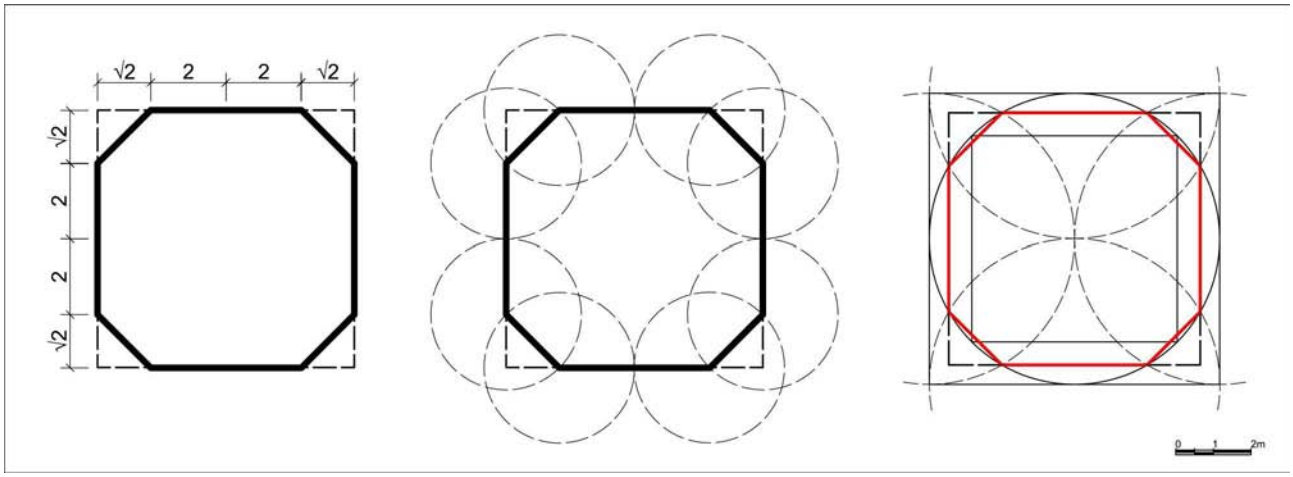

Fig. 3: Diagrams of the geometric construction of irregular octagon corresponding to the inner perimeter of the central block of the Serramanna cemetery chapel

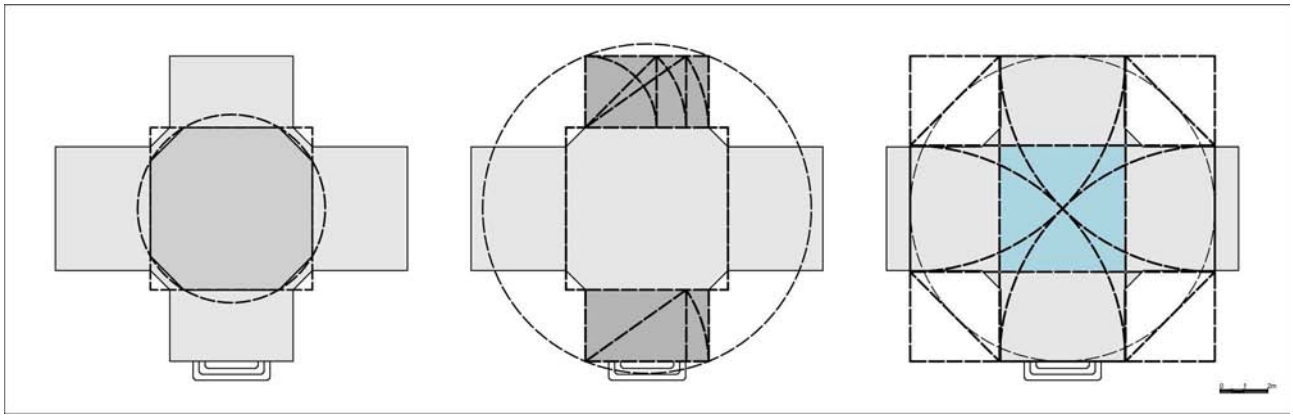

Fig. 4: Diagrams of the geometric construction of the outer perimeter of the plan of the Serramanna cemetery chapel

As can be seen from the 1st chapters of contract, the project designed by Enrico Pani includes the demolition of the old cemetery and the construction of a new one. In these chapters we can find the only indications of the characteristics of the cemetery, since there are no traces of the drawings: in particular Chapter II, *Designazione, forma e principali dimensioni,* describes the main geometric and functional characteristics of the new cemetery. Art.21, *Designazione sommaria delle opere di appalto*, lists the works included in the contract. Among these, step 2 shows the item: «*Murature diverse per la formazione dei muri di cinta, di due stanzette, dell'oratorio e sottostante ossario*». This entry clearly refers to the funeral chapel, with underground ossuary, and two small rooms attached to it: the autopsy room and the janitor's room. Article 22, concerning the form and main dimensions of the works, specifies that: «*La forma del cimitero è quella di un rettangolo di m.i70.15 di lunghezza per m.i72.20 di larghezza esternamente ai muri di cinta. Più un fossetto esterno lungo la zona perimetrale prescritta dai Regolamenti di un metro di larghezza, della sezione di cui nella figura a margine, che nel senso longitudinale seguirà nel modo più possibile regolare la pendenza del terreno. I muri di perimetro avranno un'altezza totale sopra zoccolo di m.i2,00 – comprese le copertine, e lo zoccolo poi le altezze che risultano dal p.o quotato annesso al progetto. Gli spessori saranno da 0,60 in fondazione a 0,46×0,40 per tutta la rimanente altezza fino al p.o di posa delle copertine. Alle distanze fissate dai disegni ci saranno i pilastri di rinforzo sporgenti sempre in elevazione m.i0,05 per parte sui latistanti muri, ed in fondazione 0,10. Le stanzette e le altre due parti sporgenti dell'oratorio avranno 0,60 in fondazione e 0,50 in elevazione. Il perimetro dell'oratorio poi avrà 0,70 in fondazione - m.i 0,60 per l'altezza dell'ossario e m.i 0,50 in elevazione. In tutte le parti secondarie poi si seguiranno rigorosamente le dimensioni che dettagliatamente si vedono nei disegni riportati*». From this article we learn that the cemetery was designed with nearly square shape (a rectangle measuring 70.15 meters long by 72.20 meters wide), enclosed by a wall with a surrounding externally small moat; are also specified the size of the different parts of the main works. Section III describes the execution mode of the works, the Chapter IV is about the quality and origin of materials, Chapter V is about the amount of works and their unit price and different rules for its accounting, Chapter VI explains rules and procedures governing the procurement and Chapter VII the "Special Conditions", containing particulars of the material from the demolition of the old cemetery. In addition to the chapters of contract, the Serramanna historical archive preserves a document with the final computation on the accomplished works and a written record of the conclusion of the works signed by the contractor Francesco Saddi and the construction manager Ing.Enrico Pani, testifying the date of completion on June 1, 1897.
Today the cemetery has a plan configuration that results from the different expansions become necessary over time (Fig.2). The dimensions described by Enrico Pani in its report match those of cadastral maps updated to 1957, where they keep the nearly square size, with the sides, respectively, 70.15 meters and 72.20 meters long.

3. The cemetery chapel

The cemetery chapel is a central-plan building with a central block of octagonal shape covered by a dome and four wings, each of which with a triangular pediment crowning, and a portico in the main front. The cahapel is polygonal and cruciform in design and it results from the overlapping of two forms: the circle (by which the construction of the octagon) and the Greek cross.

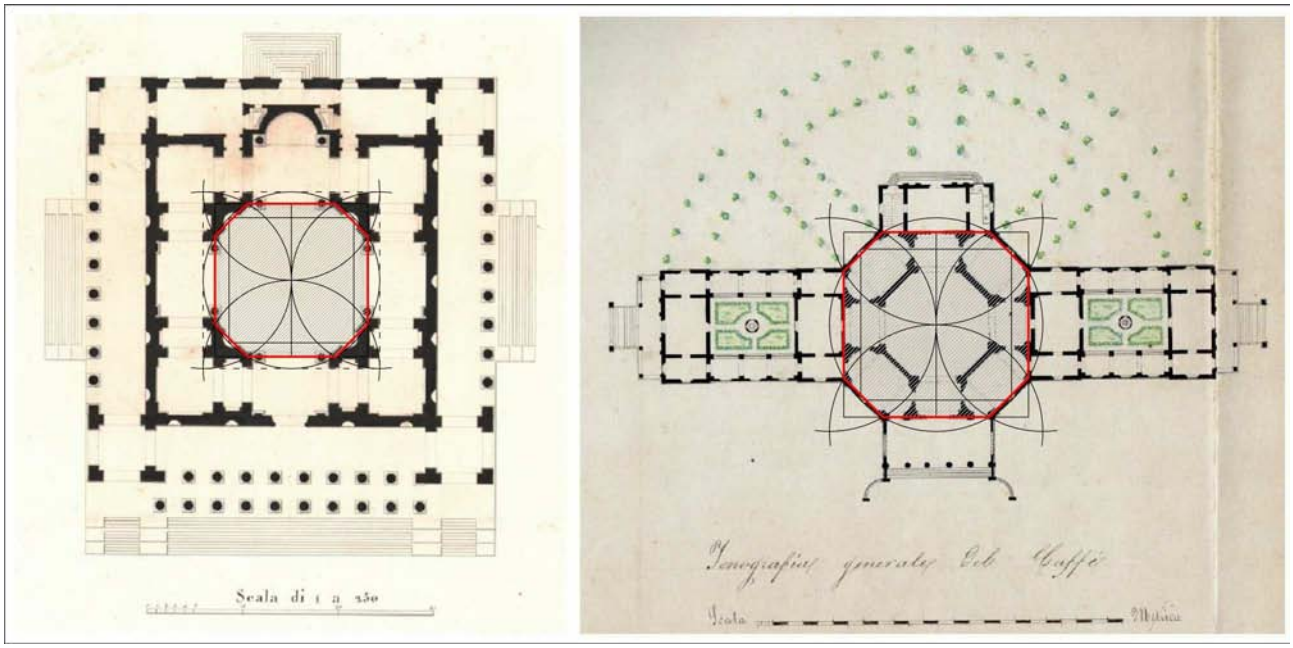

Fig. 5: Design drawings of the Thesis of two of the students at the school of Gaetano Cima in Cagliari. Designed in the mid-nineteenth century, even in these two examples we find the use of irregular octagon. On the left the project for a church by Luigi Corona (1845), on the right a project for a Cafe by Filippo Vivanet (1855). The geometric structure of Vivanet project, is similar to that of the cemetery chapel designed by Enrico Pani, who also graduated with Gaetano Cima in 1864.

The combination of a portico with a dome refers to the model of the Pantheon in Rome. A typological reference for the Serramanna cemetery chapel can be represented by the *Tempietto Barbaro* in Maser (Treviso), designed by Palladio, but you can find similar models in numerous other examples of cemetery architectures such as the *Oratorio di San Gregorio Magno* in the Villetta cemetery in Parma (1818) [9].
The centralized plan structure of the Serramanna cemetery chapel has two main axis of symmetry: an irregular octagon defines the main body of the church and its center organizes both the plan and the exterior of the building. In the construction structure, circle, square and octagon, are all hinged at one center: from them is generated a more complex geometric figure that define the building installation. Usually buildings with centralized plans direct the emotional perception of the viewer to the function of a memorial or houses of worship. The main building is embellished in the front wing with a prostyle portico and its basement was used as an ossuary. Auxiliary buildings are linked to the main octagonal block by means of extended symmetrical wings on either side, containing the presbytery and two subsidiary rooms associated with the requirements of the cemetery (the autopsy room and the janitor's room).
Starting from the architectural survey, we can find some geometric constructions of the chapel plan: they may be considered the basis of the project by Enrico Pani. Clearly, the obtained geometries were affected by the errors introduced by the building up of the chapel and, as typically happens in the architectural survey, by the intrinsic errors inherent in the performed measurements. With the availability of the lost drawings of the project, certainly the research results could have further confirmation.
A first geometric construction is one that considers a circle and two squares inscribed and circumscribed to it [9]. Following this rules we can get a first geometric construction that allows us to trace the geometry of the irregular octagon used by Enrico Pani to define the layout of the main building and its four wings.
The setting of the entire building plan can be carried out considering the two perimeters respectively inside and outside of its walls. At the inner perimeter of the central block, we detect an irregular octagon (Fig.3). According to the measures derived from the architectural survey, this irregular octagon has the shorter sides with a length of 2 meters, while the larger ones are 4 meters. Considering the square on which it is set this octagon, we can find a second geometric construction. The resulting square has the side of 6.82 meters. The distance detached from the irregular octagon on each side of the square is equal to $\sqrt{2}$ meters. Tracing circles with a radius of 2 meters on the vertices of the octagon, we find again the geometry of the plan system. In all the cases, the geometry of the chapel plan can be always brought back to that of a circle and a square.
The geometry of this particular irregular octagon it can be found in some different examples of architectures of the same period. Some examples will be found among the projects implemented in the Degree Thesis by

students of Gaetano Cima in Cagliari, designed in the mid-nineteenth century [3]: in the design of some of these buildings we can find the use of the same irregular octagon (Fig.5).
The four wings extending from the main body of the Serramanna cemetery chapel, are matched into two pairs: two are spaces for ancillary rooms, two are extensions of the central block and represent prostyle portico and the chancel of the church. The four auxiliary structures not only are combined in pairs from a functional point of view but also for their size and geometry. Starting by considering the two wings that house the porch and presbytery, the geometry of each of these two spaces is constituted by a root 3 rectangle. The root 3 rectangle construction begin with a root 2 rectangle. Consider the diagonal within the root 2 rectangle, we can use the diagonal as the radius of an arc whose trace touches the square base line. Enclose a rectangle around the new figure, this is a root 3 rectangle.
So, if we look at the outer perimeter of the whole building, the geometry of these two offshoots corresponds to a dynamic rectangle obtained from a square with side length of 3 meters. Both of the two rectangles have the aspect ratio of 1: √3 (Fig.4). The remaining two wings of the building are used as ancillary rooms, one for the caretaker and one for the autopsy room. The size of these two rooms result from an offset of a wall, beyond the line of the outer octagon that circumscribes the entire geometric composition of the building; in this way it was possible to make a space more appropriate size to accommodate the functions provided by the project.
A further geometric construction that can be considered is that of the so-called “Sacred Cut”. This geometric construction involving the square for constructing an octagon was given by Sebastiano Serlio in his *I sette libri dell'architettura* (“Seven Books of Architecture”) [5]. This geometric construction is sometimes called the *sacred cut*, a name coined by the Danish engineer Tons Brunés in his book *The Secretes of Ancient Geometry and Its Use* [5]. Starting from a reference square with side equal to the distance between the elevation front of the portico and the one of the presbytery, swing an arc from ach corner with radius equal to half the square’s diagonal. The four lines starting from the point where each arc cuts the square, is defined a center square called the *sacred cut square*. The *sacred cut square* can be found in the layout of many ancient buildings, such as the Parthenon [5].
We can use the Sacred Cut to construct an octagon whose sides have a length equal to that of the fronts of the four wings of the building (Fig.4).

Bibliographical References

[1] ANGIUS, Vittorio. CASALIS, Goffredo. *Dizionario geografico storico statistico commerciale degli stati di s. m. il re di Sardegna (1833-1839)*. Cagliari: Editrice Sardegna, 1988.

[2] ARANEA, Adriana. *L'architettura dei cimiteri e la città nel XIX secolo. Storia forma e dinamiche urbane dalla Francia alla Sicilia orientale*. Palermo: Edizioni Caracol, 2007.

[3] BAGNOLO, Vincenzo. *La Scuola di Gaetano Cima in Sardegna: architetture disegnate e architetture costruite*, in C. Gambardella, Fabbrica della Conoscenza n.10, Le Vie dei Mercanti. S.A.V.E. Heritage. Safeguard of Architectural, Visual, Enviromental Heritage. Napoli: La Scuola di Pitagora, 2011.

[4] BERTOLACCINI, Laura. *Città e cimiteri: dall'eredità medievale alla codificazione ottocentesca*. Roma: Kappa, 2004.

[5] CALTER, Paul A. *Squaring the Circle: Geometry in Art and Architecture*. Hoboken, NJ: Wiley, 2008.

[6] CASTI, Paolo. *Serramanna insolita – Fatti, curiosità e ricerche…* ilmiolibro.it, 2010.

[7] MILIZIA, Francesco. *Principj di Architettura Civile*. Finale: 1781.

[8] PANI, Enrico. *Progetto di un nuovo cimitero. Capitoli d’appalto, 20 marzo 1897*. Archivio Storico Comunale Serramanna.

[9] ROSSI, Michela. TEDESCHI, Cecilia. *Il disegno della memoria, forme segni e materiali nell'Ottagono della Villetta a Parma*. Pisa: ETS, 2010.

[10] SERLIO, Sebastiano. *I sette libri dell'architettura.* Venezia, 1584

[11] SHELLEY, Percy Bysshe. *Adonais: An Elegy on the Death of John Keats* (1821). Oxford: Clarendon press, 1891.

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The single hall churches in the historic centre of Catania (Italy): a cognitive method behind the design of sustainable refurbishment

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Abstract
The several churches in the historic urban centres are essential documents of the cities' history, often forgotten, in bad condition or disused. The courses of decay of these buildings are raising the degradation of urban and social fabric in which the churches are placed.
These problems, related to an inefficient maintenance or lack thereof, mainly affect the churches of brotherhoods, a particular subset of places of worship, usually with a single hall and typologically and technologically similar traits.
This research proposes a cognitive method that will be essential to the following design actions on the single hall churches, analysing the brotherhood churches in the historic centre of Catania (Italy).
The goal is to protect and preserve this built heritage, for a conscious reuse and a sustainable refurbishment that does not forget the energy performances.
We highlight how the energy assessment systems, already analysed in other studies in this area for different building typologies, often overlook historical/artistic instances and non-residential use of buildings.
This study emphasises the need to consider peculiar benchmarks already in the case history, reaching a correct recovery action. This action will be in keeping with the latest Charters for the Restoration and it will ensure a suitable energy improvement.

Keywords: restoration, sustainable development, conservation strategy.

1. Introduction
The conservation and recovery of the historical and architectural heritage, like a witness document of the our cities' history, are themes increasingly connected with the environmental issues and with the sustainability of the operations on built, as shown by many studies and cases of application.
Sustainability has been defined by the Bruntland Report since 1987 according to the four interdependent dimensions of ecology, society, economy and culture, although we tend to forget that often.
In architecture, the sustainable recovery should not be reduced to just energy saving measures or to performance improvement of the various structural elements that make up the traditional structure.
Instead, we must consider a multidisciplinary vision of the theme, an integrated approach to integrate the different dimensions of sustainability [1].
As for contemporary architectures, even the historical buildings should be read as an open system that interacts with the context, as part of a physical urban subsystem that communicates with other social and economic subsystems [2].
The specific application that we here propose is the preliminary study to the sustainable recovery of the single hall churches of the historic centre of Catania.
These temples, belonging to the ancient religious brotherhoods, have been present in this historical urban context since time immemorial. The churches were rebuilt after the disaster of the volcanic eruption of 1669 and the earthquake of 1693 to respond to the need of the citizens to bury their dead. Today, however, these places of worship are underused or derelict, due to poor maintenance or extinction of many of these associations.

A recovery policy of these places of worship can be therefore an opportunity to revalue the old districts of the city by the creation of a network.
In this way, the brotherhood churches represent not only important rediscovered buildings but also a catalyst factor of many activities related to trade, tourism, education, training and leisure [3], which could reinforce the sense of social identity and belonging to a place.
In this perspective, in the economic dimension of sustainability, the preliminary cognitive analysis to the restoration design should translate into design-compatible choices with the existing buildings for the intervention implementation methods and for what concerns the maintenance plan and management of the built heritage [4]. Recognizing the importance of a systemic approach to the problem, in this paper we will analyse especially the environmental dimension.
The environmental sustainability to achieve for the recovery of historical buildings must be "weak", able to focus the *optimality* based on preferential selection criteria, rather than utilitarian optimisation of resources.
The global capital quoted by the Bruntland Report (composed by natural capital, man-made capital and human capital) to us and to the future provision must not be reduced; for this reason the optimality must lead to the research of the operating methods of analysis and multidisciplinary control, created *ad hoc* for the environmental context object studied [5].
We will try to propose an expeditious analytical method that already in energy pre-diagnosis stage [6] [9] highlights the critical issues to be considered to achieve the subsequent energy assessment of these traditional buildings.



Fig. 1: The hall-churches in Catania: General plan

2. The methodology and the expeditious analysis

This study proposes a series of expeditious analyses conducted on seventeen examined churches, distributed in an area of about fifty-five hectares (see Fig.1).
The first stage of the research has provided the census and cataloguing of the buildings.
Our preliminary approach to the energy evaluation of these churches is then articulated on two different fronts: on the one hand the geometric and typological analysis, which considers the orientation, the surface area to volume ratio S/V, the position of the building compared to the block, on the other hand the survey of the technical and thermophysical characteristics calculated in static mode [7].
At a later stage, these surveys will be used for a careful evaluation of the energy performance and the needs of each temple, in order to find the most suitable and compatible solutions for energy improvement.

2.1 Typological analysis

The planimetric configuration of these churches is characterised by a single nave, usually ended by a semi-circular or straight apse, and with sizes ranging from 85 to 280 m^2. A barrel vault with lunettes usually crowns the nave at the possible side windows and a bowl-shaped vault often completes the apse (see Fig.2).



Fig. 2: Some facades of hall churches in Catania. From the left, *SS. Sacramento al Duomo, S. Cristoforo Minore, S. Sebastiano, S. Orsola*, *S. Vito*, *S. Caterina al Rinazzo, S. Agata alle Sciare, SS. Crocifisso Majorana*, *S. Michele Minore.*

2.2 Geometric analysis: the shape factor (S/V)

The *compactness* of the building, or the ratio between the outer surface and the volume, is the result of the progressive formation of the building process and of the saturation of the urban fabric [8] [9]. This characteristic can provide useful information about the evaluation of heat input and thermal losses. The value that considers this issue, identified by Italian law, is the shape factor S/V, a ratio between the gross dispersant surface area of a building and its heated volume.
The position of the church inside the urban block influences this ratio. The found relations between the studied churches and the urban fabric provide four possibilities: *isolate plot*, *corner plot*, *head plot* and *landlocked plot*. A corner, header or isolated building will have an outer dispersant surface greater than another which is set in landlocked position. The majority of the churches studied (nine in seventeen) is in landlocked plots; six temples are in corner position, one at the head and one in an isolated plot. In the calculation of surfaces and volumes, we considered the position within the block of the nave of each church and not the entire building complex; in this way, although some churches are located in corner positions, the nave was classified in landlocked position because confined by environments pertaining to the same brotherhood church. Generally, the decrease of shape factor corresponds to a greater compactness of the building, a less dispersant surface and therefore a

reduced heat loss. As well known, the knowledge of S/V is essential for evaluating the energy class; this report, with the same degree-days DD (833 in Catania), defines the limit value of energy performance for winter heating. The current Italian law considers increasing values of the limit value of winter performance with increasing S/V [10].

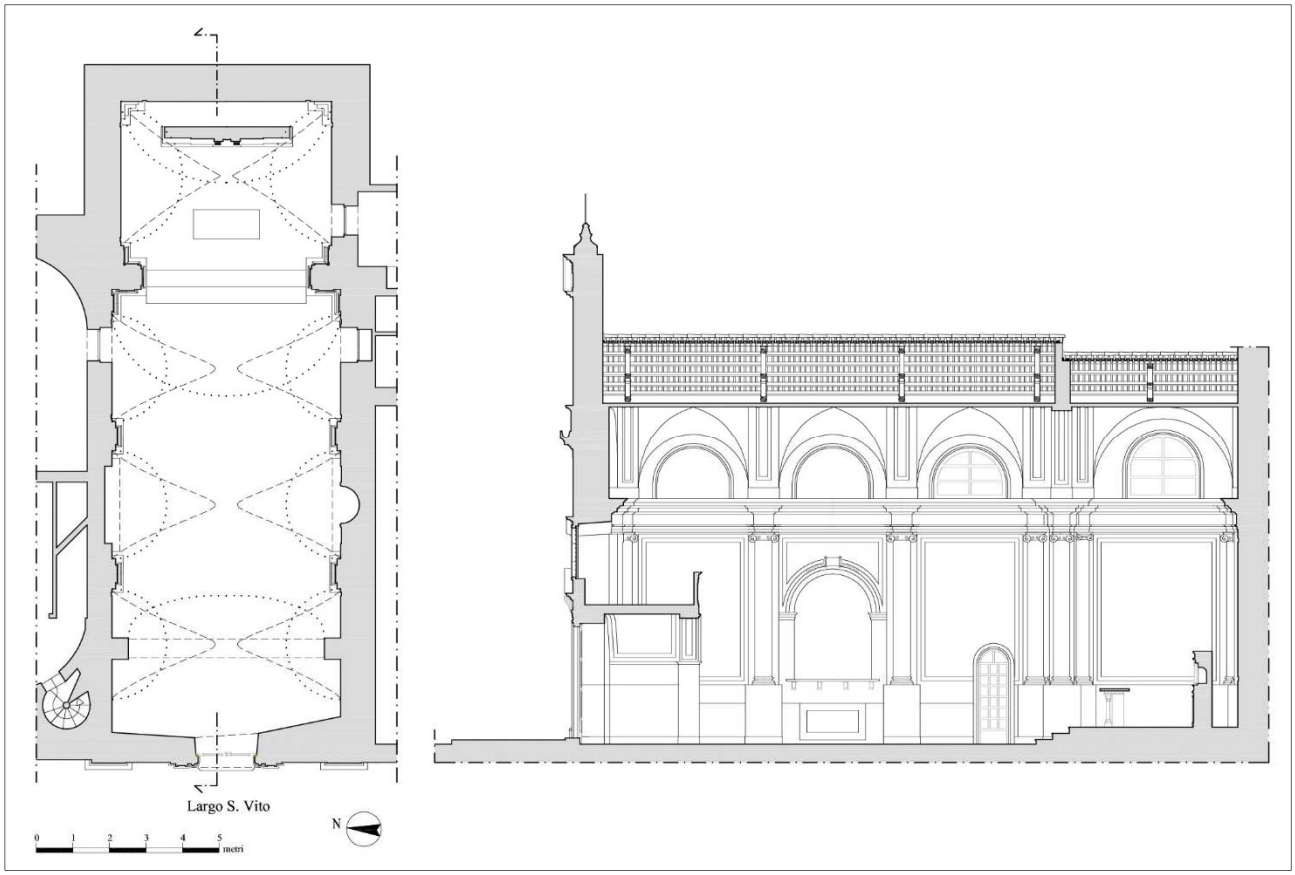

Fig. 3: Plan and longitudinal section of *S. Vito's* church.

Our case study is based on the evaluation of a new possible use that could be compatible and therefore foresee the need to equip the naves with suitable heating systems that are currently absent (see Fig. 3).
In this conjectural case, the calculated values for these historic buildings ranging between 0.28 m^{-1} and 0.58 m^{-1}, in confirmation of the relationships defined in similar studies on the residential buildings of the historic city centre of Catania. The calculated volumes range from 957 m^3 to 4625 m^3.
As an example, we can consider four representative cases, with different volumes and different positions within the block, such as the churches of *SS. Sacramento al Duomo*, *San Sebastiano*, *San Cristoforo Minore* and *San Nicolò al Borgo.*
The church of *SS. Sacramento al Duomo* is a classic example of a landlocked building, marked by a single facade on the street front facing South. The church has a volume amounting to 1485 m^3. The ratio S/V is equal to 0.32 m^{-1}. The church of *San Cristoforo Minore* originally arose in a landlocked lot, but because of the demolition of the district of *San Berillo*, it presents an isolated location in the centre of a square. The building has the main front facing South-West and, with volumes being equal to 1562 m^3, it has a greater dispersant surface and a ratio S/V of 0.47 m^{-1}. *San Nicolò al Borgo* is a building in head position and its main front faces South, while the more extensive side faces to the East. This church reaches a value of S/V of 0.56 m^{-1} thanks to a greater volume amounting to 1940 m^3. *San Sebastiano* is instead located on a corner, with the main front facing East and the side front to the South, and it has a gross volume of 1353 m^3 and an S/V of 0.44 m^{-1} (see Fig.4).

2.3 Geometric analysis: orientation and L/H ratio

The orientation of the buildings is defined in relation to solar radiation, the wind regime and the morphology of the site. It is a pure acquired set of data for the definition of the energy behaviour, because it is an unchangeable parameter to thermal improvement [8].

The survey campaign conducted as part of this research has allowed us to see how the same number of churches are exposed to the East and South (33%), while a small percentage (17%) is exposed respectively to the North and to the west. Therefore, according to the bioclimatic principles, not all examined churches have a good thermal behaviour in terms of exposure.
Many of these buildings, facing East, receive direct light only in the morning, with reduced heat free input in winter and overheating in summer. Better conditions are found in churches with the front facing South. In the winter, sunlight favours large heat free inputs indoors and evaporation of any signs of rising damp in the walls; in the summer, a greater angle of solar incidence allows a lower radiation, especially in the presence of neighbouring buildings that generate shading.
The parameter that takes into account the shading of buildings that are facing depends on the ratio L/H between the size of the road section and the height of the building.
This index allows us to numerically translate the compactness of the urban fabric of the building; the decrease of L/H reduces the value of the size of the road section and increases the shading on the fronts. Anyway, the buildings studied are located in an historic and stratified urban centre and therefore the calculated ratio L/H never reaches the numerical value of the unit (except for those churches that overlook large roads or squares.).
While the residential buildings can be characterised by the strategic presence of many openings on the facades or lack thereof, instead the specialised type of single hall churches is characterised by very closed spaces and tables in which the windows are absent or few in number.
This peculiarity can damage internal ventilation and represent a critical issue if we put it in a system with evaluations of the thermal transmittance that we will discuss in the next section. Unfavourable conditions may occur, for example, if the main front is exposed to the West and the value L/H appears high. This is the case of the church of *San Vito*, which stands in the homonymous square and which has a ratio L/H amounting to 2.39, with the prospect facing West (see Fig.2-3). An exposure like this, the low shading, due to buildings facing, and the lack of circulating air may result in excessive internal heat inputs and overheating of the internal environment during the afternoon hours of the summer.
Through this geometric and typological study, we can provide the first observations about the values of S/V, L/H and orientation. The found values of the shape factor are not very high and are closely related to the location of the buildings within the block. It happens, therefore, that the temples with similar volumes have different values of S/V because the positions occupied in the block are different. An example of this is the case of *Sant'Orsola*'s nave, in a landlocked plot (Heated volume amounting to 1960 m^3, S/V 0,28 m^{-1}) and the above-mentioned church of *San Nicolò al Borgo* , located in the header, with a greater dispersant surface (heated volume amounting to 1940 m^3, S/V = 0.56 m^{-1}).
If we then consider the orientation with equal volume, we can observe that:
- *Sant'Orsola* has lower values of S/V and dispersant surface. This church has a negative exposure to the South-West that should not be underestimated for the risk of overheating in the summer afternoon;
- The advantageous exposure to the South-East of *San Nicolò al Borgo* makes the greater dispersant surface less alarming (see Fig.5).
The churches facing North also have an intrinsic critical issue, due to their orientation, exacerbated in cases where they have a low L/H and they are subject to high shading (like *Santa Caterina's* church).

N	CHURCH
1	*S. Agata al Carcere*
2	*S. Agata alle Sciare*
3	*S. Biagio*
4	*S. Caterina al Rinazzo*
5	*S. Cristoforo Minore*
6	*S. Giuseppe al Transito*
7	*S. Maria dell'Ogninella*
8	*S. Maria della Palma*
9	*S. Martino ai Bianchi*
10	*S. Michele Minore*
11	*S. Nicolò al Borgo*
12	*S. Orsola*
13	*S. Sebastiano*
14	*S. Vito*
15	*SS. Crocifisso Majorana*
16	*SS. Sacramento al Borgo*
17	*SS. Sacramento al Duomo*

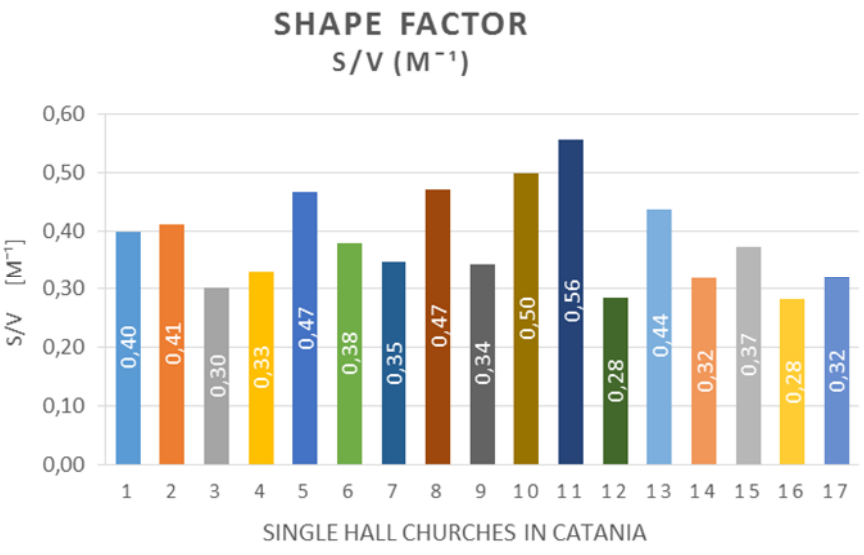

Fig. 4: Shape factor S/V.

2.4 Technical and thermophysical characteristics

After analysing the geometrical and typological aspects, the proposed expeditious method examined technical-constructive and thermophysical characteristics of the *corpus* of churches.

The envelope of each building is a mediation element between the thermo-hygrometric characteristics of the external environment and the characteristics of the inner one at different temperatures [2]; its technological and thermophysical qualities affect the regulation of heat flows in and out. The aspects to be further analysed concern especially opaque vertical envelopes and horizontal envelopes: historical specialised buildings such as the churches are also no exception.

The surface of opaque vertical envelopes are most affected by thermal exchanges between the inside and the outside; in this case, the opaque vertical envelope is formed by a masonry built with basalt blocks placed on mortar beds of lime and volcanic aggregates like *azolo* or *ghiara* (materials easily available in the Etna area) [7].

In our investigation, we recognised and classified the following two types of recurring masonry:

CVO.1: Masonry in shapeless basalt blocks with shattered stone and bricks;

CVO.2: Masonry blocks of roughly squared basalt, appropriately arranged to obtain good toothing between the different vertical facings that form the envelope.

The overall thickness of these vertical load-bearing structures ranges from 60 to 150 cm. The masonry of the external envelope of the most studied churches is treated with a traditional plaster in several layers. The local solution provides layers made by a traditional type of mortar based on lime and *ghiara* and another layer of plaster with different types of aggregates, according to the colouring to obtain (*azolo*, *ghiara* or limestone's dust). When, instead, these buildings were affected by spontaneous interventions of maintenance or refurbishment, we can find modern plasters based on cement mortar. The temples belonging instead to richer brotherhoods have a coating of faces with an elaborate brickwork formed by stone slabs and blocks in tender or compact limestone.

Just as in the other historic buildings of the area, even in these cases the brickwork of the stone facade includes several architectural elements such as base of basalt blocks, *parasta* or *lesena* in blocks or slabs of limestone, and the cornice or the trabeation with a frame in blocks of limestone.

In churches examined, the transparent vertical envelope is represented by the windows of the few openings in the front. All considered sacred buildings have a central window above the entrance door on the main front and some windows on the walls of the nave.

The front door is usually made of wood, without the fixed frame, with the shutters connected to the masonry through hinges or with motion system balance.

The windows are made with only fixed frames in wood or iron and they have simple glass interrupted by strips of wood or brass rods.

For the horizontal envelope, we classified the technological solutions encountered in:

CO.1: concrete vault;

CO.2: vault in barrel and gypsum;

CO.3: plate of reinforced concrete;

CO.4: brick-cement floor.

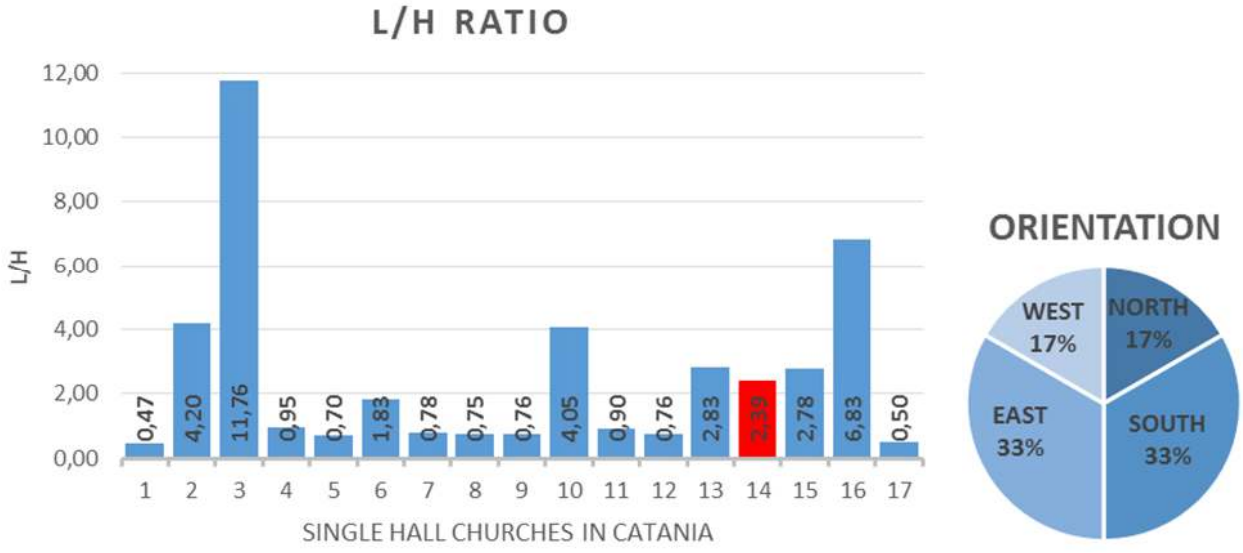

Fig. 5: L/H ratio and Orientation.

Specifically, a considerable number of concrete vaults in pumice stone and gypsum mortar was found, with a thickness varying from 18 to 50 cm; seven naves are topped with vaults made of a wooden frame that support reed mats on which spanned a layer of gypsum mortar [7] with an overall thickness of approximately 5 cm. The roofs of the churches are pitched and there are gable or pavilion roofs. Sicilian tiles always form the discontinuous surface of the roof. The main structure used in these roofs follows a constructive procedure to purlins on trusses. In many cases, in correspondence with the second roof frame the presence of a wooden plank and/or corrugated metal under-tile is also found. We therefore decided that the purpose of this research is to bring out these differences distinguishing the different solutions:
CC.1: Roof coating with wooden plank;
CC.2: Roof coating without wooden plank;
CC.3: Roof coating without wooden plank and with corrugated metal under-tile;
CC.4: Roof coating without wooden plank and without corrugated metal under-tile.
Only the churches of *Sant'Agata alle Sciare* and the church of *Santa Caterina al Rinazzo* have a flat roof to terrace, formed respectively by a brick-cement floor and by a plate of reinforced concrete.
As already mentioned, with regard to the thermophysical charactersistics of the building components, we proceeded to the rapid assessment of the U transmittances of the envelopes, expressed in W/m^{2}K, in steady state.
For this purpose, starting from already conducted studies for the historic residential buildings [2], we assumed the following values of thermal conductivity:
- volcanic stone: 1,70 W/mK
- limestone: 0,70 W/mK
- lime plaster: 0,70 W/mK
- gypsum plaster: 0,70 W/mK
- plaster in lime mortar, limestone aggregate and coloured pigments: 0,70 W/mK
- casting of lime and pumice: 0,75 W/mK
- mat of reeds: 0,06 W/mK

For the evaluation of the transmittance of the horizontal base envelope (COB), proceeding with an expeditious approach, we assumed that in all buildings there was a system designed according to traditional building methods, involving a loose stone foundation, cement screed, bitumen, laying bed flooring and marble tiles.
This stratigraphic package would respect the maximum limits of imposed U transmittance (0.49 W/m^{2}K) amounting to 0.39 W/m^{2}K. The values of the transmittance of the opaque vertical envelope are predictably high and much higher than the limit prescribed by the Italian law for the climate zone B, 0.48 W/m^{2}K [10]. This means that the thermal insulation properties of the masonry of the studied churches is insufficient and worsens when increasing the U transmittance and decreasing thickness. The range of U varies at about 0.79 W/m^{2}K, with a wall thickness of about 1.60 m, and 1.55 W/m^{2}K with a thickness of 0.60 m (see Fig.6).
However, we do not think that thicker walls ensure a better thermal insulation because, as already verified in the literature [2], in the calculation of U, a simulation in steady state is presupposed and in the subsequent phases of this research we could extend the dynamic behaviour. As in the residential historic buildings of the area, both in summer and winter, we will find the best thermal behaviour in envelopes with thicknesses near the minimum value found here (0.60 m). Even the horizontal envelopes have values of transmittance far above the maximum limit of 0.38 W/m^{2}K, expected in climate zone B.
For the concrete vaults, we found values of U between 1.20 W/m^{2}K and 2.30 W/m^{2}K according to the thickness of the vault, while the transmittance always establishes 1.67 W/m^{2}K for the vault in barrel and gypsum (see Fig.7).
The transmittance of the roof coating is closely related to the presence or the absence of the wooden plank and corrugated metal under-tile. The most critical are found in six churches in which there is the wooden plank, with U of about 6 W/m^{2}K; the presence of the plank halves U bringing 2.44 W/m^{2}K, value anyway very far from the maximum limit for horizontal or inclined envelopes (0.38 W/m^{2}K) (see Fig.8).
With transmittances in many cases even four times larger than the allowed limit, the systems of horizontal coverage appear to be the most critical components of the envelope of the buildings. If we put into play the reports form S/V and U, we can highlight cases where we have the greatest problems. The high values of transmittance in all the churches considered become more troubling when we find more dispersant surfaces and therefore higher values of shape factor S/V, regardless of the more or less favourable exposure. All churches with a high shape factor S/V (greater than 0.35 m^{-1}) have in fact worse thermal insulation properties with considerable transmittance values in all components of the enclosure (CVO + CO + CC).

3. Considerations

In summary, the proposed expeditious survey found that the single hall churches of the historic centre of Catania present a gross dispersant surface and a generally not high shape factor S/V, with an average volume of 2100 m^3. The location of the nave inside the block is affected by urban geometrical data of thermal dispersion, with equal volume, swinging S/V between 0.30 m^{-1} and 0.55 m^{-1}, except for a few cases.

The orientation and the calculation of the ratio L/H allow us then to detect the cases in which the presence or absence of shading is advantageous for the dispersing surface of each building.
In general, we can say that the values of L/H are frequently low, except in churches overlooking squares or plazas, and we find neither an excessive sunlight exposure in buildings to the South, East or West, nor large shading in buildings exposed to North. The main elements of the building have values of transmittance above the national limit value. To facilitate the comparison of all collected data, we calculated the weighted average of the transmittance of the opaque vertical envelope and horizontal envelope to have a unique value to be compared with other thermophysical quantities (S/V and L/H).
This comparison showed the critical issues related to exposure, shading and surface dispersant of some churches such as the churches of *San Sebastiano* and of *SS. Crocifisso Majorana* (see Fig.9).
In this first analysis, the systematising of all these aspects, however, highlighted the lack of a critical issue in absolute terms, because, as seen in the previous sections, the mutual influence of the different parameters taken into consideration often leads to apparently compensatory conditions.
We can speak of compensation in appearance only because the preliminary evaluation here described is based on the simplifying assumption of steady state and the relative primary energy demand in the dynamic state has not been calculated yet.

N	CHURCH	CVO TYPE
1	*S. Agata al Carcere*	CVO.2
2	*S. Agata alle Sciare*	CVO.1
3	*S. Biagio*	CVO.2
4	*S. Caterina al Rinazzo*	CVO.1
5	*S. Cristoforo Minore*	CVO.1
6	*S. Giuseppe al Transito*	CVO.2
7	*S. Maria dell'Ogninella*	CVO.2
8	*S. Maria della Palma*	CVO.2
9	*S. Martino ai Bianchi*	CVO.1
10	*S. Michele Minore*	CVO.2
11	*S. Nicolò al Borgo*	CVO.2
12	*S. Orsola*	CVO.1
13	*S. Sebastiano*	CVO.1
14	*S. Vito*	CVO.1
15	*SS. Crocifisso Majorana*	CVO.1
16	*SS. Sacramento al Borgo*	CVO.1
17	*SS. Sacramento al Duomo*	CVO.2

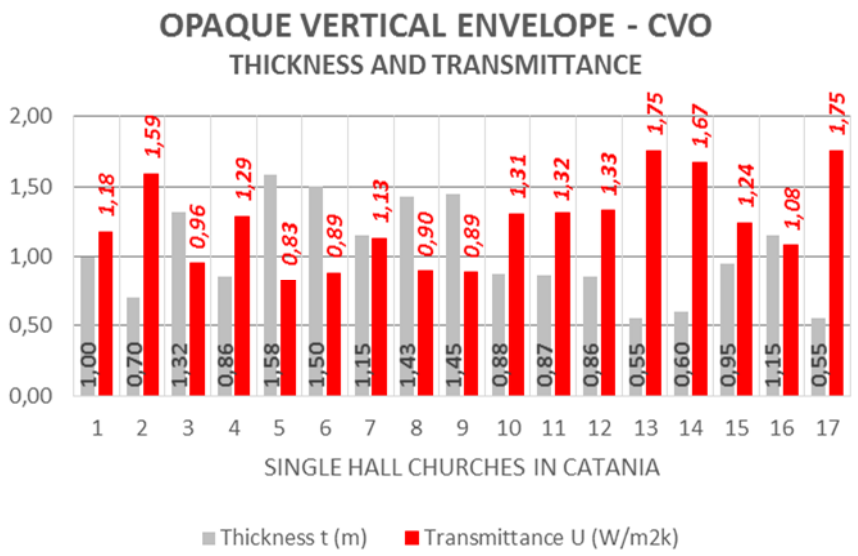

Fig. 6: Thickness and transmittance of the opaque vertical envelope (CVO).

N	CHURCH	CO TYPE
1	*S. Agata al Carcere*	CO.1
2	*S. Agata alle Sciare*	CO.4
3	*S. Biagio*	CO.1
4	*S. Caterina al Rinazzo*	CO.3
5	*S. Cristoforo Minore*	CO.1
6	*S. Giuseppe al Transito*	CO.2
7	*S. Maria dell'Ogninella*	CO.1
8	*S. Maria della Palma*	CO.2
9	*S. Martino ai Bianchi*	CO.2
10	*S. Michele Minore*	CO.2
11	*S. Nicolò al Borgo*	CO.1
12	*S. Orsola*	CO.2
13	*S. Sebastiano*	CO.1
14	*S. Vito*	CO.2
15	*SS. Crocifisso Majorana*	CO.1
16	*SS. Sacramento al Borgo*	CO.1
17	*SS. Sacramento al Duomo*	CO.2

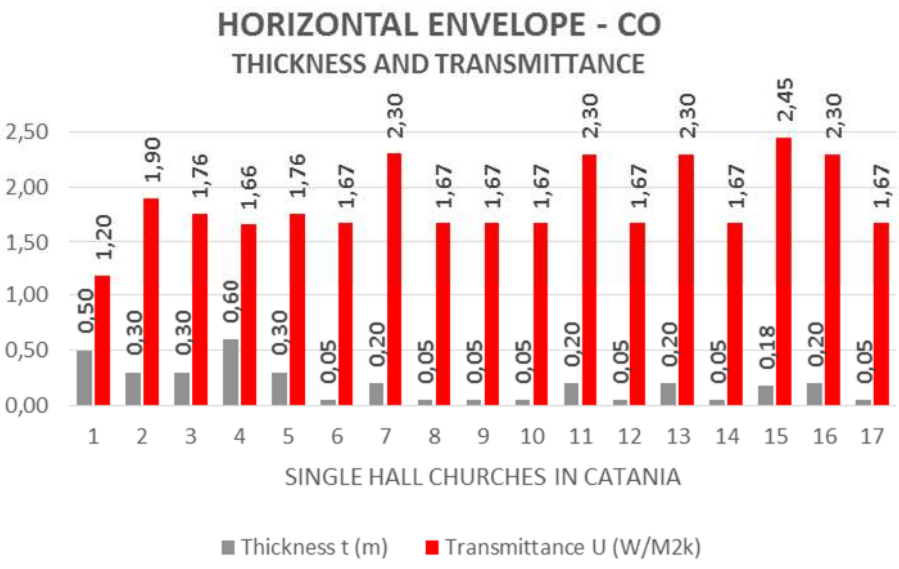

Fig. 7: Thickness and transmittance of the horizontal envelope (CO).

N	CHURCH	CC TYPE
1	*S. Agata al Carcere*	CC.1
2	*S. Agata alle Sciare*	CO.4
3	*S. Biagio*	CC.2
4	*S. Caterina al Rinazzo*	CO.3
5	*S. Cristoforo Minore*	CC.1
6	*S. Giuseppe al Transito*	CC.1
7	*S. Maria dell'Ogninella*	CC.1
8	*S. Maria della Palma*	CC.3
9	*S. Martino ai Bianchi*	CC.1
10	*S. Michele Minore*	CC.1
11	*S. Nicolò al Borgo*	CC.1
12	*S. Orsola*	CC.2
13	*S. Sebastiano*	CC.1
14	*S. Vito*	CC.1
15	*SS. Crocifisso Majorana*	CC.2
16	*SS. Sacramento al Borgo*	CC.2
17	*SS. Sacramento al Duomo*	CC.2

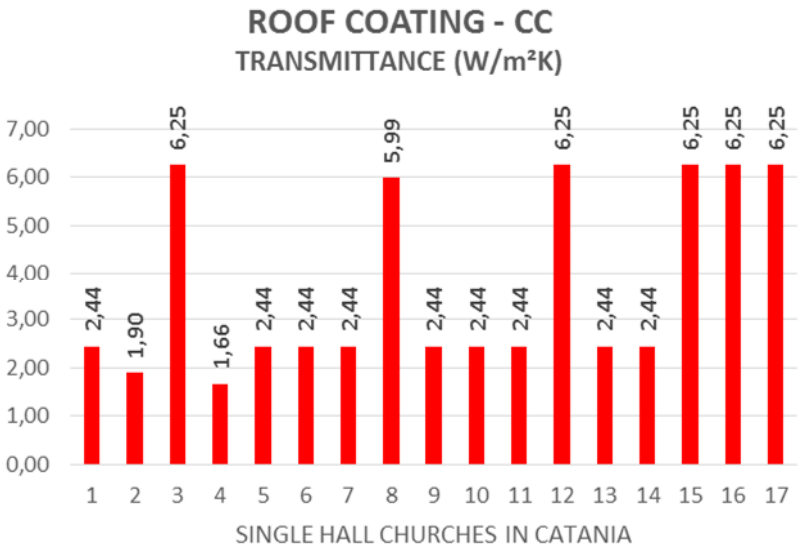

Fig. 8: Transmittance of the roof (CC).

With the aim of the design of energy refurbishment of these buildings of high-recognised cultural instance, the location of the single church and its volume makes the parameters S/V and L/H unchangeable. It is certainly more incisive to focus the redevelopment on improvement of the performance of the transmittance of the outer envelope.
This research has allowed us to face an obvious difficulty of homologation and seriality of the reflections about the sustainability of historic built. Having assumed the existence of heating in the halls of the churches is a significant assumption underlying the subsequent reflections about the shape factor and the other thermophysical quantities. In other geographical areas, especially in Northern Europe or in the US, this premise is not a hypothesis but a recurring practice. Besides, if these buildings keep their original function, the current demands of comfort will make the hypothesis conditioning indispensable, more so if we imagine a different intended use in connection with a public fruition.
The proposed expeditious survey does not seek to be exhaustive for the environmental problems of the single historic building, but it meant to represent the necessary incipit for the definition of a decision-programme of refurbishment intervention on a large scale. In this way, for the desirable rehabilitation activities applied to these often forgotten monuments, we can concentrate resources where the most critical issues were found.

N	CHURCH	Orientation	Plot	V [m³]	S/V [m⁻¹]	L/H			COB - CVO - CO
						Lp/Hp	Llt/Hlt	Lr/Hr	Um [W/m²K]
1	*S. Agata al Carcere*	Est	Landlocked	1346	0,40	0,47	-	-	1,43
2	*S. Agata alle Sciare*	Sud	Corner	957	0,41	4,20	0,24	-	0,95
3	*S. Biagio*	Est	Landlocked	3696	0,30	11,76	-	-	1,12
4	*S. Caterina al Rinazzo*	Nord	Corner	2452	0,33	0,95	0,33	-	1,13
5	*S. Cristoforo Minore*	Sud - Ovest	Isolate	1562	0,47	0,70	2,39	-	0,91
6	*S. Giuseppe al Transito*	Est	Landlocked	2759	0,38	1,83	-	-	1,04
7	*S. Maria dell'Ogninella*	Sud-Est	Corner	4625	0,35	0,78	0,40	-	1,30
8	*S. Maria della Palma*	Sud	Corner	1227	0,47	0,75	0,49	-	0,97
9	*S. Martino ai Bianchi*	Nord	Landlocked	2890	0,34	0,76	-	-	1,03
10	*S. Michele Minore*	Sud	Corner	1287	0,50	4,05	0,56	-	1,18
11	*S. Nicolò al Borgo*	Sud - Est	Head	1941	0,56	0,90	1,30	0,27	1,44
12	*S. Orsola*	Sud - Ovest	Landlocked	1960	0,28	0,76	-	-	1,18
13	*S. Sebastiano*	Est	Corner	1353	0,44	2,83	6,88	-	1,60
14	*S. Vito*	Ovest	Landlocked	1017	0,32	2,39	-	-	1,24
15	*SS. Crocifisso Majorana*	Sud	Landlocked	1819	0,37	2,78	-	-	1,58
16	*SS. Sacramento al Borgo*	Nord	Landlocked	3425	0,28	6,83	-	-	1,30
17	*SS. Sacramento al Duomo*	Sud	Landlocked	1486	0,32	0,50	-	-	1,33

Fig. 9: Summary table of the collected results through the expeditious method.

Bibliographical References

[1] LOMBARDINI Nora, CASPANI Sara, *Sostenibilità come ottimizzazione del progetto di conservazione*, in BISCONTI G., DRIUSSI G. *Quale sostenibilità per il restauro? Atti del Convegno di Studi, Bressanone 1-4 July 2014*, Edizioni Arcadia Ricerche, Venice, 2014, ISBN 978-88-95409-18-4, p. 3-11.

[2] MOSCHELLA, Angela. *Il costruito storico nell'epoca della responsabilità ambientale. Riflessioni sulla riqualificazione energetica.* 1ª ed. Acireale: Bonanno Editore, 2013. 133 p. Series: Architettura, paesaggio, città, territorio. ISBN 978-88-96950-69-2.

[3] FRANCO Giovanna, *Sostenibilità e patrimonio storico: da un caso studio, nuovi orizzonti di ricerca,* in *Techne* 8, Florence, 2014, ISSN 2239-0243 (online).

[4] PICONE Renata, MARTONE Concetta, BRANCACCIO Francesca, BRANCACCIO Ugo, BOREA Serena, CERMOLA Melania, DI BENEDETTO Stefano, DI GUIDA Marina, FALCONE Laura, VENDEMMIA Bruna, *Sostenibilità e restauro: Il centro storico e il Castello baronale di Acerra (Napoli)*, in BISCONTI G., DRIUSSI G. *Quale sostenibilità per il restauro? Atti del Convegno di Studi, Bressanone 1-4 July 2014*, Edizioni Arcadia Ricerche, Venice, 2014, ISBN 978-88-95409-18-4, p.421-431.

[5] TOSONE Alessandra, *Governing of the sustainability on historic build heritage of L'Aquila. Practice and application areas of the reconstruction phase*, in *IN_BO. Ricerche e progetti per il territorio la città e l'architettura*, Vol. 3, n. 5, - *Conservazione vs Innovazione*, edited by GULLI Riccardo, Bologna, 2012, ISSN 2036-1602 (online).

[6] CASTAGNETO Francesca, VITALE Maria Rosaria, *Compatible and sustainable procedures for the "energy qualification" of historic buildings. The case study of Marignane's historic centre*, in BISCONTI G., DRIUSSI G. *Quale sostenibilità per il restauro? Atti del Convegno di Studi, Bressanone 1-4 July 2014*, Edizioni Arcadia Ricerche, Venice, 2014, ISBN 978-88-95409-18-4, p. 855-865.

[7] SALEMI Angelo, PATANIA Francesco, CASCONE Santi, GAGLIANO Antonio, LO FARO Alessandro, LOMBARDO Grazia, MOSCHELLA Angela, Vincenzo SAPIENZA, *Thermal performance of existing buildings in Mediterranean climate area*, in URAL O., PIZZI E., CROCE S. *Proceedings of* 39th IAHS: *Changing needs, adaptive buildings, smart cities*, vol. 1, POLIScript, Milan, 2014, ISBN 9788864930138, p. 1017-1024.

[8] KEOMA Ambrogio, ZUPPIROLI Marco. *Energia e restauro. Il miglioramento dell'efficienza energetica in sistemi aggregati di edilizia pre-industriale tra istanze conservative e prestazionali.* 1ª ed. Milan: Franco Angeli, 2013. 352 p. Series: Ricerche di tecnologia dell'architettura. ISBN 978-88-20433-30-7.

[9] LUCCHI Elena, PRACCHI Valeria. *Efficienza energetica e patrimonio costruito. La sfida del miglioramento delle prestazioni nell'edilizia storica.* 1ª ed. Santarcangelo di Romagna: Maggioli Editore, 2013. 336 p. ISBN 988-88-387-6260-4.

[10] L D. n.311/2006, *Disposizioni correttive ed integrative al Decreto Legislativo 19 August 2005 n. 192, recante attuazione della direttiva 2002/91/CE relativa al rendimento energetico in edilizia.*

HERITAGE and TECHNOLOGY
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Unveiling a heritage through digital enlightenment: the Lisbon Royal Opera House of Tagus

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Abstract
The Lisbon Royal Opera House of Tagus is referred as one of the most beautiful, sumptuous and luxurious Italian opera houses of the eighteenth century. Inaugurated on March 31st, 1755, had the misfortune of being destroyed by the Lisbon Earthquake (November 1st, 1755). Even though this ephemeral existence of seven months, it has remained in the collective memory of Lisbon as a major cultural heritage, and it is considered as one of the great theatres ever created by the Galli Bibiena family. Since it was published in 1757, the only known iconography as really representative of this theatre was an engraving by J. P. Le Bas (1707-1783), in which he incise the ruins of this opera house.
Over the last decade we have realize a wide range of analyzes and studies in order to minimize the loss that represented this cultural heritage. That is, to reconstruction digitally this building, as it was the day of its inauguration, or alternatively, as was envisioned by the architect.
Thus, we aim to promote discussion our methodological approach and the latest results, essentially because this methodology is a work in progress included in a main research project, which implies a demand for complementary analyzes in order to rebuild the opera house.
Finally, we also intend to demonstrate the importance of the digital tools applied (from vectorial to generative drawing) in the enlightenment and definition of new strategies in the analytical process and in the end result, in order to fulfil the unveiling and emerge of this heritage.

Keywords: Digital Tools, Methodology, Cultural Heritage, Lisbon Royal Opera House of Tagus

1. Introduction
The present paper is part a wider result of researches, carried out over the last decade, in particular regarding the Lisbon Royal Opera House of Tagus and its architect, Giovanni Carlo Galli Bibiena Sicinio. And it is also part of the I&D Research Project entitled “The Lisbon Royal Opera House of Tagus Project: Reconstruction of the Lost Memories of a European Cultural Heritage”, witch aim to analyze the two projects attributed to the Tagus Opera House on the scopes of: iconography; dimensional, morphology, structural, constructive, architectonic, decorative, stage set design, stage set machinery, as well as operatic, according them on their cultural, political, social and historical context, in order to elaborate a representative model of what could be this building, as it was the day of its inauguration, or alternatively, as it was envisioned by its architect.

2. Unveiling the Lisbon Royal Opera House of Tagus
In 1750, after a long agony, dies King John V of Portugal (1707-1750), coming to an end his particular cultural policy envision. In May 1743, the monarch is stricken by a hemiplegia, which led him to order the elaboration of a series of successive restrictions to all types of entertainment, either in court or in theatres. Even forbidding the performance of particular balls. However an exception was created to this rule: only the liturgical ceremonies where legally permitted throughout this period [1].
This restrictions, have generated the desire for transformation, Joseph I of Portugal (1750-1777) will grab this opportunity to materialize this reform. This aspiration was also shared by many of his court, by the

foreign merchants living in Lisbon and by the Theatrical entrepreneurs. With this cultural metamorphosis, the new monarch aimed to placed his court into the great European circuit of operatic representations, and at the same time disassociated himself from its father cultural envision legacy.
Driven by the richness brought in by the gold of Brazil, the new king will not impose himself no limits on expenses in hiring the best artists in order to put together a world-class company. And to build for the first time ever in Portugal, a court theatre, design to receive the Italian opera, and its entire technological and artistic apparatus, which this buildings and representations where associated with. Consequently, with the arrival in Lisbon of Giovanni Carlo Sicinio Galli Bibiena (1717-1760) and his team of Italian architects and stage set designers, the king gave direct orders, to build not one but three theatres in the space between February 1752 and March 1755 [2].

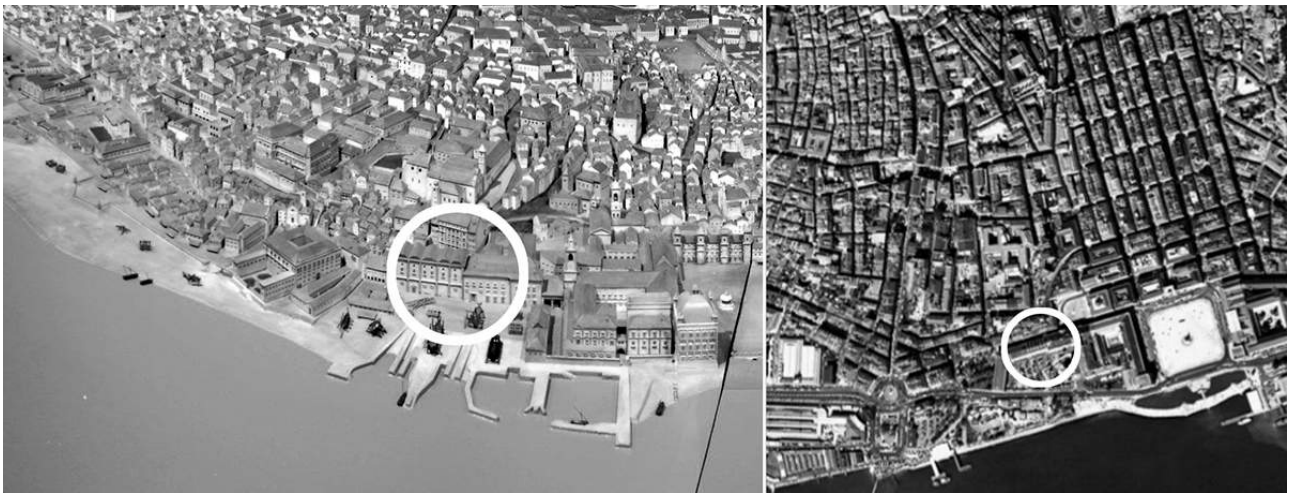

Fig. 1: On the Left signalling the Royal Opera House of Tagus on the pre-earthquake city scale model, City Museum, Lisbon; On the Right a Colour Orthophotomap in TIFF format, signalling the Royal Opera House of Tagus contemporaneous location. Projective system: Hayford-Gauss; Planimetric Datum: Datum Lisbon; Datum altimeter: Cascais tide gauge; Ellipsoid: International. University of Lisbon, Faculty of Architecture, Cartography, N.º F4310410.

The different descriptions claim that the Tagus Opera House, was orientated: on the South, in parallel with the riverbanks; on the East, in the continuation of royal palace of Ribeira; on the West, by the circus ring of the Infantado House and by the Corte-Real Palace; and finally, on the North, by the “Rua Directa dos Cobertos” or “Rua do Arco dos Cobertos”. The opera house stretches up for over 119.768m (108 “varas”, 4 “palmos” and $^{4}/_{10}$). This dimension was confirm by us in 2008, due to a discovery of a plan dated from 1759, where it is represent the city prior to the earthquake and the new city to be build. Due to a graphic scale inscription, it was possible to establish the full dimension of the Theatre, and also confirm the measurements made during the after quake survey of the city (Tombo de Lisboa, 1758). This document also clearly enabled the observation of the theatre deployment in the urban grid. [3]
The construction of the Tagus Opera House began in March 1752, and its construction lasted about three years. On March 31st, 1755, was inaugurated on the occasion of the Queen Mariana Victoria birthday. The piece chosen for the premiere was the opera *Alessandro nell'Indie*, with music by David Perez and lyrics by Pietro Metastassio. Were part of the cast Gaetano Majorano (*il Cafarello*), Domenico Luciani, Giuseppe Gallieni, Giovanni Simone Ciucci, Gioseppe Morelli and Carlo Reina. On June 6th, 1755, at the King's birthday, was represented *La Clemenza di Tito*, and on October 16th, 1755, *Antígono*. Both operas, with music by the Bolognese Antonio Mazzoni and lyrics by Pietro Metastassio. The theater had a bell-shaped form, characteristic element of the opera houses of the Galli Bibiena. It had a capacity of about 600 spectators, 350 seats in the pit and the remaining divided by 38 individual boxes, arranged in 4 orders [4]. The interior was built in wood and plaster and ornamented in white, gold and in gilded bronzes. The various references to the theatre are unanimous in the exaltation of its decorative splendour and the brilliance of the first night, confirmed by the reports of Chevalier Charles-Christian des Courtils [5] and Gerard des Vismes:

> “But the new theatre of his Portuguese Majesty, which was opened on the Queen’s birthday, March 31st, 1755, surpassed, in magnitude and decorations, all the modern times can boast. On this occasion Perez new fet the opera of Alessandro nell’Indie, in which opera a troop of horse appeared on the satge, with a macedonian phalanx. One of the King’s riding-masters rode Bucephalus, to a march which Perez composed in the Manege, to the grand pas of a

beautiful horse; the whole far exceeding all that Farinelli had attempted to introduce in a grand theatre under his direction at Madrid, for the fitting out of which he had unlimited powers. Besides these splendid durations, his Portuguese Majesty had assembled together the greatest singers then existing (x); so that the lyric productions of Perez had every advantage which a most captivating and perfect execution could give them." [6]

Finally, everything would abruptly end with the earthquake of November 1st, 1755, the Great Lisbon Earthquake. After several seismic shocks that compromised the structure, the theatre was also victim of the subsequent tidal wave and decisively it was consumed by one of the many fires that spread throughout Lisbon. The Opera House is nothing more than an ephemeral memory, a ruin perpetuated in the Jacques Philippe Le Bas engraving. [7]



Fig. 2: LE BLAS, Jacques Philipe (1707-1783), Engraving, 1757. PEDEGACHE, Manuel Tibério (1730?-1794). Drawing. 1755-57. PARIS, M. M.. Drawing, 1755-57. Etching on white paper. Dim.: 560x400mm. Portuguese National Library in Lisbon (Biblioteca Nacional), *Iconografía*, E.A. 352 A, n.º4.

After the earthquake of November 1st (1755) the theatre was never reconstructed. Such fact will have had, very possibly, to do with the mercantile transformation of society, or within the framework of the Enlightenment, or even in the scope of a gradual socio-cultural and economic reform. Which also involved the privates and the strongest corporations, to participate in the effort of the city reconstruction. [8]

With the disappearance of the Tagus Opera House several authors had emphasized the relevance of this building in the Portuguese cultural and architectonic panorama. António de Sousa Bastos, in his collection on the Portuguese theatres, claims "there was no opera house in the whole Europe with such dimensions and so fabulous wealth (…) colossal work (…) it had no rival in the whole world (…)" [9]. Therefore, it was natural when José de Figueiredo, in 1933, discovered two drawings belonging to a set of six (along with a folio with the respective legends) he had had present them as illustrative of the Lisbon Royal Opera House of Tagus had been actually built some 177 years ago. Thus, according to himself, we were going to dispose from that moment on of a "(…) direct evidence for the assessment of a building that had been so praised in

his time and of which the eminent historian of Lisbon, Mr. Matos Sequeira, wrote (…) «I did not know of the existence of any true iconographic document ».” [10]

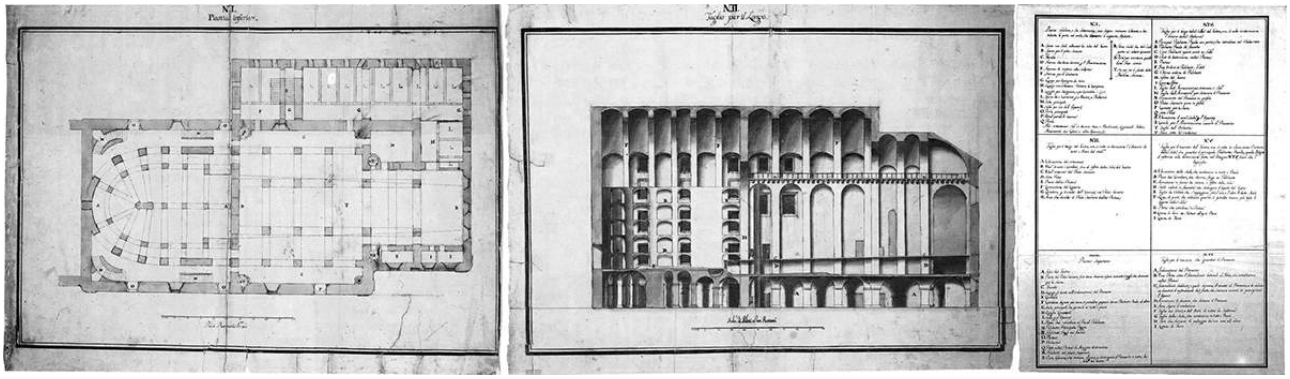

Fig. 3: GALLI BIBIENA, Giovanni Carlo Sicinio (attributed to), 1752-1755. On the **left**: Structural view of the ground floor plan; at the **center**: Opera house longitudinal section, unveiling its structure; **right**: Capitation folio. Fine Arts National Academy (Academia Nacional de Belas-Artes - ANBA.Lx), Lisbon, *Reservados*, unidentified folder.

However, from that moment on cast doubt on whether the documents could actually match the project built. One of the major researchers to substantiate this view was Augusto Vieira da Silva, who, after having reduced the plans assigned by Figueiredo to the scale of the city plan, in order to superimpose them, noted and reaffirmed that these drawings were not those relating to the project built. To this end, he stated its conclusions on three major premises:

> “1st – The measurement of the northern facade of the theatre appearing in Tombo de 1755, from the Beco da Fundição (Smelter Alley) up to Porta dos Armazéns (Warehouses Door), is 119.76 meters, while the length of the corresponding facade in the drawings, measured according to the graphical scale, is 67 meters;
> 2nd – There are several topographic maps [of the city of Lisbon] where the theatre is drawn, [nevertheless] on the [Lisbon] surveyed after the 1755 earthquake, all this [opera foot prints] differ from [one another] project. Therefore, it is not possible, to reduce them to the same scale, and superimpose them completely to the theatre project. Nowhere in the city plans we [were able] to find the south body wing [of the opera house], corresponding to the dressing rooms area, as shown on the ground floor or basement of the [Figueiredo] project;
> 3rd – A description of the theatre that is conserved says that the theatre facade corner divided the audience from the stage. In the project we [are able to] see, however, that the arch of the proscenium stood to far away, about 22 meters, to the east of that corner."[11]

3. Digital Enlightenment: Evocation versus Reconstruction

Despite the bipartition of views regarding the drawings attributed by Figueiredo in 1933, till the year of 2008 they were always taken to be the only iconographic documents relating to the project of the Opera House, or of a project for it.

All the studies, that we had knowledge of, carried out between 1938 and 2005 on the Tagus Opera House, they always focused on a direct or indirect analysis of the drawings and the captions, and under any circumstances did not present a three-dimensional proposal. With the exceptions of the "possible virtual evocation", made by Alexandra Gago da Câmara [12], and the "possible space reconstitution" of Aline Gallasch-Hall [13], which have showed a three-dimensional interpretations, during the ephemerid event of the 250th anniversary of the 1755 earthquake.

The first of such studies have been the one Silvana Moreira, under the supervision of Alexandra Gago da Câmara, tried to do through a virtual model of the Tagus Opera, based on José de Figueiredo attributed drawings and whose objective was "(...) to evoke this space with the help of new computer graphics technology, investing in three-dimensional recreation of the building in dynamic virtual reality". This study also aimed to rebuild the opera house, its ambience and its materiality, simultaneously displaying how it could have been the representation of a stage set at the opera, according to Gago da Câmara´s envision [14]. Also in this context, the architect Francisco Brandão, held in collaboration with Aline Gallasch-Hall, a model that aspired to try "to understand the organic space" and wonder what could have been its inner ambience, not showing however any visions of its exterior [15]. However this recreation was possible,

through inspiration taken from the drawings attributed by Figueiredo and also by an interpretation of certain sketches from Ferdinando Bibiena (Giovanni Carlo Sicinio´s uncle). Which led to a set of proposals on what might have been the Opera House and its interior decor according to Brandão and Hall.
In spite of all the good intentions that both studies claim to have, we think that it is important to emphasize the difference between Evoke and Rebuilding. Etymologically it derives from the Latin word evocare. And it is defined in dictionaries as a synonym for "play in the imagination" or "by imagination" [16]. In this sense, liberty is granted to authors to evoke the memory of the Tagus Opera, and also to use their narratives, as a rule to their imagination or imagery to fill the gaps of information. Originating thus a final construction, which results from the merger of factual reality and poetic imagination or the imagery culture of its creator. What may often result in the creating or perpetuating of legends or myths? Or even promotion knowledge or an illustration that thanks to all the means engaged in its diffusion will be recognized by the less well informed as an absolute and ultimate truth.
In both cases the evocations of how the building could have been, never pored nor criticized the handled drawings incongruence's, nor took into account the real measurements. Its authors preferred to taking them for real evoking the drawings under a creative and free way in order to obtain a three-dimensional model in a virtual environment only for illustrative purposes and also to widespread dissemination. And whenever you are faced with omissions of information, these are fulfilled without any obvious justification, particularly in the case of Silvana and Gago da Câmara, but also in the Brandão and Gallasch-Hall.



Fig. 4 External and Interior views of the evocation model proposed by Alexandra Gago da Câmara and her team for the Lisbon Royal Opera House of Tagus. On the left a first model from 2005, on the centre and right, a model from 2012-14.

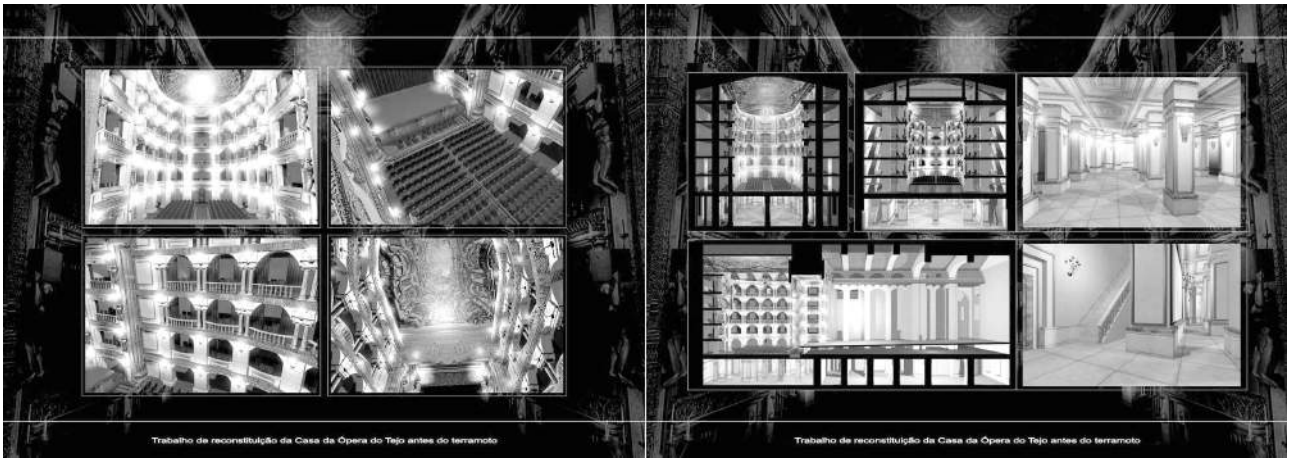

Fig. 5 Internal views of the Lisbon Royal Opera House according to the vision of Francisco Brandão and Aline Gallasch-Hall, 2005. Web: http://arquitectobrandao.wix.com/portfolio#!__2005.

In contrast, the concept of Reconstruct, is intended to mean to build by the same means or by analogues means. As is in the case of the Tagus Opera House, or as in any already disappeared building. And it stands for "(...) The action or process of reconstructing or being reconstructed; "(...) A thing that has been rebuilt after being damaged or destroyed" [17]. However, the concept can be used either in a physical, or in a symbolic sense. When used in the physical sense, refers to the specific tasks of restoration or renovation of a certain building, given its condition. When used in the symbolic sense, the reconstruction idea is associated with the recovery of a value or something that no longer exists materially, for any reason. [18]

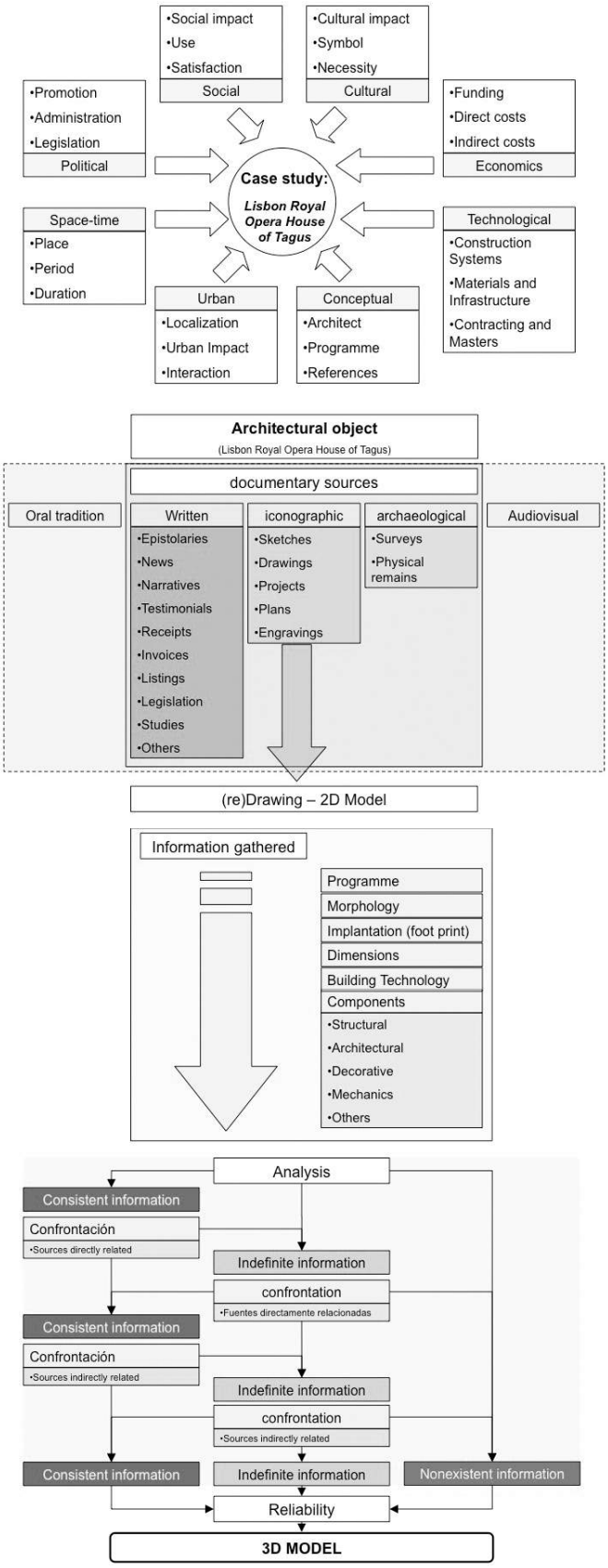

Fig. 6 Methodological approach to the reconstruction of architectural objects lost in time and in memory.

4. Methodology approach

Undoubtedly the ephemeral was always associated with the royal Opera House of Tagus. In fact, its short existence has not left us more than it's engraving of the ruin following the Lisbon earthquake. Although the theatre has continued in the collective memory of the city, its physical existence (apparent) has disappeared. Ephemeral existence we have taken into account as an important assumption.

Another assumption was that of a building (an architectural object) as the Tagus Opera does not arise by itself, but rather by a set of factors that have converged to its creation, the product of the spirit of an age ("Zeitgeist"). Thus, the model proposed by us in 2008 intended to take the definition of Barthes on the investigator. This definition states that:

> "(…) The historian is precisely the magus who receives from the dead their actions, their sufferings, their sacrifices, and gives them a place in History's universal memory. (…) Thus, the historian is the man who has reversed Time, who turns back to the place of the dead and recommences their life in a clear and useful direction; he is the demiurge who links what was scattered discontinuous, incomprehensible: he weaves together the threads of all lives, he knits up the great fraternity of the dead whose formidable displacement, through Time, forms that extension of History which the historian leads while walking backwards, gathered within his gaze which decides and discloses." [19]

Erwin Panofsky advocated a complementary approach, when he reaffirms that the works of art are not only historical and cultural objects but also reflections of technical and social testimonies. Therefore, the history of art despite being a humanistic discipline integrates the requirement of methodological plurality [20]. Nevertheless, the architecture discipline as the product resulting from the Arts, Humanities and Technology, merges these sciences across interdisciplinary and from a wide methodological plurality. Consequently, this interdisciplinary and methodological plurality leads to varied approaches, preventing the investigation to fall into their limitations, since proliferation is beneficial for science, whereas the uniformity undermines critical power [21]. This means that our research has focused on the building but also in all its scopes (political, spatial-temporal, social, cultural, economic, technological, conceptual and urban). This led to the formation of a transversal methodology, a multiple knowledge, which provides the validation of 3D buildings reconstructions proposals [22].

We started our analysis of the opera house, overlapping the plant and the cross section of the plans assigned by Figueiredo, to ensure that they were part of the same project. Then we went to (re)draw, by vectorial drawing, both folios, having as the default metrological reference the graphic scale defined on the drawings ("palmi romano [di campidoglio]"). [23]

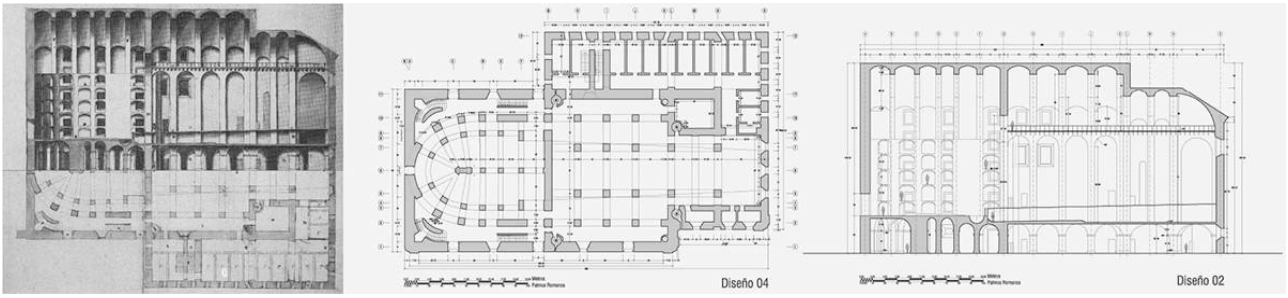

Fig. 7 JANUÁRIO, Pedro Miguel Gomes. 2008. Overlapping the plan and section attributed by Figueiredo in 1933 (**left);** Vectorial Redrawing, using CAD software, of the ground floor (**centre**) and longitudinal section (**right**) of the project attributed to the Lisbon Royal Opera House of Tagus by Figueiredo.

Accordingly, we continued performing a first three-dimensional reconstruction model, which allowed us to perform a wide range of analysis (morphological, geometric, programmatic, structural, constructive, stylistic and urban) and we were able to identify several inconsistencies. As in the case of the vertical accesses to the various orders of boxes, but especially in the vertical accesses between the vestibule area and access to the pit [24]. We continue by proceeding to the confrontation of the Figueiredo set with the current city plans, but above all with a Lisbon plant, dated 1759, which shows the deployment of royal Theatre. This city plant, that existing at the National Academy of Fine Arts in Lisbon, had been until then unpublished. [25]

In the end, we close our analysis confronting a three-dimensional model we have built, according to the plans assigned by Figueiredo. Having concluded that this project, even though they were designed for the Opera House, do not match the erected building. Specifically, it does not coincide neither with the city plan of 1759, nor with the perspective restitution in Le Bas ruin engraving.

Subsequently we have questioned whether it there would be other iconography that could get us closer to what the erected theatre looked like? Could these iconographies have been assigned to other buildings or attributed to authors, instead of the Lisbon Opera House?
Thereby, we turn to the work of Giovanni Carlo Sicinio, asking ourselves if the assignments made to the drawings previously attributed to the Theatre Royal in Salvaterra de Magos, would be correct? First, when confronting the drawings identified by Guiseppina Raggi [26] and by Luís Soares Carneiro [27], we were able to conclude that these sets of iconographies were indeed part of the same project. [28]

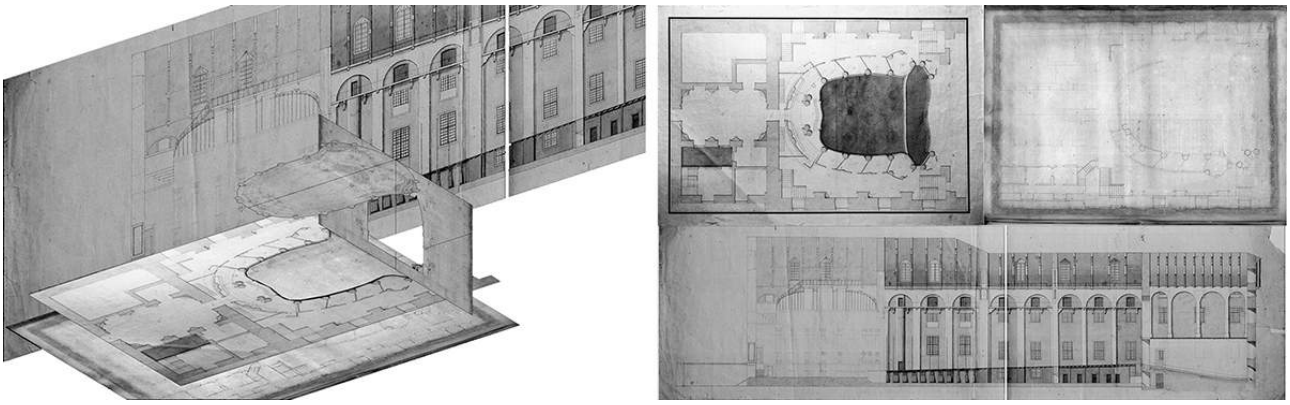

Fig. 8 JANUÁRIO, Pedro Miguel Gomes. 2007. Three-dimensional overlapping, using raster and vectorial software, of a set of drawings attributed to the Royal Opera House of Salvaterra de Magos by Giuseppina Raggi and Luís Soares Carneiro (**left**). Set of drawings existing on the Rio de Janeiro National Library Institute, in Brazil, signalled and attributed by Giuseppina Raggi the Salvaterra Opera House (**top right**). Longitudinal section existing on Ancient Art National Museum, Portugal, signalled and attributed by Luís Soares Carneiro to the Salvaterra Opera House (**bottom right**).

5. Unveiling a new set of drawings

As Soares Carneiro had done previously, we also try to deploy the drawings attributed to Salvaterra de Magos with the royal palace drawings, not being able to establish any relationship at a project level. However, Carneiro [29] justifies it due to the possibility of the palace drawings being subsequent to the dismantling of this theatre. On the other hand, although oral tradition clearly refers another place distinct from the palace drawings. In neither case was it possible to successfully identify a correspondence, which reinforced the hypothesis that the drawings assigned to the Salvaterra de Magos Royal Opera House, did not correspond at all to it [30].

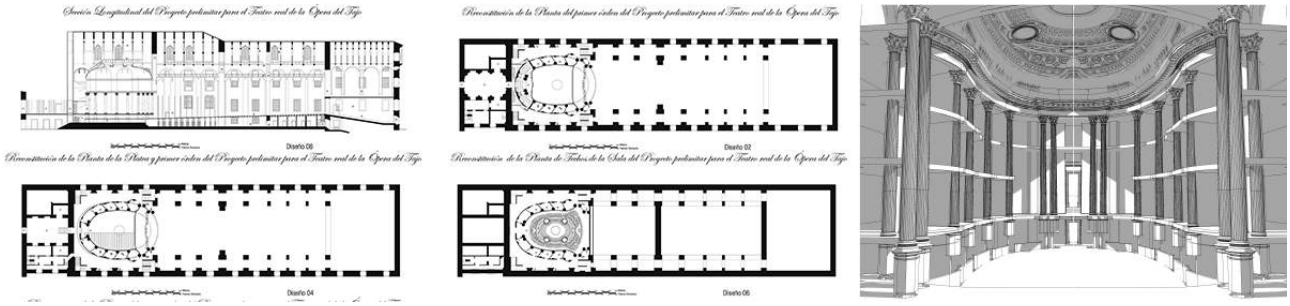

Fig. 9 JANUÁRIO, Pedro Miguel Gomes. 2008. Reconstruction model of the Lisbon Opera House of Tagus, as it was envision by Giovanni Carlo Sicinio Galli Bibiena, or as close as possible to the built theatre; Longitudinal section (**top left**); plans of the pit and 1st order of boxes (**bottom left**); royal tribune (**top centre**) and ceiling decorative plans (**bottom center**); incomplete interior view from the stage set to the royal tribune (**right**).

We decided to confront this set of drawings, previously assigned to Salvaterra, with the city plan of 1759 and the Le Blas engraving of the ruin. Having concluded, with great enthusiasm, that these drawings were consistent, either when overlapping with the city plan, either as in terms of perspective restitution. What boosted us to redesign this sets. Which brought us unprecedented information on morphological, structural,

programmatic, geometrical, proportional, harmonic, geometric, theoretical (architectural treatises) and ornamental terms. Being possible to obtain a longitudinal section and plants from the audience, the real tribune of the 2nd and 3rd order of boxes, and the ceilings plant and volumes [31]. That is, we were able to transform nonexistent and indefinite information into concise one, allowing us to go further in our goals.

More recently, during the last year, we decided to widen the scope of our investigation to the family context of Giovanni Carlo Sicinio Galli Bibiena, in the hope we could move forward in our research project. So, we focus our attention and study in the drawings brought to Portugal, particularly the drawings for the Nancy Opera House (1709). Thus, we were able to identify a significant number of common matrices to these two theaters, and based on our methodological approach we were able to produce a third model, even more complete. [32]

Bibliographical References

[1] BRITO, Manuel Carlos. *Opera in Portugal in the Eighteen Century*. Cambridge: Cambridge University Press, 1989. p.11. ISBN 0-521-35312-22; JANUÁRIO, Pedro Miguel Gomes. *Teatro real de la Ópera del Tajo 1752-1755: Investigación sobre un teatro de ópera a la italiana, para una posible reconstitución conjectural, basada en elementos iconográficos y fuentes documentales*. PhD Thesis. Madrid: ETSAM/UPM, 2008. Vol I. p. 450; JANUÁRIO, Pedro Miguel Gomes. ANTUNES, Eduardo Francisco Durão. *Proporção e Identidade, na obra arquitectónica dos Galli Bibiena: os casos da Ópera de Nancy e da Ópera do Tejo*. In AA.VV. *Proceedings of International Multidisciplinary Congress Proportions (dis)Harmonies Identities.* Lisbon: Archi & Book's, 2015, p.230-249. ISBN: 978-989-97265-0-5

[2] JANUÁRIO 2008, VOL.I, pp. 84-87, 450-452; JANUÁRIO-ANTUNES 2015, pp.234-236.

[3] JANUÁRIO 2008, VOL.I, p. 698, Ilu. 273

[4] JANUÁRIO 2008, VOL.I, pp. 539-583

[5] "(…) Le roi entretient un opéra italien qui lui coû te deux millions par an. C'est un spectacle majestueux et véritablement pompeux dont il régale sa cour deux ou trois fois par semaine. Il a fait batir à cette occasion une salle de spectacle de toute beauté et de la plus grande magnificence. Elle est octogone à quatre rangs de loges. Celle du roi est dans le fond, ornée de colonnes en facon de marbre, revê tues de moulures de bronze doré. Deux autres loges dans le meme gout sont placées à droite et à gauche au bord du théatre. Les autres sont revetues de balustrades dorées qui en forment les devants, savoir celles du premier et quatrième rang: celles du deuxième et troisème rang sont ouvertes en plein sur le devant et dorées magnifiquement d'un or brillant qui imite le diamant par le feu qu'il jette. La richesse, la délicatesse et le bon gout se disputent à l'envie. Le théatre est superbe. Il a cent quatre vingts pieds de long sur soixante de large. Le parterre occupe tonte la longueur de la salle. On y est assis commodément; il n'y a point d'amphithéatre comme en France. Quelque beau que soit ce morceau véritablement beau et digne d'un roi, il y a au milieu de sa magnificence de grands défauts. La salle n'est pas assez grande proportionnellement au théatre. Les colonnes à pilastres qui soutiennent les loges et se terminent par des figures de géants sont trop grosses pour la grandeur de la salle. II n'y a que trois loges à chaque rang; il en faudrait davantage. Je la trouve trop petite pour une salle de représentation et de dignité, et trop grande pour un spectacle particulier. Eu égard au théatre, elle devrait etre trois fois ce qu'elle est. Nonobstant ces défauts, on ne peut nier qu'on ne soit frappé, en entrant dans cette salle, par l'or et la magnificence qui éclate et reluit de tous cotés." JANUARIO 2008, Vol.II, pp.420-421, Doc. 255. *Cfr.* Des COURTILS, Chevalier Charles-Christian. "*Description de Lisbonne: extraite de la campagne des vaisseaux du roy en 1755*". En *Bulletin des Études Portugaises*. Bourdon, Albert-Alain (ed.). Tome XXVI. Lisbonne: Institut Francais au Portugal, [1965], pp.162-163.

[6] JANUARIO 2008, Vol.II, pp.701-702. Doc. 378. Cfr. BURNEY 1789, Vol.4, p.570-571.

[7] JANUÁRIO 2008, VOL.I, pp. 587-600

[8] BRITO, Manuel Carlos. "A ópera de corte no reinado de D. José". *Desenhos dos Galli Bibiena. Arquitectura e cenografia*, Lisboa: Inst. Port. do Património Cultural, 1987, pp.30-36

[9] SOUSA BASTOS, António de. *Dicionário de teatro português*. Coimbra: Minerva, 1994. ISBN 972-9316-66-X. (facsimile from Lisboa: Imprensa Libânio da Silva, 1908), pp.310-311

[10] FIGUEIREDO, Joaquim de. "Teatro Real da Ópera". In: *Boletim da Academia Nacional de Belas-Artes*. VOL.III. Lisboa: A.N.B.A., 1938, pp.33-35.

[11] SILVA, Augusto Vieira da. *As muralhas da ribeira de Lisboa*. VOL.II. 2.ª ed. Lisboa: Câmara Municipal de Lisboa, 1941, p.178

[12] CÂMARA, Maria Alexandra Gago da. "Relembrar um património perdido: a Real Ópera do Tejo, obra emblemática de encomenda régia na Lisboa setecentista". In: *1755: Catástrofe, Memória e Arte, ACT 14*. Lisboa: Colibri - Centro de Estudos Comparatistas, 2006, pp.201-211

[13] GALLASCH-HALL, Aline. "A Ópera do Tejo: uma possível reconstituição espacial e o impacte do Terramoto numa estrutura cultural de imagem". In: *1755: Catástrofe, Memória e Arte, ACT 14*. Lisboa: Colibri - Centro de Estudos Comparatistas, 2006, pp.229-237.

[14] "(…) evocar este espaço com a ajuda das novas tecnologias da computação gráfica, investindo na recriação tridimensional do edifício em realidade virtual dinâmica", *Cfr.* CÂMARA 2006, pp.201-211

[15] "(…) tentar compreender a orgânica do espaço", *Cfr.* GALLASCH-HALL, 2006, p.235.

[16] *evovar* in Dicionário da Língua Portuguesa com Acordo Ortográfico [on-line]. Porto: Porto Editora, 2003-2015. Web: http://www.infopedia.pt/dicionarios/lingua-portuguesa/evocar; *evoke* in Oxford Diccionaries. Oxford: Oxford University Press, 2015. Web: http://www.oxforddictionaries.com/pt/definição/inglês/evoke.

[17] "(...) ato ou efeito de reconstruir, reedificação; (...) edifício ou parte de edifício que se construiu novamente; (...) junção de elementos separados para se construir um todo", *Cfr. reconstrução* in Dicionário da Língua Portuguesa com Acordo Ortográfico [on-line]. Porto: Porto Editora, 2003-2015. Web: http://www.infopedia.pt/dicionarios/lingua-portuguesa/reconstrução; *reconstruction* in Oxford Diccionaries. Oxford: Oxford University Press, 2015. Web: http://www.oxforddictionaries.com/pt/definição/inglês/reconstruction.

[18] Web: http://conceito.de/reconstrucao

[19] BARTHES, Roland. *Michelet* (Translated by HOWARD, Richard). Berkeley, Los Angeles: University of California Press, 1992. ISBN: 987654321. pp.81-82. Web: https://books.google.pt/books? id=Oe95dmW8-DgC&printsec=frontcover&hl=pt-PT#v=onepage&q&f=false. JANUÁRIO 2008, Vol.I, p.xxxviii. JANUÁRIO - ANTUNES 2015, p. 239

[20] PANOFSKY, Erwin. *Meaning in the Visual Arts*. Garden City, New York: Doubleday Anchor Books / Doubleday & Company Inc., 1955. 364 p.

[21] FEYERANBEND, Paul (translated by MATA, Octanny; HEGENBERG). *Contra o método*. Rio de Janeiro: Francisco Alves, 1977, pp.41-43.

[22] JANUÁRIO 2008, Vol.I, pp.672-674.

[23] *Ibidem.*

[24] *Op. Cit.*, pp. 677-692

[25] *Op. Cit.*, pp.698-702, il. 281

[26] RAGGI, Giuseppina. "G. Carlo Sicinio Galli Bibiena. Teatro di Salvaterra a Lisbona, 1753". In: *I Bibiena: una famiglia europea*. Bologna: Marsilio, 2000, p.237, cat.82

[27] CARNEIRO, Luís Soares. *Teatros Portugueses de Raíz Italiana: Dois Séculos de Arquitectura de Teatros em Portugal*. Porto: FAUP, 2002. Vols II. PhD. Tesis, p.73

[28] JANUÁRIO 2008, Vol.I, p.299, il.71

[29] SOARES CARNEIRO 2002, p.74.

[30] JANUÁRIO 2008, Vol.I, pp.697-711

[31] *Op. Cit.*, pp.719-726, il.285-292.

[32] ANTUNES, Eduardo Francisco Durão. Ópera do Tejo, Investigação reconstituição tridimensional. Master Dissertation. Lisbon: FA/UL, 2015, 168p.; JANUÁRIO-ANTUNES 2015, pp.230-249.

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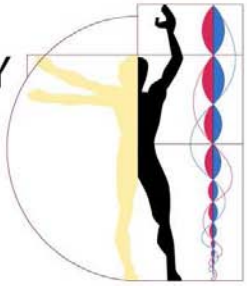

Heritage and technology: novel approaches to 3D documentation and communication of architectural heritage

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Abstract
In the past few years we have seen a drastic increasing of image-based modeling (IBM) techniques to get high quality reality-based 3D models. The low costs of these techniques as well as their attractive visual quality have lead many researchers and professionals to invest their energies and resources in several tests. The use of IMB in the field of cultural heritage is mostly exploited in applications such as documentation, digital restoration, visualization, inspection, planning, AR/VR, conservation and design.
One of the strengthen of multi-view stereo techniques is the possibility to capture millions of points in a very short time and to get a 3D textured polygonal model that can be easily used for visualizing and communicating digital assets.
Currently, we can distinguish between desktop and web based packages. If the first one needs a high performance computer for data processing, the second one use the power of cloud computing to carry out a semi-automatic data processing instead of considerably slowing-down the computer. The aim of this study is to compare two of the most known IBM packages (Agisoft Photoscan and Autodesk Recap) in applications dealing with architectural heritage.
The comparison among the chosen packages are typical user-oriented parameters such as: visual completeness/detail of the 3D model; ratio between images resolution/number of images/time processing; number of used/discharged images (useful to optimize the images network); metric accuracy; learning curve/usability.

Keywords: Digital Heritage, Structure from motion, Architectural Heritage, 3D modeling

1. Introduction
Today, the accurate and detailed reconstruction of geometric models of real objects has become a common process. The diffusion of Image-based 3D modeling techniques, through image-based free, low cost and open source software, have increased drastically in the past few years, especially in the sector of Cultural Heritage (Architecture, Archeology, Urban planning). Currently, we can distinguish between desktop and web based packages. If the first one needs a high performance computer for data processing, the second one use the power of cloud computing to carry out a semi-automatic data processing instead of considerably slowing-down the computer. In both cases the output is a 3D textured model of the object of interest.
Our research investigates the limits and potentialities of 3D models obtained by using Autodesk Recap (web based) in comparison with Agisoft Photoscan (desktop) in Architectural Heritage field, in order to verify the applicability of the method for the practitioner purpose. Our goal is to evaluate both IBM packages efficiency, accuracy, constraints and limitations in order to provide insight into the current state of 3D modeling products. Our methodology forecasts the comparison between IBM models and terrestrial laser scanner 3D acquisition in order to verify metric accuracy.
To achieve this goal we chosen three interesting case studies: a frescoed vault, a lava portal with geometrical and sculptural elements, and a 360 degrees sculptural element.

2. Employed packages

2.1 Agisoft PhotoScan

Agisoft PhotoScan is an advanced image-based 3D modeling solution aimed at creating professional quality 3D content from still images. Based on the latest multi-view 3D reconstruction technology, it operates with arbitrary images and is efficient in both controlled and uncontrolled conditions. Photos can be taken from any position, providing that the object to be reconstructed is visible on at least two photos. Both image alignment and 3D model reconstruction are fully automated.
In the photographs alignment stage, PhotoScan searches for common points on photographs and matches them, as well as it finds the position of the camera for each picture and refines camera calibration parameters. As a result a sparse point cloud and a set o f camera positions are formed. The point cloud represents the results of photos alignment and will not be directly used in the further 3D model construction procedure (except for the point cloud based reconstruction method). However, it can be exported for further usage in external programs. For instance, the point cloud model can be used in a 3D editor as a reference.
On the contrary the set of camera positions is required for further 3D model construction by PhotoScan.
The building geometry is based on the estimated camera positions and pictures themselves a 3D polygon mesh, representing the object surface, is build by PhotoScan. Four algorithmic methods available in PhotoScan can be applied to 3D mesh generation: Arbitrary - Smooth, Arbitrary - Sharp, Height field - Smooth and Height field - Sharp methods. Additionally there is a Point Cloud based method for fast geometry generation based on the sparse point cloud alone.
Having built the mesh, it may be necessary to edit it. Some corrections, such as mesh decimation, removal of detached components, closing of holes in the mesh, etc. can be performed by PhotoScan. For more complex editing you have to engage external 3D editor tools. PhotoScan allows to export the mesh, edit it by another software and import it back. After the geometry (i.e. the mesh) is constructed, it can be textured and/or used for orthophoto generation.
Therefore, we propose interesting examples applied in architectural heritage field from the detail to the large scale.

2.2 **Recap 360**

ReCap 360 is a cloud-based photogrammetry service able to create 3D textured mesh and point clouds from photos. Taking advantage of the photogrammetric approach and algorithms of Computer Vision, the service reconstructs the internal parameters of the camera and the position in space of homologous points between frames starting from the correspondence between a sequence of photographic images acquired in an appropriate manner. The service acts in a semi-automatic way. The user creates the project, chooses the resolution of the model (low, ultra), the smart cropping and/or texturing option, the export format (eg OBJ). Then the images are uploaded and sent to the cloud. The user is adviced by email when the model is ready. Then he can improve the model itself by adding survey points or reference distance and manually stitching photos and then resending it to the cloud.
The model thus obtained, in OBJ format can be imported into dedicated software for 3D modeling and rendering.
As for the previous software, a crucial phase is the realization of the photographic network of the object: it is recommended that the angle between one shot and another is about 5-10 degrees so that the overlapping between neighboring frames is of about 70%; furthermore the images around the object should be taken with different rotations and different heights so as to vary the angle of the shoot.
The experiments conducted so far are very promising even when using amateur cameras. Using professional cameras with a fixed focal length and low distortion may improve the visual and metric quality of the obtained models.

3. Methodology

The applied methodological procedure is formuled as follows:

- Identification of substantials case studies;
- Creation of the images network in accordance to the identified case studies;
- Creation of 3D models by using the two chosen packages;
- 3D acquisition of the reference scans by means of 3D laser scanner;
- Comparative analysis of visual and metric accuracy.
- Interpretation of the results.

4. Case studies

The case studies have been chosen according to the diversity of the geometrical and material features of the objects: the frescoed vaulted system of the Sant' Antonio di Padova church's choir, which is formed by a semi-cylindrical surface closed at an end by a semi-spherical cap; the splayed lava stone portal of the southern façade of the church Santa Maria Assunta in Randazzo, which is characterized by geometrical and bas-relief elements; a 360 degrees decorated console with two lateral winged lions realized for the National Exhibition held in Palermo between November 1891 and June 1892.

4.1 Frescoed vault in the Church of Sant'Antonio di Padova in Acireale (Catania)

Mariateresa Galizia

The cycle of frescoes that decorate the choir of the church of San Antonio di Padova depicts the glory of Sant'Antonio. It was made in 1755 by the famous local painter Pietro Paolo Vasta and, at his death, it was concluded by his son, Alexander. The church, considered the oldest in the city, was built in 1466 in the city center after the black death that affected the territory of Aci and it was dedicated to St. Sebastian martyr. On July 13, 1652 the church was consecrated to Sant'Antonio di Padova. Over the centuries the church was damaged by several earthquakes, thus requiring several repairs. The plan is a single nave with a barrel vault with lunettes, the choir is covered by a barrel vault and the semicircular apse by a semi-spherical cap.



Fig. 1: Image of the frescoed vault and its dataset.



Fig. 2: Photoscan textured and shaded 3D model.



Fig. 3: Recap textured and shaded 3D model.

The images were taken with Canon Eos 5D Mark II, 24 mm lens and at a resolution of 12 Mpix. The shot project toke in account the geometrical features of the vaulted surfaces and the presence of the frescoes. Therefore, two lines of zenithal overlapping images were taken in order to guarantee surface covering (except for areas occluded by overhangs) for a total of 24 shots. The poor natural lighting conditions required the use of an appropriate photographic set.
We then proceeded to the creation of the models by using the two chosen software.
The test conducted on Photoscan focused on the optimization of image alignment and geometry reconstruction parameters according to the geometric features of the surfaces to be reconstructed. As regards the alignment we chose to perform a full automatic alignment giving high accuracy to camera pose estimation. In the following geometry reconstruction step we chose smooth and high parameters. At the same time the processing was started in Recap uploading the images and launching on the cloud the 3D reconstruction.
Table 1 shows data concerning the two experiments carried out.

Frescoed vault in the church of San Antonio di Padova Lenght 6 .22 m width 5.20 m height 3.05 (9.20) m		
	Photoscan	**Recap**
# photos	24	24
# photos	0	0
Camera	Canon Eos 5D Mark II	Canon Eos 5D Mark II
Camera resolution	4308x2872	4308x2872
Lens	24 mm	24 mm
Processing time	4h e 20 min (on desktop)	2h (on cloud)
Sparse point cloud	83291	-
Mesh	7.150.000	1.900.000

Tab 1. Frescoed vault in the church of San Antonio di Padova processing information

4.2 Portal of the Church of Santa Maria Assunta in Randazzo (Catania)

Cettina Santagati

The southern portal of the church of Santa Maria Assunta in Randazzo is datable to around the early XVI century when the church, built in the early XIII century, undergoes several changes. The portal, in lava material, has solomonic decorated columns and a structure with multiple registers. It has an architectural composition with lunettes overlaid with round arches, one of them adorned with a small marble statue of the Madonna. The portal is framed by pilaster strips with composite capitals surmounted by a simplified entablature decorated with phytomorphic Gothic motifs (branch of vine), as well as a late Gothic column with spiral shaft and with a type of classicists decorative motifs like the large tile with rosettes but also diamond-point ashlars.

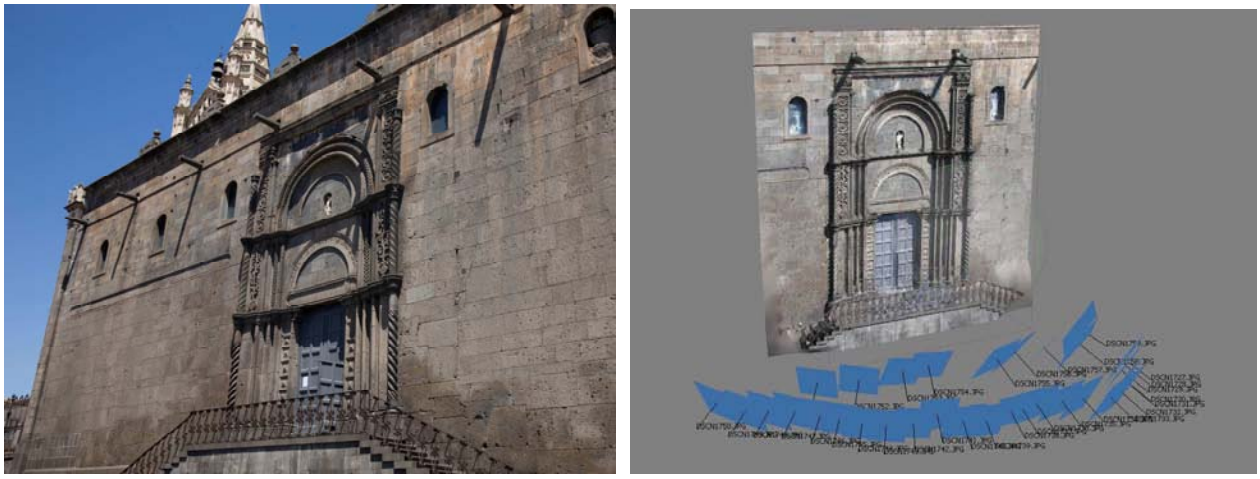

Fig. 4: Image of the portal and its dataset.



Fig. 5: Photoscan textured and shaded 3D model.

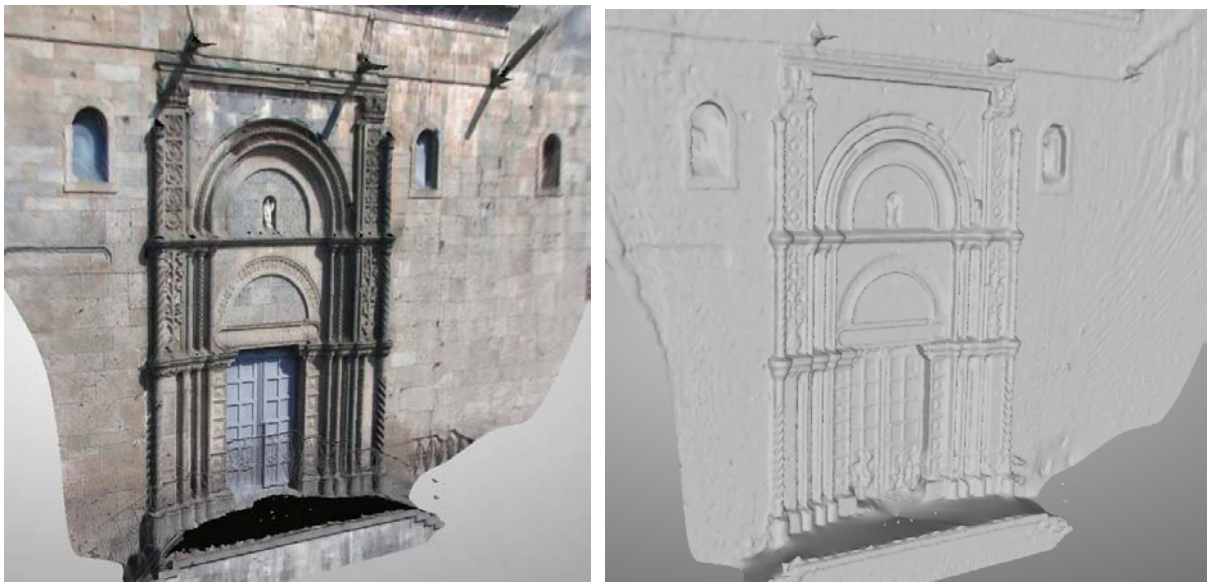

Fig. 6: Recap textured and shaded 3D model.

The images were taken with Nikon Coolpix E8800, 24 mm lens and at a resolution of 8 Mpix. The shot project toke in account the geometrical and decorative characteristics of the portal. Thus, it was planned to perform two semi-circular paths around the object at different eights shooting 33 convergent images.
We then proceeded to the creation of the models by using the two chosen software.
In this case, the processing on Photoscan foresaw the setting of aligment parameters in accordance to what previously tested. As regards geometry reconstruction, after having carried out several test both in sharp and

in smooth mode, we decided to use smooth mode (able to make a watertight without holes reconstruction) combined with ultra high mode so that to describe with more detail the geometry of Solomon columns and bas-rielief. At the same time the processing was started in Recap uploading the images and launching on the cloud the 3D reconstruction.
Table 2 shows data concerning the two experiments conducted.

Southern portal of the church of Santa Maria Assunta lenght 7,08 m height 10,70 m		
	Photoscan	**Recap**
# photos	33	33
# photos	0	0
Camera	Nikon Coolpix 8800	Nikon Coolpix 8800
Camera resolution	4308x2872	4308x2872
Lens	24 mm	24 mm
Processing time	29h e 54 min (on desktop)	90 min (on cloud)
Sparse point cloud	68774	-
Mesh	4.500.000	1.900.000

Tab 2. Southern portal of the Church of Santa Maria Assunta processing information

4.3 Plaster Architectural Element (Palermo)

Laura Inzerillo

The National Exhibition, dedicated to industry, commerce, agriculture and Fine Arts, was held in Palermo between November 1891 and June 1892. The project was committed to the young architect Ernesto Basile, assisted by engineers Ernesto Armò, Lodovico Biondi e Alfredo Raimondi, in 1888.
The Exhibition showed partial or whole reproductions of the major Sicilian monuments and was organized into three different sectors. In the first one there were the plasters, archetypes and facsimiles, works still present and exhibited into the spaces of the Department of Architecture of the University of Palermo.
Our experimentation has been focused on the 3D reconstruction of a plaster: a decorated console with two lateral winged lions.
The challenge was to carry out a closed 3Dmodel of a complex shape and, below you can observe the different result achieved by Photoscan and Recap.

In the figure below is showed the data set of 57 photos.



Fig. 7: Images of the two different sides of the console and its dataset.

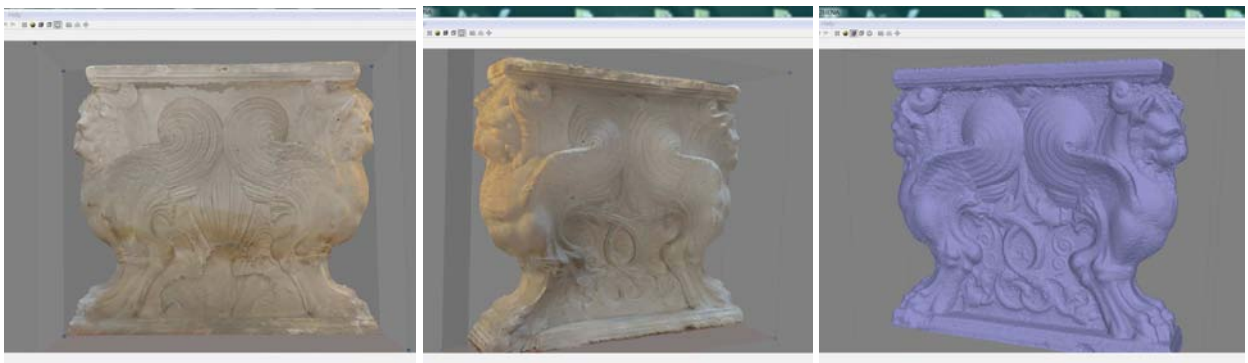

Fig. 8: Photoscan result: textured and shaded 3D model.



Fig. 9: Recap result: textured and shaded 3D model.

We used Nikon D3200 E8800 camera, with 24mm lens and 12 mpix resolution. The criteria for data acquisition have considered the wealth of decorative reliefs and winged lions, and the need of having to document the shelf at 360 °, providing an overlap b etween shots and the other. Therefore, they were made 57 sockets.
The models carried out, were made using the two software identified.
Also in this case, the processing of PhotoScan provided for the setting of the alignment parameters in accordance to what was previously experienced.
The complexity of the surfaces to be reconstructed, has guided the choice of smooth and ultra high parameters.
At the same time, the development was also launched in Recap uploading photographic images and launching cloud reconstruction.
In Table 3 are shown the data concerning the two experiments conducted.

Plaster architectural console width 0,81 m height 0,80 m depth 0,17 m		
	Photoscan	**Recap**
# photos	57	57
# photos	0	0
Camera	Nikon D3200	Nikon D3200
Camera resolution	4312x3000	4312x3000
Lens	24 mm	24 mm
Processing time	40h 27m (on desktop)	120 min (on cloud)
Sparse point cloud	127.645	-
Mesh	3.138.961	834.565

Tab 3. Plaster architectural console processing information

5. Results

The obtained models have been scaled and aligned in Meshlab with the corresponding models got by means of 3D scanners (Leica Geosystem HDS 3000 and Vivid Minolta 9i) and Haussdorff distance between the aligned model and the reference scan has been processed. The calculation range has been assigned according to the objects size: 0.05-0.00 m for the vault and the portal, 0.01-0.00 m for the console.
The deviation between compared models, in terms of homologous points distance, can be easily achieved by evaluating “vertex quality function” and “per vertex quality histogram” and by visualizing the model in “colorize by vertex quality” mode and “showing the histogram”. The vertex are colored according to a range that spans from red (deviation equal to 0) to blue (deviation ≥ to maximum value).
Figures 10, 11 and 12 show the results of the Haussdorff distance evaluation: the blue color corresponds to vertex that are outside the calculation range, that is there are no overlapping between the scan and the 3D reconstructed model.
Effectively, both in the case of the vault and of the portal, the maximum deviation begins to be appreciable starting from 0.016 m value both for Photocan and for Recap models. As regards the console, the maximum appreciable deviation starts from 0.0035 m.
Furthermore, the histograms show the deviations distribution (in terms of number of interested vertex) and the miscalculation error of the 3D geometry.

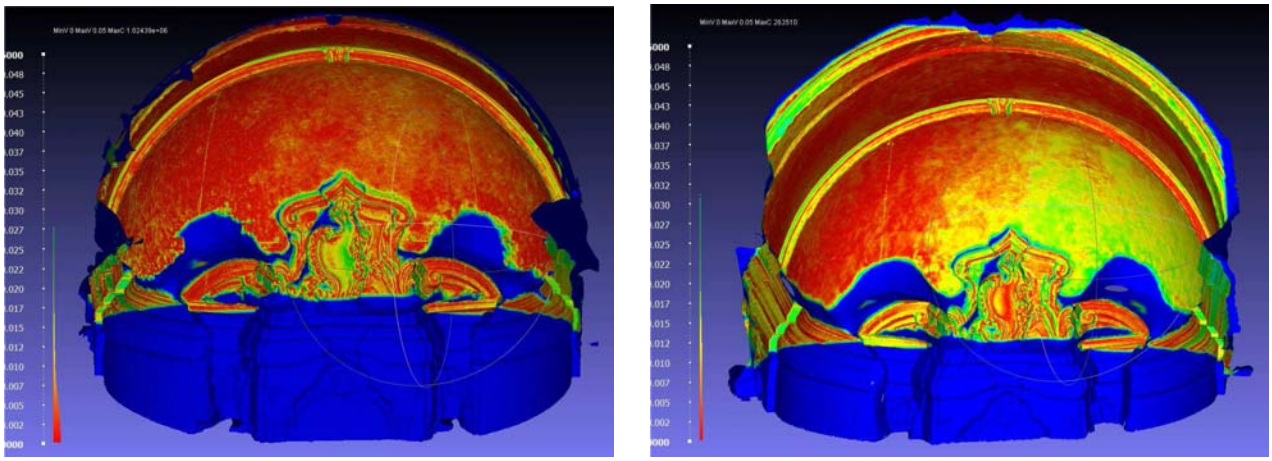

Fig. 10: On the left comparison between TLS and photoscan model, on the right comparison between TLS and Recap model and related quality vertex histograms calculated on Haussdorff distance.

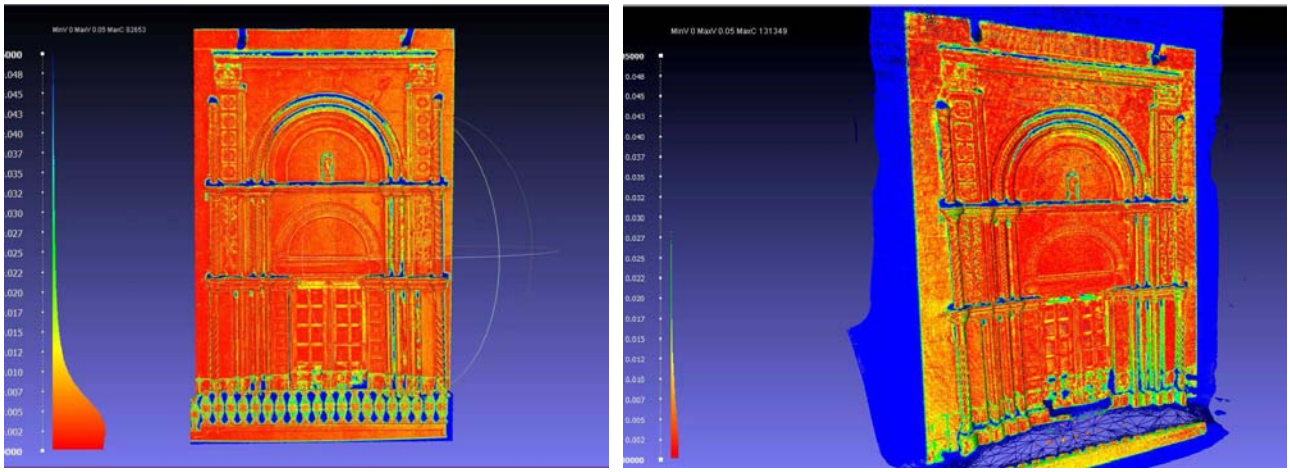

Fig. 11: On the left comparison between TLS and photoscan model, on the right comparison between TLS and Recap model and related quality vertex histograms calculated on Haussdorff distance.

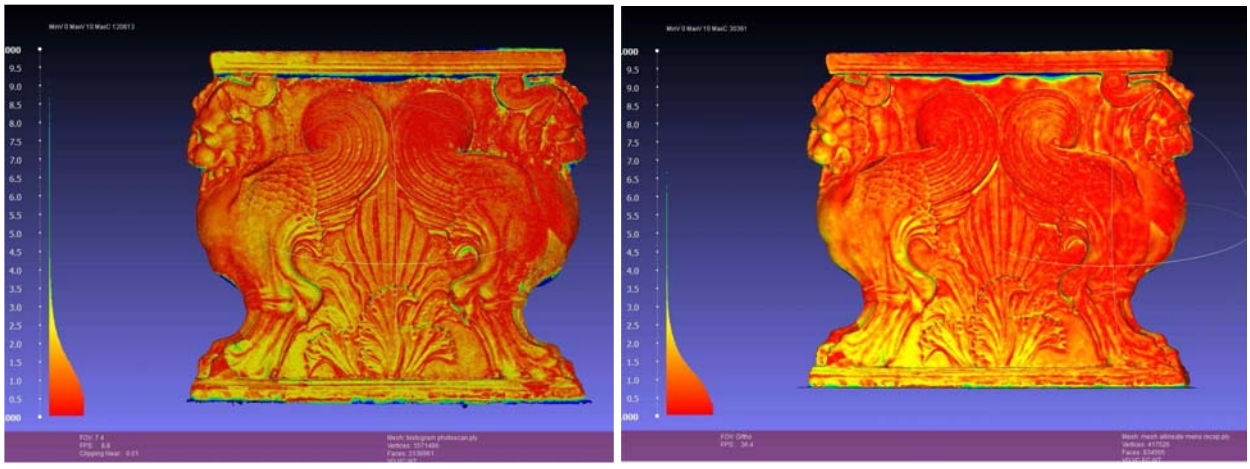

Fig. 12: On the left comparison between TLS and photoscan model, on the right comparison between TLS and Recap model and related quality vertex histograms calculated on Haussdorff distance.

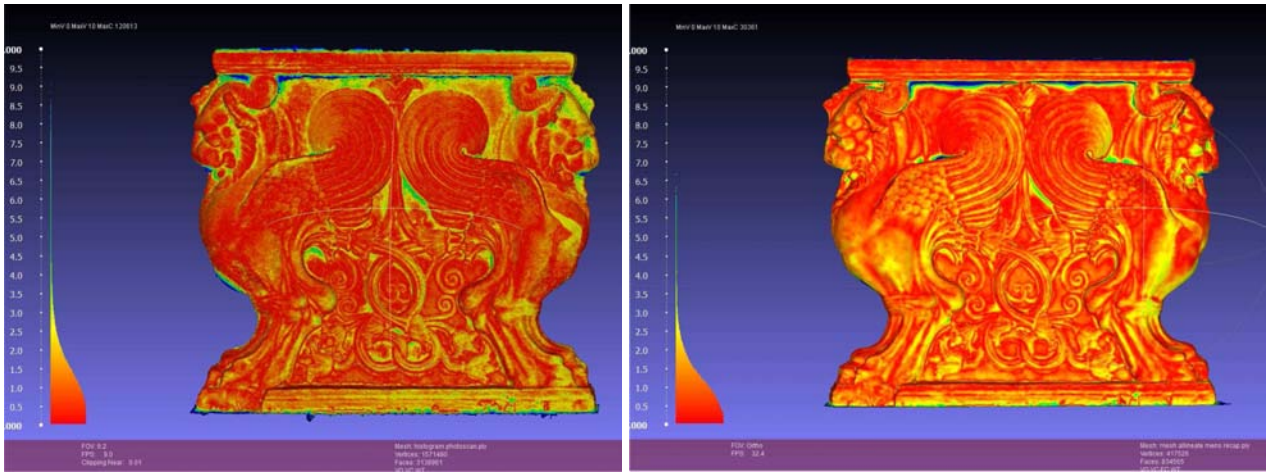

Fig. 13: On the left comparison between TLS and photoscan model, on the right comparison between TLS and Recap model and related quality vertex histograms calculated on Haussdorff distance.

6. Conclusion

Finally, we can deduce some practical considerations on the use of the two packages. We have to take into account the following parameters: required hardware, time processing, visual completeness and detail of the 3D model, metric accuracy and learning curve/usability.

Hardware: *Photoscan*. It is necessary a high hardware profile for models reconstruction. To process up to 200-300 images at a resolution of 10 Mpx, are required 12 GB of RAM. Furthermore, in presence of a professional graphics hardware, it is possible to exploit graphics OPEGL.
Recap. There are no particolar requisite except the use of Google Crome as browser.

Time processing: *Photoscan.* The tests conducted in this study show a time processing that spans from 4 up to 40 hours depending on the number of images and the reconstruction accuracy.
Recap. This package works on the cloud, exploiting the avaliable servers. Time processing takes few hours.

Learning curve: *Photoscan.* Learning curve requires a preliminary knowledge of the fundamental algorithms for mesh reconstruction. The final results are affected by the choice of the reconstruction parameters.
Recap. This package acts like a black box. The user uploads the images and, if needed, stitches homologous points on the images to scale the model or improve the 3D reconstruction.

Visual completeness: *Photoscan.* The visual completeness and the detail of the obtained 3D models depends on the parameters set for the reconstruction, as well as on the images network.
Recap. The visual accuracy of the got 3D models is function of the images dataset and of the images resolution.

Metric accuracy: *Photoscan.* As it is shown in the histograms, the deviation between the reconstructed 3D model and the reference scan depends on the size of the object. In the case of the vault and the portal the deviation spans a range equal to 0.016-0.00 m, as regards the console it is equal to 0.004-0.00 m.
Recap. For this package, the histograms clearly show that in the case of the vault and the portal the deviation spans a range equal to 0.02-0.00 m, as regards the console it is equal to 0.003-0.00 m.

In conclusion, we could assert that nowadays technology offers packages that allow to get novel approaches to the traditional 3D documentation and communication of the architectural cultural heritage. This comparative study indicates the pipeline to choice according the final purpose of 3D reconstruction.

Bibliographical References

BANDIERA Adriana, BERALDIN Jean-Angelo, GAIANI Marco. Nascita ed utilizzo delle tecniche digitali di 3D imaging, modellazione e visualizzazione per l'architettura e i beni culturali. *"Ikhnos"* . Lombardi editore, Siracusa, 2011. pp. 81-134.

BERTOCCI Stefano, BINI Marco. *Manuale di rilievo architettonico e urbano*. Novara: CittàStudi, 2012.

GALIZIA Mariateresa, SANTAGATI Cettina (2013). Low-cost image-based modeling techniques for archaeological heritage digitalization: more than just a good tool for 3D visualization? *Virtual Archaeology Review*. 2013. 4 (9), nov 2013, 123-129

KERSTEN Thomas, LINDSTAEDT Maren, Image-Based Low-Cost Systems For Automatic 3d Recording And Modelling Of Archaeological Finds And Objects. M. Ioannides et al. (Eds): Progress in Cultural Heritage Preservation, EuroMed 2012, 7616 LNCS, Pp 1-10.

INZERILLO Laura, SANTAGATI Cettina. Il progetto del rilievo nell'utilizzo di tecniche di modellazione dense stereo matching. *Disegnare Idee Immagini.* 47. 2013. Gangemi, Roma, 82-91

INZERILLO Laura, SANTAGATI Cettina, GALIZIA Mariateresa. Il Portico meridionale della Cattedrale di Palermo: sperimentazioni di rilievo attraverso l'utilizzo di tecniche Structure from Motion, in P.Giandebiaggi, C.Vernizzi (a cura di), Italian survey & International experience edizione bilingue italiano e inglese, Roma: Gangemi editore, 2014. pp 877-886

REMONDINO Fabio, EL-HAKIM Sabry (2006). Image-based 3-D modelling: a review. *The Photogrammetric Record*, 2006. 21(115), 269–291.

REMONDINO Fabio, DEL PIZZO Silvio, KERSTEN Thomas, TROISI Salvatore. "Low-Cost and Open-Source Solutions for Automated Image Orientation–A Critical Overview". M. Ioannides et al. (Eds): Progress in Cultural Heritage Preservation, EuroMed 2012, 7616 LNCS, pp. 40-54.

REMONDINO Fabio, SPERA Maria Grazia, NOCERINO Erica, MENNA Fabio, NEX Francesco. State of the art in high density image matching. *The Photogrammetric Record* . 2014. 29 (146), 144-166

RODRÍGUEZ-NAVARRO, Pablo. Automated Digital photogrammetry versus the systems based on active 3D sensors - La Fotogrametría Digital Automatizada frente a los sistemas basados en sensores 3D activos. *Revista EGA*, nº. 20, año 17, 2012, Valencia, pp. 100-111

SANTAGATI Cettina, INZERILLO Laura, DI PAOLA Francesco. Image-based modeling techniques for architectural heritage 3D digitalization: limits and potentialities. International *Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* , 2013, XL-5(W2), 550-560.

SANTAGATI Cettina, INZERILLO Laura. 123D Catch: efficiency, accuracy, constraints and limitations in architectural heritage field. *International Journal of Heritage in Digital Era*. 2013. 2 (2), 263-290

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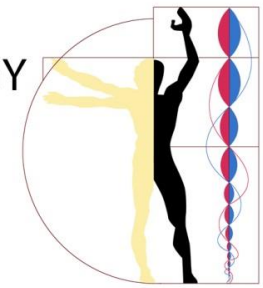

Aljezur, "between vision" of Place and Memory : The use of new technologies for the protection of a place and its heritage.

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Abstract

This communication is an integral part of a research project I & D ALJEZUR, "betweenvisions "Place and Memory, which aims to integrate diverse knowledge and expertise in towards new ways to address the balance defense of a threatened county contemplating and accentuating the registration of memory and its conservation. In this sense, and not ignoring an integrated analysis of tourism conceptual approach. Sustainable and ethically responsible, we want to test a new defense approach and promotion of the natural, cultural and historical heritage of Aljezur, a county integrated in the Natural Park of Southwest Alentejo and Costa Vicentina, and subject to various and continuous pressures for mass tourism.
In this logic, and to emphasize the relevant aspects for the promotion of sustainability we view as essential to recovery Memory as a determinant for land surveying and safeguard the collective identity of a territory through knowledge and preservation of its heritage.
With this our project, we aim to provide academic reflection for the benefits of using technology platforms based on Augmented and immersive reality allowing on the one hand, the approach between present, past and future, and secondly to be regarded as an encouragement and also a new impulse way, for the safeguarding of Aljezur´s tangible and intangible heritage, providing an outlet of collective awareness of the different social actors to its sustainable development.

Keywords: Heritage, Culture, Memory, Identity, Digital

This communication is an integral part of a project I & D ALJEZUR, "between vision" Place and Memory, which aims to integrate diverse fields of knowledge and expertise as meaning to new ways of defense approach to the preservation of cultural heritage of Aljezur a municipality of Southwest Portugal whose territory is almost entirely covered by the Natural Park of Southwest Alentejo and Costa Vicentina or into Natura 2000 network in its various forms, contemplating and accentuating the registration of memory, but also contributing to a new ethically sustainable approach to tourism.
The team which take part on this project includes researchers and specialists of different areas, from applied Social Sciences and Humanities, the Visual Arts and Culture Communication and Design, Photography, Computer Graphic and more, all converging for the protection and safeguarding of a unique and quite threatened heritage involving also civil community organizations, such as those of promote the protection safeguarding the historical and archaeological heritage and mainly the very municipality authorities.
In this sense, and based on an integrated analysis of the conceptual definition of heritage and memory, but also not ignoring innovative approach to sustainable tourism and ethically responsible, we want to rehearse a new approach to defending and promoting the heritage of an aged territory coveted and, somewhat pressed for a developmental logic opposed to its preservation. We intend to justify our intervention to the

defense and promotion of the tangible and Intangible heritage of Aljezur, a municipality almost fully integrated in the Natural Park of Southwest Alentejo and Vicentina Coast of Portugal.
In this logic, when we detach the relevant aspects for the cultural and sustainable development of a region, we assume as indispensable the recovery of memory as essential to safeguard its identity through the knowledge and the preservation of its tangible and intangible heritage
With this research project and in particular with the present proposal, we intend also to foster academic reflection on the registration of Memory and Cultural Identity of the places as elements able to foster and to develop a Cultural and ethically sustainable tourism: another possible tourism in the contexts of post *post modernity* and of a economic crisis on a global scale, strengthened by the use of new technologies.
According to Mounir Bouchenaki, Assitant Director Generel for Culture of UNESCO in 2003:
"Over the past thirty years, the concept of cultural heritage has been continually broadened. The Venice Charter (1964) made reference to "monuments and sites" and dealt with architectural heritage. The question rapidly expanded to cover groups of buildings, vernacular architecture, and industrial and 20th century built heritage. Over and above the study of historic gardens, the concept of "cultural landscape" highlighted the interpenetration of culture and nature.
Today an anthropological approach to heritage leads us to consider it as a social ensemble of many different, complex and interdependent manifestations. This is now reflecting the diversity of cultural manifestations.
The quest for the «message» of cultural properties has become more important. It requires us to identify the ethical values, social customs, beliefs or myths of which intangible heritage is the sign and expression. The significance of architectural or urban constructions and the transformation of natural landscapes through human intervention are more and more connected to questions of identity.
It is out of these reflections that a more comprehensive approach was developed during the past decade to give a better appreciation of the intangible heritage as a source of cultural identity, creativity and diversity. Intangible heritage includes customs and oral traditions, music, languages, poetry, dance, festivities, religious ceremonies as well as systems of healing, traditional knowledge systems and skills connected with the material aspects of culture, such as tools and the habitat.
(...) Cultural heritage is a synchronized relationship involving society (that is, systems of interactions connecting people), norms and values (that is, ideas, for instance, belief systems that attribute relative importance). Symbols, technologies and objects are tangible evidence of underlying norms and values. Thus they establish a symbiotic relationship between the tangible and the intangible. The intangible heritage should be regarded as the larger framework within which tangible heritage takes on shape and significance.
The Istanbul Declaration, adopted at a round table of 71 Ministers of Culture, organized by UNESCO in Istanbul in September 2002, stresses that «an all-encompassing approach to cultural heritage should prevail, taking into account the dynamic link between the tangible and intangible heritage and their close interaction.»
(...) The tangible cultural heritage, be it a monument, a historic city or a landscape, is easy to catalogue, and its protection consists mainly of conservation and restoration measures. Intangible heritage, on the other hand, consists of processes and practices and accordingly requires a different safeguarding approach and methodology to the tangible heritage. It is fragile by its very nature and therefore much more vulnerable than other forms of heritage because it hinges on actors and social and environmental conditions that are not subject to rapid change.
(...) Therefore, the legal and administrative measures traditionally taken to protect material elements of cultural heritage are in most cases inappropriate for safeguarding a heritage [intangible] whose most significant elements relate to particular systems of knowledge and value and a specific social and cultural context." [1]
Conscious of the complex interrelationship between cultural heritage, tangible and intangible, and the various levels at which it is structured, our proposal for an action within the present research in the municipality of Aljezur, aims to encompass an even more comprehensive view including the environmental, artistic, historical and also the underwater heritage, from a more holistic approach. Generating therefore a broader concept of Heritage understood as the symbiosis of Culture, Identity and Memory, in its various forms (tangible and intangible) and its various areas (artistic, historical, architectural, environmental, etc.).
Thus, we intend to create and act in a technological multidimensional array, based on the axes of Culture, Identity and Memory, the tangibility and intangibility, which is transversal to the different fields, medias and technology platforms used in the survey, preservation and dissemination of the Heritage of the Aljezur municipality. In other words, we intend to use different approaches to the technological platforms of general use or in specific physical environments specially constructed (for example: museum or interpretive centres), together with social networks and web pages. In particular by exploiting the interactivity generated by the different contents both in the Virtual Realty field, and on both Immersive and Non-Immersive Virtual Reality fields. Through which we tend to promote inclusion and the manipulation of virtual models in real situations, or even virtual travels), but also in the not Immersive reality (such as the use of vector diagrams and three-dimensional models).

Our main goal and thus our point of departure shall be to how to promote and preserve the heritage of Alzejur. To enable an answer to our concerned identified the need to promote and create a comprehensive set of contents and information in situ in real time, both for those applications to be used in traditional or in virtual paths throughout the county, out of the different interactive activities that can be generated and experienced through digital platforms in general use.
Also consider strategic contents whatever their tangibility and intangibility, such as the sea and water resources, the wonderful beaches, urban areas (the buildings, the traditional materials and the ancestral and almost forgotten building systems), the archaeological remains (Arab and Christian heritage), the tracks and ancestral pathways, the wonder landscapes (the cliffs, beautiful valleys and floodplains but also the mountain), nature (fauna, flora) and the local identity and culture (history, collective memories, the crafts, food and other ethnographical demonstrations).
Thus we created the following approaches for each strategic location which should be stored in on a database about the municipality and made available to both the scientific community as well to the users of our applications:
SEA AND WATER RESOURCES - implementation of sensors distributed along the coast or in strategically located buoys, which will be powered by solar, wind or tides, in order to gather information at predetermined time intervals on the water temperature, its density, acidity (pH), visibility (via sonar or pleasure), the current direction of the tide, the water quality.
BEACHES - beyond the information and data collected and made available in the previous section, we consider to be of scientific and the public interest obtain data about air temperature, humidity, atmospheric pressure, wind direction and strength, and on allergies to pollens, UV index, atmospheric alerts, local weather forecast, information on periods of sun exposure as a function of age group and dehydration index, geo-referenced every beach and in addition by streaming webcam overview of each beach as well as banner and undulation. Some of Aljezur Beaches are now in the major Europeans surf circuits.



Fig. 1: JANUÁRIO Pedro Gomes (photos); Atalaia Beach and Arrifana Beach

URBAN HERITAGE – geo-referencing urban layouts, particularly historic buildings and those of municipal interest and also all that must be classified and preserved, since the traditional built is being destroyed by the absence of planning rules that tend to protect it, those who still have (or had) commercial, industrial (the old mill factory) or related services, applying for Augmented Reality associated with the buildings in question in order to obtain historical data about all the services provided, allowing to travel back in time and memory Simultaneously we may make available the technical services of the municipality additional information regarding administrative processes as well as on networks and infrastructures. In this case such information may be made available in real time, in-person or virtual travel trips made by all those eventual interested.
We believe it is necessary and appropriate to create a set of indicative practice standards, to be made available, as well, as about how to apply the construction traditional techniques in a pedagogical way and into a sustainable and integrated approach to the municipality reality.
ARCHAEOLOGICAL ESTATE - the Aljezur municipality has two cores of high historical and archaeological interest, one with a strong Islamic matrix and other Christian, so it would be of great interest to create a museum and interpretation place of these two types of assets, in which were possible to perform actual or virtual visits, and where augmented reality would enable immersive travel to the past, through the three-dimensional reconstruction and interaction with virtual characters that have experienced this same space

RAILS AND PATHS ANCESTORS - the potential of cultural and historical trails and ancestral paths in Aljezur municipality are numerous, this promotion hiking (tracking) the running paths, or paths tourist cycle are included in national and European network. These experiences could be shared by multiple users, through social networks or by providing photos or on video, while these pathways could also be made available through Bublcam (http://www.bublcam.com) for the views 360º interactive, and in addition to the information provided by other reference sites.



Fig. 2: JANUÁRIO Pedro Gomes (photos); Aljezur riverside

LANDSCAPES - the municipality of Aljezur is privileged by the unique beauty of its landscape, which was safeguarded by its inclusion in the Costa Vicentina Natural Park which obviated, but did not prevent its transformation into a concrete jungle as happened in the rest of the South territory of Portugal once one of South Europe havens. In our proposal approach, we believe it is possible a complementarily relationship between the valley and the cliffs, combined with the potential of preserving some traditional agricultural practices (in particular in the floodplain) and also new ways of experiencing the proximity to the beach and sea (in the case of the cliffs) without destroying its heritage and identity essence reflected in tradition and local cuisine.

If we complete this approach with promotional videos made by drones with Bublcam emphasizing the specifics of fauna and flora, and simultaneously with the installation of fixed webcam to monitor the nature and nesting sites, it will enable the awareness and also the share us to share this unique type of specific natural heritage.

NATURE - as we have seen, the fauna and flora registration of Aljezur is of enormous importance for preservation and for his knowledge as well as for scientific research without ignoring its role in the social awareness its relevance, so that the generation of applications intended either as flora or fauna, through image gathering and image recognition for its identification and characterization, will be one of our top priorities.

Thus, surveillance, with regard to the most endangered species can be a real asset to preservation and control, so that the implementation of camouflaged webcam and powered by sustainable energy can be most valuable to integrate at the medium or long term in this project, while it will provide numerous scientific data enabling the sharing with users by building or settling an environmentally sustainable and contemporary consciousness.

IDENTITY AND LOCAL CULTURE - Finally, the issues related to identity and the local culture translated into their ethnographic expressions, folk, art (craft) and gastronomy, should be preserved, valued and shared with all relevant stakeholders opening doors to reinvention and fusion of ancestral concepts with contemporary concepts, in a demonstration of knowledge, the celebrations and the forms of expression.

Once more digital platforms commonly used along with the social networks and more conventional means may, in our view, help the preservation, recovery and, above all, the share. In the case of food, for example, the creation of conventional books or audiobooks, EPUBs, ibooks or root applications where local products (not just the sweet potato) are the recipes base in order not only to its disclosure, but also to perpetuate its use.

Only a comprehensive and integrated vision of heritage and new technologies allow reducing the environmental impact and ecological footsteps caused by tourism excesses going out to the different audiences and beneficial owners of such a magnificent place, offering specific and customizable features to be used to perpetuate the registers of Culture, Identity and of Aljezur municipality memory, which can however be extended to other places with similar features.

We intend therefore the integration possibilities of accessing not only the goods and the products, but also to the spirit of place or genius loci, according to the perspective enunciated by Norberg-Schulz and substantiated by the Quebec Declaration of 2008. Such a spirit that manifests itself not only in the lease, but also in its spatial configuration and especially in the characterization of its relationship between the spectator and the place, and boosted generating any new provisions to Aljezur.



Fig. 3: NETO, Maria João Pereira (photos). Aljezur- countryside

The excessive aging of the population of Aljezur is a potential threat in terms of survival as a municipality . Thus, it is urgent to captivate new populations, but also to celebrate and the loyalty of its inhabitants and all those who love the place generating new services, assuming that new ways of approach of Cultural tourism can serve as the future paradigm, avoiding however, any (re) territorial arrangements and administrative in no way that will benefit the region already depressed and intensely live the seasonality of the months of July to September.
In fact, by promoting a kind of alternative to traditional cultural tourism that involves and takes the journey, we encourage and rehearse new strategies of communication and preservation of tangible and intangible heritage through new forms of "journey" through the registered memory of the past and also the present, and looking ahead.

Bibliographical References

MOESCH, M; GASTAL, S.(orgs), “Um outro turismo é possível” – *Caderno Virtual de Turismo* – vol.4, nº 3, 2004 – ISSN: 1677- 6976

NETO, Maria João P, Aljezur. “Uma proposta para Agenda 21 Local”, comunicação apresentada ao 13º Congresso do Algarve, publicado em Livro de actas do Congresso, Silves, Racal Clube, Novembro de 2007 – 723 – 728.

NETO, Maria J. Pereira, “What went Wrong? Legislation and Planning in a protected Landscape in Southern Portugal”, In: *Sustainability, Space &Social Justice*- The UK – Ireland Planning Research Conference, Queen´s University, Belfast, March 2008, abstract book-151

NETO, Maria João P, “Os Territórios da Utopia – entre o ideal e o real – ou a (in) sustentabilidade das áreas de Paisagem protegida”, in: Livro de *Actas do I Seminário Internacional da academia de escolas de arquitectura e Urbanismo de Língua portuguesa – Uma Utopia Sustentável* – Arquitectura e Urbanismo no espaço Lusófono: que futuro?- Lisboa, FA UTL, 2010, 278-384

[1] BOUCHENAKI, Mounir (2003) *The interdependency of the tangible and intangible cultural heritage.* In: 14th ICOMOS General Assembly and International Symposium: ‘Place, memory, meaning: preserving intangible values in monuments and sites’, 27 – 31 oct 2003, Victoria Falls, Zimbabwe. <http://openarchive.icomos.org/468/> accessed 2015-03-23, 17:45.

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Building Color Survey in Four Districts for Preservation of Groups of Traditional Buildings in Japan

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Abstract
One hundred nine districts were designated in a program to preserve groups of traditional buildings in Japan by the end of 2014. The traditional buildings in these districts, which people use mainly for residential or business purposes, offer value as historical streetscapes for the future. Continuing repair and reconstruction make this preservation possible, but require information about original building materials, design styles, construction methods, and so on. However, surveys on color are rare though it relates significantly with street appearances.
This survey would be the first survey to be conducted in Japan for multiple districts employing the same method. It offers the opportunity to compare color trends in four districts. The survey recorded the Munsell hue, value, and chroma of the predominant colors on various parts of building facades.
Higashiyama-higashi buildings in Kanazawa consist mainly of colcothar yellowish-red. This offers a harmonized atmosphere, though it is slightly reduced by several grayish or whitish parts. The color trend of buildings in Kazuemachi, also in Kanazawa, is similar to Higashiyama-higashi, but the main hue shifts to yellow. Grayish wooden walls with very low value and chroma characterize the Hashitate district of Kaga. Kawagoe in the Kawagoe district, now a leisure venue, features two main color groups: black for warehouses made of clay, and brown for wooden houses.
Main component colors are recorded in color palettes for future maintainance.

Keywords: Color, Location surveying, Traditional buildings

1. Introduction
One hundred nine districts in Japan are involved in preservation of groups of traditional buildings. The program, which began in 1975, aims to preserve groups of traditional buildings and streetscapes for the future. The buildings in these streetscapes, most of which are privately owned, require periodic repair and reconstruction to maintain the appearance of the street. The buildings' interiors are sometimes modified to suit alternate use; however, grants for repair or reconstruction of the exterior of the buildings require that the original style be preserved.
In such situations, information about original building materials, design styles, construction methods, and so forth are necessary. However, despite its close relation to street appearance, a survey of color is rarely undertaken. This survey aims to obtain color data for building facades, which are required to maintain both appearance and atmosphere.

2. Color Measurement Method
2.1 Districts selected for color measurement
Four districts involved in preservation of a group of traditional buildings were chosen for the survey (Fig. 1).
(a) Higashiyama-higashi
Higashiyama-higashi is located on the periphery of Kanazawa, a castle town that was governed by the powerful Kaga family of feudal lords in the Edo period (1603-1867 CE); it is one of the most famous historical cities in Japan. The Higashiyama-higashi district, which consisted of teahouses before the Second World War, is a popular tourist spot now. Ledge gratings at ground floor level make a pattern on the facades. The



Fig. 1: Location of survey areas

second floors were historically used for tea ceremonies. Nowadays, buildings are used as shops, restaurants, tearooms, and museums.

(b) Kazuemachi
The Kazuemachi district is very close to Higashiyama-higashi and also consisted of teahouses. The roofs are gabled, their declined plates parallel to the street. Ledge gratings at ground floor level, similar in aspect to Higashiyama-higashi, characterize its atmosphere. Eaves stand out between the ground and second floors. Most of the buildings are deep, but narrower than Higashiyama-higashi buildings. They now contain houses, restaurants, teahouses, and Japanese-style hotels.
(c) Hashitate
Hashitate is a small village, formerly a wealthy junction port during the Edo period. Its appearance is characterized by red clay tiled roofs and whitish wooden walls and fences. Apart from few museums and a temple, most buildings are residential. This area was designated relatively recently, in 2006, because it is a scattered mixture of important traditional buildings and common present-day houses.
(d) Kawagoe
Kawagoe is located in the suburban area of Tokyo, and is a common day trip for tourists on the weekends. Warehouse-style stores line both sides of the street, along with some western-style buildings constructed in the early twentieth century. Some of the buildings were constructed after the traditional style to present a united atmosphere over the past twenty years.

2.2 Color measurement points

The areas selected for the survey, indicated by the yellow-shaded areas in Figure 1, include 18 buildings in Higashiyama-higashi, 23 buildings in Kazuemachi, 8 buildings in three areas of Hashitate, and 19 buildings in Kawagoe. In each of the four districts, Munsell hue, value, and chroma were measured at representative points on the building facades and fences. Measurements were taken on both sides of the main street or around all sides of the square.
The representative measurement points can be divided into the following 18 categories (Figure 2 shows an example of the points):
(1) Roof, (2) Eaves, (3) Underside of eaves, (4) Wall, (5) Grading, (6) Window frame, (7) Door casing, (8) Door, (9) Stone part of facade, (10) Drainpipe, (11) Shutter, (12) Pillar, (13) Signboard, (14) Pavement, (15) Meter casing, (16) Bamboo fence, (17) Fence, (18) Other components.
In cases where a component part was not uniform in color, if the colors were similar, one representative



Fig. 2: Point of color survey on building facade



Fig. 3: An example of two points measured on a single component

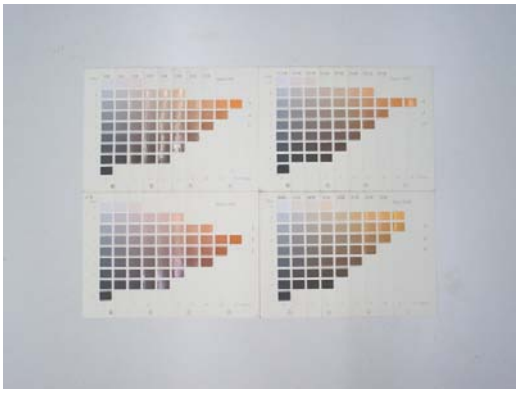


Fig. 4: Examples of color charts

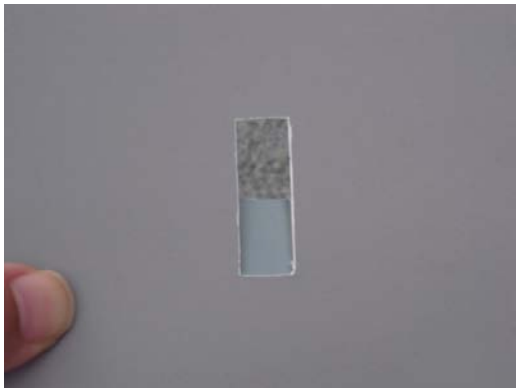


Fig. 5: Masks and color chart during measurement

point was measured; if the colors were distinctly different, two representative points were measured (Fig. 3).

2.3 Color measurement method

Color information recording sheets were prepared, consisting of a blank upper section for sketching the target building and plotting a sequential number of color recording points, and a lined bottom section for filling out records of Munsell hue, value, and chroma at each point.

Visual color measurement was adopted using a color chart called “Shikisai-no-jogi,” Japanese for “scale of colors” (Fig. 4). This chart is a cheap edition of the Japanese Industrial Standard (JIS) color chart with reducing charts from 40 to 24. It offers charts on the same interval as the JIS charts between 5R to 5Y, the main hue seen in streetscapes. The measurers confirmed the possibility of intrapolation between charts in other areas of hue, which supports the adoption of this edition. The intervals of hue are 2.5 in 5R ~ 5YR ~ 5Y and 5.0 in 5Y ~ 5G ~ 5B ~ 10RP; those of value are 1.0; and those of chroma are 1.0 between 0 and 4 and 2.0 between 4 and 14.

The measurer held several color charts and a mask with a 14 mm x 36 mm rectangular hole to the surface of the measurement point. In this way, it was possible to note the actual color of the measurement surface in half of the hole, and the color chip in the other half. A feature of the charts, which fold vertically along the stripe of color chips with the same chroma, made this possible. White (N9.5) and gray (N5) masks were used, depending on the value of the surface color.

If the surface of the measurement point was too far away to reach, a chart and a mask were held in the air in similar light conditions.

2.4 Photography of building facades

Photos of building facade were taken from the front to ensure that images of investigated streets maintained a consistent elevation. These images were taken under cloudy conditions to keep the most areas of the image in dynamic range of the digital camera used. Five photographs were taken using the auto-bracket function; of these, the best (the image that showed the least amount of flat white and black) was selected for

use in making combined images.

3. Color Measurement Result

Figures 7, 9, 11, and 13 are the combined images of the building facades in the surveyed districts. Figures 8, 10, 12, 14 are the graphs indicating recorded frequencies of color for each color attribute from each district. Each line indicates the frequency of five major categories of measured points. The grouping of the 18 categories described before into the five major categories is as follows:

<1> Roof: (1) Roof, (2) Eaves, (3) Underside of eaves
<2> Wall: (4) Wall, (5) Grating, (6) Window frame, (7) Door casing, (8) Door, (11) Shutter, (12) Pillar
<3> Stone and ground: (9) Stone part of facade, (14) Pavement
<4> Attachments: (10) Drainpipe, (13) Signboard, (15) Meter casing (16) Bamboo fence, (17) Fence
<5> Remainder: (18) Other components

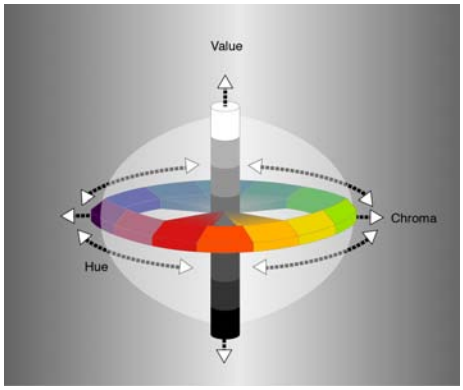
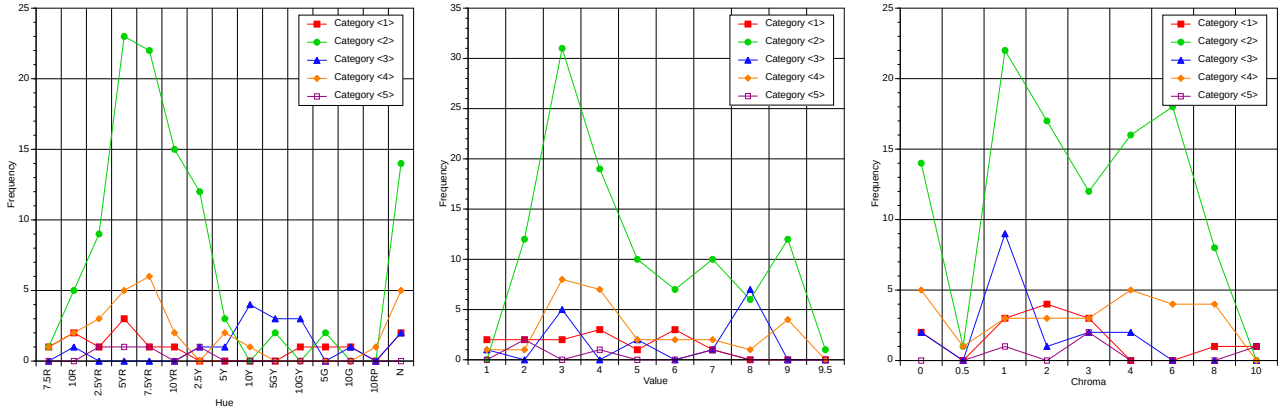


Fig. 6: Munsell color system concept



Fig. 7: Continuous elevation of buildings and Munsell HVC on several points (Higashiyama-higashi)



(1) Munsell hue (2) Munsell value (3) Munsell chroma

Fig. 8: Distribution of colors on Munsell HVC divided into five major categories (Higashiyama-higashi)

3.1 Higashiyama-higashi

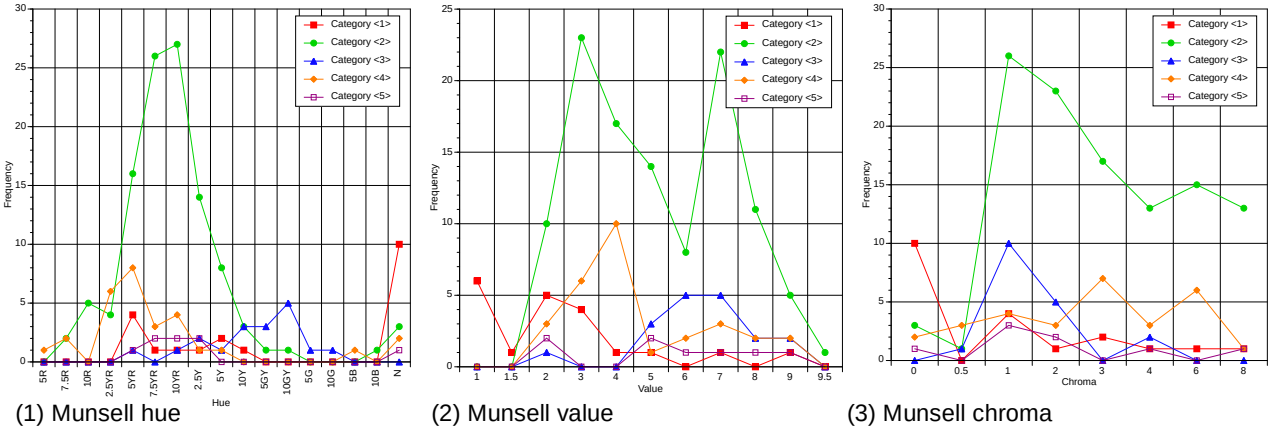
There is a peak between 5YR and 10YR, and colors between 10Y and 7.5R appear rarely, only 14% of the hue points in Category <2> (Fig. 8). In addition, neutral colors (N) appear frequently in Category <2> because of material whitening. Such color shifts of wooden components, which might be effects of rain and sunlight, give us a slightly incongruous feeling, even though white is said to be complementary to every color. Stone components have 10Y to 10GY hues in Category <3>. However, the chromas of the stone are very low (about 1), which contributes to a uniform street atmosphere. Thus, it can be said that this is a yellowish-red-based street.

Table 1: Recorded frequency of color: Hue by value (Higashiyama-higashi)

Value \ Hue	7.5R	10R	2.5YR	5YR	7.5YR	10YR	2.5Y	5Y	10Y	5GY	10GY	5G	10G	10RP	N
2			2	5	2	2									1
3		1	5	11	6	1	3	1							3
4		2	2	4	4	2	4								1
5		1		1	3	2	1	1							
6	1				3	2						1			
7		1		2	2	2		1		1		1			
8					1	2	1			1					1
9					1	1	3								7
9.5															1



Fig. 9: Continuous elevation of buildings and Munsell HVC on several points (Kazuemachi)



(1) Munsell hue (2) Munsell value (3) Munsell chroma

Fig. 10: Distribution of colors on Munsell HVC divided into five major categories (Kazuemachi)

The relation of hue and value is observed in the frequency of these two dimensions (Table 1). Low-value colors are observed on 2.5YR and 5YR; middle- and high-value colors are observed on 7.5YR and 10YR. The process of aging makes color both blacken and redden.
Chroma varies from 1 to 8 on 2.5YR to 10YR in Category <2>; this suppose to relates to the amount of time elapsed after coloration and the degree of exposure to rain and sunlight.

3.2 Kazuemachi

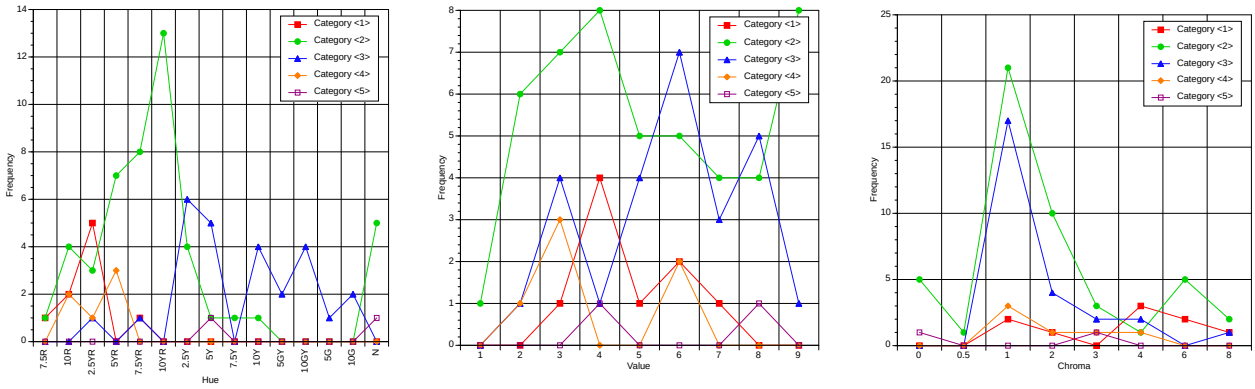
Kazuemachi is also a yellowish-red-based street, the same as Higashiyama-higashi. However, the peak shifts to slightly yellowish, 7.5YR to 10YR in Category <2>. Two peaks in value reflect the old wooden components and the new materials, some of which are artificial. The reddish hues of the drainpipes (distributed from 2.5YR to 5YR in Category <4>), the hue varieties in Category <3>, and the neutral colors in Category <1> are remarkable in this YR-based street. Drainpipes made of vinyl chloride material are colored to simulate bengara (colcothar) red, and the clay tile is black, a historically common color in this region.

3.3 Hashitate

Hashitate displays the lowest chroma spectrum of the surveyed districts. 77.1% of measured points in Category <2> have a chroma of less than 2. Hues in Category <2> fall between 5YR and 10YR. Hashitate is located on the Japanese sea; the woods that make up its walls and fences are recycled ship materials. The long period of their usage makes their color grayish. Shakudaniishi, the stone produced near Hashitate,



Fig. 11: Continuous elevation of buildings and Munsell HVC on several points (Hashitate)



(1) Munsell hue (2) Munsell value (3) Munsell chroma

Fig. 12: Distribution of colors on Munsell HVC divided into five major categories (Hashitate)

supports fences as a foundation. Even though its hue is yellow-green, its chroma is very low (about 1), which makes it coordinate with the fences and buildings.

3.4 Kawagoe

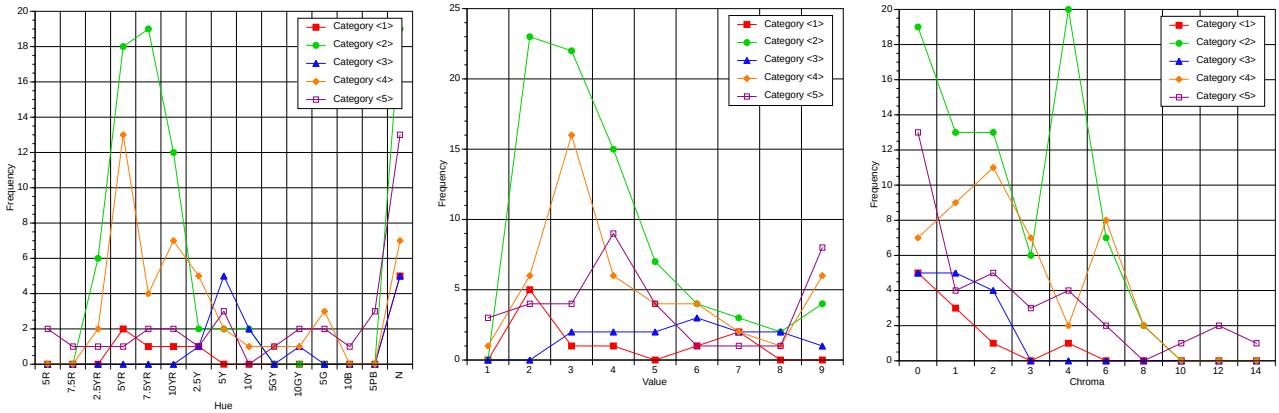
There are two main colors on Kawagoe's street. One of them, dark YR, distributes from 5YR to 10YR in hue, 2 to 4 in value, and 2 to 4 in chroma. This is the color of the wooden doors, pillars, and grates. The other main color is black, the color of warehouses and clay tiles, noted approximately twenty times during the survey. The base colors of the Kawagoe district are YR and Bk.

3.5 Color Palettes

Color palettes from each district have been made to show the entire spectrum of color used on the streets (Fig. 15). The color chips in Figure 15 are picked from the images of JIS color charts, taken in a dark room illuminated by fluorescent lights for color evaluation.



Fig. 13: Continuous elevation of buildings and Munsell HVC on several points (Kawagoe)



(1) Munsell hue (2) Munsell value (3) Munsell chroma

Fig. 14: Distribution of colors on Munsell HVC divided into five major categories (Kawagoe)



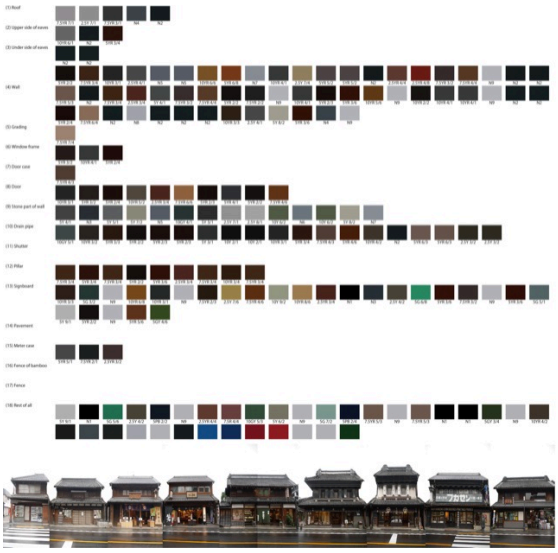
(1) Higashiyama-higashi



(2) Kanaemachi



(3) Hashitate



(4) Kawagoe

Fig. 15: Color palettes of investigated areas

These palettes allow us to understand color distributions easily; it would be possible to maintain the appearance and atmosphere of streets just by applying colors selected from these palettes. Potential improvements will raise the value of the palettes, such as picking out only traditional part colors or removing a color that evokes a feeling of incongruity.

4. Discussion

This survey focuses on color. However, color may change in time as buildings undergo the aging process. It is necessary that research be conducted in these districts on the transition of colors throughout the aging process, based on the materials used.

his survey focuses to the color. However, color might change in time along the aging process. It is necessary that researches about the transition of colors in the aging process of materials used for the buildings and their attachments in these districts.

5. Conclusion

The color survey in four districts for preservation of groups of traditional buildings in Japan was conducted to collect Munsell hue, value, and chroma color data on building facades comprising certain streetscapes. Color trends in the four districts were found through graphs of recorded frequencies of the three color attributes. Color palettes consisting of the recorded colors will guide future modification and reconstruction of these buildings and their attachments.

Acknowledgements

The author wishes to extend his appreciation to Riho Kawana and Rina Nakamura, co-resercher in this survey.

Bibliographical References

[1] *Compilations of the reports of streetscape surveys in Japan.* Vol. 1 to 31, Toyoshorin and Kaijishorin, 2003.10 to 2008. 11 (In Japanese).

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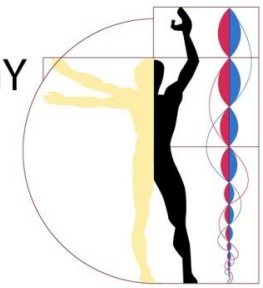

Experience, Immersion and Perception: Communication Design for Urban and Natural Environments

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Abstract

This paper highlights the role of Communication Design as an agent for the promotion of territory. Our research arises from the need to communicate the place identity by sharing different typology of documents, which together represent a heritage of memories, both tangible and intangible. The analysis of cultural tourism industry reveals that travellers are in search of experiences that involve several aspects of a place. In other words, they're interested in discovering landscape - as it is defined by the Council of Europe - its meaning and aesthetic identity. In this scenario the cultural promotion of territory should become more “experiential” and our research tries to propose some guidelines in this direction. On the one hand, we discuss the role of perception and immersive representation as means to gain experience. On the other, we present the potentialities offered by devices that act as mediator between human and ambient. We will present some case studies to highlight how a combination of different multimedia contents and a high interaction level allows us both to make accessible several kind of information and to catch the user attention through immersive visual experiences. We argue that Communication Design has to develop new communication modalities, not only for tourism purposes but also to support inhabitants in understanding their own cultural identity.

Keywords: Communication Design, Experience Design, Immersivity, Landscape, Cultural Tourism

1. Introduction

In order to foster sustainable development, several public and private institutions are interested in establishing and implementing policies focused on the protection of cultural heritage and the valorization of local identity. This is a crucial issue for our society and an hard challenge for those who deal with the promotion of territory. Basically, it means designing new forms of relationship between people, places and culture.

To this aim, we should start by reconsidering the concept of identity since it is the synthesis of such relationship. As stated by Ypma, identity «appeals to collective meaning (memoria) that in its turn facilitates the identification processes of groups and individuals» [1]. As a territory is always in transformation, as well is the identity. In this sense, we can assert that it does not actually exists the "identity" but rather many identities [2] which have shaped the whole environment, both urban and natural, over time. These past identities are simultaneously present and, taken together, allow to figure out the roots of memory shared by the local community, nurturing the sense of belonging.

Nevertheless, most of them are hidden. As suggested by Calabi [3], many times they can be identified only by means of “minimal traces”, both tangible and intangible. In order to reconstruct the common ground on which people, places and culture converge - the identity(ies) -, these traces must be gathered, interpreted and made accessible through an operation of decoding and translation. This operation involves both poietics and aesthetics; it regards the meaning creation process which is a matter of design and the main expertise of a communication designer. For this reason, the promotion of territory is of great interest to Communication

Design. It acts as a “mediator” that allows the "communicative access" to an heritage of content that otherwise would remain hidden. The value of Design research is even more evident if we consider that these content have not only a different nature (they could be tangible or intangible, related to past or present, more strictly connected with natural or rather with urban/human environment) but they can be also of different typology (texts, videos, sounds, images, etc.). Therefore, promoting a territory in the contemporary scenario requires an open approach to new media and technologies, since they affect the way in which content are produced and conveyed.
Furthermore the transformation of media occurs so rapidly that often we have to deal with "hybrid formats" in which innovation and tradition converge. For this reason, the metamorphosis of devices must be followed by the development of new representation languages.
The research presented in this paper is based on the need to merge and manage the different typology of content which represent both tangible and intangible aspects of territories. Basically, it aims at the development of a different interpretive model based on an "augmented" perception of the place identity. To this aim, the research focuses on the potentialities of digital technologies whose exploitation allows us to design experimental communication formats.

2. Cultural Tourism & Landscape

Today the cultural tourism phenomenon is rapidly changing, moving away from the traditional model of "mass cultural tourism" [4]. Currently it is mainly a local tourism, characterized by short-break holidays and an increased interest of travellers towards the less popular destinations. Generally speaking, two are the main features of cultural tourism demand. On the one hand, the attention of travellers for natural, social and cultural aspects of a place: its identities. On the other hand, an increased need of engaging experiences. In this context, the traditional model of tourism promotion does not work since it leverages mainly on stereotypes and well-established symbols which produce a stagey image of the place, far from its actual reality. We rather observe a new sensibility in travellers, which is oriented toward experience, discovery and a more direct contact with the hidden identity of places. In this scenario, paraphrasing Picard [5], the global tourism supply should be focused on “glocal” content and the emotional enjoyment of places [6]. Furthermore, while in the past the cities relied heavily on their “real cultural capital” (the tangible heritage) [4], recent studies [7] reveal that the attention of public is focusing more on intangible heritage, popular culture and storytelling. As an evidence, the data reported by Richards [4] show that after 2005 the main Italian cultural capitals, that usually exploit their physical legacy with the past, have registered a progressive decrease of their rate of growth in tourism industry. Therefore, we observe the need of a different communication strategy, which should be aimed at the creation of engaging and emotional representations of the place. In other words, to better meet the current cultural tourism demand the destination image - the sum of beliefs, ideas, impressions, and expectations about a tourist destination area [8] - should rely on, or reveal, the "Landscape".

According to the Council of Europe «“Landscape” means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors». Furthermore, it is «an essential component of people’s surroundings, an expression of the diversity of their shared cultural and natural heritage, and a foundation of their identity» [9]. But not only, landscape is also a perceptual phenomenon that belongs to the domain of the aesthetic experiences [10]. Hence, we consider the landscape a tool to gain knowledge by means of experience, direct or virtual. It's meant as something we can explore as well as a means to expresses identity. We assert that guaranteeing the communicative access to “landscape” is essential in order to give new value to the cultural capital of places. Thus, the landscape must be decoded and translated in a clear and comprehensible representation, and the potentialities offered by new digital technologies in terms of representation languages as well as interaction modalities with content, are powerful tools to reach this goal.

3. Experience, Immersivity and Perception

As it has been revealed by the analysis on cultural tourism, currently the concept of travel is quite different from the past. It has taken the form of an exploration aimed at seeking meaningful experiences, especially from the emotional viewpoint. In this scenario, the tourism supply must go beyond the boundaries of product to become experience; and this challenge affects also communication, as it is the first contact we have with a tourist destination.

As suggested by Martelloni [6], the new trend leads us to look at tourism industry from the perspective of the experience economy. According to Pine and Gilmore [11] there are four “experience realms”: aesthetic, escapist, entertainment and educational. Moreover Forlani [12] suggests that the central one to gain a richer touristic experience is the aesthetic dimension, since tourism is always a "total aesthetic experience". In an aesthetic experience «individuals are immersed in an event or environment but have little or no effect on it, leaving the environment (but not themselves) essentially untouched» [11, p. 53]. Therefore, those who take part in an aesthetic experience will want "to be there" [12]. From another perspective, D'Orazio [13] - researcher and PhD in Social Science and Digital Media - has analyzed the literal meaning of the term "experience" concluding that it's strictly connected to the idea of immersion since both of them proceed from the interaction between space and body. Specifically, he argues that experience is a quality of immersion. This statement seems to be supported by Ortoleva. He provides an interesting analysis of the effect of new digital media on tourists behaviours, suggesting that it results in «a request of experience rather than pure knowing. A request of immersion» [14, p. 97].

Starting from these assumptions, the research we're carrying on focuses on the concept of immersivity meant as a form of aesthetic experience that leverages on the human perception as well as a communication modality which is able to satisfy the cultural tourists' need of experience. Our main goals consists in the development of a grammar - a set of guideline - for design of immersive communication formats to promote and represent "landscape".

The research methodology consists of a literature review, mainly in the area of human perception, and a case studies analysis. The literature review aims to investigate the perceptual aspects that affect (or may affect) the feeling of immersion, in order to identify the main pillars of an immersive communication. Especially, it deepens the concept of naive perception as a means to gain knowledge through experience. The case studies analysis aims at identifying communication formats and/or kinds of representation that present a place in an immersive way by leveraging on perceptual stimuli usually involved in the exploration of an environment (both urban and natural). We’ve chosen this qualitative method since it allows both to address the further research activities and to validate the findings of literature review.

Nowadays, the topic of “immersivity” is tackled by several disciplines. Nevertheless its meaning appears quite confused. Many scholars and professionals claim that immersivity is the future of communication, but they neither explain what immersivity really means in this context and nor provide scientific models for immersive communication design. While the common belief considers immersivity as a prerogative of Virtual Reality Environments (VREs) and so the result of specific technologies, like CAVE or Head-Mounted Displays, our goal consists in understanding how to obtain an immersive effect through traditional devices, for instance a pc desktop - therefore without using Virtual Reality technologies. By analyzing the concept of immersivity in a wider context of inquiry, we’ve found evidence that technology itself is not the only means to gain immersion. Immersivity concerns also the domain of representation. In the present communication context, the sensibility of users toward contents is changed; it has become synaesthetic [14]. That's why a message able to involve the human senses in a coordinated way is defined by literature as “immersive”. Therefore, we can talk about immersivity also with regard to the convergence of multimedia contents. In this sense, to develop a communication that has an immersive effect on the observer we have to manage different multimedia contents which have value per se but also influence each other. Here, the challenge – and the role of design – consists in keeping together different kinds of representation within a communication product managing their interrelation. In other words, we have to design a multimodal experience of fruition within a complex and articulated system of signs.

4. State of the art

4.1 Place and Experience

In the previous paragraph we had seen the strict link between the two topics: “experience” and “immersivity”.

In order to design and promote real immersive experiences of places we have to identify how communication devices and languages can create the good conditions in order to make visitors interface with places.

A real interaction with an urban or natural environment presupposes the ability of visitors to get in touch with them surroundings. We are interested to design communication formats and experimenting new immersive languages that can support this ability encouraging a contact with places in order to help visitors catch the deep “sense of place”.

Thanks to the web, new geo-location technologies and the availability of multimedia content in real time, often bottom up, the way of exploring a space has changed: today users live a “pre-experience” of places, an “active experience” in the place itself, and a “post-experience” (e.g. with comments and ratings of visitors on forum) [15]. Furthermore this ability of specific communication devices to facilitate the contact between visitors and places presupposes the design of specific interaction levels. These levels exemplify how and when the user, while using the device, can interact with the several contents related to a place.

In order to identify these levels we had take in consideration the semiotics analysis of the travel guide described by Alice Giannitrapani [16] and we had identified three predominant functions: directive function, informative function, and interactive mediation function. These functions focus on the moment in which the users access contents: before, during, and after the exploration. The devices with a prevalence of directive function guide and precede the user in the exploration of places through the anticipation of contents, offering a “pre-experience” of them; in fact, the fruition of information precedes the contact with the actual place and usually, even if the device is portable in situ, the contents do not change. An example is the traditional touristic guidebook. Its purpose is to push and help the user both during the visit and before the real “active-exploration”, identifying landmarks, itineraries and information on the area. The devices with a prevalence of informative function give information about the site, without inviting the user to explore the place. In this case, getting in contact with spaces is not relevant to the communication goal. These devices provide a representation of the environment, such as data maps. Instead the devices with a prevalence of interactive mediation function have the highest level of mediation between the user and places; indeed, their use is principally in situ. These devices have both a programmatic and a performative aim - such as mobile guides with geo-location technology, augmented reality or use of sound - as well as information purposes, such as descriptive signage and art installations. Their main feature is high interactivity.

In next paragraph we want to present how two different communication projects can enhance a “pre-experience” or an “active experience” of a place.

4.2 Case study: Soundwalk audio tours

The first case study project is related to promote an “active-experience”.

Travel and visiting a place is the first aim of communication projects as, for example, AR travel guides and, audio guides and way finding applications and installations. These kinds of projects connect the topic of “experience” to the action of “motion” and “exploration”.

Erich J. Leed [17] points out that at the Indo-European root of the word "experience" has linked meanings related to the motion and to the travel. Interfacing with the environment, doing an experience of the spaces, so means «to put us in a condition in which the landscape may reveal itself and making another effort with our body: we must go, walk, make a dive without cultural preconception and experience it» («mettersi nella condizione per cui quel paesaggio possa svelarsi, fare ancora uno sforzo con il nostro corpo: bisogna andarci, camminarci, immergersi senza preconcetti culturali, farne un”esperienza diretta») [18, p. 171]. Giuliana Bruno [19] discusses the topics of “Experience” and “Motion” also. She assumes that a strong interaction with the environment presupposes the capacity of the visitor to get in touch with the place, through a perceptual shift from optical to haptical, from sight-seeing to site-seeing. This skill, that needs to be designed and supported, allows people to “experience the landscape", and put the visitor in the condition of perceive the sense of place.

Among the new models of devices for urban explorations Soundwalk audio tours [20] is a really interesting case study for its ability to push the visitor to feel two different experiences in the same moment: physical and acoustical. The result is an interesting "perceptual disorientation" [21].

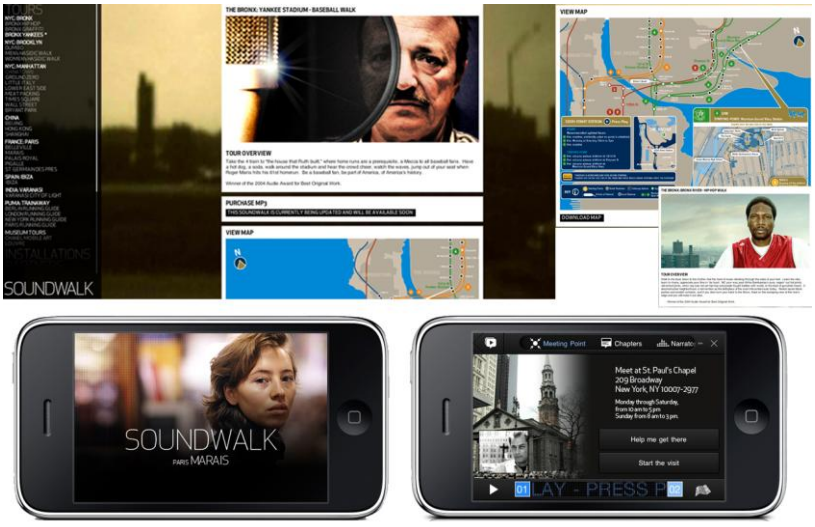

Fig. 1: Souldwalk audio tour: the communication system.

Soundwalk is an international collective, founded in 2000 and based in the city of New York and the audio tours are multimedia audio guides. The concept of Soundwalk audio tour is funded on the idea of an audio guide that, by representative authors narrations, allows exploring the urban environment providing an immersive experience in the real world. Using representative actors for the narrations, scenarios and soundtracks, the device offers new ways to discover the landmarks between the flâneur walk and cinematic experience. Initially created for support web and paper the project allowed users only to download podcasts and maps of the different tours. Now the audio tours have become a mobile application. The application offers multimedia contents (images, videos), a strong immersive audio, interactive maps and real-time information through the user"s geolocation. The mobile application offers several level of information: in it we can find the interactive mediation function. Before the visit the audio tour offers basic information and photos of the different landmarks. Only when the visitor is in loco the application shows practical information and more contents related to specific places. At the end of the experience the visitor can also share comments on social network and recommend the visit to friends (see Figure 1). The acoustic tours, created initially to explore the city of New York, now are been developed for several areas: district and entire cities (e.g. Beijing, Shanghai, Varanasi, Hong Kong). The latest audio tours are the Puma Trainaway acoustic itineraries, sponsored by Puma, for the visitor that runs through the city, and Museums Tours (Louis Vuitton Voyages, Louvre, etc.).

4.3 Case study: Soul patron web documentary

Nowadays the communication of urban or natural environments involves an open view and an analytic ability in order to capture both the different approaches in representing the contents related to a place and the continuous development and hybridizations of media and languages used for this purpose.

A useful example to show how the communication devices can offer a "pre-experience" of the places transferring different levels of information, making them accessible, are the web documentaries. In them is clear how the emerge of new technologies has led to hybrid formats that combine elements of continuity with traditional forms with elements of strong innovation. With interactive documentary, web documentary or web-doc, we refer to a particular type of documentary invented 2000, as an interactive multimedia product designed for web.

From the point of view of interaction, the web-doc lends itself to user participation; the viewer becomes an active participant, who can choose the way of explore the documentary and also often share contents. From the perspective of media, whether a classic documentary is an audiovisual product, the web-doc involves the use of integrated contents such as audio, video, graphic, text, info graphics and hyperlinks.

We can highlight distinct features of web documentaries such as interactivity in experience and its openness during the content narration. Sandra Gaudenzi [22] explains how different degrees of interactivity can help to

classify these new forms of documentaries. Gaudenzi presents three different levels of interactivity that determine the categories of documentary. We can find a “semi-closed interactivity” when the user can browse but not change the content, a “semi-open interactivity” when the user can participate but not change the structure of the interactive documentary, or a “completely open interactivity” when the user and the interactive documentary constantly change and adapt to each other.

Furthermore Arnau Gifreu [23] discussed how we can also categorize the different modalities of interact with the narration: “linear documentaries”; “on line non linear multimedia documentaries”; “on line generative documentaries”. The online linear documentaries have a narrative structure divided into themes, sequences, and chapters. In them contents are presented in a linear way or divided into different parts. The on line non-linear multimedia documentaries offer one or more modes of interaction and contents organization making the user freer during the navigation. Into the on line generative documentaries the user is not only limited to viewing content in a linear way or navigating in different modes , but instead he can interact leaving an imprint of his time in the application by comments and shared contents adding personal experiences to the documentary.

The case study that we will present shows a strong integration of multimedia contents and several level of interaction. It illustrates an innovative use of the languages in interactive digital communication.

Soul Patron [24] is a semi-open web documentary presented by Frederik Rieckher in 2010. The web doc wants to present the mythical protector of deceased children, Mizuki Jizo, by a digital journey through Japan. The guide of the journey is Tokotoko, an animated bunny that was once intended to be a gift for a stillborn baby. The project consists of 34 scenes and a non-linear narration. The first scene presents Tikotoko as guide during the user travel. After the web-doc explains the several different ways of interact with the scenes. The journey begins at the Kumakuru temple and travels via Tokyo and Osaka to the Mizuko Jizo house of prayer in Kyoto. The places are presented by video with a fixed shot. The audio is composed by audio track recorded directly in the places and presents the “soundscape” [25] of the different areas. The user can interact with each scene, zooming on visual details through close up and receiving links to at least two other scenes (see Figure 2). Every interactive visual detail is connected with information referred to social, morphological, religious data. In this web documentary the visual and audio treatments, the possibility of interact with several typology of content navigating in a non linear ways make possible to offer to user a strong immersive pre-experience of the places. In the web-doc Soul Patron so we can find a good experimentation that mix narration, innovative representation by different communication languages and several level of user content fruition.



Fig. 2: Soul Patron: example of screenshots.

5. The Lomellina project

This research has informed a funded project we are working on which consists in a web-based communication system (desktop and mobile) for the promotion of Lomellina, a wide rural area near Milan (Italy). This territory is not at all considered as a suitable tourism destination, in spite of the efforts spent by local institutions. Nevertheless, a deeper analysis of its assets has revealed a considerable cultural, natural and historical heritage, which well represents the urban and natural environment of Lomellina, and needs to be promoted.

To represent and promote its “landscape”, we have used several immersive communication formats which bring together different kinds of "texts" (photos, documents, videos, etc.) in order to provide a visual synthesis as much as possible immersive - from panoramic photography to interactive 360-degree photography. The combination of these representations results in an “augmented” experience, which is able to involve haptic perception only by means of visual information. Since there are many viewpoints through which observing the landscape - from the 360-degree panoramic up to the extreme close-up - the sight has an explorative dimension (see Figure 3). That's because our impressions about a place mainly arise from the movement of our body in the space. On the one hand, the eye is able to capture in a single glance the surrounding environment. On the other hand, it is also able to provide synthetic information about textures, colours and shape of objects. Through the close-up, the eye is guided in a visual search for meaningful signs.

We can provide an "augmented" perception also through images and sounds that exploit perceptual memory. As a matter of fact, when we closely observe an object, the visual information about the material of which it is made recall the corresponding tactile sensation (see Figure 4). Therefore, we can consider textures, colours and shadows as visual and tactile information at the same time. As suggested by Aristotle [26], memory is the driving force behind the experience; we can feel ourselves emotionally and perceptually immersed in a past situation simply by observing an image. In this sense, an extreme close-up on dew, combined with a long shot of a rice field enveloped by the winter fog, recalls a specific mood and nurtures our ability to perceive the atmosphere - the landscape - so depicted (see Figure 5).



Fig. 3: The Lomellina project: combination of viewpoints.



Fig. 4: The Lomellina project: close-up.



Fig. 5: The Lomellina project: the mood of place.

6. Conclusions

The tourism demand has highlighted how the topics of Experience, Immersivity and Perception are becoming more and more indispensable requisites in the discovery of places. The growing interest of public and private institutions in the enhancement and representation of the “sense of place” needs to be supported by adequate communication systems.

Promoting a place so means to make accessible its identities through specific languages and appropriate formats: that is the aim of Communication Design for urban and natural environment.

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Bibliographical References

[1] Ypma & Associates:
http://evertypma.nl/images/stories/publications_media/crisismagazine/evertypma_2011_the_crisis_of_designing_identities.pdf

[2] BAULE, Giovanni; CALABI, Daniela; SCURI, Sabrina. Narrare il Territorio: Dispositivi e Strategie d'Innovazione per gli Spazi Percepiti. In COLETTA, Claudio; COLOMBO, Sara; MAGAUDDA, Paolo; MATTOZZI, Alvise; PAROLIN, Laura Lucia; RAMPINO, Lucia. *A Matter of Design. Making Society through Science and Technology. Proceedings of the 5th STS Italia Conference 2014*. Milano: STS Italia, 2015, p. 201-215.

[3] CALABI, Daniela. Design della comunicazione per i territori. In SCURI, Sabrina. *Territori empirici. Comunicare l'identità dei luoghi: un progetto di design della comunicazione*. Roma: Aracne, 2013, p. 19-28.

[4] RICHARDS, Greg. Cultural Tourism 3.0: The future of urban tourism in Europe? In *Città Ri-visitate: Nuove Idee e Forme del Turismo Culturale.* Bergamo March 13-14, 2014.

[5] PICARD, David. Cosmopolitanism and hospitality. In SMITH, Melanie; RICHARDS, Greg, *Routledge Handbook of Cultural Tourism*. London: Routledge, 2012.

[6] MARTELLONI, Rossella. *Nuovi territori: riflessioni e azioni per lo sviluppo e la comunicazione del turismo culturale.* Milano: Franco Angeli, 2007.

[7] DU CROS, Hilary, *Tourism and Intangible Cultural Heritage*. Madrid: UNWTO, 2012.

[8] CHON, Kye-S. The Role of Destination Image in Tourism: A Review and Discussion, In *The Tourist Review*, 1990, 45(2), p. 2-9.

[9] European Landscape Convention:
http://www.coe.int/t/dg4/cultureheritage/heritage/Landscape/Publications/Convention-Txt-Ref_en.pdf

[10] D'ANGELO, Francesco. *Estetica della natura*. Roma: Laterza, 2003.

[11] PINE, Joseph B.; GILMORE, James H. *The Experience Economy*. Boston: Harvard Business Press, 2011.

[12] FORLANI, Fabio. "Esperienze, marketing e territorio". Director: Tonino Pencarelli. Università degli Studi di Genova, Dottorato di ricerca Impresa e Mercato, 2004.

[13] D'ORAZIO, Francesco. Immersione. In ABBRUZZESE, Alberto; GIORDANO, Valeria. *Lessico della comunicazione*. Roma: Maltemi, 2003, p. 271-275.

[14] ORTOLEVA, Peppino. *Il secolo dei media. Riti, abitudini, mitologie*. Milano: il Saggiatore, 2009.

[15] GRANIERI, Giuseppe; PERRI, Giampiero. *Linguaggi digitali per il turismo*. Milano: Apogeo, 2009.

[16] GIANNITRAPANI, Alice. *Viaggiare: istruzioni per l'uso. Semiotica delle guide turistiche*. Pisa: Edizioni ETS, 2010.

[17] LEED, Eric J. *La mente del viaggiatore. Dall'Odissea al turismo globale*. Bologna: Il Mulino, 2002.

[18] CARERI, Francesco. *Walkscapes. Camminare come pratica estetica*. Torino: Einaudi, 2006.

[19] BRUNO, Giuliana. *Atlante delle emozioni. In viaggio tra arte, architettura e cinema*. Milano: Mondadori Editori, 2006.

[20] Soundwalk: http://www.soundwalk.com/

[21] GRAVANO, Viviana. *Paesaggi attivi. Saggio contro la contemplazione*. Milano: Costa & Nolan, 2008.

[22] GAUDENZI, Sandra. "The Living Documentary: from representing reality to co-creating reality in digital interactive documentary". University of London, Centre for Cultural Studies of Goldsmiths, 2013.

[23] GIFREU, Arnau. The Interactive Documentary. Definition Proposal and Basic Features of the New Emerging Genre. In AA.VV. *McLuhan Galaxy Conference*. Spain: Conference Proceedings, 2011.

[24] Soul Patron: http://www.soul-patron.com/

[25] SCHAFER, Raymond M. *Il paesaggio sonoro*. Milano: Ricordi Lim,1985.

[26] ARISTOTLE. *Analitici Secondi*. Roma: Laterza, 1973.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Pompeii - Nature and Architecture

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Abstract

This paper is aimed at surpassing the cultural tradition that encourages the humanistic knowledge more than the naturalistic one in the refurbishment of the archaeological sites. The contribution of botanic sciences in the reconstruction of ancient landscapes is essential to gather wide-range information about the ancient flora. Supporting this cross-disciplinary approach means intensifying the debat and the comparison between all of the different specialists involved in the problem. The main purpose of this paper is to integrate the restoration of architectural and residential buildings with archaeobotanical restoration of areas which were once thought for the green areas. To exemplify the method that we wanted to use in this paper, we have fine tuned the data relative to the plants findings related to Regio I's insula 9. For the philologic study of Pompeii's ancient green spaces, the archaeobotanic data prepared by Annamaria Ciarallo have been analyzed. The recovery of botanic species is fundamental for the fruition of archaeologic heritage, while integration of the study of paleobotanics in the restoration of archaeologic sites is an added value to the analysis of the historical landscape.

Keywords: Ancient Pompeii - Archaeobotanics - Architectural Restoration - Historical Landscape - Regio I



Image 1: J. L. Chifflot (1903) House of the Centenary - cross section through the peristyle.

1. Greek influence in the urban implant of Historical Pompeii

Ancient Pompeii preserved the Italic trace even after intensely absorbing and re-elaborating the influences of Greek architecture and town planning; the fact that the city was divided in neighborhoods since the Sannitic Age can be understood from the few names given to the streets, thresholds and towers stored in the Oscan inscriptions. In the urban expansion of the IV century, the town was planned according to greek models, initially inspired by Nepalis, built by Greeks in consonance with Hippodamus of Miletus' principles, the first town planner to discuss of the polis'space in its double meaning of the greek word city/state and physical city. Hippodamus' idea was focused on the division of the urban territory in three parts: sacred, common and private; in his idea, the spatial organization is to be connected with the social organization, and the space is divided in specific sub-spaces and consigned to the social groups. Hippodamus was not the inventor of the grid arrangement, seen as a technical form of spatial arrangement, but actually the inventor of the territory's division in line with a connection between land and law. The orthogonal grad - that was not invented rather codified by Hippodamus - is an example of aesthetic/functional innovation that builds a city plan respecting tradition and democracy; in the colonization project the expansion plans were compared to existing cities and are identified basing on their relationships: the planning of new cities is not out of this criteria, the urban design is not subtracted from the comparison with the reality of ancient cities. In fact, as much as Pompeii was object of remarkable urban and architectural transformations already from Samnites that were not able to exclude the greek influence; the city's layout derived from Hippodamus does not show the rigid right-angle placement and the blocks do not have constant sizes, as it is in Nepalis; even the houses are differentiated, as written by Capasso in the act of describing Neapolis' housing typology and highlighting how the development given by the Greek and Roman civilizations to the primordial form of courtyard houses was different: "*not even the way of grouping the rooms around the primordial courtyard was identical;… it is though certain that the Greek civilization… added to the original implant other open-air areas, surrounded by colonnades and wide rooms. These kinds of extension were obtained later on by the Roman house, taking them… from the Greek house; so we reach… the Pompeian House, which in its essential arrangement is very similar to the Hellenistic period's Greek houses… a different lifestyle was there between the Nepalis' and Pompeii's houses, and it deserves to be described. Neapolis' house was predestined to a cozy life, far from the street's movement. And, according to this, Priene's exploration has demonstrated that the houses' entrances… were not placed down the main roads, but in the alleys that cut orthogonally. Maybe the same happened in Naples, in which the islands were left almost blind towards the Decumanus. Instead, the sense of life's intimacy demonstrated by the Pompeiian house is lesser, as this typology tends to leave front doors on the main streets"* (Capasso, 1905). Nevertheless, despite the lack of exactness, Pompeii represents an example of systematical urban planing in Italy; the roads' system fixes the area's general division rule in squared and rectangular elements which the houses will be placed. So the block/insula the mediation element between the single housing unit and the city itself, as it is defined outside by a public element, the street, and inside by the aggregation of a private element, the house. The ash blanket has perfectly conserved the basic element of the ancient, still recognizable in the fragmentation of the block: the domus.

1.2 Urban Housing and Green Spaces in Ancient Pompeii

The building development of the inner city seems to have happened in later moments even if, probably, in a short period of time (Franciosi, 2009); anyway, the archaeological site offers the possibility of knowing the Pompeiian house built during its historical and social development, lasted more than four centuries. In the northern area we see the more ancient houses with severe facades, closed by big limestone squared blocks from the first Samnite age (425-200 b.C.). In the second Samnite age (200-80 b.C.) in the building development we have a deeper Hellenistic influence from the close cities of Dicearchia, Cumae and Neapoli; in the field of architecture we see new elements from the Greek culture, such as peristyles, nucleus of the Hellenistic house. In the republican period (80-27 b.C.) housing architecture is characterized by the restoration activities that were necessary following the damages suffered in the war and by enlargement projects of the existing buildings. An important infrastructural contribution can be seen in the early imperial age (27 b.C. - 54 a.d.) with the connection of the Pompeiian water pipelines with the aqueduct built by Augustus in the Serino valley, and this water provision encouraged several Hellenistic-inspired trends such as the art of gardening (*ars topiaria*) that introduced new architectural and decorative forms. In the last period (54-79 a.d.) Pompeii's buildings were partly interested by renovation works as a consequence of the 52 a.d. earthquake; the Isis Temple and the Amphitheater are the only monuments that were completed before the eruption of the year 79 a.d., while in the wealthier houses the refurbishment was almost completed, although nullified by the explosion of the Vesuvius.

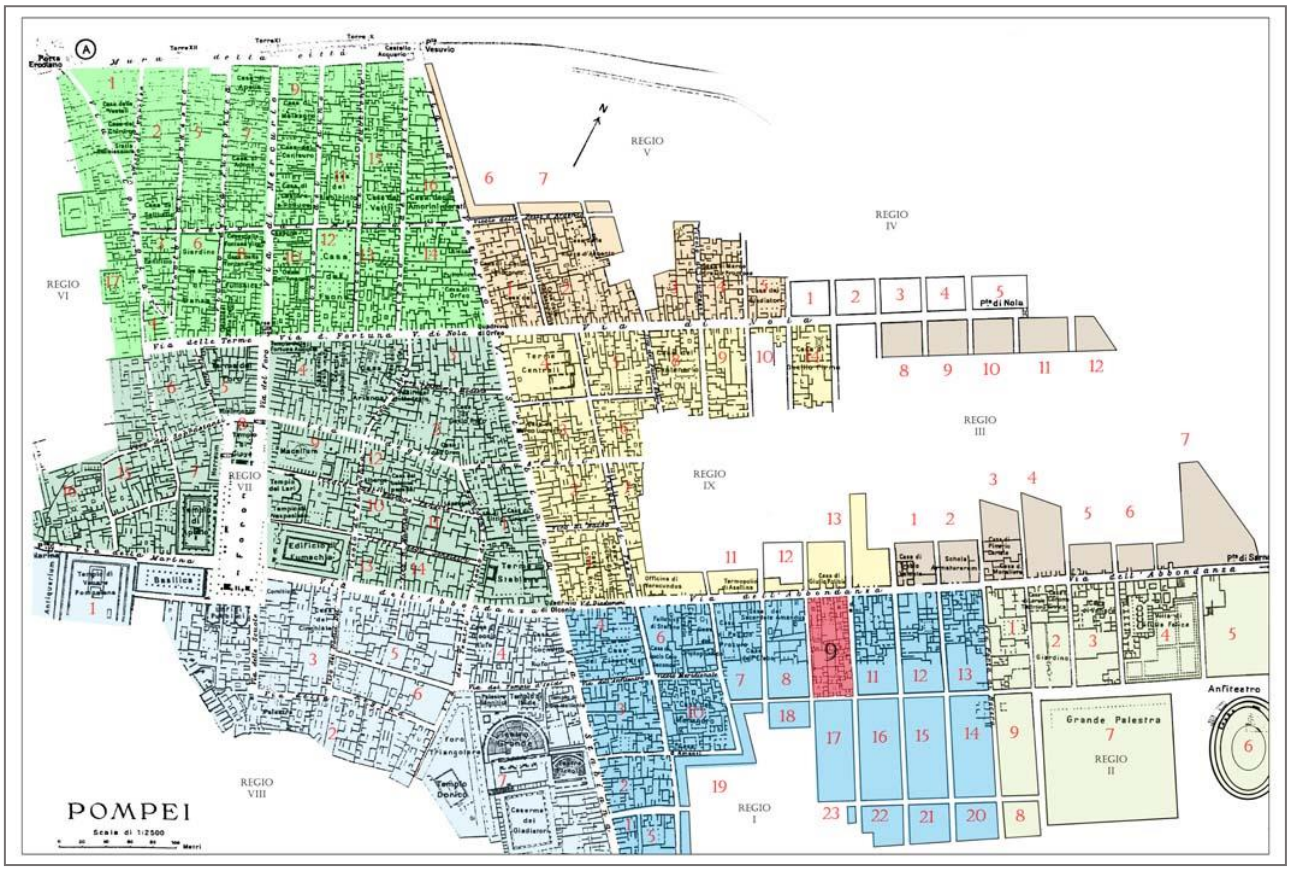

Image 2: Pompeii city plan the numbering of blocks and houses in Ancient Pompeii. The numbering of the blocks and hauses of Ancient Pompeii, commonly accepted in Pompeiian literature, is conformed to the division of the archeological site in nine Regiones, wich are in turn devided in insulas, as coded by Fiorelli in 1875.

Pompeii, commonly accepted in Pompeiian literature, conforms to the division of the archaeological site in nine *regiones,* in turn divided in Insulas, codified by Fiorelli in 1875 The Vesuvian cities of Pompeii and Herculaneum are amongst the richest documentations available about archaeobotany; the peculiarity of the ancient city's burial allowed plant findings; the documentation represented by the ground's shaping and from the cavities left by the roots represent only the tangible example of the green areas' organization in a two-millennums-old town Ciarallo, 2012). Annamaria Ciarallo in her book *Gli Spazi Verdi dell'Antica Pompeii* states that "… *there's no house in Ancient Pompeii that didn't have a green space: in the oldest houses, that can be dated back to around the fourth and third century b.C. in their original structure, the smallest areas, the horti, seemed to respond to what highlighted by Pliny the Elder, whom relates the terms hortus and heredium"* (Ciarallo, 2012). In the most ancient times of the classical world, the voice *heredium* was kind of a synonymous of *hortus,* of which the etymology can be deducted by Greek χορτοσ/grass, term which was subsequently associated to a grassy, bounded spot(Nibby, 1839), up to specifying a specific-sized piece of land intended to produce vegetables and fruit. These cultivated areas inside the houses were used for familiar farming up to the second centuryy b.C.; the houses of this period correspond to the italic type, and recall the etruscan model recalled by Vitruvius' descriptions, built in bricks or ashlar stone formed by a singular rectangular room, covered by a four-slopes roof, pierced to allow the smoke's expulsion. Since the second century b.C. the influence of the Hellenistic world started to interest the Pompeiian house, too, in fact the typology evolves and more rooms are added around the open-air central space; the introduction of architectural elements such as colonnade and arcades transforms the *hortus* in *perystilium/colonnade garden.* In the Patrician domus, we have the insertion of new Greek style architectural elements, as in the case of the introduction of the *perystilium,* which is the nucleus of the Hellenistic house that was never supplied with the atrium, unlike the Samnite house, whose presence is seen by the *House of the Surgeon* (VI, 1, 9.10); the peristyle is no longer a central court but it becomes a garden, closed in the ionic or doric columns quadrangle; following the atrium and the tablinium, which are generally in axis with the entrance, the peristyle creates a suggestive architectural perspective. In Pompeii the green spaces inside the houses have a great importance; in each house, even in smaller ones, a green space is always present. The study of the plant findings from the green spaces of the domus have demonstrated that they were characterized by

lawns with several herbaceous species, few shrubby species and fruit trees (Ciarallo, 2012). The green areas spotted within the walls have been identified by Dr. Ciarallo's team on the base of the characteristics and the private/public intended use; within the urban space, near the domus', public and sacred buildings green areas, productive and artisanal green spaces have been located (Jashemsky 1979°; Ciarallo 2004).

2. Architecture and Nature in the Domus Pompeiana

In the domus pompeiana the green space is introduced diffusely and constantly, juxtaposing new spaces to the typology of the house; in the older Smite tradition Pompeiian houses, the green space is always organized in a small *viridarium* placed outside the *atrium* and the *tablinium,* while in other houses example the *viridarium* creates a middle environment between the court and the garden, transforming the peristyle in a garden or *pergola* in which vines create a domestic garden. The evolution of the Pompeiian domus goes on according to a specific architectural formula, that transforms plants into architectural elements. Within the walls of the domus, where the soil is sufficiently wide, the *hortus* is placed side by side with an original architectural solution: the viridarium; full and empty spaces are organized according to a axis symmetrical and ornamental conception of the different environments; the vegetation elements become construction elements of the domus: plant covered walls and hedges that create routes, transforming open spaces in green spaces in which vegetables, medical and ornamental plants can be cultivated. The Pompeiian domus' ornamental garden, the same as the roman one, can be found in the space of the peristyle and it is made by flower beds delimited by drainage channels, fences or laths. Most of the times the gardens were richly monumentalized with statues, fountains, bodies of water and triclinia cover by pergola and sacred by the Lari shrine. Pompeii was strongly affected by the Hellenistic-Inspired fashion of the gardening art, which lead to new architectural an ornamental forms; the gardens were enriched with caves and artificial waterfalls, connected with the rituals dedicated to nature; the vegetable garden was transformed from a food-productionarea to pleasant amusement and relaxation spot. The gardens were filled with statues of the deities of fecundity and Dionysiac mysteries, placed on the sides of the marble pools that, recalling the Egyptian culture, were presented in the shape of *euripi,* canals that symbolize the route of the Nile and used to keep the plants alive. A constant element in the garden was the nymphaeum, whose faux rock coating was designed to make the environment of the cave a place of meditation and veneration of the nature's forces. In the organization of the Pompeiian domus the nature was being introduced, implementing in it an emulation, and artifice: the green space in fact had a fundamental importance in which the element water was used as ornament (Borghi, 1997). In the domus water is predominant, it gushes through marble steps or sprinkled from apsidal fountains placed in front of the garden's last wall, whose mosaic coating allowed it glares to shine. The meals had a sacral connotation, too, and from a merging between sacred and profane we have the birth of the concept of *triclinium* or *biclinium* set in the nymphaeum-cave or open air, in the garden; in internal triclinia the love for nature is expressed through the decorated walls with the so-called *horti picti,* paintings that represented plants and animals.

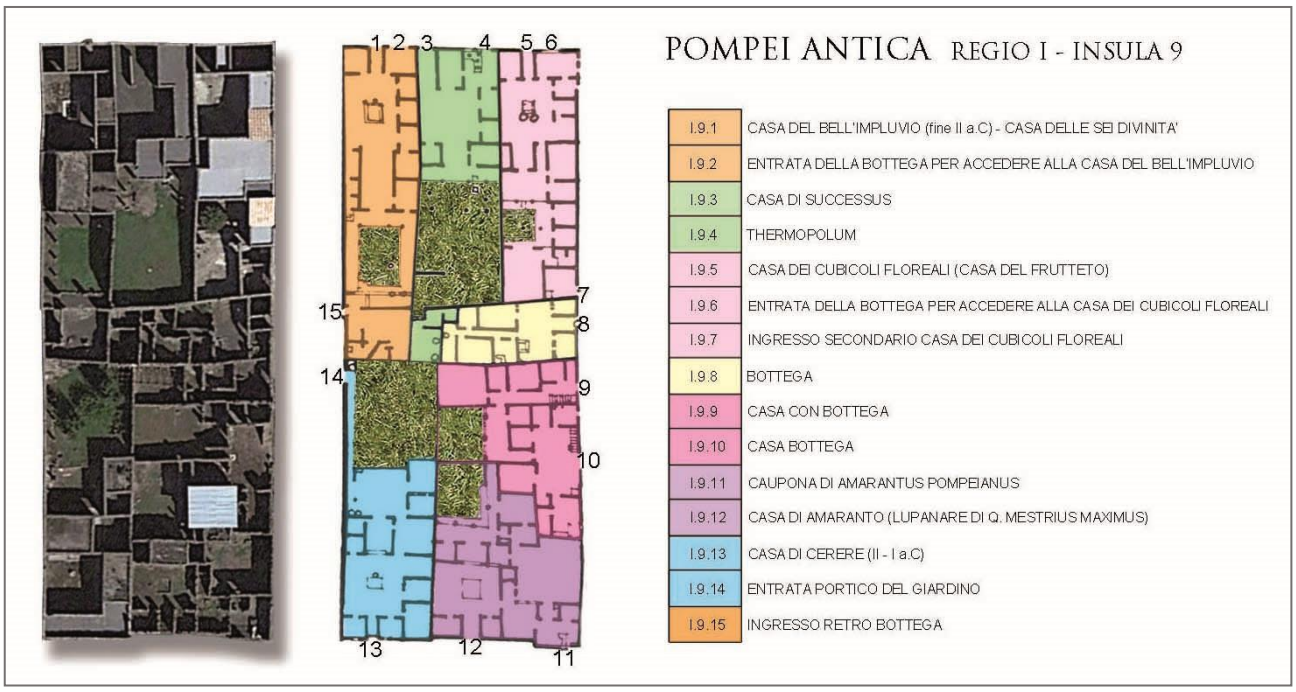

Image 3: Pompei**,** Insula 9 Regio I. Recostruction of the building types. 2015 sat image Earth.

2.1 The architectural elements

The excavation of an urban complex such as Pompeii gives a broad and varied documentation of the private houses used in the classical world, which is testimony of domestic architecture's evolution during the centuries. In Pompeii, the most used type of house is the *domus atria,* characterizing architectural element of the italic-roman civilization; the house was developed around a central nucleus that was the *atrium,* a generally large court crowned by an opened roof (*compluvium*) and equipped with a water collecting tank (*impluvium*). In the earlier centuries, the fireplace was in the atrium, around which family life took place. This room was soon abandoned, even though a small raised platform called *cartibulum* kept symbolizing the implrvium's fireplace. The traditional pertinence of the atrium was a shrine reserved to the domestic worship, usually shaped as a small hollow or kiosk, with the back wall frescoed with *lararium* images. Vitruvius describes five types of *atrium*: *Tuscanicum*, the most ancient and widespread, in which the weight of the roof is supported uniquely by the horizontal beams; *Tetrastylum*, with a column in each of the four angles of the impluvium; *Corinthium,* with a broader number of columns ad a wide opening for the light; *Displuviatum,*of which we don't have an archaeological documentation, with roof slopes towards the lateral walls to drain water in showers in the four angles; *Testudinatum*, without the impluvium, used only in small and nonimportant environments. The entrance of the house, articulated in *vestibule* and *fauces*, lead to the atrium, around which we have the bedrooms (*cubicula),* the banquet hall (*oecus triclinare* or *triclinium*) and the boardroom (*tablinuim*), placed in front of the fauces (entrance), behind which there was a space used for the garden (*hortus*). This type of house, which had no openings towards the outside, appeared to be closed to itself. This building types, that was differentiated according to the different cases for size, was substantially modified during the second century b.C: thanks to the song influences coming from the hellenistic house type, influences that can be read by especially in the substitution of the *hortus* with a big garden portico (*perystilium*) surrounded by rooms. The environments of the house looking the decumans, when not used as house, were opened towards the streets and hosted shops. Pompeii shops that still exist on the front of the domus from the second century b.C. are amongst the most beautiful that were preserved till our times from the classic world; they were built by a rectangular ground floor space and an upper floor served by a wooden or brick stile, attached to one of the sides of the ground floor. The shops of the roman period, as similar to the ones of the Samnite-Hellenic period, were quite bald and often the upper environment had a balcony. Focus of this study is the Insula 9 of the Regio I, in which several insulas with different appearance can be recognized, as a result of different moments of urbanization (third-second century b.C.); this Regio for its decentralized position was not totally build; the agricultural usage continued being amongst its peculiarities, making this segment of the city unique in the urban landscape of Ancient Pompeii (Helg, 2005). In the rectangular insula 9, oriented perpendicularly to Via dell'Abbondanza, there are several domus, taverns and artisan shops dating approximately from the second century b.C. In the header of the insula that faces Via dell'Abbondanza, one of the most busy streets of the ancient city, there are three house entrances: the house of the *Bell'Impluvium* (House of the Beautiful Impluvium I.9.1), the house of *Successus* (I.9.3), and the house of the *Cubicoli Floreali* or House of the Orchard (I.9.5). Besides the entrance of the three domus, in the facade of the entrance opened to the important commercial street, there were three openings that coincided with the shop (I.9.2 - I.9.4 - I.9.6); the propinquity with a arterial commercial road influenced for sure (as demonstrated by the findings from the site) over the richness of the domus, the three houses preceded by the shops were rich and finely decorated. In the lateral alley on the eastern side of the insula small and slightly decorated houses can be seen, in which prevalently artisanal activities were performed (I. 9.8 - I.9.9 - I.9.10). The other header of the insula is interested by the accesso to the Amarantus house and *caupona* (I.9.11 - I.9.12) and the House of Cerere (I.9.13), which from the analysis of the findings seems to be the only house of the insula that was exclusively residential. The excavation for this insula were completed about 1951, and unearthed several spaces destined to plants cultivation; the current state of these green areas is degraded and with damages meadows. In the House of the Beautiful Impluvium (I.9.1), that is named after its amazing impluvium coated in mosaic and inlaid with polychrome marbles, the green zone was the peristyle garden. The wide rectangular space was surrounded of the four sides by a brick columned portico, while today the garden is surrounded only on three sides; on the back of the garden there were originally the rooms that faced directly the portico, and the brick pillars are still visible in the underlying basement (Unpeeling Pompeii, 1998). Along the whole perimeter of the garden there is a brickwork gutter to collect rain water, deep enough and coated in *opus signium* (Ciarallo, 2012). In the House of Successes I. 9.3, that is named after the painting of a child, with a sign that says "Successus", the structure of the garden/ peristyle is perfectly preserved that in the moment of the excavation showed a white panel that was lost and a niche with floral elements. The garden was delimited with a portico of which two central brickwork columns are visible, on which two semi-pillars are placed with semi-columns to frame the access. On the eastern and western sides three columns of the original portico are visible. In the northern portico the mouthpiece of a lava stone cistern and a travertine patella are still visible. Today the meadow is very damaged (Ciarallo, 2012). In this house the entrance is moved to occupy the facade with a thermopolium and a triclinium on its

side, so that the position of the fauces, which is usually central, is moved (Helg, 2005). In the House of Orchard I.9.5, a small garden called the xystus is placed behind the tablinium, surrounded on the sides byn brick columns coated, in the lower part, by red stucco. The garden is in a good state of conservation, and it is cultivated as meadow with red borders (Buxus sempervirens) with an oleander tree in the center (Nerium Oleander). Probably in the period before the eruption it was used as an amphorae shop, the garden along the north, east and southern sides presents a gutter to collect rain water.



Image 4: House of the Beautiful Impluvium, Peristyle garden.



Image 5: House of the Orchard, Peristile garden.

For the House-Shop I.9.8, Jashemesky mentions the narrow open space placed on the back of the house, supporting the thesis that originally it was used as a garden (Jashemesky, 1993), but analyzing today's structure the area is not identifiable as a garden (Ciarallo, 2012). In the House with Shop I.9.9 the green space is delimited from a portico on the back of the shop that, judging by the conspicuous number of pigment jars found during the excavation, hosted the boutique of a painter; it can be lead to an xystus, a garden generally located in the covered zone of the peristyle, among the most known shapes of roman gardens. This green space, on an upper level, was delimited by a portico of which nothing remains today. The garden is now bare soil, and along the western side there's a gutter for rain water collection that is almost buried, in very poor conditions, with two wells on the northern and southern sides. Behind the Amaranths Caupona (I.9.11), formerly destined as viridarium, Jashemsky hypothesizes that there has been a broad open air area for gardening. Today, it is not possible to understand the original asset. In Q. Mestrius Maximus' Amarantus House (I.9.12), anciently used as xystus, is a garden on the back of the house, preceded by the tablinium; the green space is surrounded on two sides by a portico; brick columns and pillars are united by brickwork plutei. Along the southern and eastern sides of the garden is the gutter for the collection of rain water. The broad and deep masonry canal in opus signum is well preserved. The current status of the garden is bare soil. In the House of Ceres (I.9.13), an ancient xystus has been substituted by a wide green area in the back of the domus, due to the terrain drop the garden is on a higher floor. The green space accessible straight from the entrance 14 shows a wide portico with brick columns on the western side, and the portico is closed by a wall. The garden is currently cultivated as meadow with fruit trees: prunus persica, prunus domestica, ole europea and vitis.

2.2 Vegetation

The data of the vegetal findings of the Regio I's Insula 9 has been extracted by the list of the plant findings at the Laboratory of Applied Researchesof the Soprintendenza Speciale per i Beni Archeologici di Napoli e Pompei (Ciarallo, 2004) (Ciarallo, 2012); in the list, the location of the findings is declared, identified following the division of the Ancient City coded by Fiorelli in 1875 that consists of the division of the archaeological site in nine Regiones divided in turn in insulae. According to this division each finding has been identified with the numero of the Region and of the Insula, followed by the civic number. On the base of the elaboration of the cartography (scale 1:2500) of the archaeological excavation published in the Guida Napoli e Dintorni of the TCI, in which the nine Regiones have been classified with the subsequent insulae, the implementation of the data of the plant findings of the Insula 9 Region I have been caried out; in this insula can be found: four domus (*Bell'Impluvio, Successus, Cubicoli Floreali, Cerere*), two non-coded houses, a Capon (*Amarantus Pompeianus*) and a Lupanar (*Q. Mestrius Maximus*). In this housing units vegetal findings have been unveiled (not-wooden parts, pollen, seeds, fruits, pods and leaves) from plants belonging to the following families: *Boraginaceae* 1 species - *Caprifoliaceae* 2 species - *Cariophyllaceae* 4 species – *Chenopodiaceae*

4 species - *Compositae* 3 species - *Corylaceae* 1 species - *Cruciferae* 1 species - *Dipsacaceae* 1 species - *Equisetaceae* 1 species - *Euphorbiaceae* 1 species - *Fabaceae* 1 species - *Graminae* 9 species – *Juglandaceae* 1 species - *Leguminosae* 9 species - *Malvaceae* 1 species - *Oleaceae* 1 species – *Pinaceae* 1 species - *Poliganaceae* 2 species - *Primulaceae* 1 species - *Punicaceae* 1 species - *Ranuncolaceae* 1 species - *Rubiaceae* 3 species - *Urticaceae* 1 species - *Violaceae* 1 species and *Vitaceae* 1 species. In order to connect the object/insula to the vegetal data/finding, a GIS has been built to logcally connect the alfa numeric values to cartography in order to recall the data and contextualizing it in a dereferenced map. In this wait is possible to overlap spatially, manage, analyze and integrate logically different sets of data. The capacity of the GIS system to integrate the informative plans of the environmental context allows to verify and assess the correlation between archaeobotanical and environmental data, leading the archaeobotanical research to an environmental determinism capble of managing simultaneously restoration criteria, mechanical, manual and chemical interventions aimed at reclaiming, recovering and restoring the green areas in relation to the biological cycles of the botanic species and to the site's weather conditions, because it is the knowledge of the local botanic heritage and of the species' vegetative cycles to determine the efficacy of archaeobotanical restoration in Ancient Pompeii's green areas. Botanic research has been particularly difficult. First of all, in the ancient world there was no universal nomenclature. The newfound iconography itself has lead historians into error most of the times. Many of the species in the frescos, in fact, were not actually cultivated in Pompeii, which was a small-town after all, but recalled the time's gardening "latest fashion" from Naples an Rome. So, due to the absence of the Binomial Nomenclature and to the unreliable frescos, the determination of the whole zone's flora and the characterizing vegetation have been discovered basing on micro and macro plants findings, and also thanks to palynology and to the study of dominant winds. According to the identified species and to the placements that have been found, the conclusion is that Pompeii's gardens had several functions: in some cases proper farms, for the production of food and textiles, some other times simply an ornamental function and in other cases curative and religious aims; each inhabitant of Pompeii, in fact, used to cultivate a small private pharmacy while some other species were cultivated for sacred rites. The different functions were not translated in a sharp separation of the gardens but lived together harmonically. So great importance was given to the utility of the species without leaving behind the aesthetic aspect. As perfectly explained by Ciarallo, the floral list of the whole Vesuvian territory is an open system that has to be continuously updated. To date, it is made up of 308 species belonging to 194 genres and 64 families. Even thought it is true that the majority of the species that have been found grow in the summer, allowing us to reconstruct basically that seasonal period (we recall that the eruption has happened in August 79 a.D.), it has been surprising to find in the Vesuvian plain several species that are now growing in high altitudes. The punctual description of the vegetation of a specific area, such as an insula, has been carried out only following the unearthing of at least three finds, whether wooden of non-wooden such as pollen, seeds, pods, fruits, leaves. The *a latere* vegetal finds have been fundamental same as the molds left by roots and the agricultural layouts discovered. Following this premises it has been possible to determine the vegetation of the housing units of the Regio I's insult 9. Such composition confirms again the multi functionality of the Pompeiian garden and the abundance of species.



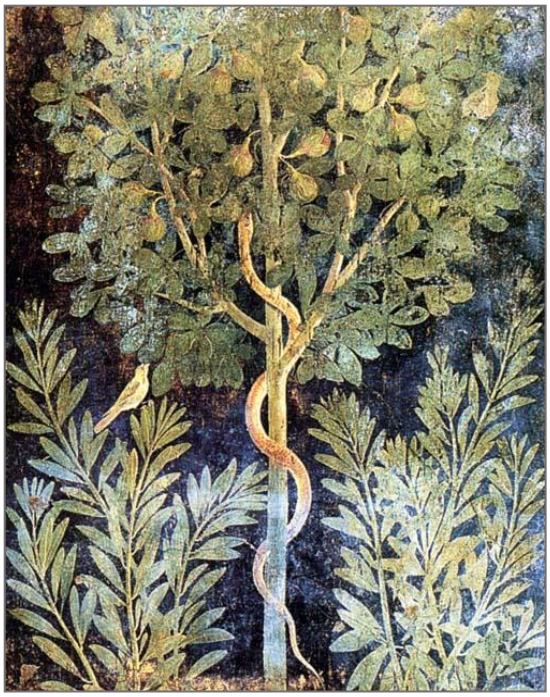

Image 6: Citrus limon L. - House of the Orchard.

Image 7: Ficus carica L. - House of the Orchard.



Image 8: Nerium oleander L. - House of the Golden Bracelet.



Image 9: Rosa Galica L. - House of the Orchard.

Conclusions

This paper strongly highlights the connection that existed over twenty centuries ago between Pompeii's inhabitants, their dorms and the public green spaces. This particularity contributes to the Pompeii's charm that, not having public monuments that can be compared to Rome's majesty, keeps its small-town implant untouched through its real-life domus that can be gathered by analyzing the domus, in which the green areas have a great importance not only in the gardens but also in the internal frescos; in fact, they frequently depicted vegetal subjects in such an accurate way that their varieties could be defined. In fact, in the paintings that were exhibited in the gardes, not only spontaneous species were depicted, but also the

crossbreeds selected for their beauty or, in the case of food plants, for the good taste or farming productivity of their fruits. Streets, tombs, fountains, thermal baths, houses, frescos and gardens, vegetable gardens ad public green spaces are places in which strong connection with modern times can be found, starting from people that lived in those areas more that two millenniums ago, and especially to understand the origin of the plants used by the Ancient Pompeii's inhabitants: analyzing these places doesn't only mean to gather social and economical life data, but also information regarding the historical panorama of the Vesuvius area. The vegetal findings of the gardens within Pompeii's walls build up an extraordinary heritage, that testimony on the one hand the unique distribution of the green areas within a 2000 years ago city, and on the other hand supplies information regarding on the re-implant criteria discovered in the course of 250 years of excavation, that have entered restoration history over century. The most important source of information for this paper has been "Gli spazi verdi dell'Antica Pompei" precious and precise work by Annamaria Ciarallo, whom the IBAF/UOS group of the CNR has had the honor of knowing personally and furthermore the possibility of being present in the Applied Research laboratory of which Annamaria was responsible herself. Thank to this study that, on the one hand, has mapped the whole garden's state-of-the-art within the excavation, and on the other hand it reached interesting discoveries such as the identification amongst the other material in the time's containers rests of cloves, an spice imported from the East. The study also informs about ancient crops, about the presence of bushes and fruit plants and on the cultivation techniques, highlighting the architectural and ornamental elements that organized these green spaces; it also proposes documents about the romantic vision of the ruins and about the imprint given by Pompeii's discoveries in the building of the nineteenth and twentieth century gardens. Antonio Niccolini, for instance, designed the Villa Floridiana in Naples with neoclassical shapes and arranged the park according to the criteria of the English pictorial garden, other than decorating in perfect Pompeiian style the coffee house in Villa Lucia. Cairo's work arrives almost 40 years after the one by the American archaeologist Wilhelmina Feemster Jashemdki, whom studied an catalogued between 1955 an 1970 all was "green" in the excavation and surveys from the Vesuvian archaeological sites. Seeds, leaves, roots, fruits, nothing was unnoticed. And yet that work was uncertain and inaccurate, and it could have mislead the archaeologists from all over the world. The new study, besides describing what came out from the laboratory and universities' high-tech investigation, corrects and integrates with new elements the state-of-the-art of Ancient Pompeii's archaeobotanic heritage. The correction of the preceding papers has been made from the palynology analysis that, according to the experts, have allowed to have, in comparison with Jashemski studies, the almost perfect certainty about the intended use of Pompeiian green spaces: garden, vineyards, oil groves.
Thank you Annamaria, Science has lost a great source of knowledge wisdom.

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Bibliographical References

[1] A.A.VV. (1998), J. Berry (a cura di), Unpeeling Pompeii: Studies in region I of Pompeii. Electa 1998.

[2] AA.VV Pompei e gli Architetti Francesi dell'Ottocento, catalogo della Mostra organizzata da Institut Français de Naples e dalla Sovrintendenza Archeologica, Macchiaroli, Napoli, 1981, p.205-280

[3] BORGHI, Rachele. L'acqua come ornamento nella domus pompeiana: documentazione archeologica e fonti letterarie in Architettura e Pianificazione nell'Italia Antica a cura di Quilici L. e Quilici Gigli S.,Erma di Bretschneider, Roma,1997, p.37-50.

[4] CAPASSO Bartolommeo. Napoli greco-romana, Berisio. Napoli,1905, p.104.

[5] CIARALLO Annamaria. Flora pompeiana Erma di Bretschneider, Roma, 2004, p. 111-117.

[6] CIARALLO Annamaria. Gli spazi verdi dell'Antica Pompei, Aracne Roma, 2012, p.399-402.

[7] CIARALLO Annamaria. Pompei verde, Electa Napoli,2006, p.17-36.

[8] CIARALLO Annamaria. Verde pompeiano, Electa Roma, 2001.

[9] CIRILLO Clelia. La lettura dell'isolato semplice del Centro Antico di Napoli, in Storia, Architettura e tecnologia dell'insula 34 del decumanus major a cura di R. Iovino, Giannini, Napoli,1991, p.169 -191.

[10] CONTICELLO Baldassare. Sull'evoluzione del giardino nell'età classica in Rivista di Studi pompeiani (1993-94) VI, *[1]* Roma, 1994 p.7-13.

[11] FRANCIOSI Vincenzo. Pompei: lo sviluppo urbanistico in Appolline Project Vol.1 Studies on Vesuvius North slope and the bay of Naples a curadi G.F De Simone, R.T. Macfarlane, Herder, Roma, 2009, p.7-13.

[12] HELG Riccardo. Abitazioni atipiche a Pompei: le regiones I e II in La forma della città e del territorio, vol. 2 a cura di L. Quilici e S. Quilici Gigli, *Erma di Bretschneider*, Roma, 2005 p.147-168.

[13] JASHEMSKY Wilhelmina. The gardens of Pompeii, Herculaneum and the villas destroyed by Vesuvius, Aristide D. Caratzas Pub New Rochelle, 1979.

[14] LA ROCCA Eugenio. et alii Guida Archeologica Pompei, Mondadori, Milano, 2002.

[15] MAGGI Giuseppe. L'evolversi degli studi sugli impianti delle città vesuviane in Ercolano,1738-1988, 250 anni di ricerca archeologica: atti del Convegno a cura di L. Franchi Dell'Orto, *Erma di Bretschneider,* Roma 1993, p.259-263.

[16] MARINI Luigi. Delle parti delle case urbane secondo il costume italico in L'Architettura di Vitruvio - Vol. II, Marini, Roma,1837, p.12-18.

[17] MONESTIROLI Antonio. L'Architettura della realtà, Clup, Milano,1979.

[18] NAPPO Salvatore Ciro. Storia dello scavo in le Guide di Archeo n°2/2004, De Agostini, Milano, 2004.

[19] NIBBY Antonio. Roma nell'anno MDXCCCXXXVIII, Tipografie delle Belle Arti, Roma, 1839.

HERITAGE and TECHNOLOGY
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Galeazzo Alessi: narration, representation and contemporary theatricality for a XVI c. architectural heritage

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Abstract
The rich and polyhedric production of Galeazzo Alessi in XVI century Genoa left a deep legacy for the architectural identity of the city: not only proposing constructive and compositional models totally innovative compared to the previous centuries, but, above all, by defining an architectural paradigm so explicit and characteristic that it would be an inspiration for the following centuries.
The model of Alessi, in fact, comes to affect the urban and architectonical identity of the great expansion projects in Genoa up to the end of XIX century, the model from which only the XX century proposals will depart.
Starting from the intervention on the urban scale of Strada Nuova, to the structuring of the large villas, then to the great Basilica of Carignano and up to the design of Porta Siberia, Alessi's production in Genoa is extremely varied and still emblematic in the city landscape.
The proposed study aims, therefore, to give an account of a campaign of studies, surveys, performances and exhibitions, carried out on the occasion of the celebrations of the fifth centenary of Galeazzo Alessi's birth -in cooperation with the Ministry of Properties and Cultural Activities and Foundation Franzoni- which are now the subjects of a study, in view of the definition of a multimedia exhibition where, above all thanks to the versatility of the various forms of representation, the character and the importance of an architectural expression of strategic importance for Genoa could be understood.

Keywords: Drawing, survey, communication, heritage

1. The reasons of a resarch (MLF)
The architectural identity of the city owes much to the rich and multifaceted production of Galeazzo Alessi in XVI c. Genoa that left a deep legacy: not only proposing constructive and compositional models totally innovative compared to previous centuries, characterized by a perfect symbiosis between architecture and local landscape but, above all, by defining an architectural paradigm so explicit and characteristic that in subsequent centuries it would be a continuous inspiration motive.
The model of Alessi, in fact, comes to affect the identity of the great architectural and urban expansion projects in Genoa at the end of '800, the model from which only twentieth century proposals will depart, introducing an architectural style in substantial break with the historical one.
The production of Alessi in Genoa is extremely varied and still emblematic in the cityscape, starting from the intervention on the urban scale of Strada Nuova, with types of buildings new in comparison with the medieval landscape still dominant, to the structuring of large villas of the ascending Genoese nobility, also connoted by innovative compositional relationship with the complex gardens that were tied, structured according to a succession of monumental terraces where caves nymphaeums, fountains and stairs were set, then moving on to the grand conception of the Basilica of Carignano and to the design of Porta Siberia.
The proposed study aims, therefore, to account for a campaign of studies, surveys, performances and exhibitions that have been conducted on the occasion of the celebrations of the fifth centenary of the birth of Galeazzo Alessi -in collaboration with the Ministry of Heritage and Cultural Activities

and the Foundation Franzoni- and which are now the subject of further reading , in view of the definition of a multimedia exhibition in which, above all thanks to the versatility of the various forms of representation, it is possible to come to an understanding of the character and the importance of an architectural expression of strategic importance for Genoa.
This is followed by the studies undertaken by Massimo Malagugini, in these celebrations with the first popularization results and the first approach to the relief of Cave Doria, and by Maria Elisabetta Ruggiero on the achievements of the great villa gardens and the caves of Alessian inspiration.



Fig. 1: Panels of the exhibition. Six different tours have been proposed In order to introduce the architect and his work in Genoa.

1.2 The project of an Alessian tour (M.M.)

The medieval layout of the city of Genoa is, even today, highly recognizable and equally characterizing the urban fabric of the historic center. Subsequent interventions have, to a large extent, affected portions of land still undeveloped allowing intervening without modifying the existing one.

These events took place especially in the Renaissance, whose experiments have affected areas until then reserved to crops. In this context we must read the works of architect Galeazzo Alessi from Perugia, who represented the greatest reference for the Renaissance architecture of Genoa.

His works, which have become true models for villas, religious or military buildings, now appear as scenic elements capable of catalyzing the utmost attention not only as for their architectural quality, but also as for their disposal on the territory. Each work by Alessi's confirms the existence of a close alliance between the building and the surrounding environment to the point that, even today, the Alessian Genoese works (with assured paternity) maintain their privileged position in the complex contemporary urban environment.

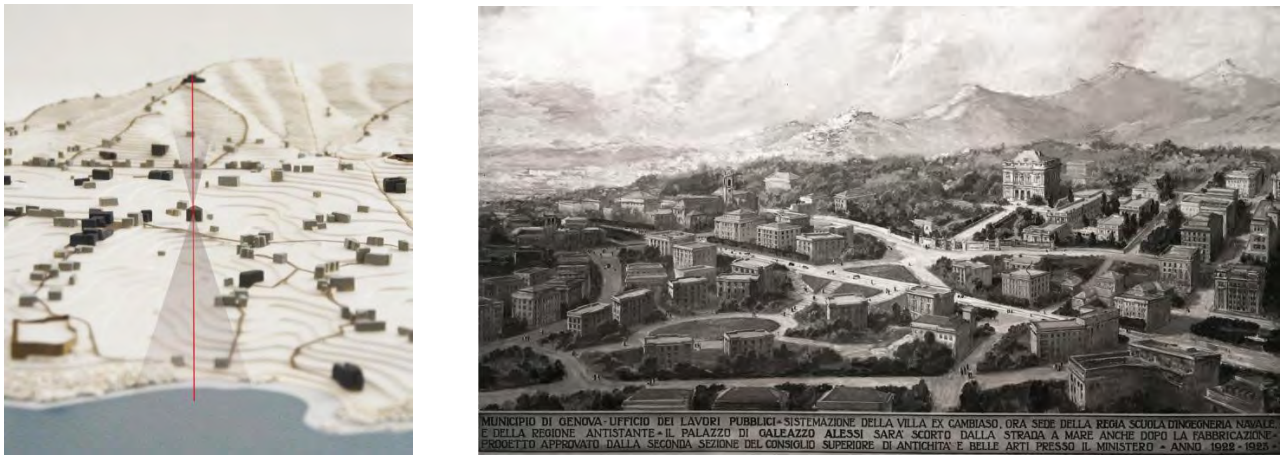

Fig. 1-2: Model of the area around Villa Cambiaso and drawing with a proposal for the garden in front of the Villa 1922

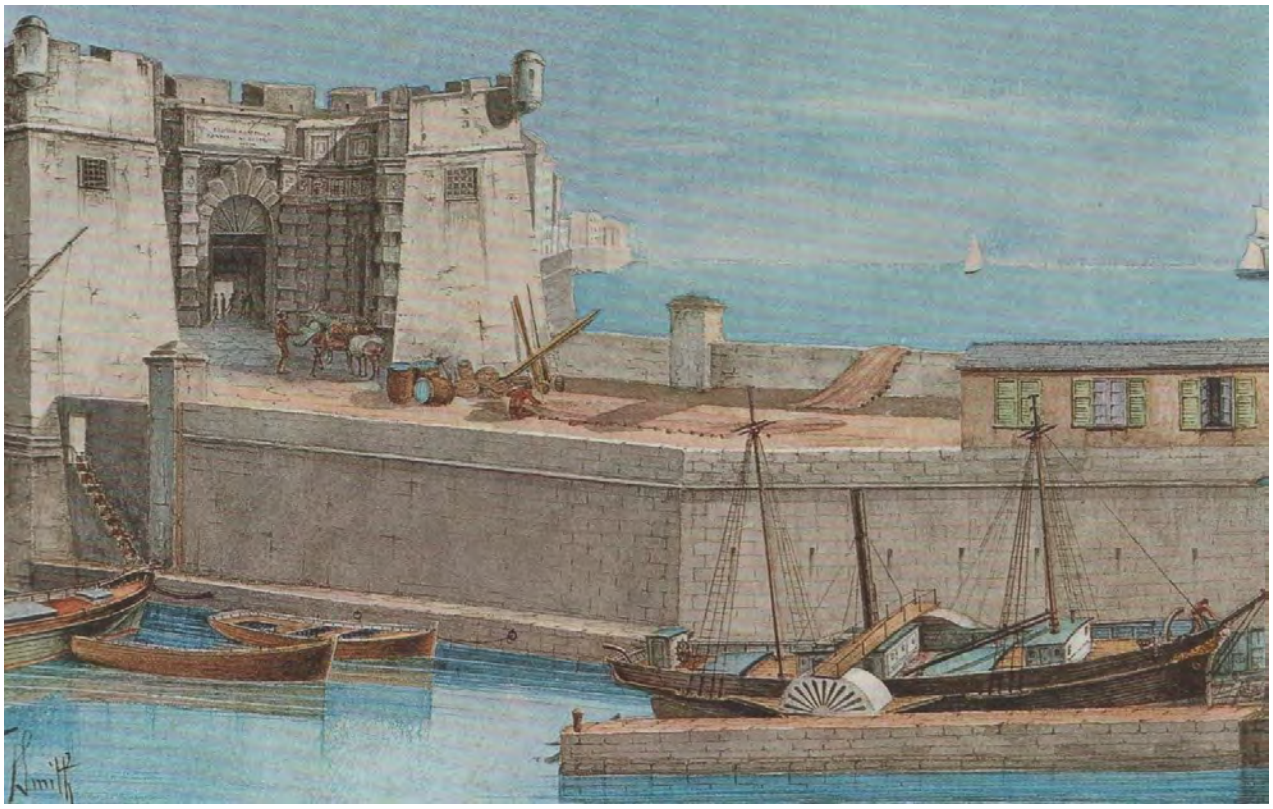

Fig. 3: Porta Siberia in the historic harbour. Watercolour by Smith XIX c. (Collezione topografica Comune di Genova)

The tour started from the perhaps best known among the works of the architect, the Basilica of Our Lady of the Assumption in Carignano that for almost five centuries has been the reference point of the perceptual city to anyone who came to it arriving from the sea. [1]
As part of the recent "Alessian Itinerary", proposed by the University of Genoa in collaboration with the Municipality, the Ministry of National Heritage and Culture and the Franzoni Foundation, we have tried to focus our attention precisely on those works of undoubted paternity by the architect from Perugia, managing to compose a typological sampling of buildings - or parts of them - fully able to wholly paint the activities of Alessi.
Its location, on the top of the omonymous hill, made this building recognizable in any view of the city, instilling that dome squared between two towers into the minds of travelers.
Neither the urban development of the late nineteenth century, nor the twentieth century building extensions were able to hide the bulk of the basilica from the city skyline. The plant of the villa designed by Alessi is beautifully represented by what are now the headquarters of the Polytechnic School of Genoa, namely Villa Giustiniani Cambiaso, in the district of Albaro.
Beyond the harmony resulting from the proportions of each individual element, the villa confirms the interest of the architect from Perugia as for the relations with the context: it is placed in the domain of Valletta and has been designed with a section that seems to link the Southern context - the valley and the sea - with the opening facing upstream towards the sanctuary of the Madonna del Monte. This, not surprisingly, is placed right along the same axis, and the villa seems to be its focus and scope of vision. .

The third stage of the proposed itinerary is a military building: Porta del Molo, better known as Porta Siberia.
Again the hand of the architect has designed a building in close relationship with the surrounding environment: it was for nearly four centuries, the true gateway of the city to the sea, an hostile bumper with its powerful architecture towards the sea but reassuring and adhering to the fabric of the “Quartiere del Molo” in its front towards the city.
The door of the Pier, after years of neglect, is returning to live since it became the seat of the Museo Luzzati as part of the redesign of the entire area of the Old Port by the Genoese architect Renzo Piano, who has attributed to it an extremely significant role, evoking, in part, the role of outpost of the sea that time and changes have definitely taken off.
After presenting a door built directly on the sea, where once there was not even the earth, the fourth stage of the itinerary introduces a building directly dug through the ground and the rock; a real cave that, seizing the underground, once again demonstrates the endless design capabilities of Alessi.

This is Cave Doria, an extraordinary example of underground architecture designed according to the Renaissance canons and proportions, but certainly drawing inspiration from ancient Rome. The special feature of the cave is not so much the clear central plant underlined by a rich marble flooring, as the materials with which the entire space is covered: not stones, but organic materials.
All the architectural elements (pilasters, lintels, chests) and all the decorations (narrating mythological stories) are coated and made entirely with shells of various shapes and colors. The itinerary shows finally an intervention on an existing building, particularly evocative and representative in the Renaissance (the dome made to cover the transept of the cathedral of San Lorenzo) and a further villa (Grimaldi Sauli in Bisagno) that appears today strongly altered.
The combination of these six stages of the itinerary, through the vision, the analysis and the study of these precious artifacts, confirms the extreme variety of the work of the architect from Perugia in the city of Genoa, offering interesting insights on the role that he has played in identifying these models for the future development of the entire city, and on the unavoidable link that his works have had with the context for which they were designed.
From these considerations a further analysis has started which aims to deepen these issues making them easy to be understood not only by scholars and insiders. The itinerary then does not intend to stop at a publication of the results of the researches conducted, but wants to become a true vehicle of communication of the research itself and the issues addressed.
In this sense, we have tried to raise awareness on this issue not only in the scientific community, but also in the entire city, with the objective of being able to communicate, half a millenium later, the work done by Alessi through the critical reading of its works in Genoa,
This led to the need to identify a recognizable identity to each initiative, defining in the first place a logo as a connotative element, easily recognizable to every event. For this aim students of the Laboratory of Graphics of the Degree in Industrial Design, have been involveed to define a logo and a coordinated image to uniquely mark the celebrations for the fifth centenary of the birth of the architect from Perugia (1512-2012).
Later on, it was developed a communication system capable of consistently conveying the results of the research and critical readings coordinated by the Scientific Committee for the Alessian celebrations (composed by Maria Linda Falcidieno, Lauro Magnani, Luigi Gambarotta and Claudio Paolocci) and

developed by a team of scholars, teachers and researchers of the entire University of Genoa which, in turn, have faced different issues.
For this it has been achieved, in correspondence of each analyzed architecture, an apparatus for scientific posters to repropose a systematic approach to the study on the concerned Alessian works.
To look at the work and read it with the same criteria with which the other works of the same itinerary are read - or are going to be read - : this was the key that led to the identification of a sequence of topics common to each stop on the itinerary, apparently integrated by those insights that every work has suggested, with the aim of tracking exhaustively a complete portrait of the Genoese works of Galeazzo Alessi.
For each building we have tried to use the full potential of the representation with the aim of the communication of research and reading of the work itself, investigating, through new techniques of relief and digital modeling, new communication systems, interactive and engaging, capable to recover the original splendor of the visited works .
For this aim the digital survey of the Cave Doria is going on and its completion will offer a virtual tour of an artifact difficult to reach from the usual touristic and cultural routes, making an important first step towards the popularization and knowledge of an extraordinary artifact.
This visit will also have the role of stimulating the interest of the public - already wide - that goes through the spaces of the Palace of Prince Doria to the garden where the cave was annexed a few decades after its creation and that today is completely stifled by the expansions of the twentieth century and isolated by the nineteenth century caesura of the railway.

To explore virtually that space will mean to know in detail its architectural structure, but also the individual iconographic decorations. The magnificence of the natural context in which it was inserted before it was "buried" by popular building will come again to light.
But it will also mean to be able to instantly compare it with other similar ones, with models to which it was inspired and with the works that have been inspired by this one. Everything made in full compliance with a unified image easily recognizable and capable of bringing together all the forms of communication linked to the Alessian Itinerary.



Fig. 3: Sketch for the entrance of Grotta Doria with the panels of the tour.



Fig. 4: Interiors of the Grotta Doria

1.2 Mysterious and spectacular architecture to be rediscovered and narrated (M.E.R)



Fig. 5 View of Villa Cambiaso, P. D. Cambiaso, Genoa 1811-1894 pencil on paper, Genoa Top. Collection of Comune, inv. 1809/67

The will to undertake an operation of enhancement of historic monumental gardens, inspired by the Alessian compositions, was born because of the imminent danger of permanently losing their memory due to the progressive degradation and their spectacular nature. [2]
In fact, they have as main character the ability to enhance the link between architecture and the surrounding landscape, thanks to their complex structuring enriched with architectural elements of great value. The villas, designed or studied in their general conception, are a true innovation in the Genoese landscape of the XVI c. [3]
They succeed, even with a well-defined and regular volume, to establish a strong link with the environment thanks to the composition of the applicant lodges and openings which, in turn, are the privileged points of view aiming at nodal points of the wide surrounding garden.
This garden, according to a Renaissance type logic, develops a series of formal solutions that constitute an extraordinary setting along a determined axis. [4]
In this architectural production it is possible to locate the will to search, through and within that particular sense of the landscape which is the garden, an architectural extraordinary occasion, in the true sense of the term, namely the element completely foreign to what is the 'ordinary', the 'usual', as if to further overcome the concept of technique and aesthetics with an expression that transcends the limits of the ‘rational’. [5]

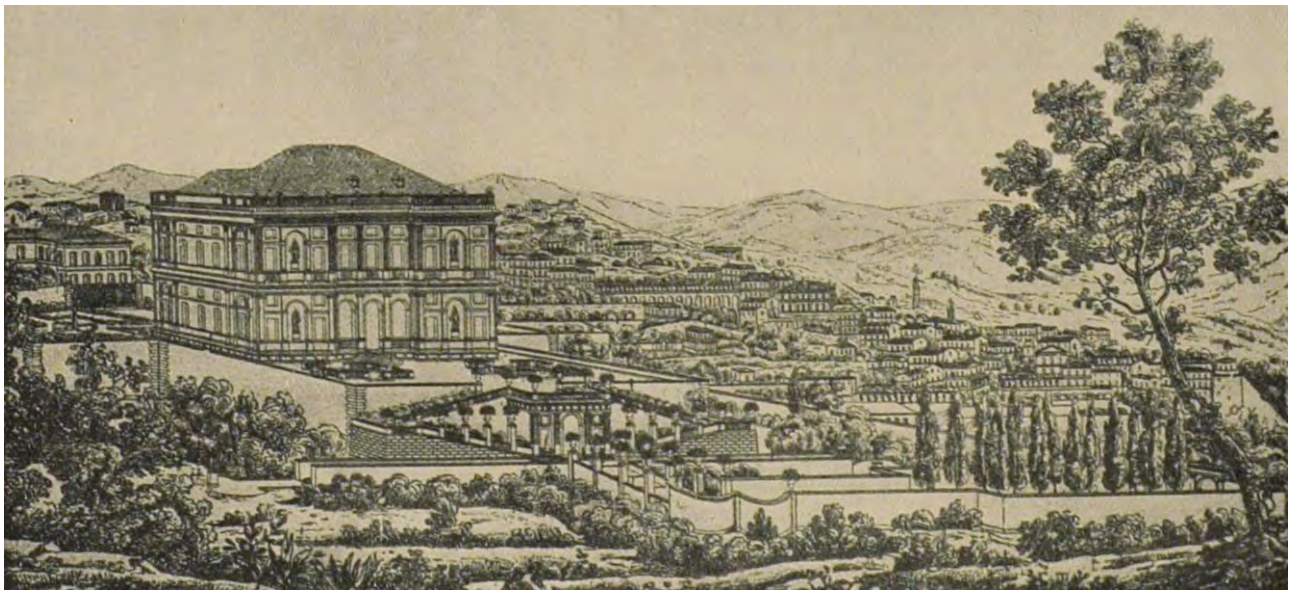

Fig. 5 Villa delle Peschiere- built on alessian model. View. P.M. GAUTHIER, *Le plus beaux edifices de la ville de Genes et de ses environs*, Parigi, 1818-32.

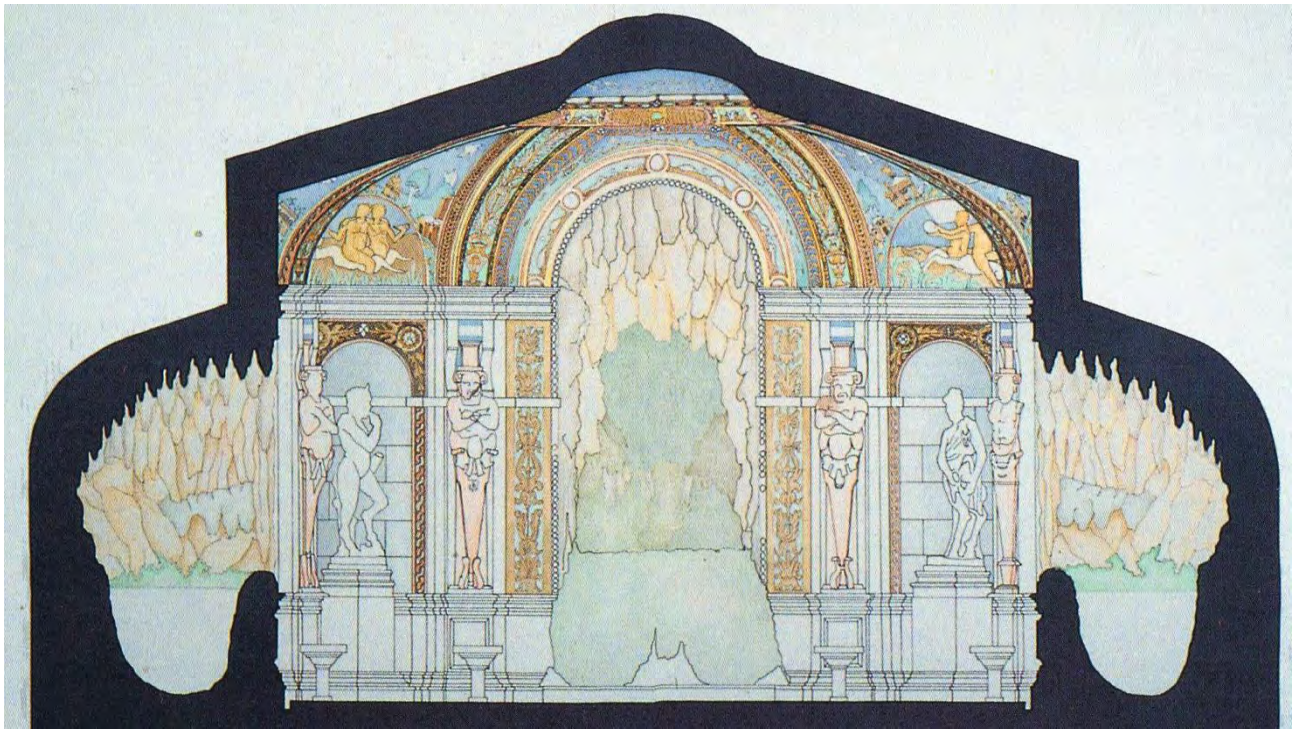

Fig. 6 Section of the grotto - Villa delle Peschiere. Survey and rappresentation directed by Prof. Luisa Cogorno

It appears obvious that these characteristics lend themselves well to the possibility of forming the catalyst element of the operation of enhancement.
Giulio Carlo Argan defined the garden as the "maximum quality or aesthetic value which may result in the practice of agricultural crops"[6] and in fact just the refinement and evolution of these techniques make possible the structuring of entire gardens whose main aspiration is to recreate a ‘perfection’ echoing the garden of Eden or a ‘magnificence’ that can better express the ambition, if not the expression, of the philosophy of its creator [7] .
Within them, especially with the influence of XVI c. Mannerism, in the compositions increasingly complex and rich, it is possible to find embedded architectural episodes that have the specific intent to impress with a series of tricks, presenting metamorphic forms of art and nature, where the boundaries [8]
In these gardens the magnificent series of waterfalls, where the XVI and XVII c. Italian plombiers excel, the hand of man is and wants to be evident without any desire to conceal it.
They are indeed extraordinary examples of style and technique that amaze precisely because of their grandeur. In other solutions, on the contrary, what is being sought is actually a kind of 'magic' that can confuse even more the viewer.
During the centuries these "inventions" get different forms depending on the taste of the time, but always have a common feature, where the possibility of unifying reality and representation with an extreme form of mimesis of nature becomes the cornerstone of their substance .
In XVI c. artificial “grottoes”, in fact, there is the research for the introduction of an element, quite natural and apparently in itself far from a real architectural form, in which the style of the decoration is entirely oriented to the evocation of combinations of materials, such as shells, corals, glasses and colored stones, in anthropomorphic and zoomorphic compositions.
The installation of these caves then, albeit hidden from simulations of rocks, waterfalls and ponds, is often inspired by geometric shapes that are complex and constitute a hidden clue to the work of man.
The environment that these structures offer is an enchanting one where myth and reality can become confused and the viewer can feel the protagonist of a scene, a fantastic narrative.
The villas of Genoa, along with the Florentine and Roman ones and with some French realizations, are the main patterns of this genre and offer a magnificent and diverse repertoire of this type of scenic solution .

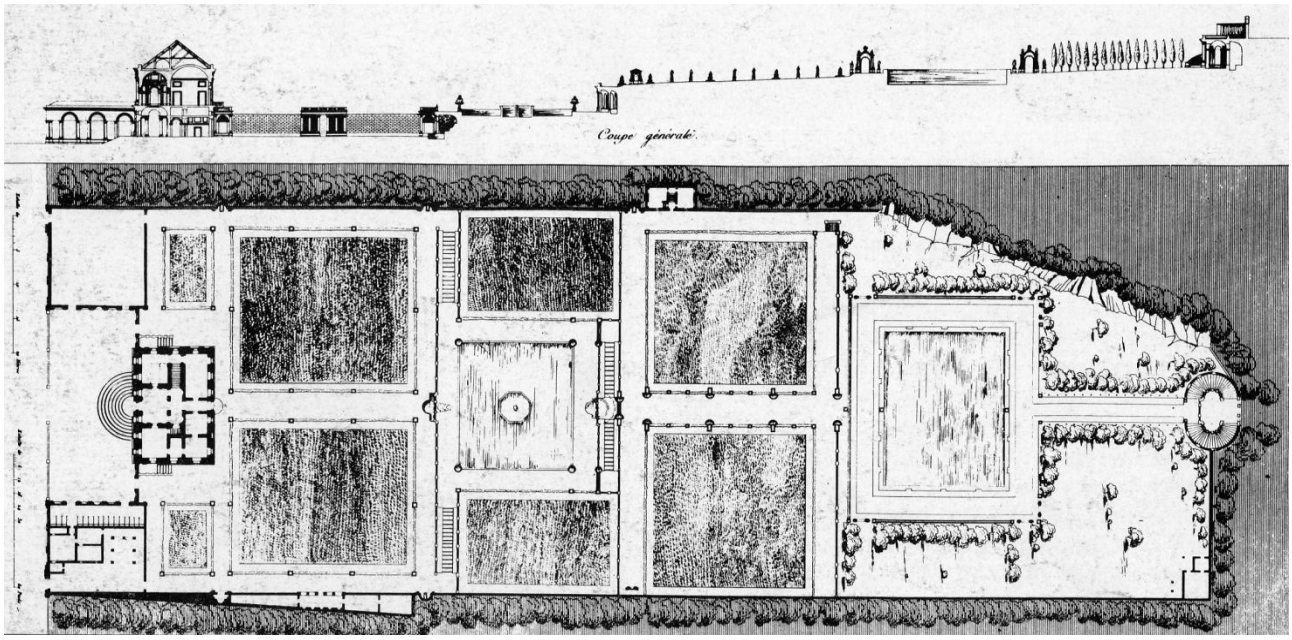

Fig. 7 Villa Imperiale Scassi- built on alessian model. Section and Plan, P.M. GAUTHIER, *Le plus beaux edifices de la ville de Genes et de ses environs*, Parigi, 1818-32





Fig. 8 Villa Imperiale Scassi-the terraces and the upper ninpheum, no more existing.

The designs of travellers, illustrators and treatisers represent a real literature of this kind in the ongoing attempt to steal and reveal the hidden secrets that these structures contain: from Gauthier who seeks not only to reconstruct their architectural consistency, but also to redefine their relationship with the scene setting of the whole garden and the villa which it is associated to, up to Furtenbach that investigates their finest details. [9]

The search of the secrets of these places continues up to this day and age with significant operations aimed at trying to reconstruct what neglect and abandonment have by now affected.

Many of these structures were once in fact aligned or related with waterworks expressed in various forms. From the top of a slope they articulated with a clear relationship to the core architecture. However, the development of the city has gradually altered this bond, interrupting or even destroying whole parts of it [10].

The work of virtual composition, that manages to put together the detected and still existing parts with those reconstructed on the basis of historical representations and descriptions, thus appears to be a valuable tool to bring to light such an important expression of this architectural period.

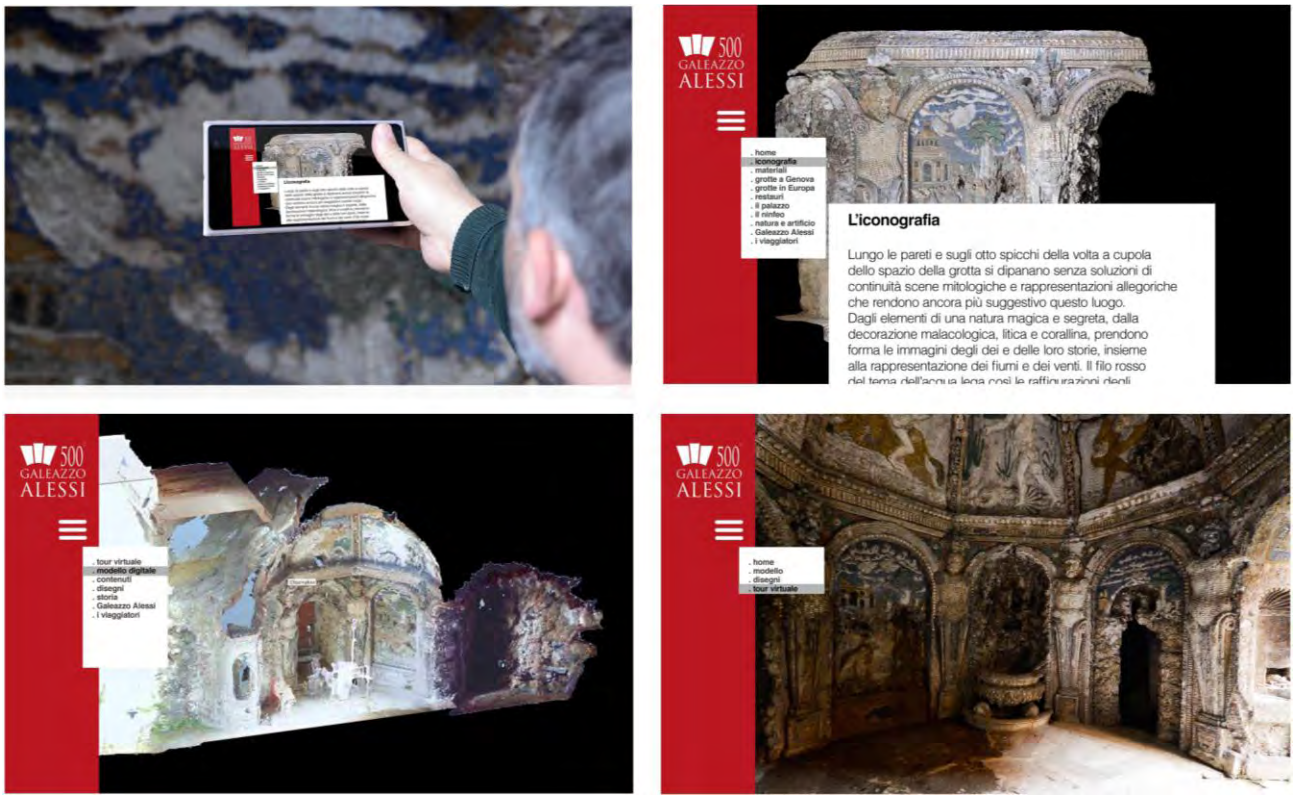

Fig. 9 Proposal for the App focused on Grotta Doria - Genova - and its decoration and architecture. In this way, thanks to modern technologies, it is possible to communicate and approach the subject of ancient *grotte* even when they are on different places of the urban territory. Survey and images produced using CAM2 Laser scanner Focus 3D S120 – Panogear – motorized panoramic *head*. Author: Massimo Malagugini and modus architecturae -genova)

Bibliographical References

[1] GHIA, Andrea, *Il cantiere della Basilica di Carignano* in Atti della Società ligure di Storia Patria pp263-394, vol 39, n.1 (199)

[2] LABO' Mario, *Galeazzo Alessi a Genova* in Atti del V convegno nazionale di storia dell'Architettura pp 367-378, 1948

[3] SALZER), Donna Marie. *Galeazzo Alessi and the Villa in renaissance Genoa* Cambridge (Mass.): Harvard University UMI Dissertation Services, 1992.

[4] DE NEGRI, Emmina, *Galeazzo Alessi architetto a Genova,* Genova, Università degli Studi di Genova, 1957, 116 p.

[5] MARCHI , Paolo (a cura di), *Le Ville del genovesato,* Genova, Istituto di rappresentazione architettonica dell'Università degli Studi di Genova, 1983, 143 p.

[6] ARGAN, Giulio Carlo, *Giardino e Parco*, in CAZZATO Vincenzo, (a cura di) p. 16 *Tutela dei giardini storici: bilanci e prospettive*, Roma, 1989

[7] IACONO, Maria Rosaria Iacono*. Botanici e Giardinieri alla Reggia di Caserta,* in *La festa delle arti. Scritti in onore di Marcello Fagiolo* 2 vol. Roma, Cangemi ed. 2014 pp 734-741 (a cura di) Cazzato V. Roberto S., Bevilacqua M.

[8] MAGNANI , Lauro, *Il Tempio di Venere.Giardino e villa nella cultura Genovese,* Genova, Sagep, 1987, ISBN 9788870582468, 240 p.

[9] MARCHI , Paolo (a cura di), *Pietre di Liguria,* Genova, Sagep, 1993, ISBN 8870584895, 338 p.

[10] MANIGLIO, Annalisa, *Giardini Parchi e paesaggio nella Genova dell'800,* Genova, Sagep, 1980, ISBN 9788870581164, 208 p.

HERITAGE and TECHNOLOGY
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A Geographic Information System for the documentation of medieval and modern fortifications. The district of *Castello* in Cagliari.

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Abstract
This paper shows some results of the documentation of the medieval and modern walls in the district of *Castello* in Cagliari. The area appears today as a result of urban transformation and project interventions that over the centuries have changed the design and urban landscape. This system determines a complex structure of the survey, that, set on the graphical analysis of documents and on the survey of existing structures, is supported by historical and archaeological disciplines and "non-destructive diagnostics investigations". The "place" where collect data from the studies conducted in the context of the different scientific areas is represented by a geo-referenced database, which allows to an easy management of information and the ability to overlay and display the different layers of information. Identified the cartographic base in a recent photogrammetric survey, the work is proceeded with the digitalization of historical cadastral maps, graphical analysis of the projects and the survey of historical military structures in the south area of *Castello*. The survey starts a process aimed to creating a database that can be implemented and became functional to identify the archaeological risk and a prior assessment tool to any project action.

Keywords: Cagliari, bulwark, GIS, survey, graphical analysis

1. The District of *Castello* in Cagliari: birth and development of a defensive line
Since 1217 the Republic of Pisa gives rise to a settlement on the hill that still dominates and characterizes the urban landscape of Cagliari and plans the *Castello* District. According to tracking methods established in the thirteenth-century design practice takes shape the medieval town set on three parallel streets [1] and together with the development of the settlement is built the defensive line according to the morphology of the places.
The perimeter that modeling the shape of the settlement consists in a succession of square towers connected by high rectilinear curtains partially visible within the existing urban texture. At the beginning of the fourteenth century the walls will be characterized by a change, aimed at strengthening defenses which involve in the construction of three new towers (*torre di San Pancrazio, torre del Leone and torre dell'Elefante*) for the protection of the accesses to the city and the districts of *Marina* (*Lapola*), *Stampace* and *Villanova*, all planned after the Aragonese conquest of 1326.
A further growth will be achieved through the realization of three circular towers that determines a significantly extend of the western sector of the city. Starting from the early sixteenth century a new line of defense, entrusted by pentagonal bulwarks, that require large spaces and cause an important change of urban form. After some minor interventions carried out on the initiative of the Spanish viceroys, will be required the intervention of the military engineers, authors of the design that will guide the development of the city and of the defensive line until the eighteenth century. In 1800 the last work of the Savoy defense, the bastion of *Cortina del Molo*, replace the bastion of *Sant'Efisio*, and from 1821 will begin the first demolitions of the *Porta S'Avanzada* which will continue with greater intensity since 1867, following the cancellation by the Royal Decree (31 December 1866) of Cagliari from the list of the strongholds of the Kingdom.
The different projects that have determined the form taken by the fortress over the centuries is described through historical documents, iconographic sources, projects of military engineers and cadastral maps.

The analysis of these documents become the place of the comparison between the information contained in detailed maps, in the city views and in the cadastral maps, representations for signs of a growth mainly driven by the evolution of firearms and, in the second half of nineteenth century, by the interventions of embellishment and transformation of the European city. Together with the surveys of some sections of the defense walls that still exists, the signs “returned” by historical maps can lead to a reconstruction of the moments of realization and to identify the traits "hidden", optimize the use of non-destructive diagnostic technologies, and conduct (towards the creation of a map of the archaeological risk that identify and hypothesize the position of the segments partially demolished or incorporated within the existing urban fabric) to the possibility of a prior assessment of the urban context project . The survey's area is placed between the bulwark of *Villanova* and the *torre dell'Elefante* where the investigation continues and deepens a line of research aimed at the creation of a catalog of the sixteenth century bastions of Sardinia [5].

2. The Geographic Information System

The project of documentation requires the creation of a georeferenced database and therefore the presence of a cartographic base suitable for the connection of the data. Identified this base in a recent photogrammetric survey adapted to a GIS oriented use, has been conducted a digitization of a representative set of archival documents that could follow the different phases of expansion of the defensive walls, the acquisition of a complete photographic documentation of the structures involved in the survey (aimed at the production of orthorectified photos useful for the metrological analysis), an instrumental survey of the military architectures identified in the sector, and the establishment of a series of fact sheets of the areas examined to get a complete documentation [**2**] . For this purpose has been conducted a digitalization of the documents and a graphical analysis that together with the metric survey have conducted to the development of some representative maps and a hypothetical reconstruction of medieval and modern defense line.

2.1 The iconographic documentation

The first iconographic documentation, that shows the fourteenth century medieval line and the city before the intervention of the military engineers, consists in a document kept in the Archive of the Crown of Aragon of Barcellona, and in a city view dated 1550 and drawn by Sigismondo Arquer for the Cosmographia Universalis published by Sebastian Münster . The first document describes the sector between the *torre dell’Elefante* and the *torre del Leone* connected by a curtain with its three round towers. The defensive wall appears protected by a barbican (incorporated in 1553 in the curtain of *porta Castello* built by the military engineer Rocco Capellino) with an access at the *torre dell'Elefante* and a double pass that leads to the *torre del Leone.* The representation of S. Arquer, the oldest printing plant of Cagliari, describes the work of the viceroy Joan Dusay that in the early sixteenth century executes some changes in the area of *San Pancrazio*, in the area of *Santa Croce* and in area of the *porta dei Leoni*, where expanding the existing wall in the direction of the port and of the district of Marina and reconnecting, where is represented a corner tower (indicated in figg.1 - 6), the track made by the Republic of Pisa and the Crown of Aragon in the previous centuries. The city view also represent the convent of the *Monache Cappuccine* in the distict of *Marina,* the curtain of *De Cardona,* built in the first half of the sixteenth century in the west front of the district of *Castello.*

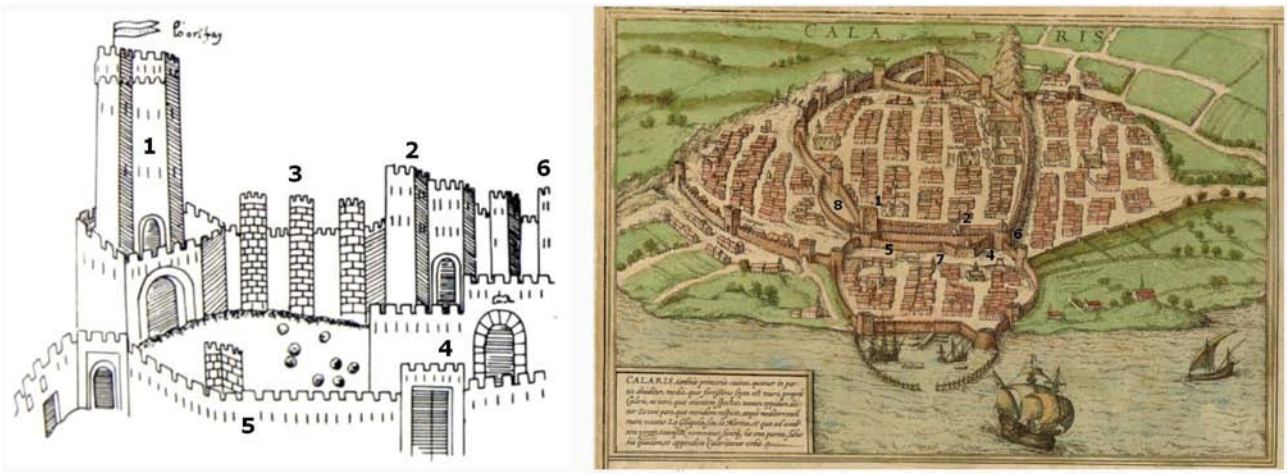

Fig. 1: the document kept at the Archive of the Crown of Aragon (1358) and Sigismondo Arquer's view of Cagliari (1550): 1- *torre dell’Elefante*, 2 – *torre del Leone*, 3 – medieval towers, 4 – *porta dei Leoni*, 5 - barbican and tower, 6 – corner tower, 7 – convent of *Monache Cappuccine*, 8 – curtain of *De Cardona.*

2.2 The drawings of the military engineers

Since 1552, during the Spanish kingdom, military technicians sent by Charles V redesign the defensive perimeter of the most important strongholds of Sardinia. The drawings are realized by Rocco Capellino who stayed in the Island until the 1572 despite his projects and works in progress, since the 1563, are changed by the intervention of Jacopo Paleari (called *El Fratin*) that, between 1573 and 1578, with the support of his brother Giorgio, will complete the new defensive line of Cagliari represented in a drawing dated 1578 (fig.2). In the *Castello* district the work will involve in the north area of *San Pancrazio*, in the west area of *Santa Croce* and in the south-western sector between the bulwark of *Villanova* and the *torre dell'Elefante*.
This segment in particular, subject of the investigation proposed, preserves the entire perimeter of the sixteenth century, eighteenth-century extensions, the latest transformations of the late nineteenth century and, hidden within the existing urban texture, some sections of the medieval perimeter. The drawing shows the Capellino's defense front entrusted to the system *Balice-Sperone* with two bulwarks connected by a curtain that protect the district of *Marina* and shows the entrance to the *Porta dei Leoni*, which is reached after passing the *Porta Stampace*. In the project is readable the medieval defense line set back from the new front where we can identify two circular towers and another medieval tower located in the east of the access system of *torre del Leone*.
The document also provides an important starting point for reading; a careful redesign shows, along the curtain of *porta Castello*, a detail that suggests the presents of an opening, near the convent of the *Monache Cappuccine* in the same location occupied by a small corner tower that is shown in the drawing of Sigismondo Arquer and near a passage often cited by archival documents. Finally, in the design of Giorgio Paleari dated 1578, we can observe the completion of the south east defensive line with the addition of the bulwark of Villanova (designed by Jacopo Paleari) and the medieval wall which shows the presence of three round towers and a different graphic representation from those reported by Capellino's drawing.

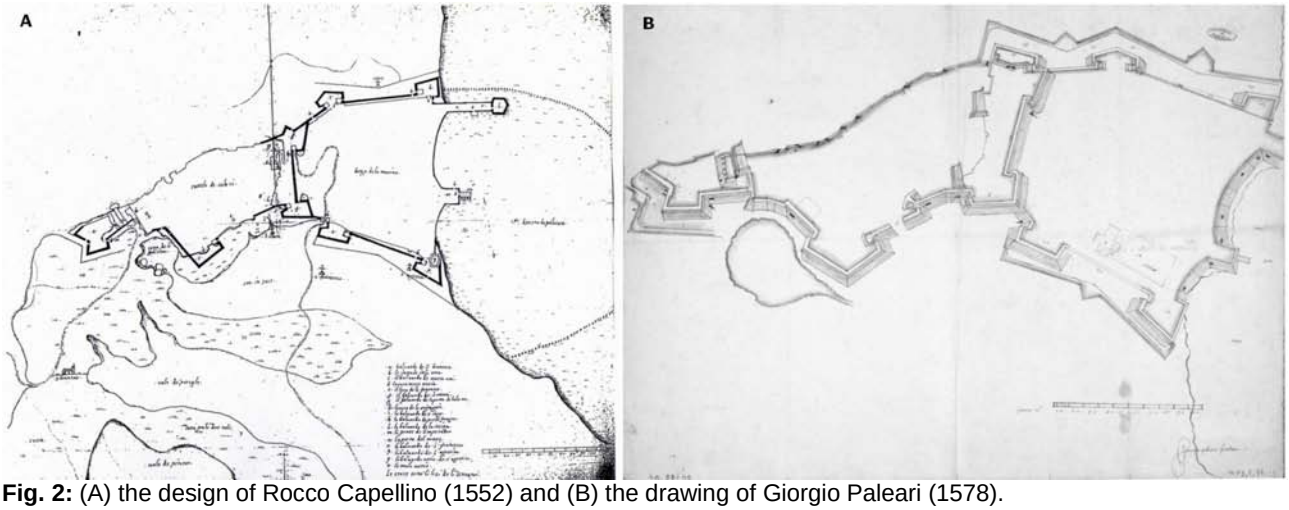

Fig. 2: (A) the design of Rocco Capellino (1552) and (B) the drawing of Giorgio Paleari (1578).

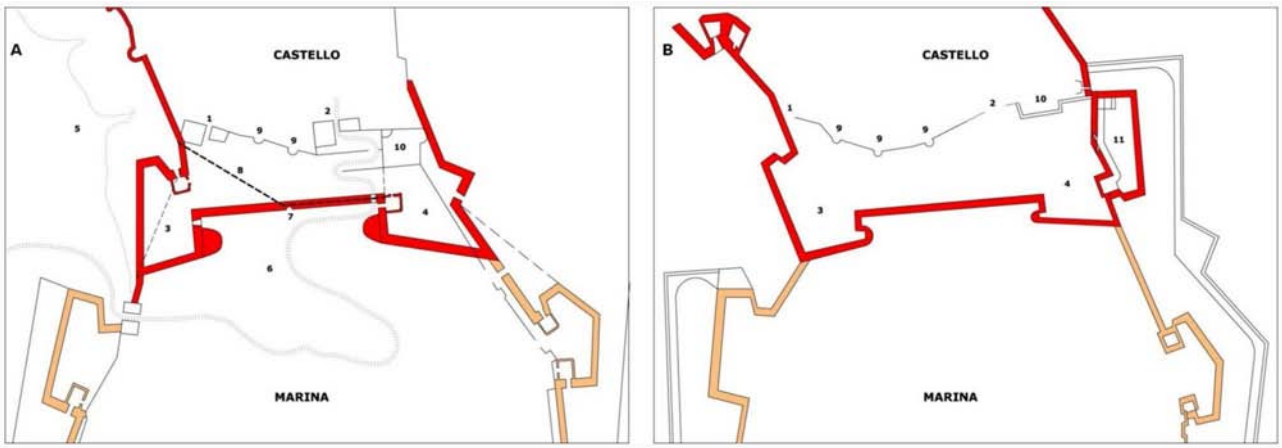

Fig. 3: most important elements identified in Capellino and Paleari's drawing: 1 – *torre dell'Elefante*, 2 – torre del Leone, 3 – bulwark of *Balice*, 4 - bulwark of *Sperone*, 5 – convent of *Santa Chiara*, 6 – convent of *Monache Cappuccine, 7 – access (hypothesis), 8* – barbican, 9 – medieval tower, 10 - bulwark of *Fontana Bona.*

2.3 Graphic analysis of the map of 1773

In the eighteenth century, with the annexation to the Kingdom of Sardinia, under the rule of the Savoy, the defensive line of Cagliari reaches its maximum extent and completeness.

The projects of military engineers (De Vincenti, De Guibert, De Besson), bring a substantial enhancements to the shape of the city. Almost all the sites are initiated in the thirty years that runs from 1720 to 1750 while the last of the lower flanks of Savoy (the one of the bulwark of *San Francesco*) is realized in 1773.

There were many famous designers who took turns in the direction of the work and, given the timing of implementation of the fortifications, often the engineer in charge carried out the work designed and initiated by his predecessor. An example is the horn work of *Buoncammino,* a massive north expansion of the fortress that, for all the duration of the work, almost 20 years, enjoyed the contribution of almost all the technicians sent to fortify the city in this period.

The map of 1773, kept at the *Archivio di Stato* of Turin, while not presenting a detailed drawing, distinguished, through the graphic representation, the military structures and therefore identifies the functioning of the defensive line at the end of work of the engineers of Savoy in the second half of the century. In particular, the area examined shows the knight in the service of the bulwark of *Balice*, the access system of the *porta dei Leoni*, the lower flanks realized in the eighteenth century in the bulwark of *Balice* and in the complex of *Sperone* - *Villanova* and an interesting description of the block placed in the University Street with the San Giuseppe Street not still yet connected with the Genovesi Street, like we can observe starting from the nineteenth century cadastral map.

Through a graphical overlay of documents, is possible to highlight the correspondence between the two urban voids represented in the drawing of 1773 and the cadastral divisions of 1930 and identify some elements that lead to the definition of the medieval line and especially of the barbican (reported in the fourteenth documents and drawing by Sigismondo Arquer) that develops along the University street (fig.4).

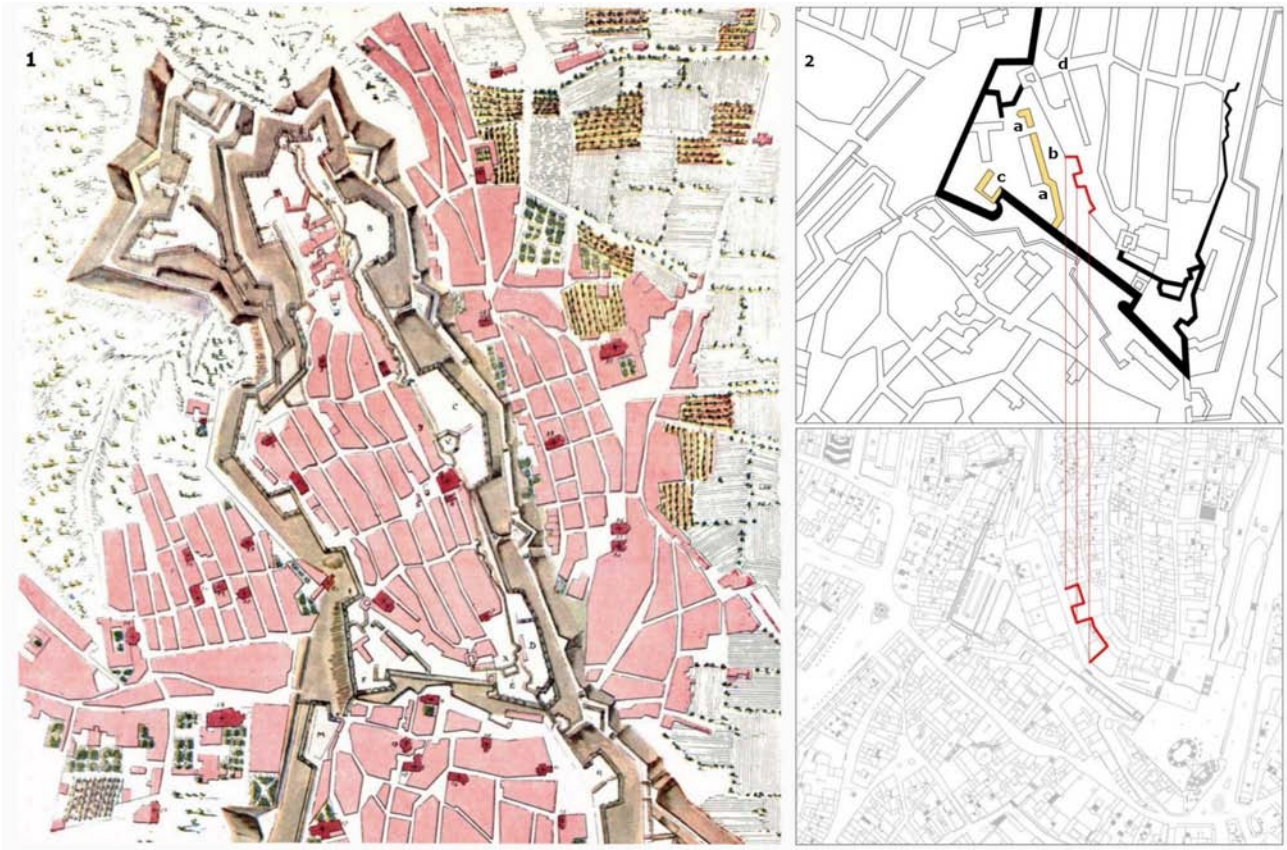

Fig. 4: 1 – a part of the map of 1773, 2 – elaboration of the map of 1773 and graphical correspondence with a recent aerophotogrammetrical survey that shows the barbican (a) along the university street (b), the knight of bulwark of *Balice* (c) and the San *Giuseppe* street (d) still closed.

2.4 Cadastral maps

Another documentary source is represented by cadastral maps that offer some points for reflection and allows to highlight some functional steps of the fortification works; the nineteenth century cadastre does not present distinction between empty and full spaces but, along the curtain of *porta Castello'*s, identifies the sequence of structures used for the construction of the bulwarks [4]. The Cadastral map of 1930 shows the light wells and courtyards isolates and in particular allows to detect the trace of the medieval wall still visible within the public building (secondary school) placed in *San Giuseppe* Street. Analyzing the map, it's possible to observe the gunboat and the gallery of the bulwark of *Sperone*, and identify (with n. 2172 and n. 2174 reported in the map) the vaulted room part of the access system of the *porta dei Leoni*.



Fig. 5: Cadastal map of nineteenth century and a more recent map dated 1930.



Fig. 6: Digital elaboration of cadastral map of nineteenth century and a map dated 1930 : 1 – *torre dell'Elefante*, 2 – torre del Leone, 3 – bulwark of *Balice*, 4 - bulwark of *Sperone*, 5 – gunboat of *Sperone*, 6 – gallery of *Sperone, 7 – vaulted room, 8* – the access system of the *porta dei Leoni,* 9 – medieval tower, 10 - bulwark of the *Fontana Bona.*

2.5 Survey of military structures and hypothetical reconstructions of the defensive line

The survey (conducted through a instrumental network aimed to the insertion of the structures in the cartographic base) has involved three areas of the sector investigated [**3**]. A first segment is represented by a medieval wall present within the Arts high school (fig.7), a second from the structures located inside the monumental complex of St. Remy (fig.8-9) and a third from the curtain of *porta Castello* (fig.7). The first section analyzed it is recognized by a medieval wall, present in a courtyard of the Institute and a part of the medieval curtain located between the *torre dell'Elefante* and the *torre del Leone*. This wall belongs to XIV century expansion present in the drawing of the 1358 (fig.1). The structures present within the complex of the St. Remy (fig.10) shows themselves the different phases of the SE area which includes the medieval and early sixteenth century structures, the bulwark of the *Sperone* realized by Rocco Capellino, the work of Paleari and the late nineteenth century design that originated the staircase with double branch and the covered promenade with three naves that runs along the *Regina Elena* street [6]. The curtain of *porta Castello* presents a thickness conforms to what was found in the examination of the works realized in the

area of *Santa Croce* in Cagliari by Rocco Capellino, with a total thickness of seven meters (tree meters of external masonry plus 4 meters determined by the length of the structures that support the embankment of the bulwark) as emerged in the course of diagnostic investigations [7] coordinated by prof. Roberto Balia (a specialist in applied geophysics of the University of Cagliari) on assignment of the Municipality. The data emerging from the survey operations and from the graphical analysis of historical maps have therefore allowed to create an hypothetical reconstruction of the medieval and modern defensive line between *the torre dell'Elefante* and the complex of San Remy; this first result is shown in fig. 11 where the traits measured were included in the referenced cartographic base (an aerophotogrammetrical survey) together with the cadastral map of 1930.



Fig. 7: medieval wall present within the arts high school and the curtain of *porta Castello*.



Fig. 8: *Porta dei Leoni* and functional spaces of the bulwark of *Sperone* realized by Jacopo and Giorgio Paleari.



Fig. 9: The monumental complex of San Remy. Some structures and functional spaces present in the bulwark of the bulwark of *Sperone* and in the bulwark of Villanova.

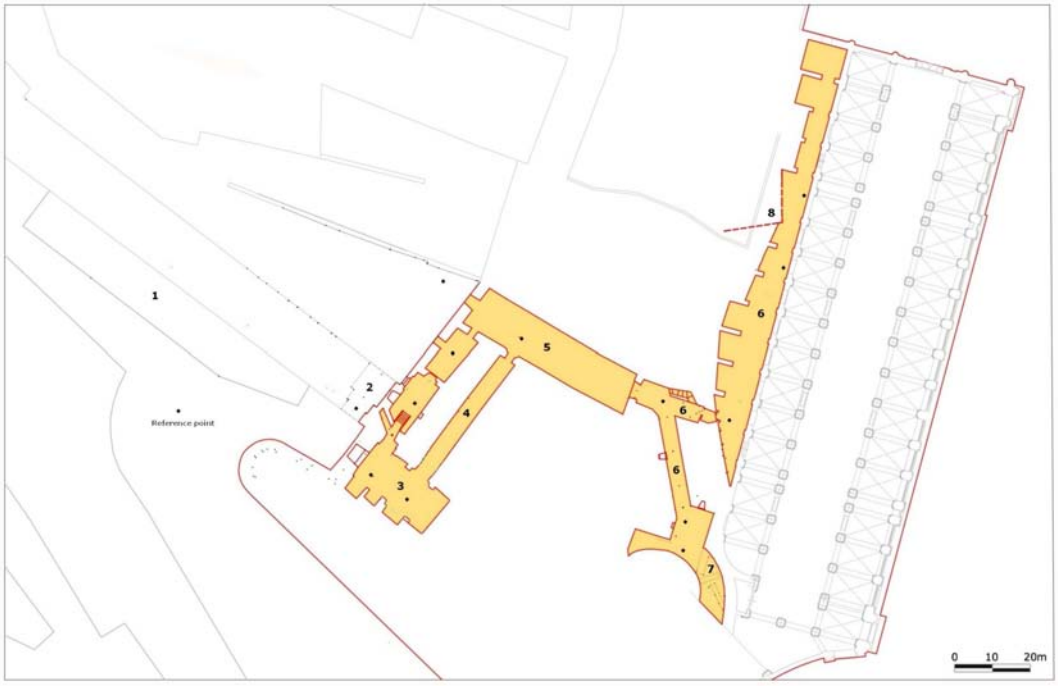

Fig. 10: Instrumental survey of the military structures located within the monumental complex of *San Remy*: graphical representation of the first results (1- curtain of *Porta Castello*, 2 - *porta dei Leoni*, 3 - gunboat of *Sperone,* 4 - internal passages realized by Capellino, 5 - gallery of *Sperone*, 6 - internal passages realized by Paleari, 7 - archaeological investigations, 8 - medieval corner tower (hypothesis).

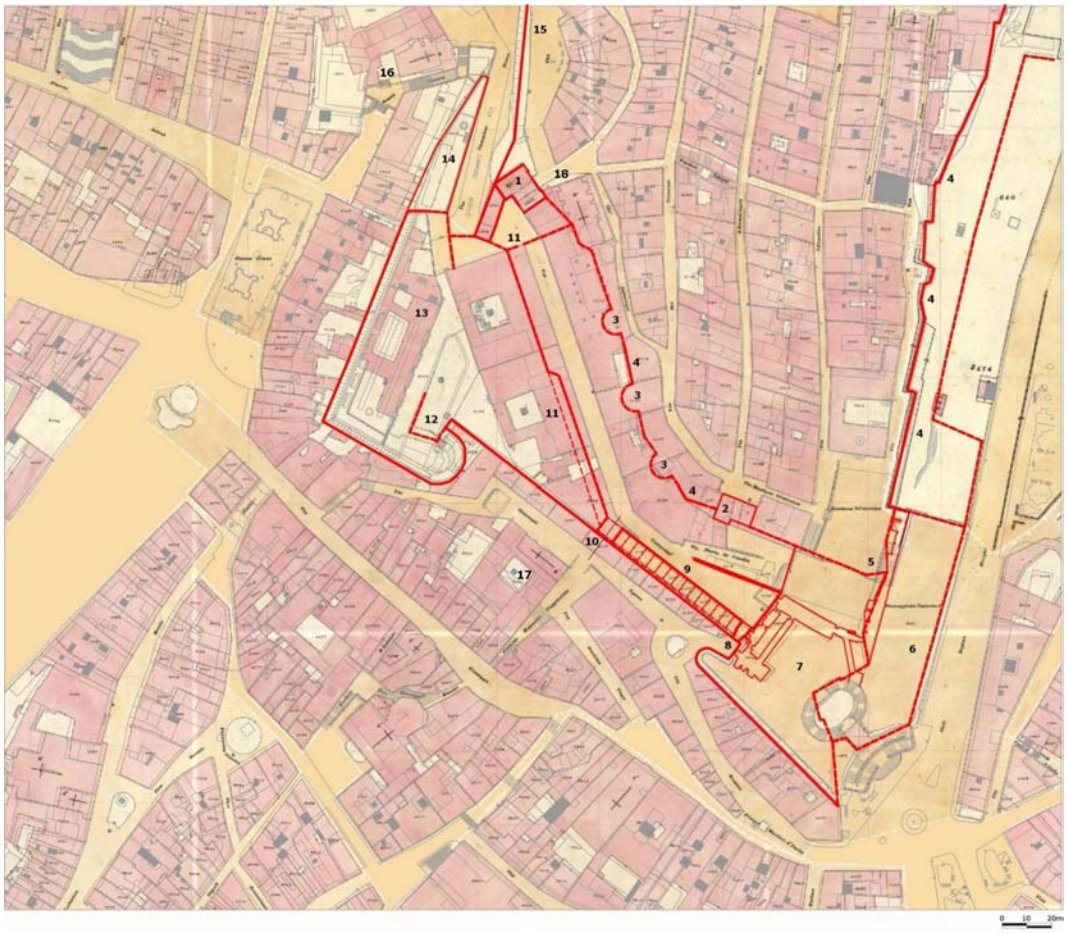

Fig. 11: 1 – *torre dell'Elefante*, 2 – torre del Leone, 3 – medieval circular tower, 4 – medieval wall, 5 – medieval corner tower (hypothesis) and bulwark of *Santa Caterina* (*de la Fontana Bona*), 6 – bulwark of *Villanova, 7* – bulwark of *Sperone, 8 – porta dei Leoni,* 9 – curtain of *porta Castello*, 10 - bulwark of the *Fontana Bona,* 11 – medieval barbican, 12 – knight of *Balice*, 13 – bulwark of *Balice*, 14 – low flank of *Balice*, 15 – Curtain of *De Cardona, 16* – Convent of *Santa Chiara, 17* – Convent of *Monache Cappuccine, 18* – Church of *San Giuseppe.*



Fig. 12: 1 – *torre dell'Elefante*, 2 – torre del Leone, 3 – bastion of *Balice*, 4 – Curtain of *Porta Castello*, 5 – Curtain of *De Cardona*, 6 – medieval wall (areal view of the aerea from https://www.google.it).

Bibliographical References

[1] CADINU, Marco. *Urbanistica medievale in Sardegna*. Roma, Bonsignori, 2001.

[2] CUNDARI, Cesare. *Il rilievo architettonico. Ragioni. Fondamenti. Applicazioni*. Roma, Aracne, 2012.

[**3**] DOCCI, Mario, MAESTRI Diego. *Manuale di rilevamento architettonico e urbano*, Bari, Laterza, 2009.

[4] MAGGI, Girolamo, CASTRIOTTO Jacopo Fusto. *Della fortificazione delle città*, Venezia, 1564, Edizione consultata, Ristampa anastatica, Padova, 1982.

[5] PIRINU, Andrea. *Il disegno dei baluardi cinquecenteschi nell'opera dei fratelli Paleari Fratino. Le piazzeforti della Sardegna*. Collana DAP, Firenze, All'insegna del Giglio, 2013, ISBN 978-88-7814-596-2.

[6] ERBÌ, Salvatore, PISU Valentina, *Il complesso di San Remy a Cagliari. Analisi dei progetti, rilievo delle opere e rappresentazione dell'evoluzione di un sistema difensivo*. Thesis in Architecture, Faculty of Engineering and Architecture, University of Cagliari, A.A. 2013-2014, thesis advisor prof. Andrea Pirinu.

[7] PIRINU, Andrea. *Metodologie integrate per la documentazione delle fortificazioni alla moderna della Sardegna. Il baluardo di Santa Croce a Cagliari*, in AA.VV. Proceedings of Italian Survey and International Experience, Roma, Gangemi Editore, ISBN 9788849229158, pp. 459-466.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Building in / Building on. Composition strategies for re-conversion of productive buildings

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Abstract
The strategic role of *brownfields* in current development dynamics of European city has been extensively explored during the last 20 years through theories, projects and realizations.
In this scenario, the contribution wants to deal with the re-conversion of abandoned productive artefacts in terms of architectural project. Confronting with the pre-existence, the project should have the capacity to assume what exists as an *archaeological trace,* a recognizable element that, through active participation in new building's life, put up the diachrony of architectural fact, to be intended as a superposition of signs coming from different times.
Productive buildings are often related, from the typological point of view, to the archetype of the *hypostyle hall,* characterized by ordered recurrence of punctual structural elements, or of the *big hall*, characterized by minimization of vertical supports and large free spans. Through a non-exhaustive catalogue of paradigmatic projects we can identify key modification strategies. We distinguish two very general categories of intervention: the first one provides for the intervention within the existing perimeter with minimal alterations of external shape (figure, project by Bolles+Wilson for U-boat Halle in Hanover); the second intervention possibility provides for the *aggression* of the building from the outside, by setting up new volumes to increase existing surfaces (figure, project by Arm Architectures for *Friche Belle de Mai in Marseille*).

Keywords: disposed productive building, architectural composition, urban regeneration,

1. Role of brownfields in urban development
The abandoned productive areas in all the European territory are the result of a complex system of situations. We can indicate here in this regard the more relevant causes: the gradual transfer of manufacturing and industrial production in so-called developing countries to take advantage of cheap labor and to minimize costs of production; the transformation of the western economy from an industrial economy itself, that is mainly linked to the production of material goods, to a service economy (intangible goods); the substantial transformation, within the same European territory, of production geographies in relation to the establishment of so-called joint territories and continental trade corridors.
The numerous regeneration of industrial areas conducted in Europe during the last thirty years show the capital importance, from the strategic point of view, of the abandoned sites for the development of contemporary city. The possibility of re-using a urbanized site represents a sustainable urban growth option as it allows to avoid the increasing of sealed surfaces. Often production sites were located at a certain distance from urban centres according to compatibility between residential and production/logistics activities. At the same time they had to be easily accessible from infrastructures and so they were located near highways exits, often made *ad hoc*, or stations and rail terminals.
The phenomena of unregulated urban growth occurred in the whole continent during the last thirty years have in many cases undermined the original location choices and so production sites are now very close to recent urban areas and sometimes they are completely surrounded by them. The same urban aggression seems to impose the regeneration of brownfields.

Among the major regeneration operations of abandoned industrial sites conducted on the continent we want to remember the most emblematic examples.
The regeneration of the Zollverein coal mine site, in Westphalia in Germany, is an interesting experience of a mine site *musealization* started since 1986, the year of site closure. The great number of buildings, realized in different historical periods, were partly changed in monuments and partly re-functionalized with new didactic uses (Fig. 1). This experience, all voted to didactic, entertainment and memory, shows all its limitations because now we can't see powerful re-appropriation processes of recovered places. In fact we can say, watching effects of other European experiences, that only where we have a mix of uses (among which housing cannot miss) addressed to the triggering of a *city effect*, we can have a true and long term regeneration of derelict lands.

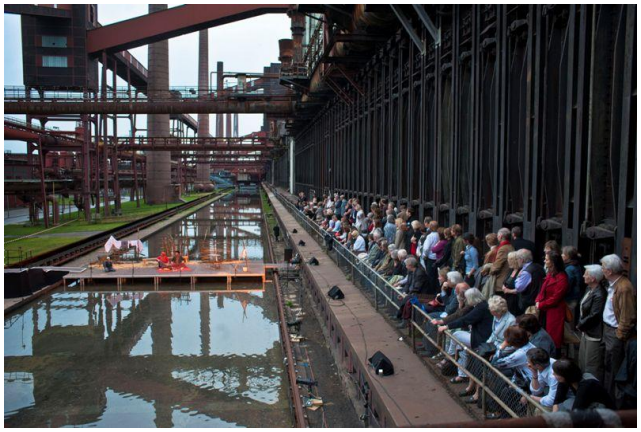

Fig. 1: Zollverein plants changed into polyvalent place

The regeneration of Ex-Pirelli site at Bicocca (Milan), conducted by Gregotti International since 1997, can be considered and happier experience (Fig. 2). As a result of an international competition, the Bicocca area was transformed into an urban part characterized by a multitude of uses, including housing, tertiary activities, education (in fact it was established an University), etc ... well connected with the rest of the city. The urban project is based on a system of rectangular blocks with buildings defining central open spaces which are configured as squares or public gardens. The old organization of workshops was partly assumed, because the design team decided to define a brand-new urban drawing based on the alignment represented by one of the main urban development axes.



Fig. 2: Ex-Pirelli area at Bicocca in Milan (left), Dublin Docklands in Dublin (right)

Dublin Docklands regeneration experience is now still in progress. It covers an area of about 520ha and began in 1997. The site was characterized by a strong material (lack of adequate infrastructures, poor conditions of buildings, lack of public spaces and services) and social degradation. The idea behind the big project was to create the new expansion of Dublin City Center in an place characterized by a great potential

value due to the presence of various channels and the Liffey River and to many public transport nodes and interchanges (Fig. 2). The Liffey's mouth appeared congenial to accommodate a new residential and tertiary neighbourhood. The establishment of a public-private partnership Urban Transformation Society, the Dublin Docklands Autorithy, as promoter and actuator of regeneration works, is the most interesting element of the operation. We should underline, however, that the specific weight of private interests seem to prevail over the idea of a sustainable long term urban development[1].

2. Re-conversion of productive abandoned artefacts as an architectural composition problem

Facing industrial re-conversion problem from the point of view of the architectural design means reasoning about the intervention criteria and methods on disposed artefact. It must be intended as a building that, after a first life cycle, for different reasons, cannot host original uses and it should be necessarily adapted to new activities.

2.1 Transformations in historical buildings: typological persistence and uses

The architecture of European historical multi-stratified cities, with particular reference to the Italian situation, provides a very extensive list of buildings that during their existences have changed uses several times: we are often in front of monastic buildings became barracks and then schools, churches became libraries, residential buildings changed into offices.

These transformations are frequently spontaneous and they stand as adjustment processes conducted by users themselves. They operate modifications addressed to the definition of new distributive configurations by introduction of new elements or through the alteration of what exists. In this regard, we can recall the emblematic story of the disappeared building disappeared of *Pubblici Granili* of City of Naples, a store of grain and foodstuff, realized by Ferdinando Fuga and started in 1779[2]. With the enormous devastations suffered by the city of Naples during the Second World War, it became a refuge for thousands of homeless people who had lost their homes in bombings. Changing operations carried out by new occupants determined the formation of new openings and windows and altered the internal distribution. However, given the inability to efficiently change, for typological and structural reasons, a logistics building of the Eighteenth Century into a residential building, the inhabitants living conditions were precarious and unhealthy as described by the writer Anna Maria Ortese in the collection entitled *"Il mare non bagna Napoli".*

This case demonstrates the fragility of a transformation conducted without a program, without a preliminary evaluation of architectural types possibilities, without a clear work plan. In other cases, the transformations are conducted on the basis of a precise transformative program consciously acting on pre-existing artefacts and operating, in happier cases, in compliance with the original typological organization.

In this way, we can recall the story of two ancient buildings that over the centuries have changed their uses through projects and conscious operations. They are the Theatre of Marcellus and the Baths of Diocletian in Rome that during the Fifteenth and Sixteenth Century, in full Renaissance Age, were the subjects of transformative operations.

In particular, the Theatre of Marcellus had been turned into a fortified building from the Late Middle Age and in the Sixteenth Century it was changed into an aristocratic palace by Baldassarre Peruzzi. He preserved the typical semi-circular planimetric shape and the whole arches system, as a typical feature of the Roman Theatre architecture. For distribution requirements he closed some arches but he was careful avoiding to intervene on the façade layout, realizing new walls back from the street front. He also provided a super-elevation hosting the noble floor. The result was a building in which the modern text, manifesting its recognisability, was overlapped on the Latin text (Fig. 3). We should underline that the Modern language, that in those years was distilling, was based on classical conventions as they were presented in Vitruvian Treaty that scholars were re-discovering, on examples provided by many ancient ruins brought to light by archaeological excavations and on classical building that for first time, in a climax characterised by recover of tradition, were considered as references for new architectures. Consequently, the language proposed by Peruzzi for new parts of the building is a reinterpretation of the classical style and it defines this way an unitary entity formed by old and modern elements with similar features.

Michelangelo's attitude was completely different when he confronted with the great ancient monument of the Baths of Diocletian. He had to change a part of the ancient building into a church and he decided to maintain pre-existing elements as the time had delivered them to the Modern people, avoiding to complete destroyed or *spoliate* parts. He also worked with modern language for new elements obtaining a composition balance

[1] For more information about the Dublin Docklands regeneration, please read Gaspare Oliva, "Interessi pubblici e privati nel progetto urbano, il caso dell'Irlanda. Quale ruolo per la ricerca?". In: L'architettura è un prodotto socialmente utile?" Torino, 2014

[2] For more information about Ferdinando Fuga project for Granili building please read Paolo Giordano, "Ferdinando Fuga a Napoli: l'Albergo dei Poveri, il Cimitero delle 366 fosse, i Granili", Edizioni del Grifo, 1997.

for these ones (Fig. 3). The opposition between the existing and the new parts, characterized by different levels of finiteness and different treatments, must be read within the author's poetic sensibility which is usually defined as "Michelangelo's Non-Finiteness", but It can be also considered as a harbinger of an attitude that will be manifested in architectural culture only after four Hundred years. In fact in Nineteenth Century, architects will begin to reason about the need to make architectural interventions of different ages distinguishable. Only in Twentieth Century, as we shall see in the next paragraph, this attitude will become a theory and a codified intervention practice.
All the architectures we have considered are public buildings that can be defined, with Rossi, *primary elements* of urban structure[3], which are characterized by a clear and precise typological organization and therefore they show a remarkable ability to adequately accommodate a wide range of uses, very often with minimum adaptation solutions.
This feature, that is typical of great architectures of history, can also be attributed to productive buildings, according to the critical interpretation provided in this paper. In fact they are determined in their internal organization and articulation primarily by internal operating rules and they are almost immune to contextual influences. For these reasons we can define them as *atopic*[4] artefacts. The clarity of distribution system is probably the starting element for a conscious regeneration project.

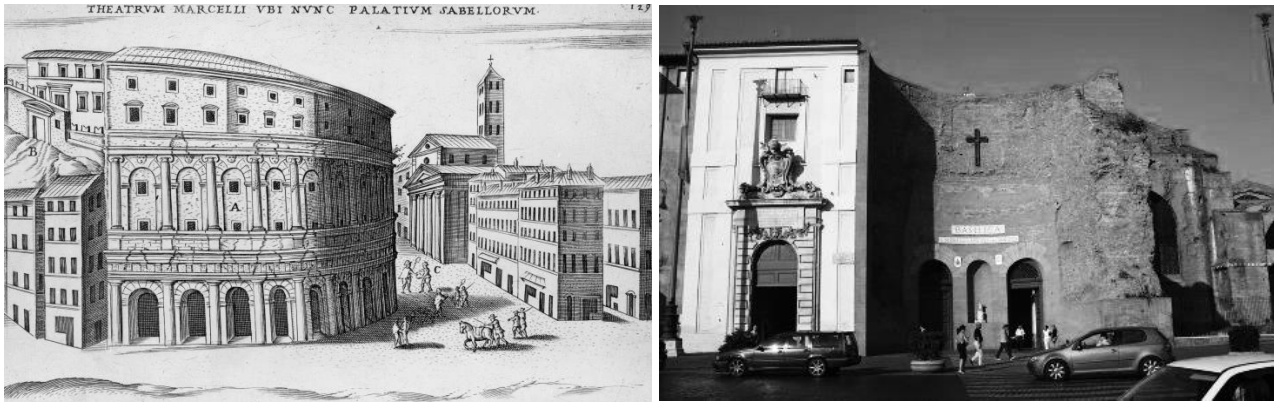

Fig. 3: Theatre of Marcellus changed into a palace in Giacomo Lauro, Antiquae Urbis Splendor, Roma 1637, tav. 129: *Theatrum Marcelli ubi nunc Palatium Sabellorum* (left); Diocletian Baths changed into a Christian church by Michelangelo as it appears today (right).

2.2 Intervention criteria for productive abandoned buildings: learning from architectural restoration

On intervention methods, on the identification of compatible uses with the type-morphological and constructive features of pre-existing building, on issues related to the testimonial value of historical buildings, for the entire Twentieth Century architectural restoration culture, especially in Italy, has tried to build a theory, to codify procedures, to define the operating methods which today represent a priceless heritage[5]. It is based on the staging of different building's life phases, on the recognisability of contemporary intervention compared to historical text and the consequent possibility of intervening with a contemporary language and "style" even on ancient buildings.
This paper therefore aims to extend these methodological approaches to the re-conversion of disposed productive buildings that can be considered, in conceptual forcing frame, on the same level of historical buildings carrying testimonial values. Production buildings of the late Nineteenth and Twentieth Century are in fact, as is well known, the testimony of crucial periods in European history: the industrial revolutions. Within a project of conscious transformation they should be considered this way.
Intervening on pre-existence, regardless of its consistency, with the inclusion of new elements and systems, is not simply the addition of signs to a text, because this operation produces a brand new architecture, hopelessly different than the previous building, which incorporates the previous but doesn't renounce to be

[3] For an exhaustive definition of this concept please read the Second Chapter of Aldo Rossi "L'Architettura della Città", 1966, CittàStudi Edizioni. In general, with the expression *primary elements* we intend big public buildings and monuments in urban textures, assuming an invariant role in urban transformation and development processes and stand as catalysts of activities at the urban scale.
[4] Here, the term *atopic* means a building with a context (conditions of place where it is located) independent configuration.
[5] The debate of the Twentieth Century about the architectural restoration finds its culmination in the document named "Carta di Venezia per il restauro e la conservazione di monumenti e siti" written in 1964. It describes ways to conduct conservation and restoration interventions on monuments and architectural artefacts and on archaeological sites.

contemporary. The re-converted building is therefore a *diachronic* architecture in which many historical moments live together. This condition of multiplicity defines the character of the new building: a palimpsest in which the overlap of deferred signs is managed and controlled by project, standing as a smart tool.
Examples of regenerated production buildings you can find in following lines, have been identified on the basis of their ability to stage the diachrony, to evoke different times and to allude to different hosted uses.

2.3 The role of architectural composition

The architectural composition, as a set of techniques and procedures for the definition of spaces and places, can approach the problem of re-conversion defining operating procedures to be grouped into very general interventions classes. Before the intervention on artefact appear therefore necessary to survey the composition consistency of the same pre-existing artefact in order to intervene maintaining its recognisability of the system. Considering what is written in the previous subsection, the introduction of new elements must be addressed to adjustment of the existing with the criterion of "do the less you can" involving the introduction of the strictly necessary number of new elements.

3. Composition strategies for re-conversion

Analysing a number of recent project experiences on abandoned industrial buildings we want to define general intervention criteria representing different approaches. In particular it is possible to distinguish two types of intervention:

- The first mode, we defined BUILDING IN, regards the intervention within the perimeter of the existing building, altering and modifying the interior with minimal interventions on the involucre. This strategy works on the typological organization of the artefact, because, acting inside the perimeter walls, it alters the distribution without significant morphological changes.

- The second mode, we defined BUILDING ON, is about the addition of volumes and external elements that, as parasitic architectures, stick to the pre-existing building altering the morphological articulation. In this strategy, the typological organization of pre-existing artefact is usually preserved, or slightly modified, while the volumetric configuration of the building is completely transformed.

Before we observe some experiences related to the described intervention types, we want to review the most common typological categories of productive buildings. This fast digression allows to observe the transformative operations in function of the disposed buildings planimetric arrangement. The aim is the evaluation of efficiency levels of each strategy in relation to the various building types.

3.1 Productive building recurring typologies

Given that the production building, from the typological and morphological point of view, is almost exclusively defined in function of internal organization needs (in reason of the working or storage activities to accommodate), we can determine with a good approximation that they are substantially atopic building. For them the influence of the context acts only on openings layout (presence of buildings on the perimeter, etc ..) and on planimetric deformations determined by eventual irregular shape lots.
We distinguish three main productive building types in function of the distribution of the vertical supports and the spatial possibilities related. The names of these types are taken from the archetypes (generic and original typological systems) we can associate to every type.
They are:

- Productive building *hall* type
  Volume with an elongated rectangular shape.
  It is characterized by the distribution of vertical supports along the perimeter in order to make the central space free to accommodate large machinery.
  Vertical supports may be made in reinforced concrete or steel; coverings can be flat, sloping or vaulted and therefore we can have horizontal beams, extrados or intrados trusses. Pilasters or columns may be placed on the same alignment of perimeter walls, standing as supports for the walls themselves, or can be misaligned. In this case, pillars can be extrados or intrados.

- Productive building *basilica* type
  In case of huge cross sections and given the impossibility of having too high beams, the single span may be inadequate and the use of a combination of more hall spaces become necessary. This solution defines a multi-aisles *basilica* cross section. In the addition paired vertical structural elements may appear. Pillars, roofs and beams can have different typologies as described in the previous lines, however, mixtilinear profiled roofs may appear.

- Productive building *hypostyle hall* type
  It is an uncommon type with a bidirectional arrangement of vertical structures. They are based on square or rectangular spans along the two axes forming an undirected space. Even in this case vertical structural elements, beams and roofs may have different geometries to be realized with different materials and technologies.

3.2 Strategy 01: Building IN

Among a large number of examples and experiences attributable to the strategy defined BUILDING IN, firstly we want to write about the interesting contribution by Francesco Venezia for the unrealized Exhibition Centre in Pompeii (2001). For the exhibition space, he proposed to reuse a system of abandoned warehouses attributable to the typology of *basilica* productive building, in which several vaulted aisles align crosswise. The author tries to reproduce the condition of the abandoned Roman cisterns that, as a result of the time's action, lose their introverted state because of the formation of cracks in the coverings. The defined solution provides a system of small internal patios bringing light into the interior spaces in a complete alteration of the original space conditions.

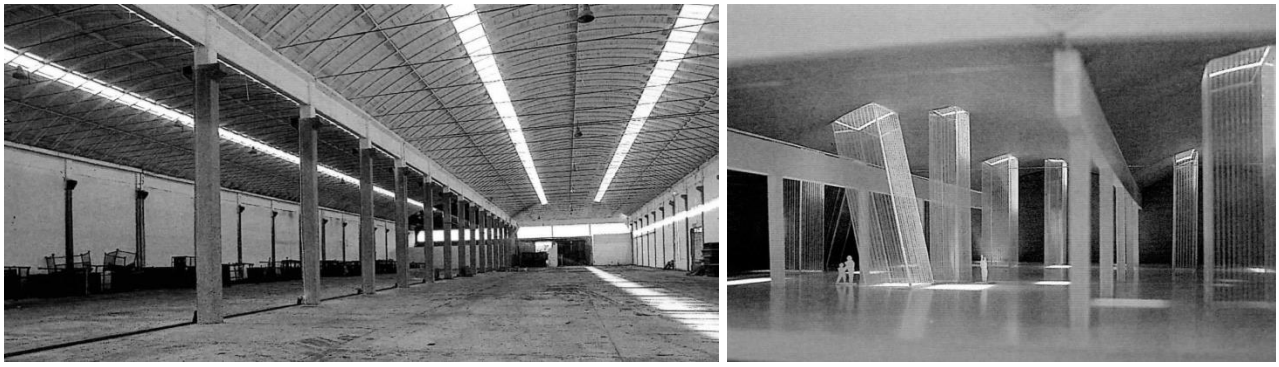

Fig. 4: Francesco Venezia, Exhibition Centre, Pompei (ITA), 2001. Internal view of the existing building (left); internal view of the project maquette (right).

In the context of Dublin Docklands regeneration, the proposal for the transformation of an Eighteenth Century gasometer (2006) by Irish firm O'Mahony Pike Architects starts from the need to only maintain the structure, that is made up of decorated and red-painted cast iron elements, and from the assumption of the powerful circular plan for the organization of new flats. The structure, with no more static rule, is associated with a glass curtain-wall defining an interesting palimpsest in which the two building life's phases are clearly recognizable. A cylindrical courtyard surrounded by distribution decks on each floor allows the access to radially arranged apartments (Fig. 5).



Fig. 5: O'Mahony Pike Architects, Gaswork building, Dublin (EIRE), 2006. External view (left) and internal view of the courtyard (right) after the regeneration operations.

The work by Andrea Oliva for a business incubator in the Ex-Officine Reggiane site in Reggio Emilia started in 2010 and it clearly expresses the transformation principle of the minimum intervention to maintain, in the best way, the building's conditions as well as delivered by history. The building has a triple aisles *basilical* cross section, metal structures and a pitched roof. The architect occludes the lateral aisles, characterized by a low height, and half section of the main nave defining a large distribution walkway. New volumes are wooden boxes and they are clearly distinguishable from pre-existing elements, that architect deliberately maintained in condition he found them. On the main facade a long horizontal window is inserted to assure an adequate light. A low elongated volume covered with metal sheet, duplicating a lateral aisle, is also added. The complete maintenance of existing elements in the condition in which they were found must be understood as a testimony of the building's life and it goes up to the preservation of graffiti realized during years on the external walls (Fig. 6).



Fig. 6: Andrea Oliva, Ex-Officine Reggiane, Reggio Emilia (ITA), 2015. External view (left) and internal view (right) after regeneration operations.

In the proposal by Portuguese COMOCO Arquitetos in Coimbra, a double shed building with vaulted roof and trusses is changed into a sports centre. The perimeter walls are not interested by modification interventions and so externally we can only find a cor-ten steel portal revealing the transformative works. Inside, one of the two buildings is completely occupied by service spaces while the other one hosts the playground. All internal partitions are made of structural cardboard, as proposed in many circumstances by Japanese architect Shigeru Ban, and they never touch the ceiling. This solution defines a building formed by an outer envelope (the existing walls and ceiling) and by a smaller inner envelope (service spaces characterized by a precise matter connotation). Between the two perimeters, as a kind of subtracted place, there's the served space, the playground (Fig. 7).



Fig. 7: COMOCO Arquitetos, Sport facilities, Coimbra (POR), 2010. External view (left) and internal view (right) after regeneration operations.

The last example we want to recall is a project by Bolles + Wilson for the conversion of an old building in which the notorious Nazi submarines U-Boats were produced. It is situated in Hanover and it has enormous dimensions. Designers decided to work on new internal levels, identifying new quotes in function of

commercial uses. The operation on cross section allows the definition of a sort of Loos *raumplan* that does not undermine the dis-measure of the enormous void volume. In fact it defines, through the multiplication of useful surfaces, new points of view on the interior space making the building's enormity more evident (Fig.8).



Fig. 8: Bolles + Wilson, U-Boat Halle, Hanover (GER), 2010. Project cross section model.

3.3 Strategy 02: Building IN

In regeneration of Ex-Pireli industrial site at Bicocca (Milan), started in 1999 by Gregotti International, the recovery of a cooling tower had represented an opportunity to conceive a new building around a pre-existence. A "C" shape building hosting offices is organized around the large tower with a distribution galleries system overlooking the giant height space. One side of the new building is a glass wall and allows to see the tower great volume, in which the project locates meeting rooms and a big conference hall.

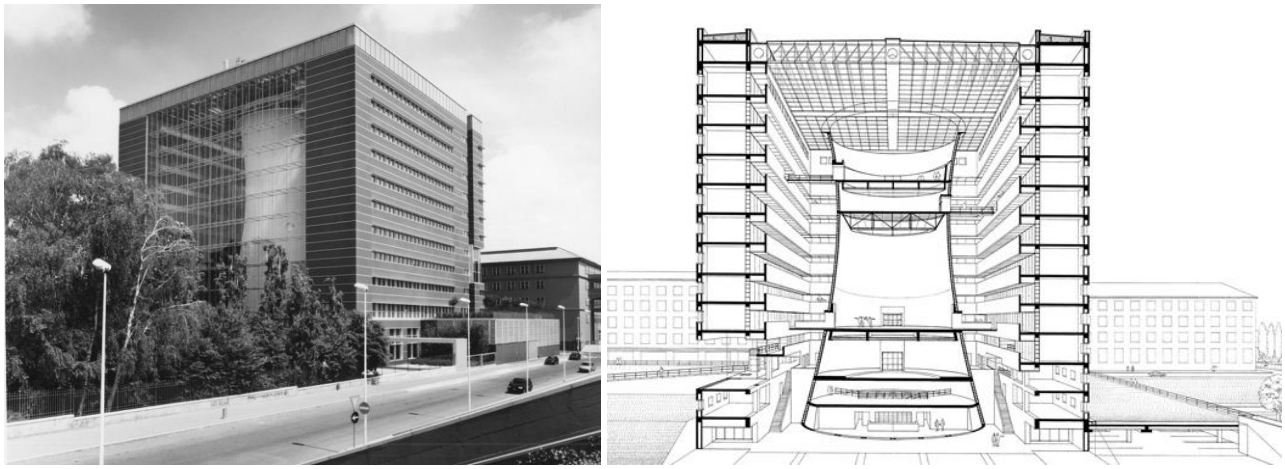

Fig. 9: Gregotti International, Pirelli RE Headquarters, Milano (ITA), 2000. Photo of the glass walled side (left); cross section drawing (right).

In FRAC building in Dunkerque, Lacaton and Vassal decline the theme of new elements addition in a particular way. In fact they flank to the existing reinforced concrete building with pitched roof, a glass volume characterized by the same shape and size. This twin building hosts offices and services spaces supporting exposition activities of the existing volume. This one is presented as architects found it: they don't provide adjustment and adequacy interventions (Fig. 10).

A couple of abandoned productive buildings with vaulted roofs and located in Copenhagen, have been changed by Plot Studio (Bjarke Ingels and Julien De Smedt) in a youth center. Project introduces new internal light walls organizing the space in accordance with new uses. Given the need to increase surfaces, designers added a new volume (a container) on covering. It rest on vaulted roofs, turning the covering of the building into an accessible terrace (Fig. 11).

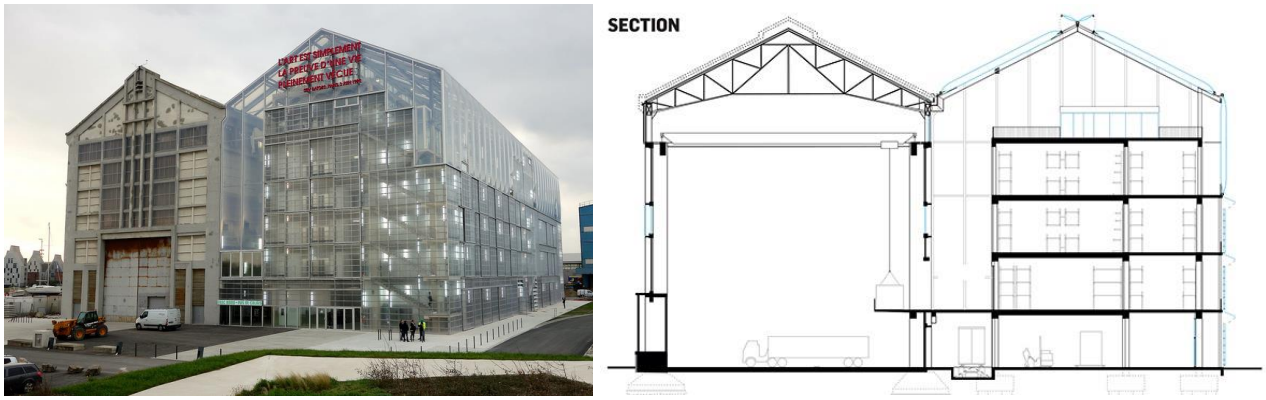

Fig. 10: Lacaton & Vassal, FRAC, Dunkerque (FRA), 2013. External view after regeneration (left); cross section drawing (right).



Fig. 11: Plot Studio, Youth Centre, Copenhagen (DEN), 2011. External view (left) and view of the covering (right) after regeneration.

The Belle De Mai building in Marseille is a disposed production complex turned into a fair and art centre by Arm Architectes. They add a new volume to existing surfaces and it stands as a white box in opposition with the reinforced concrete frame defining existing parts. They also provide a sinuous panoramic path on the roofs to facilitate the transfer between different buildings of the complex (Fig. 12).



Fig. 12: Arm Architectes, Belle de Mai, Marseille (FRA), 2011. External view (left) and view of the covering (right) after regeneration.

Bibliographical References

[1] AA. VV.. RIGENERARE UN'AREA INDUSTRIALE. REGENERATING A BROWNFIELD. THE CASE STUDY OF ASI AVERSA, NAPOLI: ArchitetturaOpenSource, ISBN: 978-88-907032-6-3

[2] Venezia, Francesco. Francesco Venezia le idee e le occasioni. Milano, Electa, 2006, ISBN: 978-88-435-8351-4

[3] Morpurgo, Guido. Gregotti e Associati, l'architettura del disegno urbano. Milano, Rizzoli, 2003, ISBN: 978-88-17-04576-6

[4] Rossi, Aldo. L'Architettura della Città. Torino, CittàStudi Edizioni, 2006, ISBN: 978-88-251-7112-9

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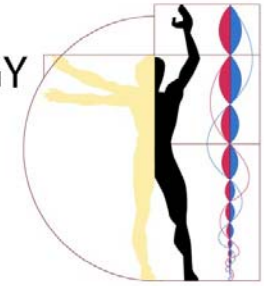

The intangible visuality of invisible cultural landscapes. The aerial view for the knowledge of the past.

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Abstract
The interpretation of aerial photograph looks not only at ancient human activities, but especially at modern human activities, as a model of comparison for reading the ancient landscape. Aerial view is a peculiar element for the observation of the landscape and its evidence, which would be otherwise difficult to understand at ground level. The interpretation of aerial photography is one of the most effective methods to identify "the invisible transformations" of cultural landscapes, reshaped over the centuries by nature, time and human interactions.

Keywords: Landscape, Cultural Landscape, Landscape Archaeology, Aerial Archaeology

1. The European Landscape Convention and the concept of Landscape
The European Landscape Convention is the first international agreement on the European Landscape. The European Landscape Convention was adopted by the Committee of Ministers of the Council of Europe in Strasbourg on July 19th 2000 and signed by Member States of the Council in Florence on October 20th, 2000. It was signed by the thirty-five States of the European Community and ratified by nineteen, including Italy in 2006, with the aim of promoting the protection, management and planning of European Landscapes [1].

The Convention considers the landscape as an area perceived by people and as the result of the actions and interactions of natural and/or human factors. The term "landscape" defines a portion of territory that is recognized or "perceived" by the populations occupying it. This identification with the territory is closely related to the forms of space and time of the human beings occupying that place, allowing them to shape and design the territory. This kind of coexistence between man and landscape is so tied to natural, cultural and anthropic factors that the concept of landscape is not defined only by the environment but also by the changes that people are implementing on their territories. This determines "the landscape "and allows us to recognize it as such.

This Convention applies to the entire territory of the Parties and covers natural, rural, urban and suburban areas. It includes land, inland water and marine areas. It concerns landscapes that might be considered outstanding as well as everyday or degraded landscapes.

Each landscape has a peculiarity which has a great influence on its inhabitants and each space can establish relationships and complex interconnections between places, like the urban and rural landscapes. The landscape is a slow and gradual development of nature, due to geological, hydrological and geomorphic factors; an element that contributes to its change over time is the agency of men, which determines the change, either positive or negative, of the landscape. The interactions between the needs of man and nature have led to the origin of new territorial organizations, such as settlements, land reclamation, agricultural activities. Yesterday just as today, the choice of a place

rather than another was determined by the ability to exploit it and improve adaptation, establishing a symbiotic relationship with the environment. In this way men considered the landscape as a resource, planning accurate and strategic interventions. This allowed the creation of different forms of landscape, that by preserving their structural integrity have been in constant transformation. In the last centuries, man's activity has gone beyond the possibilities of nature, with unintelligent and massive interventions, that have, in many cases, destabilized the "physical strength" of the landscape and have repeatedly changed its features to a messy occupation with no respect for landscape limitations. Man has changed the landscape, occupying first its surface in a meticulous way and in harmony with nature; then he intervened on the shape of the landscape, changing its appearance (deforestation, earthworks on hills and mountains) and its integrity through a savage occupation, altering cultural and historical landscapes. It has lost the awareness and interest in nature, not understanding its correct value for progress and economic development, with indiscriminate interventions on the territory resulting in a missed opportunity to increase awareness of the landscape. Every landscape could represent an extraordinary competitive tool for its uniqueness if it were protected and valued as a territorial resource.



Fig. 1: Aerial oblique view of ancient *Ostia* (Roma). *Regio IV* and *Regio V*. Positive cropmarks show several hidden structures. A very example of cultural landscape. (Bing Maps)

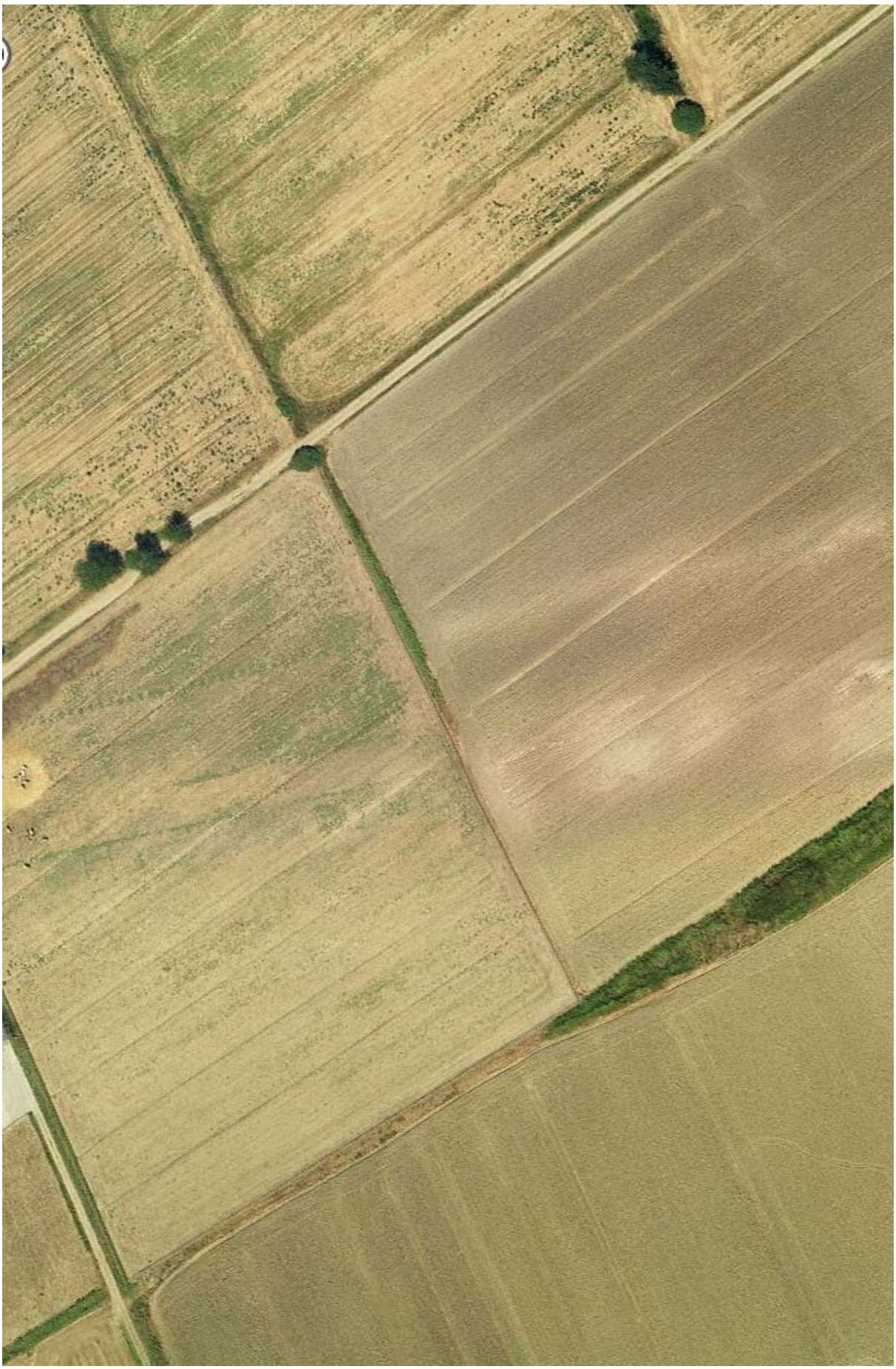

Fig. 2: Aerial oblique view of Portus of Trajan, *Ostia* (Roma). Positive cropmarks and soilmark enhance the ruins of probably roman aqueduct. (Bing Maps)

2. The cultural landscape

The historical and cultural landscape [2] is a combination of situations and expressions that took place in succession in history, interpretable as an expression of the culture that created them. However historical and cultural landscapes can be considered as tangible and intangible documents of past, present and future life and therefore they deserve to be known, protected and preserved in their integrity and in their memory. Cartography and its elaborations are tools that help to read the landscapes in their geographic, thematic and spatial connotation. Time is the element that sets a "landscape chart" in its history and that helps us, in its representation, to understand the dynamics of transformation and "revolution" of the landscape.

The word landscape has origin from the Latin noun *pagus* (village, town) and the verb *gerere* (build, administer), while the term “cultural” originates from the verb “*colere”*, which means “cultivate”. The definition of "cultural landscape" expresses an interpretation of the territory analyzed in a diachronic way because there is a strong relationship between the civilizations that developed over a territory and the territory itself in relation to the specific opportunities offered (land as resource) and the result of stratification of previous cultures (land as plot of civilization).

In the interaction between man and territory is possible to identify the same causes of the development of the course of history and its true meaning can be perceived only by understanding the causes of this relationship through man’s agency and his changes in spatial planning. So the connection between man and landscape allows to also understanding the conditions in which man is related to a nature that suffers from continuous transformations in time. Through the cultural landscape we can identify the historical development of populations and the geographic evolution of places through the analytical reading of the correlation between physical conditions and political, economic, social and cultural models. The specific values of each territory are evident from their landscape, expressing a unique identity. This identity defines the concept of cultural landscape and constitutes a value explicit in its nature and history.



Fig. 3: Serravalle Scrivia (Alessandria). Ancient roman city of *Libarna*: negative cropmarks show a square *insula* near house with swimming pool. (Bing Maps)



Fig. 4: Roman town of *Ferento* (Viterbo): the ancient urban grid evidenced by negative cropmarks. (Google Earth)



Fig. 5: San Salvatore Telesino: roman town of *Telesia***.** The urban grid evidenced by negative and negative cropmarks. (Bing Maps)

3. The ancient cultural landscape: the approach of Landscape Archaeology

For the study of ancient cultural landscapes it is particularly important to observe the signs appearing in it; the discipline of Landscape Archaeology originates from this assumption; in fact this discipline is founded on the collection of evidence that the landscape hides over the centuries and that consciously or unconsciously man destroys through continuous agricultural works, illegal development and so on. The archaeological survey is one of several tools for finding these signs, because it allows to investigate the horizontality of human presence and the scheme of this in the modern landscape. History is produced in the landscape through human actions that overlap creating a layered chronological landscape. The speed of transformations is not however an exclusive factor of our time. There have been periods in Prehistory, Antiquity and in the Middle Ages, characterized by an impressive dynamism. The archaeological survey is a technique of acquisition of new archaeological documents from the landscape, but it is not the only one. In fact Landscape Archaeology uses different sources for different purposes. Aerial photography is one of them [3].



Fig. 6: Viterbo. Probable Etruscan tombs; three rectangular tombs and one T tombs with a dromos and two lateral rooms. (Google Earth)

4. The use of aerial photography for the knowledge of ancient cultural landscape

Man always seeks new techniques to exceed his natural limits of observation and visual perception; usually we are used to observe everything around us by a more or less horizontal point of view.
In these conditions our vision is limited to small areas and the natural and the artificial elements limit our partial perception. The oblique view is great: fox example the roof of a building, a platform or a panoramic viewpoint. So it is possible to observe all visible and hidden elements placed in landscape.

Thanks to the archaeological research in aerial photography conducted in recent years it was possible to stress its importance for the study of ancient landscapes [4]. Aerophotointerpretation is a methodology for the study of the ancient cultural landscape [5]. Giulio Schidmt advocated that this discipline should not be confused with a simple reading of a picture, but should be seen as an actual analysis and synthesis [6]. Through aerophotointerpretation it is possible to identify different elements in order to understand certain unseen features [7].
Aerial photography is an information efficient tool, but it is “mute” [8]. Aerial view is a way to give voice to the picture and decipher the traces in the territory for the temporal reconstruction of past landscapes [9]. All the traces founded in aerial photography (positive and negative cropmarks, shadowmarks, dumpmarks, soilmarks) are archaeological “signs” only after verification on the ground through surveys or archaeological excavations [10].

Conclusions

Aerial photography is necessary in order to understand the continuous transformations of a cultural landscape and its dynamics. This, together with the survey and the archaeological excavations, is indispensable for archaeological research and for the study of past landscapes. The technique of aerial surveys, as all investigative disciplines, presents certain limits in contexts such as a dense urban settlement. Many times relevant features are not detected in the principal site, but in adjacent areas to the one investigated; those are often considered less important [11]. All the traces found in aerial photography (positive and negative cropmarks, shadowmarks, dumpmarks, soilmarks) (Fig. 1; Fig. 2; Fig. 3; Fig. 4; Fig. 5; Fig. 6) are recognized as archaeological “signs” only after being verified on the ground through surveys or archaeological excavation. The use of aerial photography contributes to a comprehension of the dynamics of the origin of a landscape, its cultural and structural transformation and also its abandonment. Also the reading of historical aerial pictures will allow the chronological analysis of the territory, of which it will be possible to read the succession of marks in the multilayered landscape.

Bibliographical References

[1] The European Landscape Convention signed in Florence in 2000 in Italy and it was preceded by the first National Conference for the Landscape in 1999. Before ratification of European Landscape Convention, it was preceded by Codice dei Beni Culturali e del Paesaggio in 2002.

[2] PICCARDI, Silvio. *Il paesaggio cultural*. Bologna, Patron, 1986.

[3] CAMBI, Franco. TERRENATO Nicola. *Introduzione all’archeologia dei Paesaggi*. Roma, Carocci Editore, 2000.

[4] CAMBI, Franco. *Archeologia dei Paesaggi Antichi: fonti e diagnostica*. Roma, Carocci Editore, 2003.

[5] CAMBI, Franco. *Manuale di archeologia dei paesaggi. Metodologie, fonti, contesti*. Roma, Carocci Editore, 2011;

[6] FABIANI, Fabio. *L’urbanistica: città e paesaggi*. Roma, Carocci Editore, 2014;

[7] FARINETTI, Emeri*. I paesaggi in Archeologia: analisi e intepretazione.*Roma*, Carocci Editore, 2012*; QUILICI, Lorenzo.

[8] QUILICI GIGLI, Stefania. *Introduzione alla topografia antica*. Bologna, Il Mulino, 2004.

[9] BOURGEOIS, Jean. MEGANCK, Marc. Aerial Photography and Archaeology: A Century of Information. Ghent, Accademia Press, 2005.

[10] CERAUDO, Giuseppe. PICCARRETA, Fabio. *Manuale di aerofotografia archeologica. Metodologia, tecniche e applicazioni*. Bari, Edipuglia, 2000.

[11] CAMPANA, Stefano. MUSSON, Chris. PALMER, Rog. *In volo nel passato. Aerofotografia e cartografia archeologica*. Firenze, All'Insegna del Giglio, 2005.

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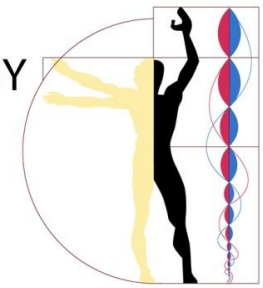

THE ROLES OF INDUSTRIAL HERITAGE AREAS ON URBAN RENEWAL: THE CASE OF "ÖDEMİŞ"

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Abstract

Industrial heritage is important not only for showing the history of the area but also for the identity of the area. Industrial heritage has big effects on the historical, social, cultural, technological, architectural aspects those have close relations with urban renewal.
This study is based on the hypothesis of "industrial heritage zones shape the urban renewal". Within this scope the aim is to develop a model that can evaluate the effects of the identified industrial heritage zones and reused industrial buildings on sustainable urban renewal. Besides that it was aimed to find the effects of urban renewal approaches on the economical, social, spatial problem solving processes. The model also provides an attention to the buildings in the industrial heritage areas in the context of visual importance, architectural characteristics of its time, art, history, archeology, technology related issues for the industrial history.
By this model, it was tried to adopt a wide range of involvement of the society to the urban renewals in order to raise the living standards of the city and to develop urban sustainability and social transformation approaches. This model was tested in a Republic town called "Ödemiş" which reflects the industrial history of Turkey. The conclusions show that industrial heritage areas should be strongly integrated to urban renewals to reach holistic sustainable renewals.

Keywords: Industrial heritage, industrial archaeology, urban renewal, Odemis

1. Introduction

Wearing of industrial buildings in city center, their fall astern from technological developments, losing their functionality due to various reasons and their evaluation within the scope of functional transformation are started to be accelerated in last few years. Within this regard in cities that consisting of industrial structures are started to be defined as "industrial heritage" which have architectural identity with creating certain serious areas.
This procedure also brought urban renewal nowadays. In general urban renewal means changing the buildings by considering social-economic and physical conditions in which are worn due to many reasons and their transformations, rehabilitations, revitalizations and appending them to city life. Usage of structures by re-functioning are defined as low step of the city renewal and reference points.
This study is created within the scope of saving industrial heritages that are placed in urban area, became old and effecting the city by socially, economically and locally by creating their sustainability and solving local, economical and social problems of the city with integrative point of view.
This study is based upon the hypothesis that renewal of industrial heritage is creating the renewal of the urban. Within this regard industrial heritage definition means creating sustainable urban renewal of industrial buildings and creating a model for evaluation of industrial heritage buildings for renewal. While evaluating the industrial heritage areas with the created model; urban sustainability and public transformation improvement are intended to increase the urban life quality and public participation via broad scanning. This model is tested on Republic's city Ödemiş that is reflecting the industrial history.
In this it is aimed to examine roles of economical, social and local problems of Ödemiş to create a integrative and sustainable urban renewal scenario to solve the related problems. Also it is aimed to evaluate visual precautions and industrial qualifications and functions as parallel to their times; consideration of art, history, archeology, architecture and technology and contribution to these.

2. Industrial Heritage

Industrial archeology is standing out as a new working area within the second half of the 20.century. Industrial archeology is appeared due to wearing of industrial buildings, their failure in adapting to new technology, their lost of function by city pressure and various reasons totally for different aims of usage with different aims. Industrial archeology term can be defined as scientific discipline as consisting of activities to create services by mechanical devices and/or mechanism and original architecture that is subjecting totally for itself. [18] Industrial archeology term is firstly used by Michael Rix in "Amateur Historian" magazine by British historian to define products of Industrial Revolution [17] Rix is defined industrial archeology as "Working area that is evaluating industrial heritages after industrial revolution" and tried to draw attention to protect and improve architecture.[10] Rix defined industrial heritage ruins important. His usage of the term archeology is an propellant power for British Archeology Council and at the year of 1959 this council had established a research committee as defining its national policy to record first period industrial heritages and their protection. Another publication related with Industrial Archeology is the book that is established by Hudson at the year 1963as "Introduction to Industrial Archeology". [8]
In 1963 Industrial Monuments Survey is established. However its start of usage as definition to protection history and its entry with widespread usage is started at 1970's. First industrial archeology congress is made in 1973 at England in Ironbridge Gorge industrial region. (Figure 2.1) Industrial heritage is defined in many areas with different terms and in early times they are defined as technical heritage or technical monument. At the meeting of TICCIH* –The International Committee of the Conservation of Industrial Heritage by 1978 in Sweden "industrial monument" and "industrial heritage" terms are used. In TIICH regulations "industrial heritage is defined as ruins of industrial culture with historical, technological, architectural, social-cultural and scientific values." (TICCIH,2003). Other resources that are defined within the scope of industrial heritage are described as cultural assets which are immovable cultural sources, structures and industrial landscapes. [13]

Another council that is working on protection of industrial archeology after TICCIH is ERIH –The Europen Route of Industrial Heritage. This community is established to announce changes in old industrial heritages and contribution to evaluation to tourism oriented evaluations. (http://www.ERIH.de-)
Required conditions for industrial heritage to be accepted to ERIH:

- Original and attractive as Industrial Heritage,
- Important place in European history,
- Open to improvements
- Located in region which has tourism potential,
- Attract different types of human groups,
- Located in a place that there is adequate transportation connections are placed,
- Creating symbolic value.

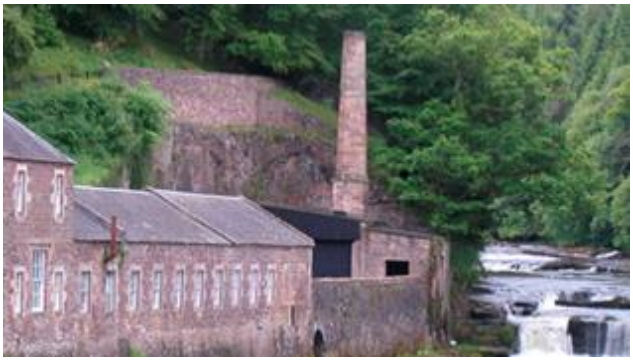



Fig. 2.1: Lanark Textile Factory, England, built in 1785.

In accordance with TICCIH's report for 2003, industrial heritage value of the heritage sources are defined in accordance with the criteria given at the following:

- Industrial heritage is sum of the historical results. These evidences are providing industrial and technological improvements to be understood.
- Despite of physical working area, reflection of human behaviors on products are aiding to increase the evaluation of products and cultural improvement.
- Industrial heritage is an economical resource. Its right usage provides gaining of energy and protection of cultivated area.

- Industrial heritage has great role in economical and urban benefits in lost and damaged areas. Providing sustainability for reuse is making contributions to public improvements.
- Industrial heritage structures and areas are required for modern life and heritages from past must be contributed into city life for usage of nowadays (TICCIH, 2003)

3. The Effects of Industrial Heritage to Urban Renewal

Fast improving, changing, cities that their population is increasing day by day and which are rich from cultural heritage are creating great opportunity from social cultural and economical aspects to evaluate existing potentials and by this way there can be new functions for their revival and improvement [5].Cities after revolution there industrial structures left as ruins and other places that have architectural qualities are defined as “region within the scope of industrial heritage” and by this way urban areas are changed. After changes these areas are started to be renewed in accordance with the economical, social-cultural and local improvements. This renewal procedure can be summarized as evaluation of the city potential, providing public and economic benefits.
In accordance with comprehensive perspective, long and short terms of objectives within the scope of industrial heritage are;

- Determination and improvement of environmental values in industrial area,
- Protection and sustainability of industrial heritage,
- Integrity of old industrial areas with cities,
- Evaluation of the advantages procured from physical environmental values with renewal area central identity,
- Definition of new functions placed in city centre and procurement of awareness raising with new functions and creating the place as a new centre of attraction,
- Stopping of physical decline in industrial heritage area and procurement of present qualified structure,
- Renewal of housing zones,
- Improvement of regional infrastructure,
- Creating a central area with multidisciplinary working program that environmental and urban quality is reached to highest levels,
- Improvement of functional transformations to procure protection and sustainability parallel with industrial heritage thought by the production techniques in area,
- In parallel with regional improvement strategies, renewal of industrial area, activation of dynamics socially, local and economically up to related dynamics,
- Enrichment of equipment areas, restoration of pedestrian transport, improvement of transport network in the scope of renewal at industrial areas,
- Increase of labour power and economical growth,
- Creating of open and closed public areas for urban citizen’s usage,
- Creating sustainable urban areas for regional users to fulfil their requirements and their requests,
- Procurement of efficient usage in present potential,
- Strengthening and enrichment of renewal area with recreation and tourism functions,
- Providing vision for future of the city,
- Prevention of pollution, increase of environmental quality,
- Emphasis of social equality in renewal approach,
- Renewal usage approach of industrial identity with first identity and their consistency works for re-use,
- Definition and shaping of new profile of the population in industrial area,
- Providing persistency of the users in related area of industry after the renewal,
- Local authorities can be defined as participation of private sector and public-private sector partnership, universities and non-governmental organizations. Urban renewal projects that can be arranged within this scope will provide sustainability of the city within the industrial heritage and providing their gains in urban scale.

4. The Case of Ödemiş

Ödemiş has an important value to be evaluated due to urban improvement for the reasons both its central location on Küçük Menderes reservoir and industrial structure of Aegean Region. Industrial activities of Ödemiş are improved due to agricultural raw materials. Raw materials needed for industrial activities are present in city. Due to perish of agricultural raw materials industry is improved in the region. Also by the help

of transportation opportunities to İzmir there is an suitable environment prepared for marketing. Industrial structures placed in district can provide information about industrialization of Aegean Region. Industrial improvement in Ödemiş city is examined within the scope of improvement periods.

4.1. 19. YY. Situation of the Industry

Main factor that increasing the improvement of Ödemiş is construction of İzmir-Aydın railway at 1888. Aydın-Ödemiş line is 214 km long and it is completed by Oriental Railway Company in 1890. There is 1.100 sterling of payment is arranged for construction of Dinar and Ödemiş line from London centre. [9] Within the first month 10 km of Ödemiş line is completed [9]As a result of this improvement surrounding districts and villages can reach to city easily and Ödemiş had became a marketplace. Ödemiş industry is improved parallel with agricultural products. West Anatolian economy is divided into two categories at the end of the 19.century as export and internal market. One group of goods were ruled to export sector before the transportation that are needing less process; on the other hand, industrial institutions were mainly making productions for consumer goods [11]

Within this period one of the important traditional working area was leather trade. In 1884 at İzmir Flag 17 of the 62 tanning yards were at Ödemiş. In tanning yards leathers that are half processed with old technology are exported to Europe and they have returned back with huge price difference after processed. Valonia trees were widely common in West Anatolian forests and because of consisting of tannin material it was at the first place in export goods [2]

There is a olive oil factory that belongs to Davidyan brothers in 1896 in which is ten minutes away from Ödemiş. Except from this factory olive oil is made in refineries for many years. Also at the end of the 19. Century pure silk fabrics for sheeting with gold are produced. There were bedclothes produced, too. [16] During 19.Century weaving production is improved in Aegean region against factory products of Europe. Ödemiş was specialized in silk cloth [15] One of the oldest sector in Ödemiş was rope trade. Tevfik Güran who had researched for Ödemiş's social- economical structure at the middle of 19. Century said that at the year 1844 %14 of the district were working on rope trade and recorded that these have important income [7] At the end of the 19.century industrial institutions of İzmir and its surrounding distinct are found inadequate, but however despite of these it is found one of the most industrialized city in empire. In this period foreigners and minorities were seen to be dominant in industrial institutions

4.2. Industry's Situation at the beginning of 20.Century

Ödemiş is defined at the middle of three monumental mosques as; Küçük Camii (1811), Büyük Camii (1854) and Yeni Cami (1912) [1] At the year of 1900's in Ödemiş there were 3517 house, 817 stores, 27 khans, 3 hamams, 1 olive oil factory, 1 flour mill, 1 grape and grape juice workshops. Population of the village was 15.981 in1904.

There were two olive oil factory was established between 1902 and 1904 years [7]

At the year of 1916 there were 550 thousands of kilos cannabis production and 150 thousand kilos of rope is exported in 750 wenders [7]

At the year of 1919 there were 6 tileries, 2 olive oil factories, 100 olive oil workshops with older technology, 123 water mills, 750 hand looms separated to villages for rope production and there were lots of silk cocoon manufacturing shops.

In 1922 at a factory that belongs to Karagözoğlu Hüseyin Bey, there were 615 kg of tahina, 641 kg of halva, 128 kg of sesame oil is produced yearly and in another factory at Meşrutiyet Street there were 384 kg of tahina, 1282 kg of halva and 40 kg of sesame oil is produced yearly.

4.3. Industry's Situation at Republic Period

In accordance with the statistics of industrial institutions of İzmir city in 1923 there are 81 flour mill in Ödemiş that working with water [2]At the first years of the Republic, there is 8 olive oil factory, 5 flour factory and mill, 1 soda factory, 2 sesame oil factory and one million kg of olive oil is produced in these days averagely. Also in this period there were 3 hosiery active and there were simple hand looms for public to knit themselves white clothes in order to fulfill their needs. At the year 1924 there is an agricultural devices factory established by Ali Efendioğlu Mehmet Cemal Bey. Sesame oil is also produced in factory in which there are six workers were working [7]. In 1927 there were 15 olive oil manufacturers at Ödemiş, production of silk textiles (handkerchiefs, scarf fabrics) knitted cloth and waist cloth production and also there is rope production in which is an old art of Ödemiş that are done by old fashioned flywheels. In same district there is Buldanlı Haşim Efendi silk textiles factory is established and closed in 1928. Economical structure of the

Republic of Turkey was depending upon agricultural production and marketing of these goods until beginning of 1930 [12]. At the year 1931 for the purpose of producing cannabis and gathering cannabis producers under a single roof it is established by Aydın Fig Producers Partnership (Ödemiş Ropers Cooperative) and this cooperative had brought a machine to Ödemiş to separate cannabis from fiber [19]. There were 7 sesame oil and flour manufacturing shops by the year 1935. Butchery, cold air storage and ice factories are established by the year 1936.

4.4. Industrial Situation of the Industry at the Second Half 20.Century

To understand the industrial situation by the second half of the 20.century studies about urbanization in these days must be examined. Ödemiş had realized the most important movement about urbanization at the year 1940. This period is named as II. National Architectural Period and the most important attempt in this period is the participation to competition of the city plan in Ministry of Municipality Mutahhar Başoğlu period.
In jury report Ödemiş is described as a humble city and it is not suitable to offer monumental buildings, there is no need for roads to be passing out from ring roads, transportation with camels must be done from the parallel of the ring road in order not to disturb city centre [4].
Also in this jury report Birgi's beauty and historical value is included and it is declared that these are not adequately stressed and evaluated [4]). By applying this construction plan Ödemiş's physical structure is changed a little nowadays. At the year 1945 there are 5 olive oil factories are present and twenty workers were working there and others were useless. Except from that there are 22 rendering plants in different regions. There were 88 mills that 5 of them were working with electricity. Milled flavours in this mills are approximately 45000 tones. There were three sesame oil and sesame factories working with four workers per each. There were 100-150 tones of sesame oil and halva production yearly. Two tanning yards were placed and there were also working with four workers and approximately 20 tonnes of leather is obtained [6]. At the year 1944 in Ödemiş Station Area; there were Soda Factory, Animal Market, 3 olive oil factories, Foundry, Fig Agricultural Selling Cooperative, Station Building and storehouse structures (Figure 4.1) By the year 1956 there were 5 olive oil factory, 22 rendering plant with plough and other manufacturing shops that are producing agricultural equipments.

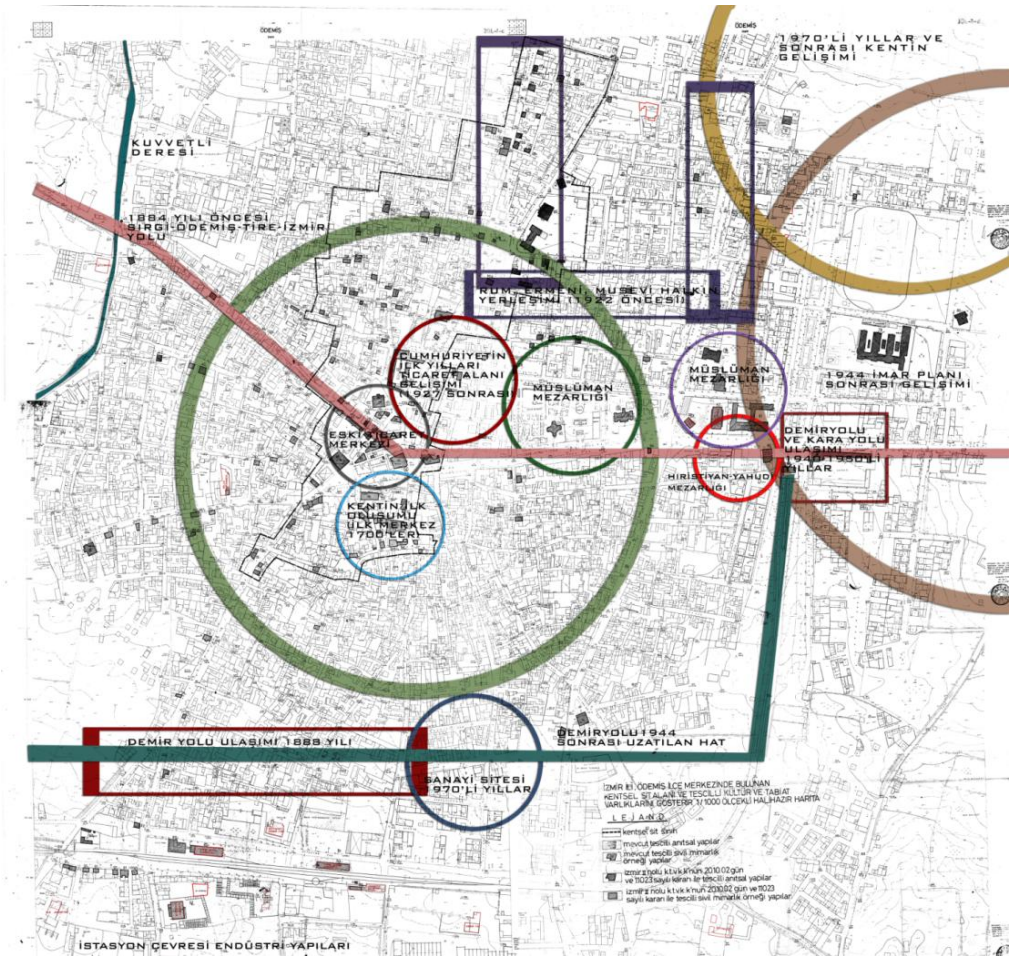


Fig. 4.1: Industrial Situation in Ödemiş

4.5. Industrial Heritage in Ödemiş City

When Ödemiş is considered for relationships between industrial areas and cities, industrial structures are closed in which they are established in places that there are not much population in time, some of them were grown and others were continued to their activities. Integration of such places with industrial areas that are not adequately used must be shaped as reinforcing places series for social and cultural structures and these are required for city's improvement. In last years industry of Ödemiş is depending upon agricultural products; mostly to cricket and olive oil factories with main food production. Nowadays in Ödemiş there are small and middle scaled places with Small Industrial Area is important [14] Also Ödemiş Organized Industrial Area is planned to be established. With the city structure in 1930's Ödemiş had became one of the most modern cities in Turkish Republic. Economy of the Ödemiş is depending on mostly agriculture and industrial improvement was too slow but however, from the year 1950 new construction plan is started for application in order to establish factories. In 1990's open industrial structures were increased because of the growth of city and removal of the city center to outside of the city, as a result of all there were not adequate residence areas. By these developments Ödemiş city centre is lost its identity and there were undefined areas formed.

5. The Model Proposed

City Renewal Plan for Ödemiş is an project that aiming to improve city vision within the scope of Industrial heritage areas. Within the scope of city renewal social, economical and cultural dimensions were based upon and protection of historical industrial heritages in city and their evaluation for public life is accepted as main concern. These industrial constructions will be renewed by the action coming from bridges and memories from past of citizen's of the region as accepting them a reality and validity of the social and physical conditions will provide the original structure of the model. Model that is created parallel with such approaches,

- Creating city renewal programs for basing upon industrial heritage,
- Industrial heritage structures must be evaluated as within the scope of Ödemiş's industrial heritage structures,
- Present universities and other cultural-historical heritage in city will be evaluated and planning the city as culture and information city and its contribution to turism,
- In renewal area Ödemiş city cente and Birgi historical structure is placed as "industrial heritage route" and proving the original renewal program for Ödemiş in order to integrate "industrial heritage route" that consists of the city structure.

Model in which is planned within this scope there is a original functionality planned for solving local, social and economical problems of the city and heritage areas that are included to city of Ödemiş that located in Küçük Menderes Reservoir. Another property of the model is to maintain Ödemiş to be competitive in global cities as cultural city and transformation to a cultural area. In model public participation dimensions to increase life quality of the city is integrative and renewal of the city. Sustainability of the city is maintained by evaluation of "Ödemiş Industrial Heritage Areas" and city culture will be created.

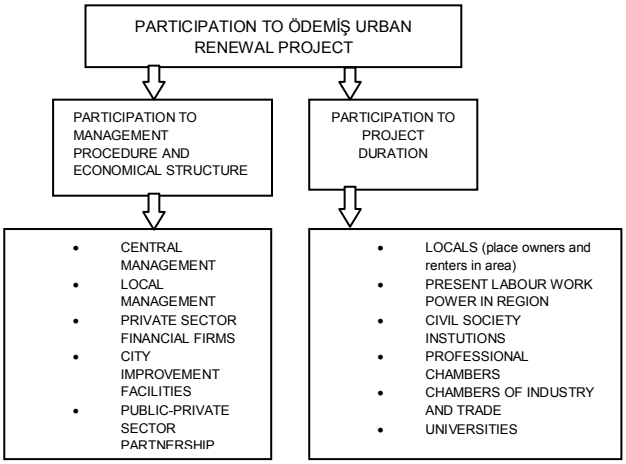
In created city renewal scenario, protection of industrial areas will be evaluated within the scope of reuse with equilibrium of identity of the region and their present functions are creating the main criterias in project.

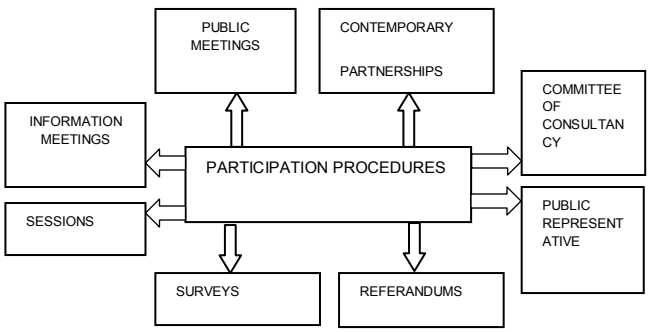
In planned new period, city will be adopted and initiatives required to maintain city conditions will provide contribution to city renewal and project realized parallel with such aims. By this way "information and cultural city" vision will be supported. Within the scope of the scenario Ödemiş city is accepted as tourism focused city. Main theme in tourism focused city is determined as "Information and Culture City" that "Industrial Heritage Culture" is maintained. Ödemiş will become a city that housing and cultural tourism is reinforced. Pre requisite for them is to decentralization of the storage units, dis-functioned and old industrial structures and improvement via tourism sector is planned. House locating will increase the house percentage by the help of the rehabilitation works and construction on the fertile lands of the city will be prohibited by this way. In accordance with the created scenario it is tourism oriented so that present building areas will be rehabilitated by the proposal of house+housing and within the scope of the tourism structure support units are tried to be provided. In Ödemiş city there are trade and service sector will be affecting the economical and social life and finance sector will be planned to be improved in the area and there will be contribution maintained by the understanding of historical structures and industrial heritages. Scenario in which is planned with this approach will be maintained as sustainable. However transportation needs and parking problems are the main problems related with tourism and housing. In the related scenario tourism and culture structure will provide prestige by economical and social development and bring prestige, also its location near city activity area and its contribution to historical structure of the Ödemiş is positive and improvement of the city in cultural platform will also brought social, economical and local benefits. Renewal project also consists of Ödemiş City Center with Birgi city structure.

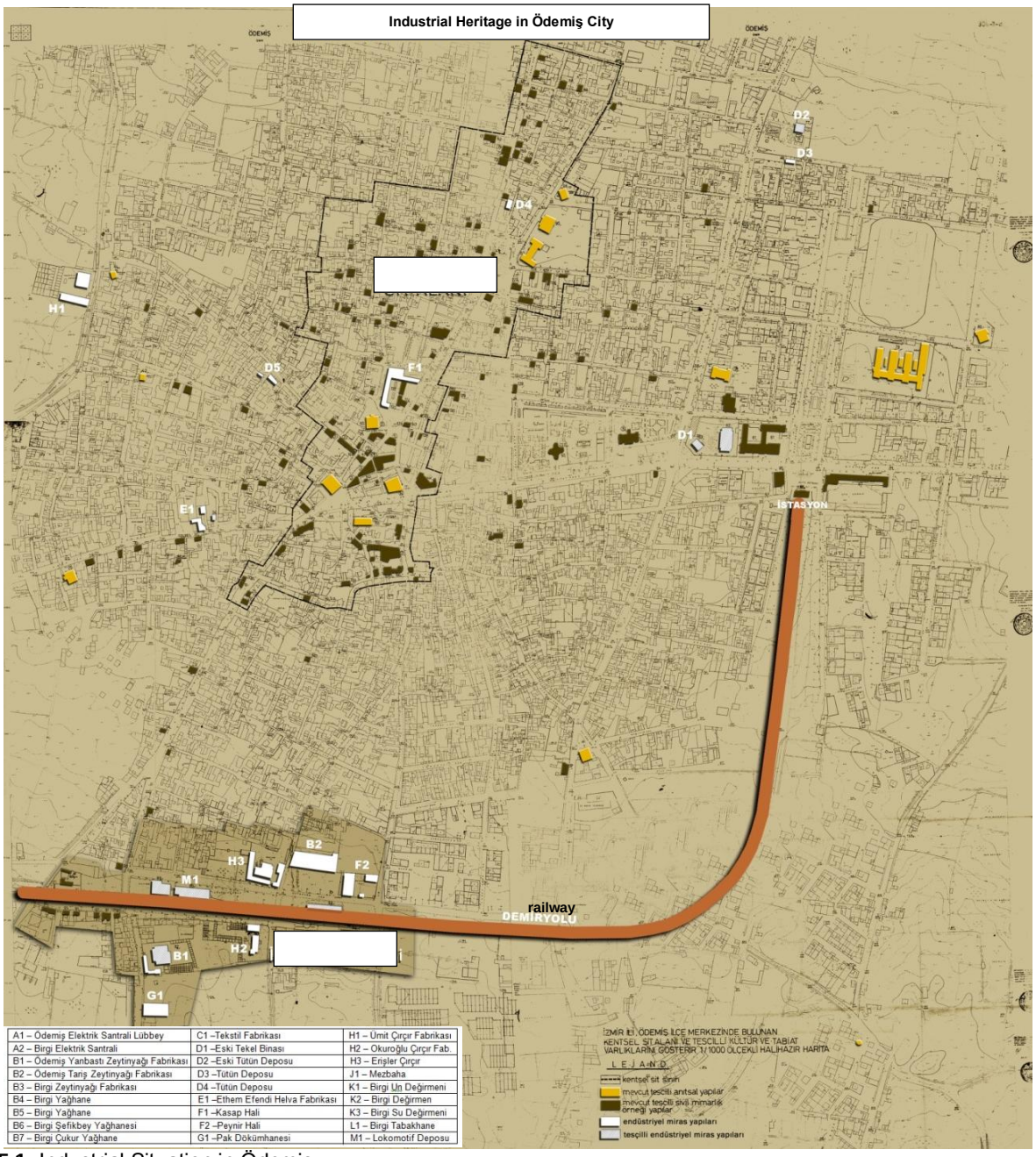
Projects within the scope of planning:

1. Ödemiş City Center Works
   - Arrangement of open public areas
   - Renewal works in industrial buildings that lost their present functionality, parallel with the integrated planning decisions
   - Environmental arrangements and pedestrianization works,
   - Restoration of monumental and civil architecture buildings,
   - Functioning and renewal of Ethem Efendi Halva Factory within the scope of “cultural and informal city” understanding
   - Evaluation of Ümit Ginnery within the scope of this region and refunctioning it for cultural purposes,
   - Rehabilitation of related housing areas
   - Evaluation of industrial heritage due to tourism and cultural functions that are localized in city structure,
   - Improvement of street structures,
   - Improvements in social structures,
2. Station Region works
   - Arranging open public areas
   - Industrial heritage structures that are localized in the region are accepted as parallel with the cultural and touristic vision with the integrated functions
   - Improvement of railway structure
   - Restorations of authorized monumental and civil architectural structures
   - Improvement of street structures,
   - Pedestrianization works,
   - Arranging of city equipments,
   - Localization of trade units
   - Development of social structures
   - Works related with railway transportation within the scope of city renewal project
   - Works that must be done for industrial heritage of the area within the scope of cultural and tourism functioning,
3. Birgi Works
   - Arranging open public areas
   - Renewal works in industrial buildings that lost their present functionality, parallel with the integrated planning decisions
   - Evaluation of industrial heritage due to tourism and cultural functions that are localized in city structure,
   - Restoration works by protecting the historical structure of the region
   - Promotion works related with the region
   - Improvement of street structures,
   - Works that must be done for industrial heritage of the area within the scope of cultural and tourism functioning,

Within the scope of this scales there are lots of components. Architectural concerns, economical dimension of the project, creation of new sustainability for the economical dimension of the project (evaluation of past production techniques, continue to light labor work again, creation of cultural tourism and creation of industrial history) are describing these components.







A1 – Ödemiş Elektrik Santrali Lübbey	C1 –Tekstil Fabrikası	H1 – Ümit Çırçır Fabrikası
A2 – Birgi Elektrik Santrali	D1 –Eski Tekel Binası	H2 – Okuroğlu Çırçır Fab.
B1 – Ödemiş Yanbastı Zeytinyağı Fabrikası	D2 –Eski Tütün Deposu	H3 – Erişler Çırçır
B2 – Ödemiş Tariş Zeytinyağı Fabrikası	D3 –Tütün Deposu	J1 – Mezbaha
B3 – Birgi Zeytinyağı Fabrikası	D4 –Tütün Deposu	K1 – Birgi Un Değirmeni
B4 – Birgi Yağhane	E1 –Ethem Efendi Helva Fabrikası	K2 – Birgi Değirmen
B5 – Birgi Yağhane	F1 –Kasap Hali	K3 – Birgi Su Değirmeni
B6 – Birgi Şefikbey Yağhanesi	F2 –Peynir Hali	L1 – Birgi Tabakhane
B7 – Birgi Çukur Yağhane	G1 –Pak Dökümhanesi	M1 – Lokomotif Deposu

Fig. 5.1: Industrial Situation in Ödemiş

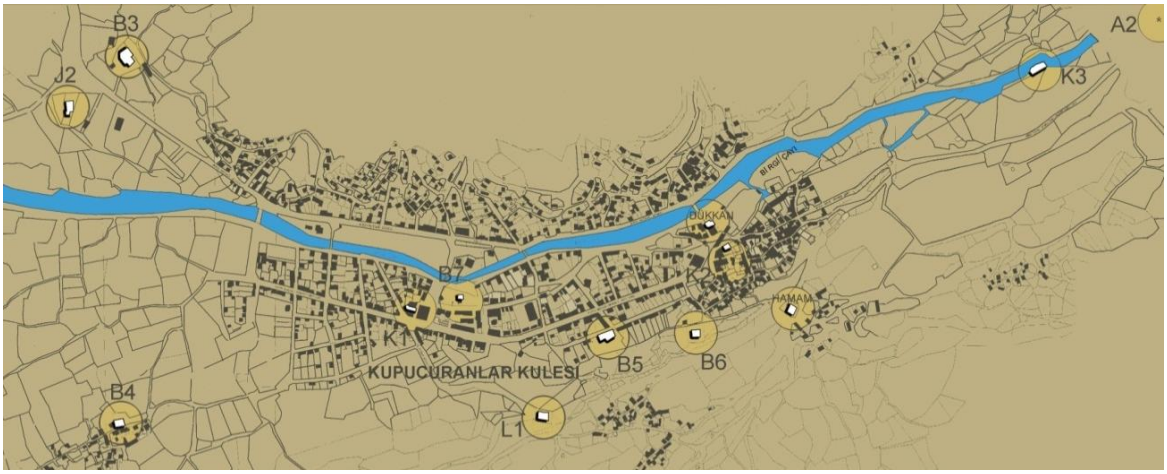


Fig. 5.2: Industrial Situation in Birgi

6. Findings

In this study regional evaluation within the scope of the heritage for urban renewal are analyzed and these regions were determined to be creating the urban renewal in area.

Regional planning decisions that are created within the scope of industrial heritage with the urban renewal procedures are;

- Providing vision to city's usage in future,
- Emphasizing industrial identity of the city,
- Transformation of the city that not conflicting with the long and short terms of goals of the city,
- Balanced and active evaluation of the city for industrial heritage potentials,
- Accepting result-oriented approaches,
- Creating a new point of view in regional and city level and creating a new centre of attraction,
- Contribution of public participation in highest levels,
- Activating the physical, economical and cultural dynamics of the city,
- Providing partnerships of public, private and civil institutions,

Are found to be required.

While earning industrial heritage areas, their sustainability and solving local, social, economical problems of the city there must be integrative urban renewal approach is needed. By using created model industrial model areas are evaluated and public participation is accepted for urban sustainability and improving public transformation approaches and improving new point of view is aimed. Urban renewal projects within this scope are directed to integrity, sustainability, social and economical evaluation approaches.

Industrial heritage areas in Ödemiş are tested for the data that are obtained coming from past for physical data and public life sustainability in accordance with the model that based upon social, cultural and economical dimensions. Model that is created within this scope are determined that Ödemiş City in which is located at the Küçük Menderes reservoir must be redounded to urban renewal, its sustainability must be procured and while solving local, social and economical problems urban renewal requirement is accepted to be developed.

Integration of industrial areas in Ödemiş with closer areas and shaping them as reinforcing structural places are in the first place for the city improvement.

Also created model is aimed to be applicable for industrial heritage areas. Within the scope of the related model for Ödemiş city there is a scenario created for renewal of the place. This scenario is fictionalized for city renewal approach of Ödemiş city to solve problems related with local, economical and social problems and creating a renewal program for city in integrative and sustainable manner.

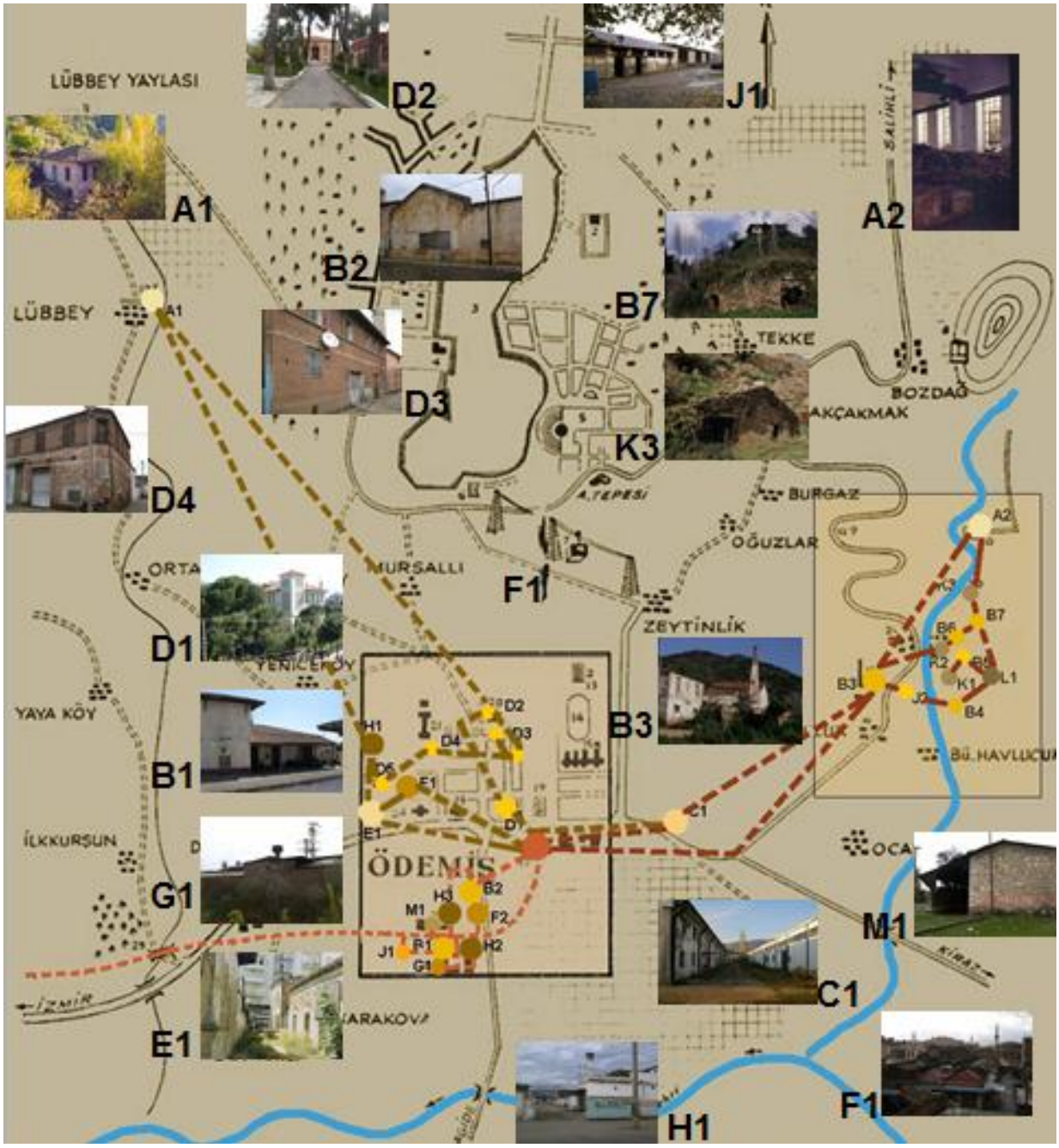
Within the scope of Ödemiş city urban renewal, social, cultural and economical dimensions are based upon and protection and evaluation of industrial heritage structures with sustainability of the public life is accepted to be the main approach. These industrial structures with regional life style of the regional citizens are accepted as bridge and memory between past and it must be aimed to create a model with original structure for the validity of the Ödemiş city's social and physical conditions.

Also there is a route offered to reinforce the promotion of industrial heritage areas in international area.

Ödemiş is evaluated parallel with this approaches and its compatibility with other globalized cities can be realized only playing a role as cultural city and information city.

In Ödemiş city public participation must be maintained with urban renewal thought that consisting of increasing the life quality of the city.

Ödemiş industrial areas that are evaluated with those conceptual approaches will be accepted to sustain Ödemiş Industrial areas and creating the city culture.



Ödemiş Industrial Heritage Structures Route Proposal

A1 – Ödemiş Power Plant Lübbey	C1 –Textile Factory	H1 – Ümit Ginnery
A2 – Birgi Power Plant	D1 –Old Tekel Building	H2 – Okuroğlu Ginnery
B1 – Ödemiş Yanbastı Olive Oil Factory	D2 –Old Tobacco Store house	H3 – Erişler Ginnery
B2 – Ödemiş Tariş Olive Oil Factory	D3 –Tobacco Store house	J1 – Butchery
B3 – Birgi Olive Oil Factory	D4 – Tobacco Store house	K1 – Birgi Flour Mill
B4 – Birgi Rendering Plant	E1 –Ethem Efendi Halva Factory	K2 – Birgi Mill
B5 – Birgi Rendering Plant	F1 –Butcher Marketplace	K3 – Birgi Water Mill
B6 – Birgi Şefikbey Rendering Plant	F2 –Cheese Marketplace	L1 – Birgi Tannery
B7 – Birgi Çukur Rendering Plant	G1 –Pak Foundry	M1 – Locomotive Storage

1 ROUTE **2 ROUTE** **3 ROUTE**

References

[1]ALTINOLUK, Ü., (2006), "*Ödemiş'te Kentsel Rehabilitasyon Projesi*", Ege Mimarlık Dergisi, 56:6-9, İzmir
[2]ANONIM, (1926), *İzmir Ticaret ve Sanayi Odası Mecmuası*, Ödemiş Özel Sayısı, Şubat 1926, s.389.
[3]ANONIM, (1927), *İzmir Ticaret ve Sanayi Odası Mecmuası*, S.8 – Ödemiş Özel Sayısı, -,s.385.
[4]ANONIM (1945),"*Ödemiş Şehir Planı Müsabakası Jüri Raporu Kısaltımı*" Arkitekt, sayı:3-4, s.55.
[5]ÇAKILCIOĞLU, M., CEBECI, Ö.F., (2003), "*Kentin Çöküntü Alanlarında Uygulamada Yetersiz Kalan İmar Planlarının Yerine Alternatif Plan Süreçleri*", Kentsel Dönüşüm Sempozyumu, YTÜ Oditoryumu, 11 -13 Haziran, İstanbul.
[6]DURAL, H., (2004),"*Ödemiş Tarihi*", Ödemiş Belediyesi Kültür Yayınları, İzmir.
[7]GÜNEŞ, G.,(1997) "*Sosyal-Siyasal-Ekonomik-Kültürel Açıdan Ödemiş Kenti*", 9Eylül Üniveritesi, İzmir.
[8]HAUSER,S., (1999), *Zur Musealisierung der Industriegechichte der Fall Ironbridge*, Industriedenkmalpflege und Geschichtskultur, 1:9.
[9]Hizmet Gazetesi, Sayı:166, 1888
[10]HUDSON, K., (1963), *Industrial Archaeology, an Introduction*, London.
[11]KASABA, R.,(1994),"*İzmir*", Ed. Çağlar Keyder, Eyüp Özveren, Donald Quataert, Doğu Akdeniz Liman Kentleri, 1800-1914, Tarih Vakfı Yurt Yayınları, s.17, İstanbul
[12]KEYDER, Ç., (1993), *Dünya Ekonomisi İçinde Türkiye*, 2. Baskı, İstanbul.
[13]KIRAÇ,B., (2001), *Türkiye'deki Tarihi Sanayi Yapılarının Günümüz Koşullarına Göre Yeniden Değerlendirilmeleri Konusunda Bir Yöntem Araştırması*, Doktora tezi, MSÜ Fen Bilimleri Enstitüsü, İstanbul.
[14]KOÇOĞLU,A., (1998), *Ödemiş'in Ekonomik Coğrafyası,* Ödemiş Belediyesi yayını.
[15]MARTAL, A.,(1999),"*Değişim Sürecinde İzmir de Sanayileşme 19. Yüzyıl*", Dokuz Eylül Yayınları, s.131,İzmir.
[16]ORDONEZ, J.F., (1985), *The Technical and Industrial Built in the Southern States of Europe, Situation of the Technical and Industrial Built Heritage in Europe, Architectural Heritage Report and Studies*, Strasburg.
[17] RIX,M. (1955), "*Industrial Archaeology*", The Amateur Historian, 2 :225-229.
[18] TANYELI,G., (2000), "*Endüstri Arkeolojisi Yapılarının Korunması ve Yeniden İşlevlendirilmesi*", M-Domus, 8: 50-51
[19]Yeni Asır, 11 Eylül 1931

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St. Erasmus in Isernia: a medieval cave church

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Abstract
Recent studies on the territory have rekindled interest in cave settlements. Thanks to the widespread use of digital technology and new architectural survey methods it was possible to perform a census of these underground structures identified by the local population. The structures were also classified and surveyed thereby helping to disseminate this data beyond our national borders.
However, the general population is unfamiliar not only with the numerous caves located along the Apennine and sub-Apennine chain in the Molise region, but also with the paintings in underground places of worship which nevertheless do sometimes capture the attention of scholars.
This article intends to contribute to the dissemination of the historical and architectural heritage of the Molise region and has taken as its emblematic case study the medieval cave church of St. Erasmus in Isernia. The study focuses on different aspects such as the architectural layout of the church and how it fits into the typological classification of the changes made to the natural cave. It then examines the liturgical area to understand the geometry of its spatial conformation, how it was modified, and its decorative features. Finally, the study also considers the relationship between the church and the new and old roads in the vicinity.

Keywords: Cave churches, cave dwellings, painting, survey

1. The architectural complex

1.1 Location
The Church of St. Erasmus, on the east outskirts of the city of Isernia near Santa Maria delle Monache, can be accessed from the municipal road now known as Via Roma, formerly Via Orientale. Via Roma ends in the valley of River Carpino at the bottom of the hill where the town is situated.
The church was difficult to access situated as it was high up the hillside where it exploited a natural cave as the assembly hall. After it was deconsecrated the cave was abandoned and left open to the elements and to passing vandals; it now stands mortally embraced by spontaneous vegetation while the river has continued to erode the front of the avant-corps to roughly one metre from the edge of a ravine.

1.2 History
It's difficult to know exactly when the church was built. Since there are no significant datable architectural and/or archaeological details, the shape of the albeit unique assembly hall is not enough to establish a precise historical period. However it's likely that the cave was already used as a sacred site during the pagan age or early Christianity. Nevertheless, existing data does not confirm this hypothesis.
Many cave dwellings existed in Italy during the Middle Ages. Most of them date to the period when Italy was invaded by barbarians and entire populations along its southern coasts moved inland to rather impervious and unreachable places. Here they created new settlements in natural caves located well away from important cities and Roman roads.
The fact the church was close to the settlement and the road does not mean it was one of the above-mentioned cave dwellings. It's more likely to have been part of the typical territorial settlements in the Upper Volturno area which gradually began to develop in the eighth century. During this period sacred buildings – especially if close to roads – were used to control the territory and not only as religious centres and guesthouses for travellers.
The Church of St. Erasmus stood along an important dirt road running from Pescasseroli to Candela. In fact the road began near the source of the Volturno river and after reaching Isernia circled around the east side

of the town (where the church was located) and then rose steeply until it reached what is now the Town Hall which at the time was used as a marketplace for transhumant shepherds. It then continued in a south-east direction, crossed the current border of the region and ended in the small town of Candela in Apulia.
I'll now formulate and present my own personal theory. It's very likely that during the late Middle Ages an event took place, either in the cave or nearby, believed by the local population to be a sign of God's will. So the event and the place were bound forever in the minds of the inhabitants of Isernia - probably one of the reasons why the cave was initially used as a sacred hall and later developed into a much more complex and permanent structure.
The place and timescale mentioned above seemingly coincide with several details of a survey about the assets and surroundings of the Abbey of San Vincenzo al Volturno in Isernia reported by Friar Sabatino in 881 in his *Chronicon Volturnense*. The text reads as follows: "the church of Sant'Angelo with 25 houses and all its farmsteads and chapels situated at the confluence of the Patroso river (now Carpino) with Pandulittu (now Sordo), donated to the monastery between 799 and 814 by a certain Grappolus from Isernia (*filius quondam Gdaperti*); a windmill; a large piece of land; the former convent of Santa Maria di Macchia d'Isernia; the hermitage (cella) belonging to San Vincenzo (perhaps in Isernia); half the lands of Capriati (the other half belonged to the Bishop of Isernia) and the church of Santa Maria in the same town".
The description explicitly mentions 25 houses with farmsteads and chapels located at the confluence of the rivers Petroso and Pandulittu, now Carpino and Sordo, and a hermitage of San Vincenzo which Antonio Maria Mattei believes may probably have been located in Isernia.
Since there is very little documentation we cannot say whether or not the natural cave is the hermitage of San Vincenzo. However some elements would appear to corroborate this theory: the presence of smaller rooms similar to those of a hermit's cella; the topographical similarities of the grotto located next to the river Carpino close to the confluence with the river Sordo; the fact it was always inhabited and used as a religious space associated with the sacred site.
Since we do not know when it was deconsecrated it's very difficult to establish when it was no longer used as a sacred space and hostel for travellers. Nevertheless, the restrictions imposed by its unique location, the instability of the terrain, and the repetitive, destructive effects of local earthquakes could have caused the structure next to the assembly hall to collapse and ultimately put an end to its use as a religious site. What we do know is that the church is not represented in the print by Giovanni Battista Pacichelli who scrupulously indicates all the religious sites in Isernia. We can therefore surmise it was probably deconsecrated after the twelfth century.

1.3 The lower level: the underground rooms

At first glance its unique planimetric layout and volume suggest it was built before the Saracen invasion of the Volturno region in 861. However, as mentioned earlier, the very few remains of the ornamental architecture and the lack of archival documentation has made us cautious about establishing an earlier date.
The external load-bearing walls show signs that the building was located next to another building to the north. We only have vague information about this second building thanks to traces of its outline on the rocks on which it was built and a small semicircular niche in the north wall of the avant-corps of the assembly hall.
More traces on the main façade tell us that the church also stretched towards the river; however we know nothing about this additional room or rooms. Furthermore, since the river has eroded its banks, leaving just a few centimetres above water, I was unable to perform any further study. If, as I believe, the church of St. Erasmus is the hermitage of San Vincenzo mentioned by Friar Sabatino, then I can only assume that construction took place after the monk drafted his list and that the remains date to a period when the building was much bigger and had several volumes.
My study also showed that the façade and space inside the avant-corps were built during two different time periods: the first construction period is characterised by very simple and extremely inaccurate workmanship, visible in the small rose window in the façade; instead the avant-corps is probably much more recent and dates to when the building was used as a house. The segmental arch entry door and the two superimposed rectangular windows are in line with its axis of symmetry and were built during this second period. The two windows and the grooves for the ends of the ceiling beams on the inner walls of the avant-corps made it possible to establish that the latter had three superimposed floors rationally connected by a wooden staircase. However we are unable to establish the type of staircase since there are no remains and we do not have any other useful information.
Once inside the entrance, located to the left of the façade, there's a semicircular room with a semi-dome roof where the main façade of the architectural building acts as a chord. In the centre of the arched surface there's a tall narrow passageway leading to the grotto, i.e., to the assembly hall. Its irregular shape and the visual view of the masonry core suggests that this is where the entry door was located before despoliation. Its profile also suggests that it was probably shaped like a pointed arch. The fact the door was placed here is also confirmed by the threshold, still intact and visible. This huge square block and the bases of the columns on either side of the passageway have been hewn out of a single block of stone. Moreover, the groove for

the hinge of the door is located to the left; the indent on the smooth stone mass is quite large in diameter, suggesting that there was just one single-leaf door.
On the inside wall of the main façade there is nothing more of note except for the door and windows – neither of which had traces of frames. Instead there are two very similar semicircular niches on either side of the semicylindrical wall near to the point where it joins the façade; to the left there's a brick bench on the ground, perhaps used as a seat, while towards the top of the wall an irregular opening communicates with the innermost of the two small rooms next to the avant-corps. However the height of the opening from the floor makes it difficult to tell whether it is a window that has lost its marble frame or simply a hole in the wall caused by some unknown event.
As mentioned earlier there are grooves in the semicylindrical surface to support the ends of the beams. From a hands-on visual observation I saw that these grooves are located at three different levels; as a result, the ceiling of the room on the second floor was not a stone semi-dome but a floor, or if you like a false ceiling, a technical solution that initially surprised me because I couldn't understand its role. Then when I looked more closely I saw moisture stains, and immediately realised its purpose: to protect people and objects from water infiltration.
The assembly hall can be accessed through an opening in the avant-corps; the hall represents the original nucleus of the building and was created in a natural opening in the rock face.
The hall is ostensibly symmetrical and its spatial conformation leads me to define it as organic. Its plan (undoubtedly rectified) includes a short straight stretch corresponding to the entrance opening while its two opposite, divergent and slightly curved walls start at one end and join at the other end creating a sort of semicircumference; i.e., the layout of the hall is similar to a Roman amphora.
There are three openings on the rear wall. The first is a semicircular niche with a stone frieze at the keystone of the arch; the fact it is located in the centre and dominates the other two elements would suggest that this concave niche in the natural stone wall was the tabernacle used to house an image of Christ or the saint to which the church was dedicated.
A second architectural element, a room, is located to the right of the hall. A small door connects it to the assembly hall; the base and part of the moulding of the arch are still in place. This was probably the sacristy or simply a chapel. The most characteristic element of this small secondary room are the pseudo-oval plan and the floor, at a higher level than the floor of the main hall.
The third opening is located to the left of the main hall; it's difficult to obtain reliable data about the opening because it has been modified over the years and its original shape has been lost.
Masonry benches, identical to the one in the avant-corps, are positioned along the slightly curved walls; these benches were probably used as seats. These permanent fixtures run almost the length of either wall and end just before the small door leading into the secondary room on one side, and below the modified niche on the other side.
On the left side of the hall, just before the masonry bench, a small opening in the wall reveals another room located more or less at the same height as the floor of the church. It's unclear whether it's a natural cave modified by man, or if it is entirely manmade. The following is the only reliable information I feel I can provide: it is pseudo-rectangular in shape and positioned on a vertical axis with the innermost room of the upper floor; the cave is filled with rubble that fell after the floor of the innermost room collapsed. In fact, the segmental entrance arch to the room is visible through the opening in the wall of the assembly hall.
The rather large opening is not situated in the lower part of the rock wall which means that access to the room was not through the assembly hall. This is important because if we could prove this we could also theorise the existence of a secret room. However, as we all know, without archival documentation (as is the case here) only an onsite study and an ad hoc archaeological excavation can provide the evidence we need to turn this hypothesis into an acceptable fact for the scientific community. This solution is difficult to implement, not least because of the uncertain static conditions of the site.
Grooves are located at different levels in the upper part of the walls on either side of the assembly hall; they were made to house the ends of the wooden beams. The grooves and the unique inclination of the stone roof lead me to believe that the hall and avant-corps had false ceilings which not only masked the irregular ceiling, but also channelled any water dripping from the rock face. Without any further data it's difficult to say when this technological solution was actually adopted. However, based on what I have just described, it could easily have been built at the same time as the initial construction, or just afterwards.
One last comment. There are no frescoes in the hall, but the fact they are present in the room on the upper floor indicate they were also present on the walls on the ground floor.

1.4 The upper floor: smaller rooms
As mentioned earlier the church has two small rooms on the upper floor; these two independent rooms to the left of the construction have their own separate entrance. The way the space is divided and the position of the door between these two rooms (not in line with the main entrance door) indicates that the construction was built in stages. Obviously the one furthest inside the hillside is the oldest.



Fig. 1: Internal images of the church.

The entrance to the outer cell has a small rectangular threshold (150x60 cm); the threshold is recessed compared to the outer wall and is located roughly 50-60 cm from the corner of the main façade of the church. There is one unusual element: the stone architrave has a rather unique workmanship not found anywhere else in the church, i.e., a small segmental arch in the centre of the intrados, in other words a sort of 'eye' through which one can watch the road in front.

Given the difference in the level of the floor of the small room and the area outside, it's possible that steps were placed both inside and outside the façade to facilitate access: at least this is the impression one gets when looking at the squarish stones strewn haphazardly near the entrance. After crossing the threshold -not without some difficulty- there is a narrow pseudo-quadrilateral space surrounded by rather thick walls with medium to large stone elements and a slightly pointed barrel vault; light enters through a small rectangular window on the church façade. The elegant stone window with a 4-5 cm thick sill– now broken in several places – is slightly recessed compared to the inner wall. The small narrow space appears to have been used as a home. In fact, the floor is made of stone and the walls have no decorative architectural elements. Apart from the door and window, there's a rectangular niche above the architrave, a hearth in one corner and, next to the fireplace, a segmental arch door leading to the second small room.

Like the first small room, the second small rectangular room is also very Spartan; it has a curved round arch roof. Compared to the first small room its axis of symmetry is rotated to the right and, as mentioned earlier, the floor is missing. The only important feature is the fresco on the rear wall facing the entrance.

The painting covering the entire wall is surrounded by a polychrome moulding running around the round brick arch in which it is embedded. It is very faded due to water infiltration and damage caused by microorganisms and vandals. The fresco, depicting the crucifixion of Christ, could date to the fourteenth century although it appears to have been painted on top of another painted image perhaps dating to the Late Middle Ages.

Christ is positioned in the centre and is slighter bigger in size compared to the figures on either side: St. Onuphrius, the Virgin Mary, St. John and another unidentified saint possibly St. Erasmus given that the church was dedicated to him.

The background was probably either a landscape or an image that gave depth to the fresco. The two parallel white lines near St. Onuphrius' legs almost certainly indicated the ground. In addition, although the lower part of the fresco is unfortunately almost completely lost, it probably depicted several minor figures similar to the small person praying at the feet of St. Onuphrius.

The small parts of the fresco not covered by the thick oil layer prove that the original painting was tastefully executed in pale colours. This interesting detail is visible in the nuanced colours still present on the cheeks and hands of St. John and St. Erasmus.

2. The survey

When I entered the building for the first time I was so moved that I decided to document it. It was a bright, crystal-clear sunny day and light poured into the underground rooms deep under the hillside; the excellent conditions allowed me to examine this architectural space and admire the fresco I knew existed in the church.

I immediately decided to perform a photographic and geometric survey and also decided on using a direct method. Pushing the reasoning expressed by Claude Lévi-Strauss a little to the limit I can honestly say that I wanted to carry out a so-called "primitive" survey. Clearly I didn't want to use the tools used by the ancients or exploit their methodological expertise, instead I wanted to perform a survey using modern methods and the oldest tools I could find on the market, in other words: a plumb line, level and yardstick. I chose this

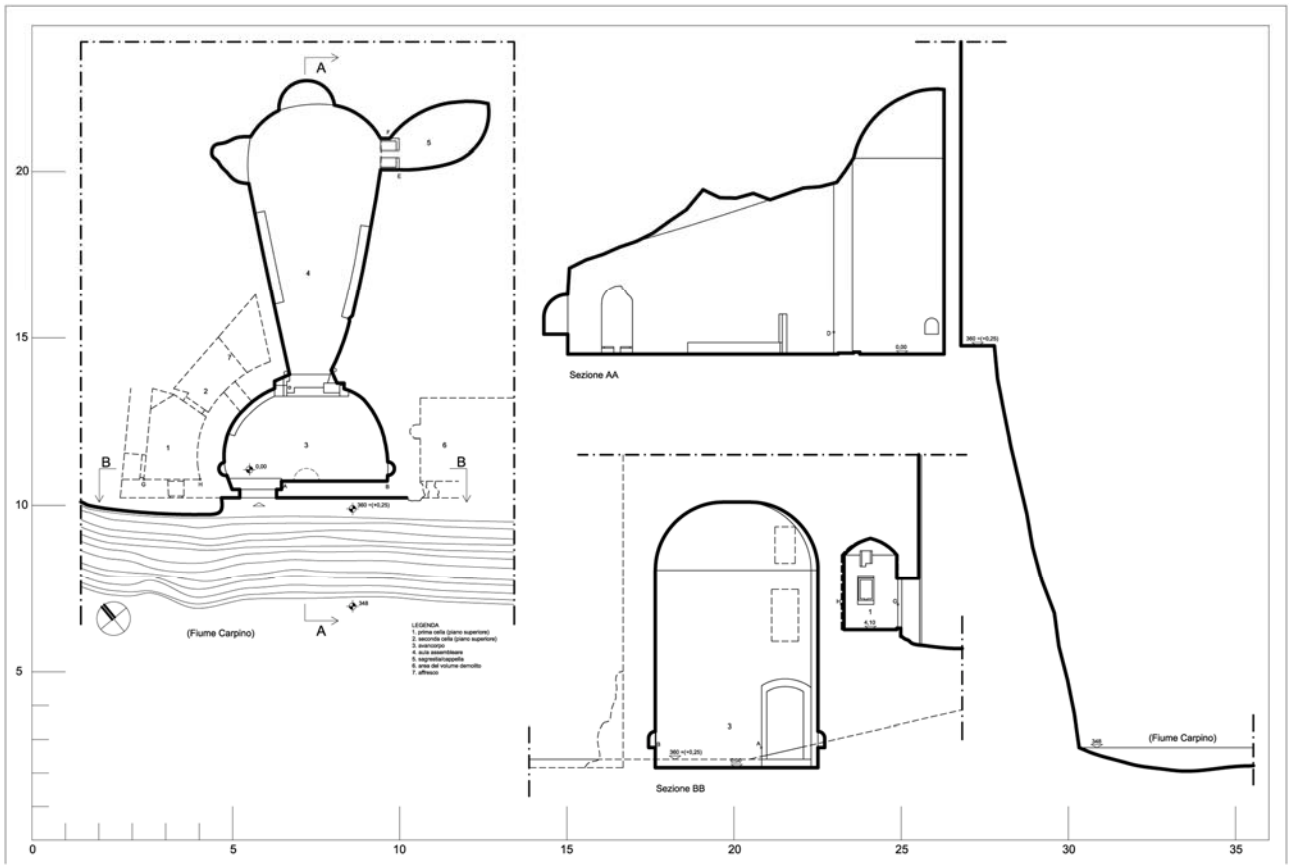

Fig. 2: Survey, plan and sections.

approach because given the onsite situation the best reduced ratio I could use in my graphic restitution was medium to large since the latter provides a result that is the right compromise between my desire to document the building and the time it takes for the survey. Furthermore in these representations, graphic errors still make it possible to use these tools. Finally, the unique orographic characteristics of the site forced me to use this method if I was to protect both myself and the more bulky instruments.

Given the conformation of the church I very quickly planned the shooting stage and performed it just as quickly. My onsite schedule was limited to three days and since the documentation stage was not sponsored by a client with any particular requirements my goal was to record the conditions of the site after it had been abandoned for several decades. So I planned to obtain two-dimensional graphic images and a set of photographs. To make things easier I added an electronic meter to the tools I had already chosen and, obviously, a camera.

On the first day I concentrated on the two small rooms on the second floor; in the first room I placed two survey stations about one and a half metres from the floor at the end of the side towards the valley. From there I performed a series of trilaterations and recorded the main points I needed to establish its geometry. Several vertical measurements along the side of the wall allowed me to document the shape of the roof. The fact the floor was missing made it very difficult to survey the second small room, but using the same system adopted for the first small room I was able to record the layout of the second room by using the inner façade of the wall between the two rooms as my base line. Instead I considered the thickness of the door separately and was obliged to simplify the geometry.

Once I finished the survey of the two small rooms I focused on the difference in level between the second and first floors. In this case I adopted the section survey method; I used a wooden pole 150 cm long to which I attached the level and the plumb line to create my artisanal measuring instrument which I used together with a yardstick.

On day two I concentrated on the underground rooms of the first floor. Two stations on the inner façade of the entrance wall were enough to survey the avant-corps taking as my physical reference points the ends of the wall with a constant section to the right of the entrance door. I then surveyed the assembly hall, again using two stations on either side of the entrance.

On day three I surveyed the secondary room of the church using the same procedure previously used for the plan of the other rooms. Then I focused on the heights of the inner space of the avant-corps and assembly hall: I placed a metric rod along the middle line of the rooms and took a measurement every 50 centimetres.

Restitution of the data took another two days and involved the elaboration of the plan and section. However, I was unable to obtain a complete drawing of the main façade because there was very little space in front of the church. This is unfortunate because this drawing is absolutely crucial if one wants to establish the morphological, architectural and functional changes made to the church. As a result, some questions are yet to be answered.

3. Conclusions

Some people consider the survey of a building as the "operative tool of history", i.e., a survey reveals how it was constructed, what changes have been made over the years, its functional logic, etc. In other words, a survey can either confirm or disprove the information found in bibliographical, archival, iconographic sources, etc. It also means that every building is like a book to be read: the surveyor has to use his own intelligence and scientific knowledge to interpret the building to the best of his ability. This is another reason why a survey is the best instrument to gather data and is crucial during restoration, cataloguing and classification. Only survey can provide true comprehension of the architectural object and its complexities.

Professor Angelo Vassallo also concurs with this approach. He maintains that "Architecture is a relational system from which it is impossible to subtract one topic […] and this relational system has to be taken forward and a balance maintained". His words indicate that surveys highlight the "relational system" and that as an interpretative tool they are the crossroads where historical and technical knowledge meet. As a result, a survey is a complex research tool involving measurements, history, archives, and technical and technological bibliography. In fact this is the only way to identify the criteria, or if you like the *ratio*, behind the way a building evolves over the years.

Accordingly, only this kind of documentation will allow us to accurately identify what measures are required during restoration and also establish what still needs to be studied in order to gain as much knowledge as possible about the history of the building.

As concerns the work performed on the Church of St. Erasmus, I was obviously very pleased with the results. However since I focused primarily the plan and section I cannot rule out that the building may be surveyed again in the future. In this case future surveyors should focus on the main façade, volumetric morphology and fresco, perhaps as part of a restoration project that could return it to its former glory when it was easily visible to the naked eye. Why? Because the entire complex is an important example of underground architecture not only in the Molise region but also in Central and Southern Italy.

Bibliographical

[1] CIALDEA, D., *Il Molise terra di transito I tratturi come modello di sviluppo del territorio,* Ripalimosani: Editrice Arti Grafiche La Regione, (CB), 2007. ISBN 9 788888 102085

[2] CEFALOGNI F., *Isernia strade vie vicoli e piazze l'onomastica storica,* Isernia: Cosmo Iannone Editore, 2000.

[3] CUNDARI, C., *Il rilievo architettonico Ragioni. Fondamenti. Applicazioni,* Roma: Aracne-Kappa, Roma 2012. ISBN 9 788854 847415

[4] COPPOLA PIGNATELLI, P., *Spazio e immaginario Maschile e femminile in architettura,* Roma: Officina Edizioni, 1982.

[5] DAMIANI, P., *Palazzi e chiese della città d'Isernia*, Venafro: Vitmar, 2003.

[6] DE VINCENZI, F., MONACO, D., *S. Erasmo ad Isernia. Ipotesi sulle origini di una chiesa rupestre*. In: Almanacco del Molise, anno XVII, n. II, Campobasso, 1986.

[7] DOCCI, M., DIEGO, M., *Storia del rilevamento architettonico e urbano*, ROMA-BARI: Editori Laterza, 1993. ISBN 9 788842 042006

[8] EBANISTA, C., MANCINI, M., *Insediamenti rupestri di età medievale in Molise: luoghi di culto e abitazioni*. In: Atti VI Congresso Nazionale di Speleologia in Cavità Artificiali, Napoli, 30 maggio 2 giugno 2008, Rastignano (BO): Officine Grafiche, 2008.

[9] FEDERICI, V., (edited by), *Chronicon Vulturnense del Monaco Giovanni*, Tipografia del Senato, Roma, 1925.

[10] HAUSER, A., *Storia sociale dell'arte*, III voll., Torino: Einaudi, 2001. ISBN 9 788806 160159

[11] LÉVI-STRAUSS, C., *Il pensiero selvaggio. Alla scoperta della saggezza perduta, Milano:* il Saggiatore, 2003. ISBN 9 788851 520755

[12] MASINI, M., *Metodologia di rilievo e di analisi della cultura costruttiva dell'architettura ipogea*. In: MENESTÒ Enrico, (edited by), *Quando abitavamo in grotta*: atti del primo Convegno internazionale sulla civiltà rupestre: Savelletri di Fasano (BR), 27-29 novembre 2003, Spoleto: Fondazione Centro italiano di studi sull'alto Medioevo, 2004.

[13] MATTEI, A.M.*, Storia d'Isernia*, vol. I, Napoli: Athena Mediterranea, 1978.

[14] MENESTÒ, E., (edited by), *Quando abitavamo in grotta*: atti del 1. Convegno internazionale sulla civiltà rupestre: Savelletri di Fasano (BR), 27-29 novembre 2003, Spoleto: Fondazione Centro italiano di studi sull'alto Medioevo, 2004.

[15] OLDONI, M., (edited by), *Chronicon Vulturnense del monaco Giovanni*, Cerro del Volturno (IS): Volturnia Edizioni, 2011.

[16] PACICHELLI, G.B.*, Il regno di Napoli in Prospettiva*, Napoli: nella stamperia di Michele Luigi Mutio, 1703.

[17] VALENTE, F., *Luoghi antichi della provincia di Isernia*, Ferrazzano, Enne, 2003.

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Implications of earthquake return periods on the building quality

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Abstract
In the pre-modern age, before scientific computational procedures were formulated, effective earthquake-proof structural solutions were developed following rules simply based on "common sense" and experience. This kind of knowledge, handed down from generation to generation, led to the definition of structural solutions suitable to resist a variety of critical situations.
In this way, both the original morphology and the evolution in time of most effective construction techniques are directly related to the level of criticality of local actions: in areas affected by severe and frequent natural disasters, special systems had to be developed. In order for this to happen, it is necessary that the memory of the natural event and the knowledge of the damage are not lost. The risk consciousness induces local society not to forget nor abandon traditional construction techniques, but rather to maintain and improve them. In this work, a couple of examples are selected, representing this ambivalence: Castel del Monte (on the southern slope of the Gran Sasso Mountain, Italy) and Lefkas (one of the Ionian Islands, Greece) are both characterized by high seismic hazard but with different return periods: 200 and 30 years, respectively. This has led, in the first case, to alternately forget and rediscover the tradition and, in the Greek one, to the development of a structural system able to resist simultaneously two kinds of criticality, the geotechnical and the seismic one.

Keywords: Memory, Seismic protection elements, Vernacular architecture, Earthquake, Empirical knowledge

1. Introduction
Experiencing seismic events has to do with a natural phenomenon that recurs constantly over the time, so that the human sensitivity to this kind of problem has ancient origins, as old as the art of building. The Mediterranean area, where the ancient building tradition goes with a frequent seismic activity, is an effective view point for this issue. From the beginning builders and local populations were induced to a careful analysis of the earthquake phenomenology through the basic means at their disposal: observation and experience. Therefore, although the scientific approach to seismic-resistant design is recent, the empirical search for effective solutions, based on tradition and experience, has ancient origins. The seismic vulnerability therefore falls within a historical-social dimension: over the time, local communities, subject to frequent and heavy earthquakes, have adopted special construction methods, choosing to "stay" rather than to "relocate" (Seneca, Natural Questions, VI book).
Constantly recurring earthquakes feed experience and play a some way educational role, highlighting the most effective constructive solutions and sticking misconceptions; the builders intuition is stimulated to understand the laws of the building response to the ground motion. This is, however, a difficult challenge, as the phenomenon of ground shaking and building vibration is governed by not simple nor intuitive physical laws.
In the southern Mediterranean regions, in the ruins of ancient buildings it is still possible to "read" the trace of past earthquakes; in particular, buildings and structures which survived through the time testify the effectiveness of local building traditions, rarely described in books, but empirically applied in both construction and restoration works.
The research presented here is addressed to some structural solutions suitable to oppose the effects of earthquakes, which were developed in the context of vernacular architecture. The theme will be discussed

from a particular point of view, consisting in the intrinsic relationship between the construction quality and the frequency of earthquakes.
This study does not provide any discussion on vernacular architecture in general, but rather it refers to the specific situation of traditional buildings erected in critical areas. In relation to this kind of architecture, the deep connection with poverty is highlighted and, moreover, with the no-choice condition and with the strong link to the place where it was generated. Such a building condition is not free, is full of restrictions, is slave of the place where it stands and must learn to coexist with its native condition.
The importance of studying this kind of realities is clear, as they reflect the local cultural heritage, a knowledge form which, normally, is not written but simply handed down; they are the tangible expression of a tradition refined over the time in parallel to the calamities which affected the site.

2. Investigation methods

With reference to an interesting concept expressed by P. Touliatos [4], graphically represented in figure 1 a, b, it can be stated that the quality level of the construction techniques is often in proportion to the level of criticality typical of the area: where severe and frequent natural disasters affect the area, specific solutions had to be developed in order to survive and keep living in the place. In order for this to happen, it is necessary that the memory of the event and the knowledge of the damage that it caused are not lost; the return period of the event must then coincide, generally, with the length of a generation. The fear of the event induces local society not to forget nor abandon that type of construction, but rather to analyze, maintain and improve it (fig. 1a). Conversely, in those situations where earthquakes are a rare phenomenon and the period between two following seismic events far exceeds the generation lifetime, both population and craftsmen will lose any seismic consciousness; consequently, structures, construction details and all specific solutions will lose importance, giving way to aesthetics issues and to present fashion trends. This process leads to a progressive decrease in the quality of construction details and to forgetting all the seismic protection solutions which had characterized earlier construction types, or even to the misrepresentation of them, with no understanding of their real meaning.
As shown by P. Touliatos in figure 1b, the curve representing the building quality normally has a growth after a seismic event; next, it keeps decreasing over the time. In this way, at the occurrence of the following earthquake, the construction system will not be appropriate to resist or, at least, will be somewhat weakened. This is the theoretical scheme of a phenomenon which can be really observed in practice, even if several factors contribute to it, not only the loss of knowledge.

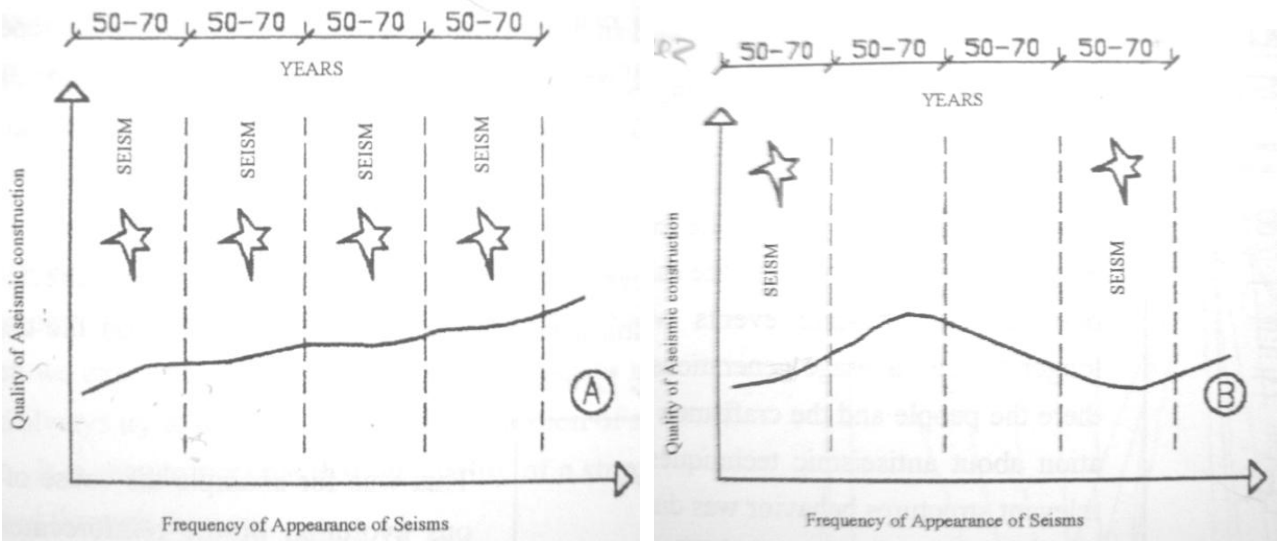

Fig 1: Relationship between building quality and return period (Touliatos P., 2003). High – frequency seismic activity **(a)**; Low – frequency seismic activity **(b)**

In the following, an attempt is made to check the validity of the above mentioned theory through the analysis of two case studies; in doing this, some additional considerations are developed. The diagram proposed by P. Touliatos [4] is highly expressive, but is not based on real data, so that the intuition it contains can not be demonstrated. One of the parameters it contains is the building quality, a concept which can not be easily quantified and which can only be deducted from other data.
In order to use the same graphic convention, therefore, an opposite concept has been used: **the level of damage**. This last, as also the earthquake magnitude, are objective evaluation parameters, which can be defined numerically and therefore easily represented in a diagram. This is what has been done through the

analysis of the two case studies. Due to the availability of relevant data for both the reference parameters, two diagrams have been obtained, which are representative of a specific historical period ending at the beginning of the modern age.
The diagrams reflect the multidisciplinary approach which is typical of this kind of research. They relate, indeed, the value of **magnitude**, which expresses the energy released by an earthquake in the epicentral area, with the **level of damage**, estimated in a qualitative way through archival documents; to the purpose of this study, it has been described through a simplified classification in three levels: High- 3, Middle - 2 and Lower - 1. In the abscissas, earthquake **frequencies** can be read; specifically, the time schedule proposed by Touliatos has been kept: a fifty-year interval, roughly corresponding to a "generation", for which a duration of 50-70 years is estimated on average.
The two selected case studies refer to Castel del Monte (L'Aquila, Italy) and to the town of Lefkada (Ionian Islands, Greece) (Figs, 2 a,2b). The first case, which emerged during the damage survey performed after the 2009 earthquake of L'Aquila, has easily highlighted the issue under discussion; the second, which constitutes a meaningful comparison, has given further evidence to the problem. Such case studies have been selected to the purpose of presenting two different realities, both characterized by a strong identity which, however, despite the common need to resist earthquakes and a well pronounced tradition, handed down the " construction memory " in a different way. While the Greek one has perpetuated a well established system to face the daily problems, on the other side of the Adriatic Sea the seismic system has often been misinterpreted to meet other needs; one for all, the adaptation to modernity.

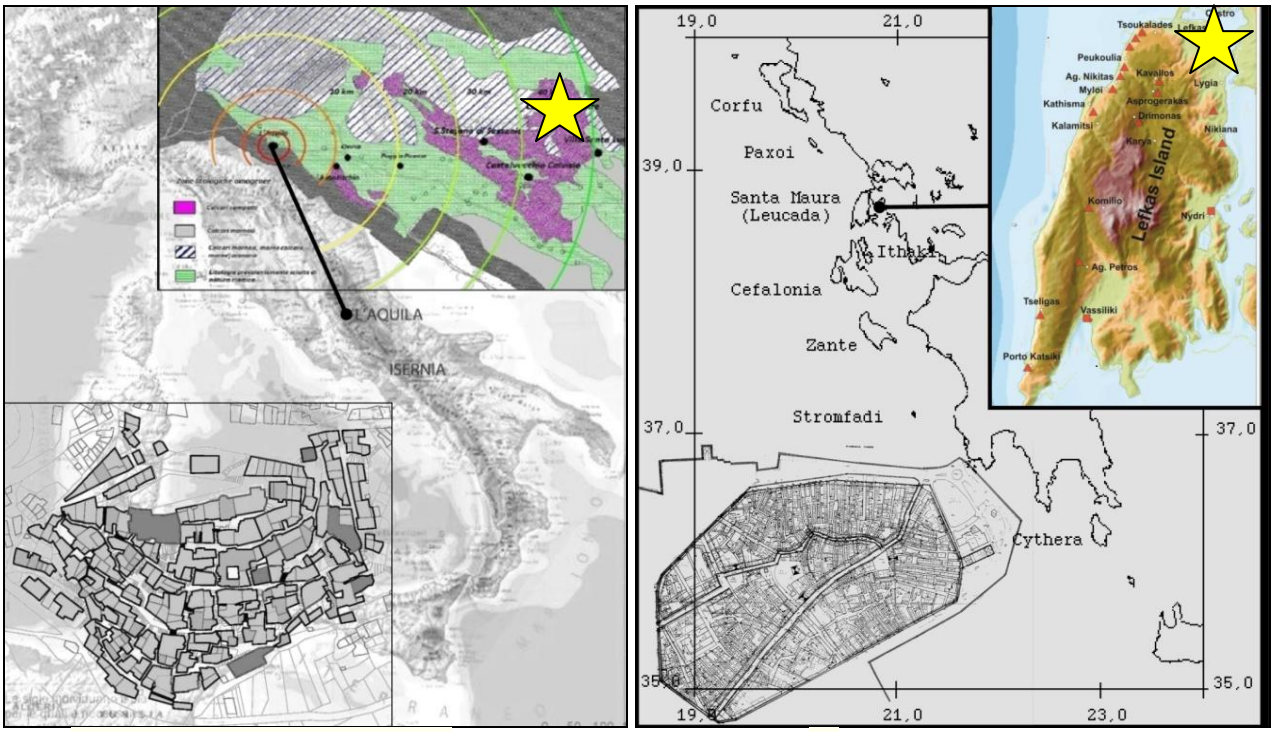

Fig. 2: Castel del Monte (l'Aquila, Italy) **(a)** ; Lefkada (Ionian Island, Greece) **(b)**

3. Selection criteria and characterization for the two case studies

The two selected cases can be compared in terms of local critical aspects: seismic hazard for both (with a geotechnical aggravating factor in the second case [15]), economy (shepherding in the Italian case, maritime activities in the other) and soil conditions (rocky in Abruzzo and soft on the Greek island).
All these situations have helped to develop peculiar building solutions which, despite the two realities are characterized by similar aspects, appear to be completely different: the first one is based on the box-like behavior, with squat, low and compact buildings, while the second consists in a lighter solution, with the presence of a sophisticated secondary structural system. Finally, as already mentioned and discussed in the following, the typical occurrence frequency of earthquakes is a basic aspect influencing the building tradition: 200 years in the Italian case, compared to 30 in the Greek one [1, 3, 9, 11, 12].
Looking first at the urban scale, Castel del Monte [16] was founded as a fortified village between the XII and XIII century; it stands on a hill, is firmly perched on the ground and the urban profile fully integrates into the natural environment: the ancient portion of the town was developed following the contour lines, usually the buildings are no more than three floors high and are anchored to the rocky soil as much as they are to each other. The dominant building typology corresponds to row houses arranged parallel to the contour lines; the historical centre is formed by jointed buildings units resulting into compact structural aggregates, further

connected by covered walkways (*sporti*) and flying buttresses. As to appearance, the chromatic aspect of façades is the same as the limestone from which they arise (Figs 3a-3c).
The analysis of the constructive details characterizing the village suggests that manufacturers were clearly aware of the need to conceive structures capable to withstand seismic actions. Specific devices, indeed, can be clearly recognized, suitable to oppose the trend of the building to open and separate into several parts, under the effect of seismic forces. This is pursued mainly by providing each building with constraint actions transferred by outcropping rocks or adjacent units through the use of compressed elements, such as masonry arches, connecting walls, spurs and buttresses.



Fig. 3: The village of Castel del Monte **(a)**; row houses arranged parallel to the contour lines **(b)**; aggregates connected by covered walkways (*sporti*) and flying buttresses **(c)**

As to the town of Lefkada, a peculiar aspect has to do with the historical centre, which was planned so as to allow for the drainage and natural flow of the rain water to the sea and to take advantage of a frequent wind condition, which helps reducing humidity, with winds blowing from N-NW [3]. The centre of Lefkada has preserved its original structure, dating back to the 18th century, and is made of independent adjacent units. The typical building [10] normally has one single floor, with a maximum of three; the ground floor has a stone masonry structure, while the upper levels present a frame structure, based on the mixed use of timber and brick elements. All the floor slabs are timber structures and the roof is covered by tiles. Openings are arranged symmetrically in plan and, in order to protect timber structures at upper levels from humidity, the outer façade was covered with wood boards. The ground floor has a maximum height of 3 m, and is made of stone masonry walls with thickness in the range 60 – 100 cm. In parallel to the masonry structure, a second structure is realized, consisting in timber columns with a centre to centre distance of 2 – 3 m. The slab timber beams provide connection of these columns to the masonry walls. Due to the high deformability, this secondary timber structural system at the first floor does not contribute to the seismic resistance; however, due to the strong connection to the slab, it plays a fundamental role in case of partial or total collapse of the masonry walls, providing support to vertical loads. It is therefore a passive protection system, which is activated in case of damage to masonry, the primary resistance system; in addition, it would allow masonry repair without interfering with the rest of the building (Figs 4a-4d).



Fig 4: Lefkada houses. A typical three floor corner building **(a)**; cracked masonry ground floor **(b)**; traditional two floor building **(c)**; the frame structure, based on the mixed use of timber and brick elements in the upper levels **(d)**

3.1 Castel del Monte

The high level of seismic hazard characterizing the selected Apennine area, especially the province of L'Aquila, has been known for a long time thanks to several studies on historical seismicity, through which information about major earthquakes has been obtained [1, 11, 12]. Apart from the event occurred in 1315, mentioned only by a few sources (currently classified with a magnitude value Mw = 5.6), the first earthquake

to cause serious damage was the L'Aquila event of 1349. Subsequently, attention has to be deserved to the 1461 earthquake, characterized by a long seismic sequence lasting months and by a magnitude level estimated as Mw = 6.5. The sequence of recent seismic events starts in the XVIII century, with the 1703 and 1706 earthquakes; other events, which occurred in 1786 and 1791, are similar to the 2009 earthquake, although producing less severe effects. Before 2009, the last tragic earthquake was in Avezzano in 1915; this was the strongest historical event in the Apennines, responsible for the destruction of all the villages in the epicentral area and for heavy damage to the adjacent ones [1, 11]

Year	intensity	**magnitude**	**damage**
1315	8	**5,6**	**2**
1349	9	**6,4**	**3**
1461	10	**6,4**	**1**
1703	10	**6,6**	**3**
1750	6,5	**4,8**	**2**
1762	9	**5,9**	**2**
1786	6	**5,2**	**2**
1791	7,5	**5,3**	**2**
1874	5,5	**5,5**	**1**
1915	11	**6,9**	**3**

From studies by Stucchi and Rovida [11, 12], limiting the selection to earthquakes with magnitude not less than 4.70, it is possible to assume a value of about 200 years for the return period (table 1).
Associating, for each event, the magnitude level and the damage intensity, as detectable from the available historical documents, it is possible to propose a meaningful graphical representation in terms of the diagram of figure 5.
The diagram, which has to be read from left to right, relates to earthquakes which took place in the L'Aquila epicentral area between the XIV century and the early decades of the XX century. The decision to limit the investigation to 1915 is motivated by the choice of analyzing the relationship between seismic frequency and traditional building quality; this date, indeed, represents the separation between tradition and modernism, in relation to both building techniques and materials.
In the following, a critical reading of the diagram shown in fig. 5 is proposed, in terms of the relationship between the severity of each specific event and the corresponding level of damage in buildings.

Tab. 1: L'Aquila region - The magnitude level and the damage intensity for the various seismic events

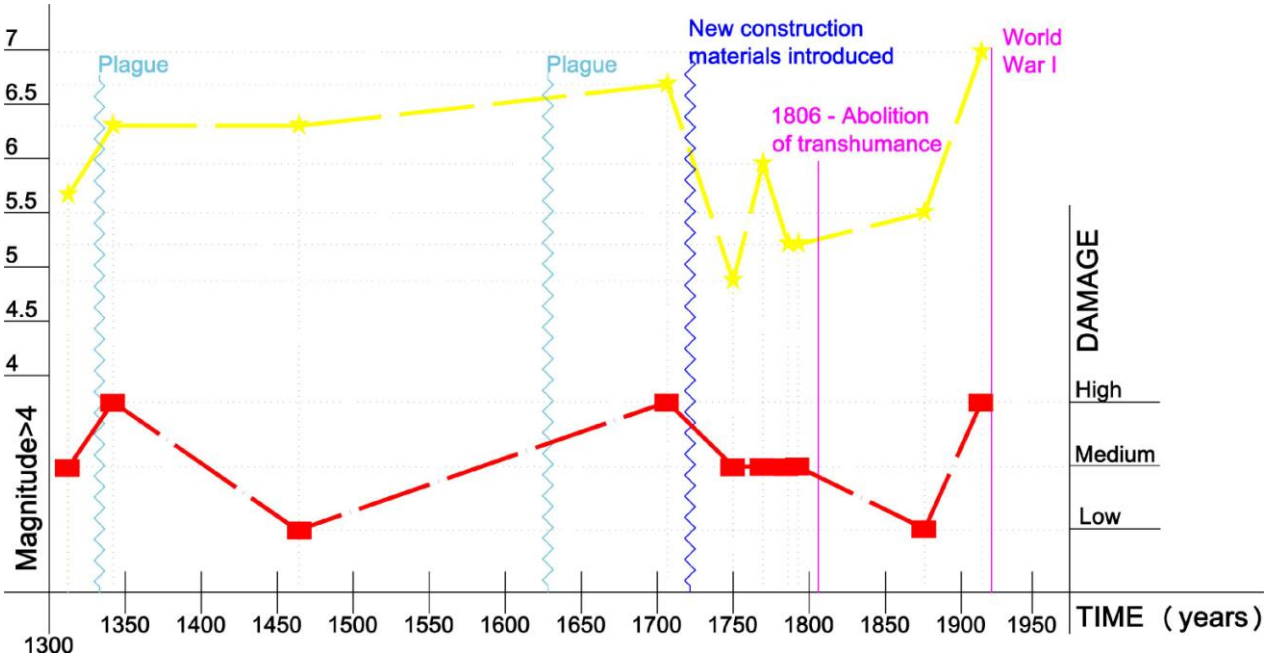

Fig. 5: Graphical representation of L'Aquila earthquakes between the XIV and the XX century.

The **1315** earthquake (M = 5.6) caused a medium level damage, while the next one, occurred in **1349**, was stronger (M = 6.4) and aggravated the damage situation. A first important issue clearly results from the analysis of the **1461** earthquake, which although being almost identical to the one occurred 112 years before, caused a significantly lower level of damage. It can be assumed that the 1349 event resulted in a test for the interventions applied after the 1315 earthquake; population, deciding not to abandon the place, implemented the necessary improvements during the reconstruction phase. Over the following period of 112 years, no other major natural event nor war weakened the structures of the village buildings; consequently,

due to masonry quality, walls were still in good conditions in 1461, capable of resisting the earthquake effects.
High damage, instead, was produced in 1703 by a slightly stronger earthquake (M = 6.6), which had a heavy impact on the village. In the previous 112 years of "peace", the original structure of the village had been kept, performing only routine maintenance works; on the other hand, the perception of the seismic event had weakened, with a progressive reduction in the interest for traditional earthquake inspired building rules. The positive structural response to the 1461 earthquake, not accompanied by a real understanding, had actually discouraged any stimulus to the development of new solutions, perpetuating a “seismic ignorance” for the next 242 years.
The **1703** earthquake is remembered in local history as one of the most severe ones: many localities in the area between Norcia, Cittareale and L’Aquila were completely destroyed, with approximately 10,000 victims. In the following time, transhumance started to loose importance and, due to economic reasons, to temporary specific needs and to the optimization of resources and time, new criteria and elements were introduced during reconstruction: vaults with header bricks, bricks for rows and wedges, and raised portions.
A low intensity event occurred in **1750** (M = 4.8), which caused limited damage; it is not known whether this has to be interpreted as the result of the effectiveness of new building solutions or was simply due to the earthquake reduced impact. Rather, the damage curve for the next three events, which took place in the years 1762, 1786, 1791, turns out to be of special interest. The analysis of this thirty year period provides again a confirmation of Touliatos’s view: the 1750 earthquake resulted in a sort of validation of the devices and new construction systems developed after the previous event, which had taken place only 47 years before. Not even 50 years had passed, the generation had remained the same, memory, intuition and fear had been preserved. With the 1750 earthquake the effectiveness of various solutions had been evaluated and consequently appropriate improvements were applied. The diagram shows that, despite the magnitude of each individual event exceeded that of the 1750 earthquake (M = 5.9 in **1762**, M = 5.2 in **1786** and M = 5.3 in **1791)**, the level of damage keeps almost constant. Similarly to what had happened in 1461, also in 1874, 83 years after the last seismic sequence of the XVIII century, a new shock, stronger than the previous one (M = 5.5), produced a much lower damage.
Earthquakes are not predictable, but knowing the damage mechanisms and assuming all necessary precautions, the consequences they can produce on buildings may be kept under control.
This second "peaceful" situation started to change on **May 21, 1806** when Giuseppe Bonaparte, through a specific law, abolished the tax on the transit of the sheep; shortly the lands, released from any obligation, transformed from pastures to farmland. This gave origin to the first migration phase towards north and the main cities such as Rome and Naples, and the mountain villages were progressively abandoned.
The consequence of this slow but inescapable process was revealed by the event occurred in **1915**, just 41 years after the previous one, but under totally different socio-economic conditions. The effects were devastating: over 30,000 people died, with destruction and victims spreading all over the country in the Fucino area. The economy related to transhumance had suffered a sudden change, which affected reconstruction after the 1874 event and promoted the conditions for a general impoverishment: decorative elements were sold, buildings were neglected, building expertise was lost. Unfortunately, at the same time when the earthquake occurred, Italy entered the first world war, and this had a strong influence on human resources, availability of materials and also on the quality of intervention works after the earthquake.
This specific time represents the end of the historical review which is proposed in this study, as it corresponds to the separation between the "tradition" time and the "technocracy" time [2]; first reinforced concrete applications for the rehabilitation of damaged buildings, indeed, took place in this occasion.
This was the beginning of a new era: mountain villages were in ruins, traditional expertise was substituted by new technologies and materials, craftsmen, custodians of the "know-how", were forced to migrate, thus interrupting the dissemination of traditional seismic design rules.
A first conclusion is directly provided by the analysis of the damage produced by the **2009** L’Aquila earthquake, which had strong effects both in the city of L'Aquila and in the surrounding province and clearly showed the presence of latent decay phenomena. Specifically, where buildings were not reduced into ruins, the observed failure mechanisms were mainly related to phenomena linked to structural or material stratification, resulting from functional changes and adjustments; this does not apply to tall and slender structures, like the bell towers at Castel del Monte and Santo Stefano di Seassanio. Other damage mechanisms are mainly related to the lack of knowledge of the real structural behavior and to the loss of consciousness of the seismic problem like:

- misrepresentation of the structural behavior of traditional seismic resistant details (Figs. 6a, 6b)
- staggered openings in masonry walls
- additions and raised portions, made with materials not conforming to the original situation (Fig. 6c)



Fig. 6: Castel del Monte houses - Example of infilled seismic joint **(a)**; Buttress not connected to the masonry wall **(b)**; raised portions, additions and material incongruity **(c)**

3.2 Lefkada

Coming to the second case study, it is usefull to recall something about the historical background and the main events which have characterized the island. Lefkada has always held the role of outpost or "border", despite being under the control of different administrations, including: the Venetians (1684-1797), the French (1797), the Turks (1798-1807) and, last, the British (1810-1864); finally, the island became part of the Greek Nation in 1864.

High intensity seismic events have frequently occurred in the island, with a return period of about thirty years (in the previews case, as already mentioned, about 200 years); and the 1825 earthquake was so strong as to be remembered in time and in the tradition as one of the worst.

Thanks to the available data [3, 8, 9], it has been possible to classify the relevant seismic events, within the contex of the relative historical events (Fig.7).

Table 2 summarizes basic information for earthquakes with the epicenter in Lefkada city occurred between the year 1500 and the early decades of the XX century.

anno	intensità	magnitudo	danno
1577	8	**6,2**	**2**
1612	9,5	**6,1**	**2**
1613	9,5	**6,1**	**2**
1625	10	**6,4**	**3**
1630	10	**6,4**	**3**
1704	10	**6,4**	**1,5**
1722	8,5	**5,9**	**1**
1723	8,5	**6,1**	**1**
1769	10	**6,4**	**3**
1783	10	**6,5**	**1**
1825	10	**6,25**	**2,5**
1869	10	**6,4**	**2**
1914	11	**5,1**	**2**

Tab. 2: Lefkada **-** The magnitude level and the damage intensity for the various seismic events

A first remark concerns the trend of magnitudes, more constant than in the Italian case and with a value almost stable in the range between 6 and 6.5; furthermore, the typical frequency of the most important seismic events is around 30 years, as already observed. Through the graphical representation of Figure 7, it is possible to account also for the consequences of other events, such an unstable political situation or the impact caused by plague.

Epidemics affected also the Italian region of Abruzzo on two separate occasions (1348 and 1629), but had a reduced impact on the area; the province located on the southern slope of the Gran Sasso mountain, indeed, is much healthier than the Greek coastal area, resulting from a reclamation work.

On such premises, it is possible to start reading and interpreting the diagram of Figure 7, beginning from the left side.

The first period (**1577, 1612 and 1613**) is characterized by a fairly constant seismic activity level, with a magnitude value between 6.1 and 6.4 and a medium level of damage. A damage increase can only be noticed in **1625**, probably due to the fact that some buildings were still under reconstruction or left in ruins because of the shocks occurred in the previous decade. In the periodicals of the time [3] this event is defined as "catastrophic": wooden and brick houses collapsed and foundations "were overturned outside, coming out of the ground." Only five years later, in **1630**, a similar intensity earthquake further aggravated the situation, causing the death of many people and the collapse of several houses.

In 1684 the island started to be subject to the Venetian rule; following an important reclamation work, the new city of Lefkada was established, and the inhabitants were imposed to move from the old location, which

in this occasion was adapted into a fortified citadel for the new administration's exclusive use. The land on which the locals had to build their own homes was so markedly changed: from rock to soft soil.

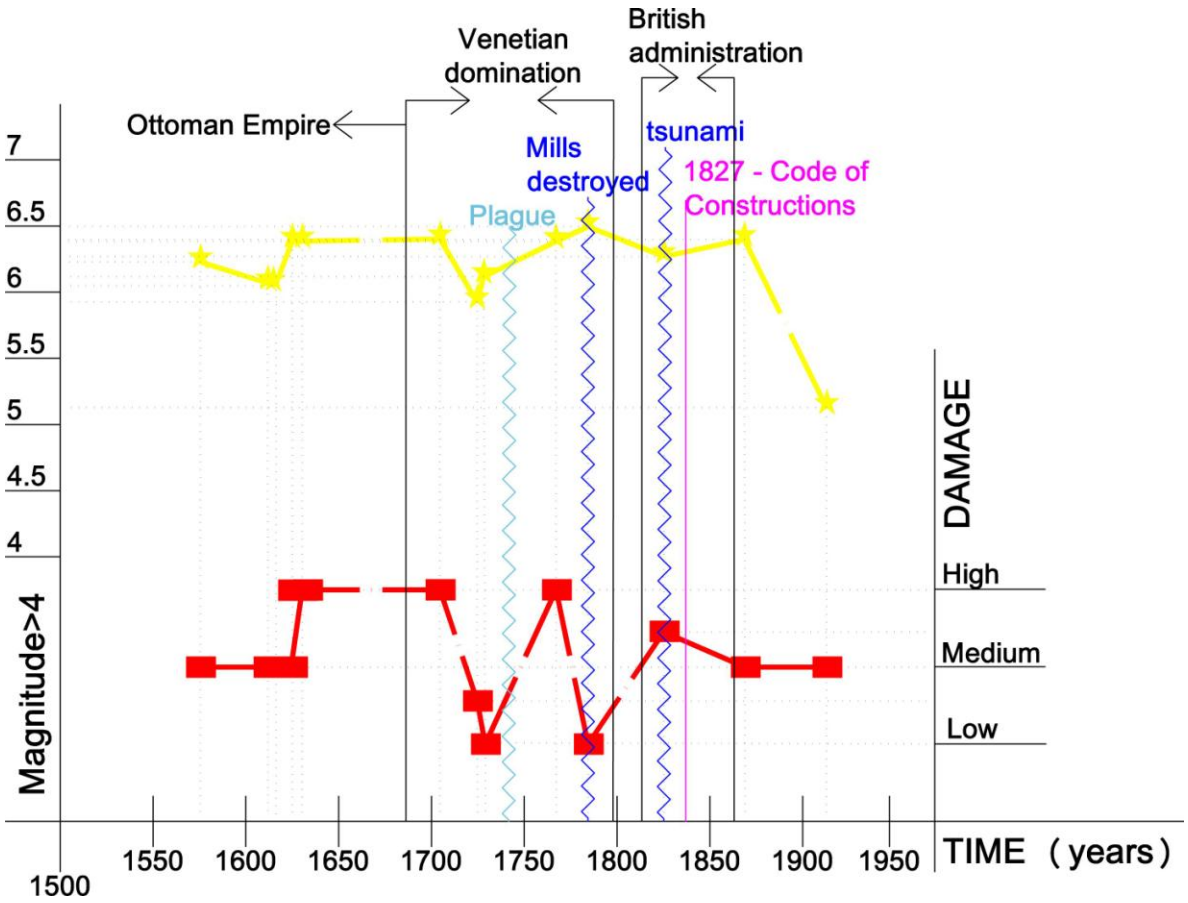

Fig. 5: Graphical representation of Lefkada earthquakes between XVI and the XX century.

Twenty years later, in **1704**, a new earthquake hit the island and caused severe damage. With reference to this event, interesting data are reported by [3]: timber houses and churches survived, while all stone made buildings were destroyed. It is understandable that the typical traditional timber buildings (still in use) this time responded satisfactorily, unlike what had happened during the previous earthquakes in 1625 and 1630; on the contrary, the stone civil and religious buildings had serious damage. The nature of the soil was changed and the inhabitants had to adapt their knowledge; the 1704 earthquake (M = 6.4) was a test for the new buildings. A marked improvement in the building structural behavior, indeed, can already be observed 18 years later: the **1722** and **1723** earthquakes, slightly less severe than the previous one (M = 5.9 and M = 6.1, respectively), produced an overall medium-to-low damage level, with only some minor cracks in the stone churches. In **1743** a new earthquake occurred causing again some damage to churches only; nevertheless, the main problem that worsened the global situation and mainly influenced the subsequent reconstruction, was the plague that struck the island in the same years. The following earthquake, which occurred in **1769**, was fatal: in the city, consisting of 826 homes, 497 collapsed while the others presented serious damage. The situation was so bad that for the first time extra ordinary measures were prescribed, by which rescue was asked to some expert civil engineers from the island of Corfù [3]. All this resulted in a total reconstruction work almost from scratch, well designed and based on a widely tested empirical knowledge. As a consequence, the **1783** earthquake, although presenting the same magnitude (M = 6.5), produced minimal damage. However, looking at a Report dated May 12, taken from a dispatch from Mr Balbi to Mr Foscarini (two Venetian administrators), the following description can be read: *"In the city a house fell and the others have only brought some problems ... the mills and crushers collapsed"* [3]. This fact was, indeed, the really serious outcome of the 1783 event. At that time, local economy was mainly based on the trade of food and sea products [13], which had been largely implemented by the Venetians; the damage caused by the 1783 earthquake to mills and crushers resulted in severe difficulties for the economic recovery and, as a consequence, also for the possibility of keeping a good level in the building quality. The year marked by the seismic event which is still remembered as one of the worst earthquakes in the seismic history of the entire area, is **1825**. Two negative factors overlapped: earthquake and tsunami; this last struck the island and the city of Lefkada itself. Apart from the collapse of buildings, severe economic recovery problems were

produced, because of the destruction of many shops and harbours; this was in addition to what had happened 52 years earlier. In the city, 60 people died and about 80 were seriously injured; perhaps because of previous shocks, strong and close to each other, this event had devastating consequences [3]. The British administration proved to be extremely effective in managing the situation. A survey was organized, covering the entire city: in Lefkada 1295 houses were identified, 61.7% in stone, 11% in clay and 27.18% in wood. As to what concerns the damaged buildings (86.8%) data can be summarized using this same classification, also considering, however, what is declared in some notes of the time, stating that *"there is no building that did not suffer some damage "* [17, 18]:

- stone houses (61.7% of total): 17.6% is classified as "fallen", 15% "not reparable", 60% "repairable" and 7% did not present any damage;
- clay houses (11% of total): 70.6% collapsed, 11.8% are not reparable and 17.4% repairable. No clay houses are undamaged;
- timber houses (27.2% of total): 9.9% collapsed, 14.4% are not reparable, 47,15% are repairable and 28,40% presented no damage.

The severity and the impact produced by this earthquake pushed the British administration (in office since 1810) to issue a building code with prescriptions for both reconstruction and repair works. The Code of Construction of **1827**, based on a careful analysis of the most affected buildings and materials, had the purpose of highlighting the constructive solutions which had successfully reacted to the seismic event. Thereafter, it was imposed as the reference code for both new building and for reconstruction activities. With the following earthquakes occurred in **1869** and **1914** (M = 6.4 and M = 5.1, respectively), the damage assumed a homogeneous trend, which can be estimated as average. The Code of Construction had established the criteria to be used, identifying a special construction system suitable also for extreme situations.
As previously mentioned in section 3, it is a peculiar mixed system (masonry and wood), drawn from the tradition to respond to important environmental critical factors. Many have claimed paternity for this system; its origin, indeed, simply comes from the need to respond to a couple of simultaneous disastrous situations: soft soil associated with high intensity and frequent ground motion. The enduring need implies that local people do not lose consciousness of the danger, but rather keep refining effective building solutions. The earthquake which took place on August 14, 2003 (M = 6.2) provided a further proof of this. From the report *"Learning from Earthquakes"* [8]: it is possible to know that, out of 3165 inspected houses, access was forbidden to 126 only; the remaining 1544 were immediately usable and 1495 in need of repair. An excellent result, considering the modern constant trend to the use new materials or even to demolition in case of interventions in historic centers with the aim of upgrading, expanding and renovating. The system codified in 1827 still resists to both earthquakes and technocracy as well. However, it can be said that the buildings in the city could exhibit a positive behavior as a response to the repeated ground shocks on August 14, 2003 thanks to the combination of good building quality and excellent craftsmanship, prepared by a long historical experience to face the challenge coming from earthquakes.

4. Conclusion

Any sort of material heritage is always accompanied by an intangible heritage: the local architectural heritage and technical culture from which it has been generated are the tangible result of a knowledge transferred through memory and tradition. As it is pointed out in [14], the term *tradition* is strongly connected to the meaning of the etymological matrix from which it is derived: from the Latin verb *tradere* (= to deliver, transmit); it defines in fact tradition as the process of "handing down from generation to generation an event, a costume or the entire culture of an ethnic group, not by fixing them in a document, but by words and the way of living". Both the Italian and the Greek case represent limit situations in the response to one or more criticalities; in general, common architecture is always the vehicle of material culture, perfectly compatible with local needs and developed by iteration.
Through the proposed diagrams and the relative discussion, an analysis has been proposed about the symbiotic relationship between the architectural heritage and the memory of criticalities, and also between need stimulated skills and the desire to stay at a site. The diagrams are both the result of a first analysis of specific cases, which help to better understand and argue an intuition by P. Touliatos , with reference to emblematic situations. Through this application to real cases, what should be obvious has emerged, namely the fact that the basic prerequisite for a growing trend in figure 1a is not only given by the frequency of criticalities, but also by the boundary conditions affecting the society. The discriminating factor is the economic and political stability, in the absence of which other necessities overcome reconstruction. Other factors also influence the architectural quality in the reconstruction phase or during the interventions which follow a destructive event. As it was shown, they are mainly epidemics and migrations, which cause a weakening of the community; the absence of competent manpower; the destruction of shops or food reserves, which endanger a recovering economy; the concurrence of other critical events, like a tsunami or a

fire or even a war. In general: not only a form of "cognitive impoverishment", but also specific circumstances or, simply, the availability of construction materials. Frequently recurring earthquakes certainly enhance reaction capabilities and the revival speed of past experiences, a fundamental requirement to "stay" and not to lose the effective architectural Memory.

Acknowledgments

Prof. P. Touliatos has initially stimulated and constantly encouraged the development of this research. Dr. C. Papakosta has provided a valuable contribution during the entire process of reading and translating historical documents in the Lefkada archive. Finally, arch. C. Marsili has "accompanied" the study of the reconstruction works which followed major earthquakes in the L'Aquila region.

Bibliographical References (Arial – 11 pt – Lower case letters - Bold – Left aligned)

[1] Postpischl D. *Catalogo dei terremoti italiani dall'anno 1000 al 1980.* Bologna: Quaderni della Ricerca Scientifica, 114, 2B, 1985, pp.239

[2] Marconi P., Il recupero nel contesto della cultura europea. In: A. Bianchi e Milella O. *Centri storici minori del Mediterraneo*. Catanzaro: Rubettino, 1999, pp. 109-115

[3] Papadatou-Giannopoulou C., *Lefkada ricercando*, Patrasso 1999), pp.171-194 [in Greek]

[4] Touliatos, P. *Approach, identification and intervention in historic constructions. The technological point of view.* Athens: NTUA, 2003

[8] *Learning from Earthquakes Preliminary Observations on the August 14, 2003, Lefkada Island (Western Greece) Earthquake*. EERI Special Earthquake Report — November 2003

[9] Fokaefs A., Papadopoulos G.A. *Historical earthquakes in the region of Lefkada Island, Ionian sea – Estimation of magnitudes form epicentral intensities.* Bulletin of the Geological Society of Greece, vol. XXXVI, Proceedings of the 10th International Congress, Thessaloniki, April 2004

[10] Vintzileou E, Touliatos P, Zeris Ch, Repapis C, Adamis Ch, Zagkotsis A, et al.. *Assessment of and Recommendations for Interventions to Buildings in the nucleus of the city of Lefkada.* Research Report, , Athens: Laboratory of RC, NTUA, 2004 [in Greek].

[11] *Guidoboni* E., Ferrari G., Mariotti D., Comastri A., Tarabusi G. and Valensise G*. Catalogue of Strong Earthquakes in Italy (461 B.C.-1997) and Mediterranean Area (760 B.C.-1500).* CFTI4Med INGV-SGA. 2007 http://storing.ingv.it/cfti4med/

[12] Rovida A., Camassi R., Gasperini P. and M. Stucchi.*CPTI11, La versione 2011 del Catalogo Parametrico dei Terremoti Italiani.* Milan, Bologna, 2011 http://emidius.mi.ingv.it/CPTI

[13] Papakosta C. E. *Sailing from the Ionian sea: people, ships and trade in the island of Lefkada in the 18th century.* In: Denizler Bildiri, Part 4 Traders and Corsairs, 2013, pp. 294-302

[14] Cineri V., Zamperini E. *Il recupero di un patrimonio intangibile: la cultura tecnica delle maestranze locali.* In: D'Agostino S. and Fabricatore G. *History of Engineering Storia dell'Ingegneria.* Proceedings of the 5° International Conference, Naples: Cuzzolin editore, volume I, May 19th - 20th, 2014, pp. 475-487

[15] Tonna S., Chesi C., Vintzileou E., Katopodis K. *Traditional building criteria in the Lefkada island: peculiarities of the foundation system*, in: SAHC2014 – 9th International Conference on Structural Analysis of Historical Constructions, F. Peña & M. Chávez (eds.) Mexico City, Mexico, 14–17 October 2014

[16] Tonna S., Chesi C., Marino L., *The transumance architecture: handing down seismic knowledge while migrating*, in: Versus 2014 (Conference on Vernacular Heritage, Sustainability and Earthen Architecture, Valencia , Spain, 11-13 September 2014), 2015 Taylor & francis Group, London, pp. 707-712

[17] Folder n° 5 regarding 1825 earthquake (Archives of the Prefecture of Lefkada) [in ancient Venetian]

[18] Journal of the United States of the Ionian Islands 18/30.06.1827. No LXXXVL (Archives of the Prefecture of Corfu) [in ancient Venetian]

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
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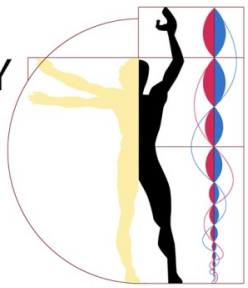

Architectural History from a Performance Perspective
The Latent Potential of Knowledge embedded in the Built Environment

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Abstract
This paper commences from the understanding that the built environment constitutes a vast repository of embedded knowledge and portrays an ongoing study of pre-industrial architectural case studies including buildings and settlement pattern so as to gain insights into their fine-tuned relation of their location specific performative capacities and inherent sustainability characteristics. In this way architectural history can provide valuable insights for contemporary designs. In turn, recognizing the value of past architectures for future design can help strengthening arguments towards informed and functional preservation with the aim to maintain and improve on the ability to analyse historical architectures and the related embedded knowledge. This paper presents selected case studies across a range of cultures, times, locations and climate zones, focusing on questions of knowledge production, performance capacities, cultural patterns of use and operational logics. Moreover, this includes ways of identifying further research and the dissemination of the findings through addressing not only an expert audience but also the wider public to which the research must be made accessible in order to result in the demand for related policies.

Keywords: embedded knowledge, performance capacities, locally focused studies, geographically dispersed studies

1. Introduction
The work presented here within is based on the understanding that the built environment constitutes a vast repository of embedded knowledge. This knowledge may be part of living traditions in which the specific architectural design and the operational logic of the respective architectures is still known and accessible, or in other cases the particular traditions may no longer be alive and thus a careful analysis must ensue to open up the knowledge embedded in such architectures and settlement patterns. In this paper we discuss examples of an ongoing study of pre-industrial case studies including buildings and settlement pattern to gain insights into their fine-tuned relation to their location specific performative capacities and inherent sustainability characteristics. In this way architectural history can provide valuable insights for contemporary designs. This approach is based on the fact that the very forefront of current sustainability approaches acknowledges the complexity of historical architectures and environment interactions in a broad sense that displays a balanced use of local resources and sustained locally specific economies.

In turn, recognizing the value of past architectures for future design can help strengthening arguments towards informed and functional preservation in order to maintain the ability to analyse historical architectures and knowledge. This to say, when addressing the question as to which projects to prioritize in terms of preservation it is necessary to incorporate what we term different domains of architectures with their specific modes of knowledge advancement that often includes the integration of multiple crafts and knowledge fields: vernacular, representational, civic, special purpose architectures, etc. Therefore the aim is to account for a breadth of different types and purposes of architectures. Which cases to prioritize may at

times be difficult to assess, in particular when little is known about a given architecture, though the latter may serve as an indicator of the necessity to learn more about candidate projects for preservation from a performance perspective before a choice is made. This paper presents selected case studies some from the same and others across a range of cultures, times, locations and climate zones, focusing on questions of knowledge production, performance capacities, cultural patterns of use and operational logics. Concentrated studies of projects from the same culture, timespan, location and climate zones can serve to show how knowledge may have evolved across domains (vernacular, representational, civic, and special purpose architectures). Dispersed studies spread across different cultures, times, locations and climate zones help advance contemporary knowledge about pre-industrial architectures from a performance perspective towards a pallet of examples relevant for different settings, conditions, and circumstances. Concentrated comparative typological studies examine how specific types may have been differentiated and evolved locally, while typologically oriented dispersed studies examine how a specific typology has been expressed differently according to different settings, conditions, and circumstances. Additionally some case studies require inquiry and analysis into their operational logic and use if and when this knowledge is otherwise lost. The research is discussed, together with strategies to identify further research and the dissemination of the findings through teaching and through addressing not only an expert audience but also the wider public to which the research must be made accessible in order to result in the formulation of accepted policies. Overall the aim of this research is to show the value of historical architecture analysis for advancing sustainable contemporary designs that deserve this description.

2. Locally focused performance-specific studies across typologies

In the following part we portray concentrated studies of projects from the same culture, timespan, location and climate zones that can serve to show how knowledge may have evolved across domains (vernacular, representational, civic, and special purpose architectures). For this section we have selected two architectures of the Safavid period in Persia, that are located in Isfahan, with primary focus on environmental modulation capacities, including the combination of solar, thermal and airflow related aspects: [i] as a civic and representational architecture Khaju Bridge (ca. 1650 AD) (Fig. 1, Fig. 2), and [ii] as a vernacular and special purpose architecture a Pigeon Tower (ca.1500-1700) (Fig. 3, Fig. 4).

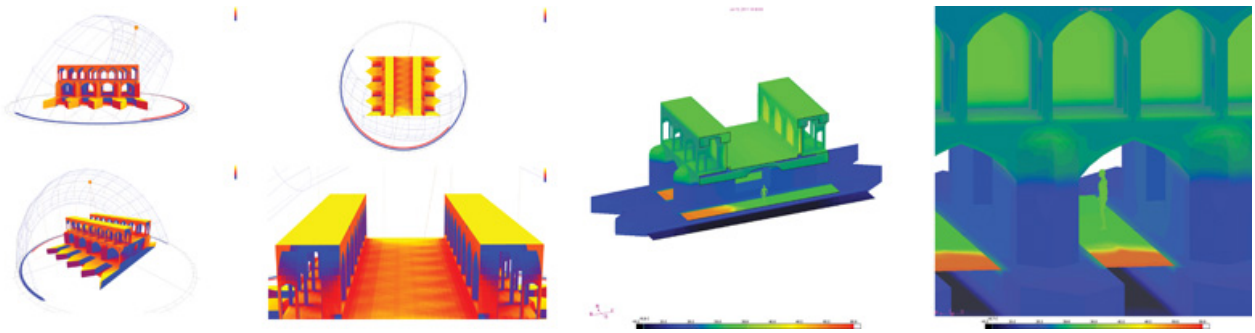

Fig. 1: Khaju Bridge, Isfahan, ca.1650 AD: solar analysis (left) and thermal analysis (right).

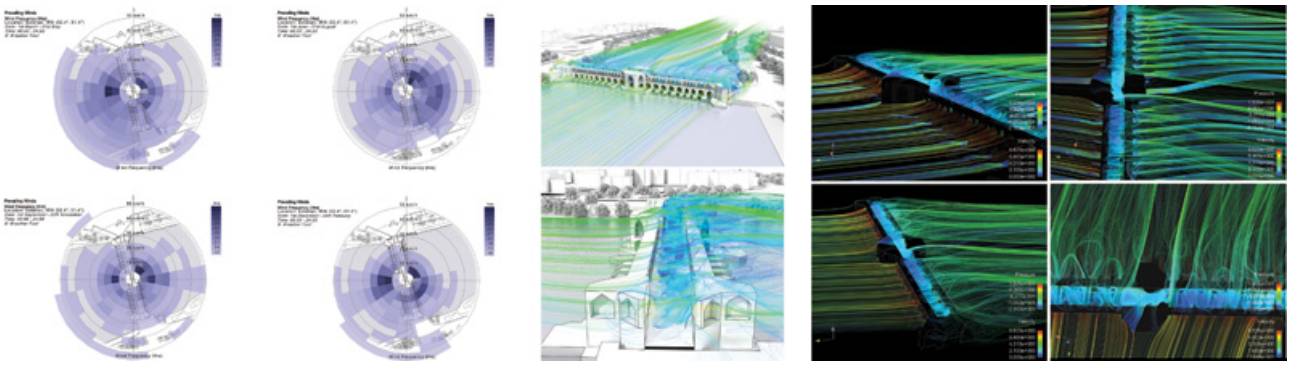

Fig. 2: Khaju Bridge, Isfahan, ca.1650 AD: seasonally prevailing wind directions (left) and airflow analyses (centre and right).

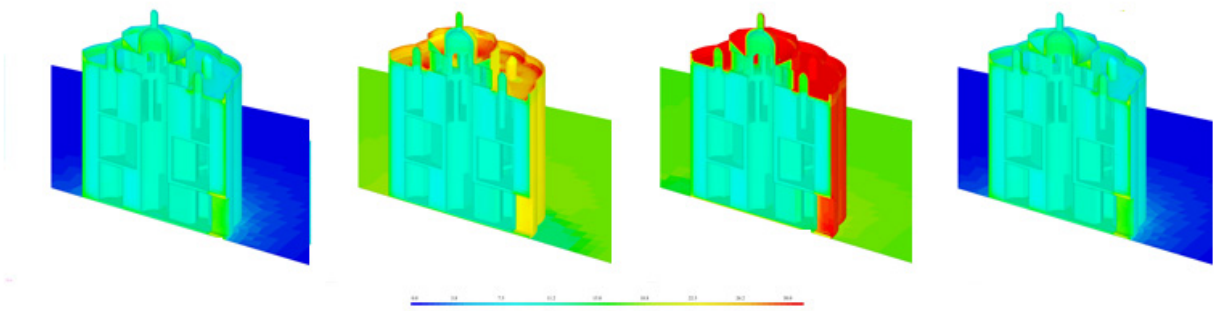

Fig. 3: Pigeon Tower, Isfahan, Safavid period: thermal analysis, from left to right 09-00, 12-00, 15-00, 18-00 (21 June)

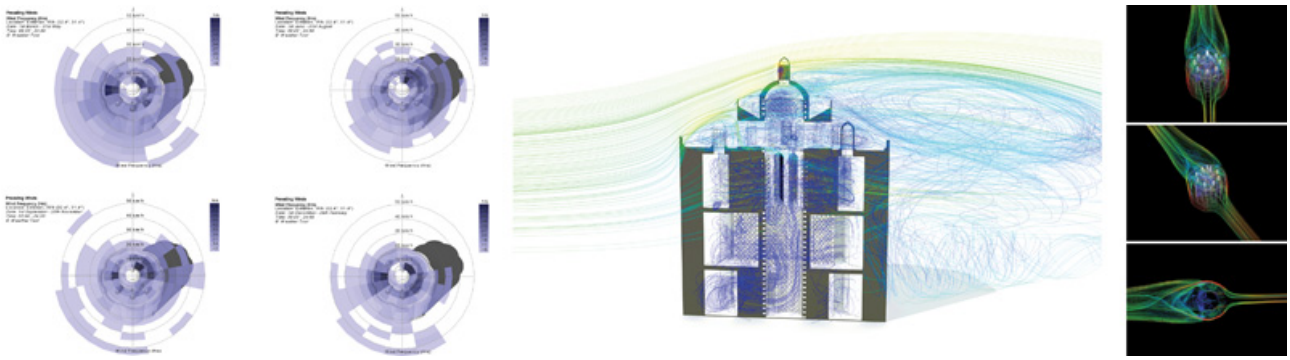

Fig. 4: Pigeon Tower, Isfahan, Safavid period: seasonally prevailing wind directions (left) and airflow analyses (centre and right).

[i] The Khaju Bridge (*pol-e khajoo*) in Isfahan is a prime example of a complex multifunctional civic architecture that emerged in the context of the convergence of knowledge and skills in Isfahan the new capital of Safavid Persia, where different cultures met. The bridge was built around 1650 AD under Shah Abbas II on the foundations of an older bridge and spans across the Zayandeh River, the largest river on the central Iranian plateau. The water level of the river varies seasonally and can dry out entirely during severe draughts. The two-level masonry weir-bridge is 132 metres long and 14 meters wide. Located on its upper level is a 7.5 metre wide roadway that is framed on both sides by arched arcades. The lower level, which is accessible only to pedestrians, comprises of 21 arches that are connected by a vaulted space along the length of the bridge. 18 of the lower level arches span over low-flow deep canal intakes equipped with sluice gates that can raise the water level upstream up to 6 metres. The bed of the canal intakes are stepped cascades that dissipate hydraulic energy during large flood flows. The sluice gates served to regulate the water level of the Zayandeh River for the purpose of irrigation of upstream gardens and fields. The stepped chutes on the bridges downstream side and the arches and vaulted space of the lower level double up as spaces for public use. The bridges highly sophistication hydraulic performance prompted Dr. Mehrdad Hejazi at the Faculty of Engineering at the University of Isfahan to state that it ‘represents the ultimate achievement of Persian hydraulic engineering.’ [1] On the lower level the design accomplishes a comfortable microclimate by way of utilising airflow in conjunction with evaporative cooling. In order to gain insight as to how this comfortable microclimate is generated we conducted solar, thermal and airflow analysis in order to understand their interrelated calibration while taking advantage of the water body of the river. The laminar airflow along the river becomes turbulent and is slowed down in the arched and vaulted space of the lower level of the bridge and streams over the water surface of the river, thus benefitting from evaporative cooling. Effective self-shading of the masonry arches and vaults entails little thermal gain during the daytime. Airflow that streams along these surfaces also benefits from the cooling effect of the thermal mass of the bridge. Overall it is of interest to observe that while the different elements and performative capacities of the bridge have precursors, their integration into an integrated project is unique.

It seems likely that the knowledge to calibrate the relation between shading, solar gain, thermal inertia and ventilation was acquired through the long-term development of vernacular architectures such as dwellings, etc. as well as civic architectures such as public water cisterns, etc.

[ii] One interesting example of a special purpose vernacular architecture are the Pigeon Towers of Isfahan that were built in great numbers during the Safavid empire. The pigeon towers of the Isfahan region are a prime example of a highly refined vernacular type. The primary function of these up to 20 metre tall buildings

was to provide shelter for several thousand wild pigeons with the purpose to collect the pigeon dung as fertilizer for agriculture in a region where soil lacks nitrogen, as well as for use in tanneries for the softening of leather. Circular or rectangular in plan with internally buttressed walls pigeon towers could either be freestanding as single structures, or be integrated into other structures, such as the perimeter walls of gardens. The larger towers could house ten thousand pigeons. Such towers consisted either of a single hollow space or drum or, alternatively, of an inner drum enclosed by an outer one. Some large towers were organized in plan as eight smaller and connected drums around a central and larger drum. This particular spatial organization served to increase the surface area of the interior and therefore also the number of pigeon nests. Turrets provided for access and ventilation. Humans accessed the tower generally only once a year to harvest the dung. A seventeenth century travel report stated that the region around Isfahan featured thousands of these pigeon towers. This raises the question as to how one can design for pigeons? Obviously a long vernacular tradition underlies the knowledge necessary to accomplish this task: a careful modulation of the interior climate based on a finely calibrated relation between thermal inertia and effective ventilation that keeps the interior at a steady temperature throughout the day in spite of a steep exterior temperature gradient over the course of the day. As to the high level of interior climate control features in numerous building types of the region, as shown above, it seems reasonable to assume a lateral distribution and utilisation of knowledge. The implications are a better understanding, development and calibration of what is known today as buildings in free-running mode that are not heated, cooled or air-conditioned, and that operate on thermal inertia instead in response to exterior climate in relation to the spatial and material organisation of buildings. [2] [3] The question as to what lessons to draw from this lateral knowledge production is much harder to address, given that in many parts of the world living vernacular traditions no longer exists. This should yield ample concern with keeping still existing vernacular traditions alive and to draw as much insight as possible where vernacular architecture still exists even though the vernacular traditions may be extinct. A third mode may concern the simulation of vernacular development through generative evolutionary computational methods. However, the latter cannot be discussed here in any detail. At any rate, one important aspect that needs addressing is the widespread prejudice that pre-industrial buildings were uncomfortable in comparison with today's expectations. Such studies can assume a key role towards this end, while also delivering useful empirical data for contemporary design.

3. Geographically distributed studies I: typological variations

Adding to the inquiry of the previous section is a better understanding of specific building types in variations that result from local differences, which yields the need for a first type of geographically distributed studies. In the following part we portray two variants of the Kiosk typology in two different cultures, locations and climate zones, yet, from more or less the same time. This study can serve to show how particular types of buildings may be varied to adhere and correspond with local conditions, circumstances and cultures. For this section we have selected examples from at the time rival empires, a Persian and a Turkish kiosk: [i] Fin Kiosk in Kashan, Safavid Empire, and [ii] the Bagdad Kiosk in Istanbul, Ottoman Empire. The word kiosk (*kušk*) is of Persian origin. It indicates the purpose of shading and initially identified a type of more or less open garden pavilion. Kiosks became widespread in Persia, India, Pakistan and the Ottoman Empire from the 13th century onwards. The kiosk came to exemplify in particular Ottoman architecture, perhaps, as it has been speculated, because it was the first stationary and permanent interpretation of the Seljuk Nomadic tent.

[i] Fin Kiosk (Fig. 5) is located in Fin Garden in Kashan. The walled garden is organised by two main axes that constitute the primary walkways. Square-shaped in plan the kiosk is located at the intersection of these two axes that intersect its volume. While roofed over the axes remain exterior space. The four corner spaces constitute the interiors of the kiosk. Arcaded recesses in the main façade shade the outward facing openings of the interior spaces. Thermal inertia, self-shading, and also shading by adjacent trees, effective ventilation and evaporative cooling through a pool in the centre of the kiosk and water-channels along the axes, are combined in the passive environmental modulation of the spaces of the kiosk.

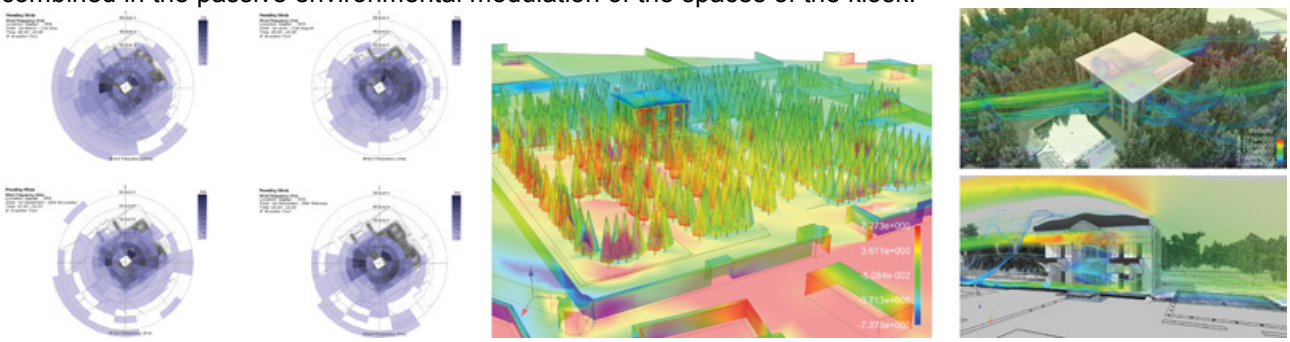

Fig. 5: Fin Kiosk, Kashan: seasonally prevailing wind directions (left) and airflow analyses (centre and right).

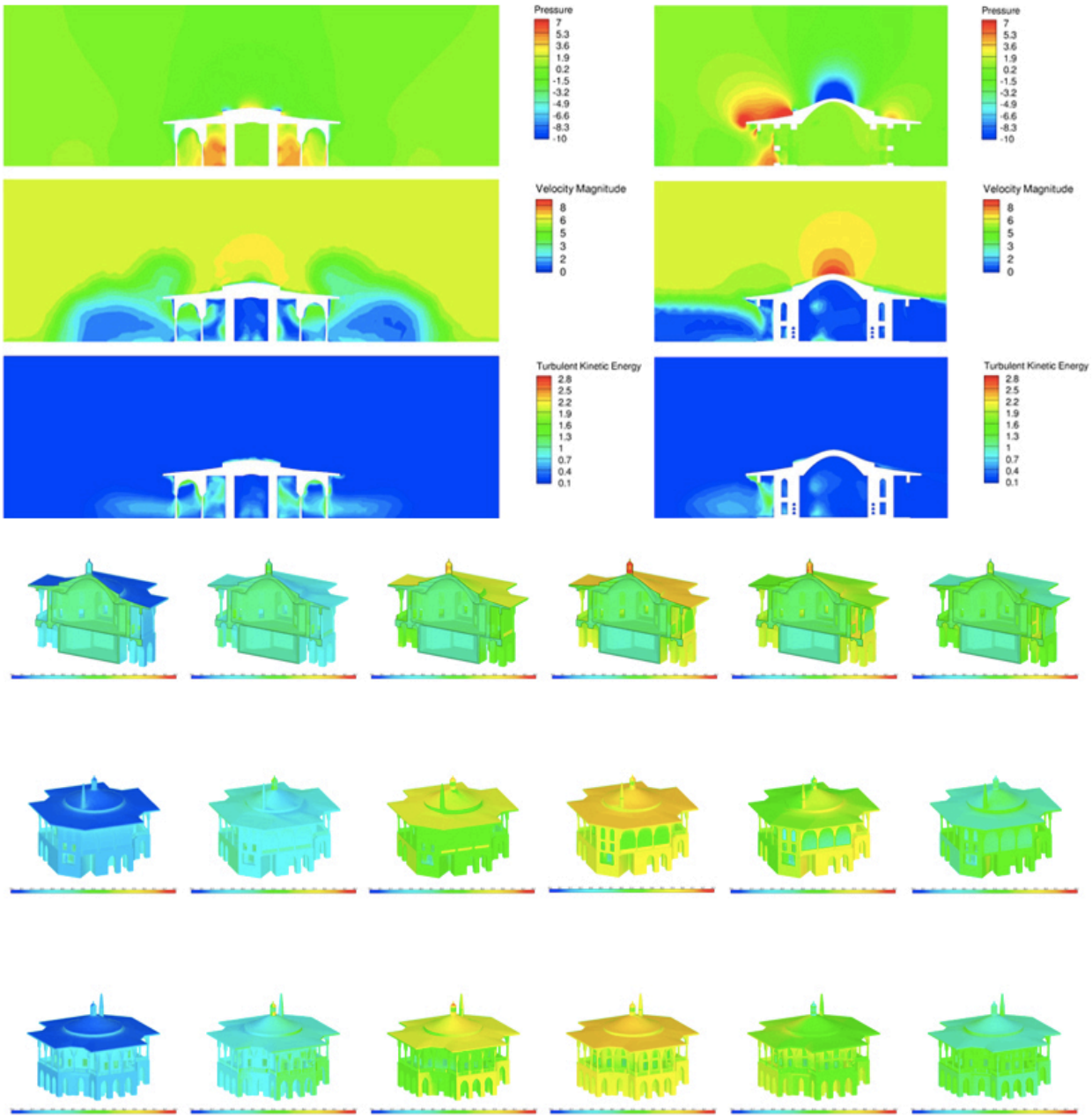

Fig. 6: Bagdad Kiosk, Istanbul: airflow analysis (top) and thermal analysis (bottom).

[ii] Prime examples of Ottoman kiosks can be found in Topkapı Palace in Istanbul, the official residence of the Ottoman sultans from 1465 to 1853. This includes, for instance, the Bagdad kiosk (*Bağdad Köşkü*) (1638-39) (Fig. 6) that served different purposes over time ranging from summerhouse, to celebratory space, to library. The double storey building is accessed at the lower floor from the lower level garden and at the upper level from the raised level of the Forth Courtyard. The use of the basements has not been established beyond doubt. The plan is organised on an octagonal footprint with four of the faces recessed and an additional enclosed space added into one recessed space. The meandering outline of the envelope of the pavilion organises the interior into four apses that are occupied by divans – a type of low and wide matrass with leaning cushions. The windows feature glass elements, as well as opaque timber shutters in the interior that both serve to regulating the amount of light, thermal impact and ventilation. The meandering outline creates setback spaces in the arcades below the protruding roof overhang and creates pockets of different climatic exposure, both on the exterior of the envelope, as well as in the interior of the kiosk. The arcades could either be open or covered with textile draping, to provide a more exposed or more sheltered and private space. In addition to the spatial organisation of the kiosk a series of gardens and open spaces surround the complex at the mid- and lower level, and water basins and fountains at the upper level, which all contribute to its climatic modulation.

Both kiosks display an almost equal amount of sheltered exterior space and interior space that is, however, organized quite differently in plan. While both kiosks display a symmetric and centric organisation Fin Kiosk locates the sheltered exterior space along its axes of symmetry and the interior spaces at the corners in direct contact with the surroundings, while Bagdad Kiosk locates its interior space in the centre wrapped by a semi-sheltered exterior. In both cases the spatial and material organisation of the actual building cooperates with the layout and plantation of the surrounding areas in order to provide a heterogeneously modulated climate that offers choice to the habitants.

As with the locally specific cross-domain studies the implications are again a better understanding, development and calibration of what is known today as free-running buildings. What can be gleaned is the great scope of different ways of organizing space and material towards this purpose. We seek to conduct such studies for all cases in which it is possible, i.e. the study of the Persian Pigeon Towers in the previous section is paralleled with corresponding ones in Anatolia.

4. Geographically distributed studies II: settlement patterns

In the following part we portray three case studies of settlement patterns across cultures, times, locations and climate zones that serve to show how we may think differently about todays unnecessarily limited options that underlie a homogenous global trend of urbanisation. For this section we have selected three studies of settlement patterns each of which is situated on a different terrain and provides collective space as an extended ground in a different manner: [i] Yaodong Pit Cave Dwellings, Huangtu, China, [ii] the Neolithic settlement Çatalhöyük located in Central Anatolia (circa 6,500 to 5,500 BC), and [iii] Mardin, an Anatolian town located on a steep hillside. We have selected these three examples due to the fact that they each in their own way deemphasize the free-standing architectural object which prevails today, and thus offer opportunities to consider ways of organizing settlement patterns that are not part of the contemporary canon.

[i] Northern China's semi-arid Loess plateau (Gansu, Henan, Shanxi and Shaanxi provinces and the Ningxia Hui Autonomous Region) features various types of underground dwellings. An estimated 40 million people still live in underground dwellings known as *yaodong* (house cave), which can be divided into three types: [i] dwellings dug into loess cliffs on the side of valleys (cliff cave dwelling), which date from ca. 2000 BC; [ii] dwellings dug into a flat plain and organised around a sunken courtyard (pit cave dwelling), [iii] vaulted dwellings made from stone or brick with one or two storey above ground that are covered with loess (earth sheltered dwelling). [4] Of particular interest are the pit cave dwellings that are organized around sunken courtyards as these maximize the thermal mass of the ground that keeps the interior spaces cool in the summer and warm in the winter. Bernard Rudofsky brought these types of dwellings to Western attention in 1964 in the context of his seminal 'Architecture without Architects' book and exhibition at the Museum of Modern Art in New York, by way of s series of aerial black and white photographs taken in the 1930s by the German pilot Wulf-Dieter Graf zu Castell. The pits are square or rectangular in plan and 8 to 10 meters deep. L-shaped stairways lead to the sunken courtyard from which the interior spaces are accessed. The latter are up to 10 meters long, up to 5 meters wide and feature up to 5 meters high vaulted ceilings. Each sunken courtyard has a well for freshwater and a drainage well. Trees often mark the L-shaped stairways, perhaps to use the roots to stabilise the ground and to prevent airborne silt to clog up the stairways. Trees in the courtyards provide shading during the summer. This dwelling type offers an alternative to architecture as freestanding objects as settlement morphologies based on figure-ground arrangements.

[ii] Çatalhöyük is a Neolithic settlement located near Konya in Central Anatolia in Turkey and dates from circa 6,500 to 5,500 BC. With an estimated population of 5.000 to 8.000 inhabitants it was one of the largest Neolithic settlements discovered to date. Charles Gates, professor of Archaeology and History of Art, argued that 'developments in town planning, architecture, agriculture (including animal husbandry), technology and religion – come together dramatically at Çatalhöyük'. [5] Gates described the settlement as follows: 'The houses clustered together, their walls touching those of their neighbours. Although small courtyards connected by streets lined the edges of the excavated area, within the cluster courts existed but streets did not. People entered houses from the flat rooftops, descending to the floor by means of ladders. Since the town lay on sloping ground, the height of the roofs varied.' [6] The fact that the buildings were closely clustered and entered from the roof indicates that there must have been a common sense based practice of occupying collective space, in that in order to reach to any given house it was necessary to move across the roofs of other houses. The aggregation of roof surfaces into a shared elevated ground required a shared understanding in terms of access and use. The elevated new ground was limited by the perimeter of the settlement, a condition due to questions of construction and defensibility, and by trapped courtyards that established inner perimeters. The dense parts of this settlement were therefore not disassociated into discreet figures even though it consisted of individual units.

[iii] Located in a semi-arid climate zone the ancient town Mardin offers an interesting example of a settlement pattern consisting of densely aggregated architecture situated on a south-facing mountain slope overlooking the northern Syrian flat plains. The town consists of dense terraced fabric of historical buildings primarily built from locally quarried limestone that are located on a steep slope. The buildings are mostly introverted and two-storey high, displaying a repetitive quasi-modular layout and do not register strongly as discrete architectural objects in the elevation of the town. Instead they blend into a continuous fabric which itself blends in with the steeply sloping terrain. The buildings participate in the doubling of ground and its three-dimensional maze-like organisation. In Mardin the entrance level of buildings changes in accordance with the steep slope. The entrance level of a building uphill may thus be located at the same height as the first floor of the directly adjacent one downhill. Pedestrian circulation routes run either along the height-lines of the hill between rows of houses or meander up- and downhill utilizing stairs and roof terraces. Locally buildings bridge over the narrow streets and street junctions. Mardin's densely packed and labyrinthine settlement pattern resonates with traditional Arab settlements, albeit in a different spatial arrangement with its own particular characteristics owing to the steep slope of the hill the town is situated on.

What can be gained from studies like this is an expended set of design options for dense low-rise settlement types, all with their specific mode of providing a public ground that is not a left-over of building operations, but, instead frequently a positive outcome of a specific aggregation of architectures in relation to local terrain, climate and cultural customs. In order to gain a better understanding such analyses should exceed a mono-scalar perspective and relate single architectures to the impact of their specific form of aggregation and habitation. Occasionally this will require analyses also into operational logics and use.

5. Operational Logic Studies

In the following part we portray a study that focused on re-establishing the operational logic of a Persian Ice Houses (*yakh-chāl*). The exact origin of icehouses is not known. Ice pits were used in ancient China, Persia and Rome. The purpose of the Iranian Ice Houses (*yakh-chāl*) was the storage and often also the production of ice for human consumption. These structures commonly featured subterranean chambers covered by a large dome made from mud-brick that often reached 20 meters in height. Ice and snow could be brought from nearby mountains or harvested from frozen lakes in the winter, or could be produced next to the Ice Houses in east-west oriented shallow pools that measure up to a length of 100 meters and widths between 10 to 20 meters. These pools were backed on their southern side by a tall adobe wall that shaded the pool during the ice-making period in the winter and to protect the pools from the impact of the sun and wind-induced convective heat gain to reduce melting during the daytime (Fig. 5, Fig. 6). The accurate height of the east-west wall was of vital importance as it had to be high enough to shield the pool, but not so high that it would reduce the exposure of the water surface to the visible sky. The latter was essential to maintain maximum heat-loss of the water through radiation. Additionally each pool was flanked in the east and west by lower walls for the same purpose. During the cold winter nights the pools were filled with a shallow layer of water that would freeze over night and could be harvested as ice in the morning. A comparison between weekly and daily build-up and harvesting of ice showed a distinct slowing of ice build-up with increasing thickness of the ice. For this reason the daily harvesting of ice over a period of seven days would yield more than double the amount of ice compared with weekly harvesting. Through a relatively simple analysis as this it is possible to re-establish an operational logic for this and other types of special purpose architectures when this knowledge may no longer be available as part of a living tradition. In suitable cases preservation efforts should include not only the physical structure of architectures, but also their functional operation and use. However, there is ample reason to proceed with caution.

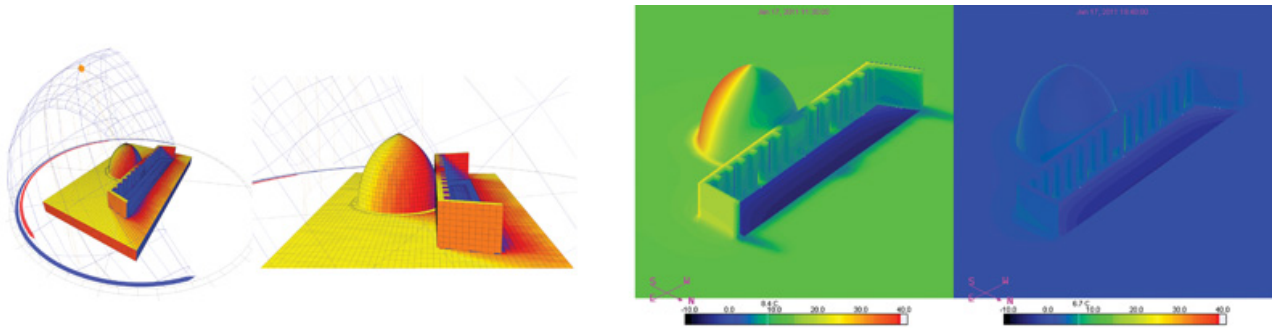

Fig. 5: Icehouse, Meybod: solar analysis (left) and thermal analysis (right).

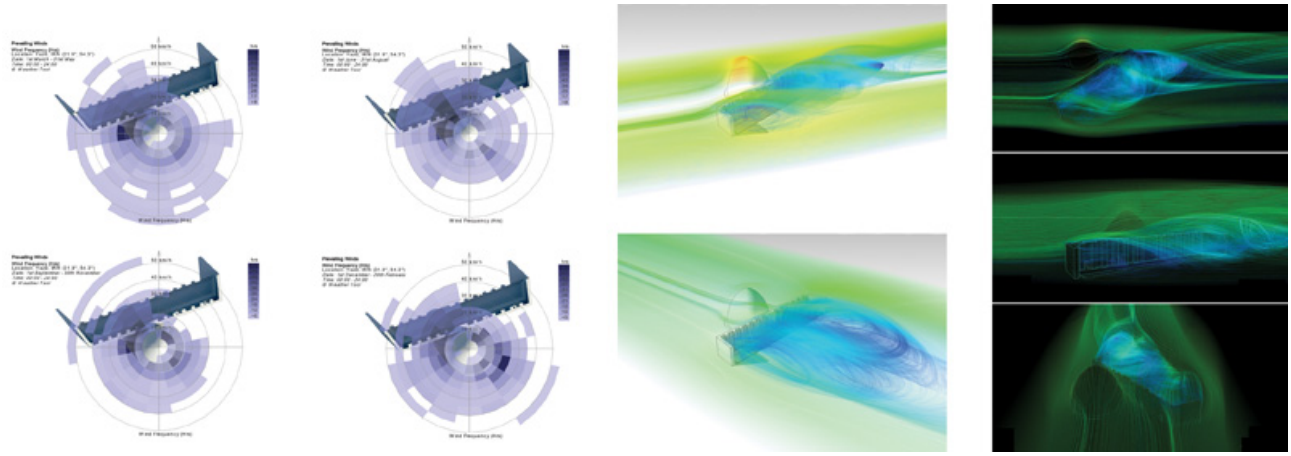

Fig. 6: Icehouse, Meybod: seasonally prevailing wind directions (left) and airflow analyses (right).

6. Looking Forward – The Future of Architectural History

Approaching architectural history from a performance perspective as discussed above can yield useful insights that can serve a more complex approach to questions of sustainability in architecture. In order to develop this further it is necessary to continue studies along the four trajectories discussed above in order to move from what is still a very coarse distribution of case studies with some in depth geographical or typological focal areas into an extensive stock of case studies in all climates and cultures. In addition it is necessary to expand the questions asked on a case-specific basis and to increase the range of analytical methods and tools wherever necessary and useful. Overall this type of inquiry can serve to revitalize the field of architectural history by expanding its scope of relevance and contribution. However, there exists another issue that requires addressing to accomplish the task of implementing the findings of the research in contemporary designs. As indicated above, there exists persistent prejudices in the broad public view, at least in the so-called developed countries, that historical architectures cannot provide a reasonable degree of comfort in today's terms. This is often even culturally celebrated in the form and format of cabins that are used for holiday purposes in which living rough is thematized. However, recent developments also show that an increasing number of such cabins are equipped to today's high standard also necessitating high-energy consumption. Both trends are not exactly conducive to convince the broad public to think differently about their local architectural heritage, or architectural heritage in general. If and when such architectures are appreciated it is in the main for the spectacle of visiting landmark cases. When we embarked onto our research on architectural history from a performance perspective we sought to communicate the findings not only to the specialist but also to the layman. This includes publishing the work not only in scientific journals, but also in popular ones. Furthermore we exhibit the work frequently providing a broad number of different types of visualisation. This includes regular architectural drawings such as plans, sections, elevations, axonometric sections, etc. and analytical drawings, and scaled models, but also overlays of renderings and analytical drawings, augmented and virtual reality visualisation to provide a both as broad and as immersive as possible an experience of the case studies. In this way visitors can experience a "walk-through" through a large number of case studies. This approach has a three-fold aim: [i] generating a more sustained interest in historical architectures in the broad public, [ii] disseminating the findings as broadly as possible, and [iii] generating the understanding that a much greater range of design options exist above and beyond the current mostly homogenous global outcomes. The assumption is that policies enforced in spite of a lack of knowledge and interest are less likely to succeed when compared with generating interest and knowledge and from this position a demand for alternative policies. It is from this perspective that we address the research so that all tasks can be integrated: research into historical architectures, informed preservation of architectures and their uses, research findings that can yield more sustainable approaches towards contemporary design, generating interest and knowledge in the broad public, and based on the former an increasing demand for supporting policies. The research portrayed in this paper commenced in 2008, but it is in many ways still in its infancy. One of the tasks is to bring more researchers from different disciplines together in pursuing this task. It is our hope that this paper is a useful step in this direction.

NOTE: The studies discussed in this paper were undertaken in the context of the international and interdisciplinary Sustainable Environment Association, a not-for-profit expertise network registered in Norway and in the European Commission Beneficiary Register. A range of Persian Case Studies have been the subject of an article in 2012 [1] and a range of Turkish Case Studies have been discussed in two articles in 2010 [2] [3].

Bibliographical References

[1] HEJAZDI, Mustafa M. *Historical Buildings of Iran – Their Architecture and Structure*. Southampton: WIT Press, 1997, p. 94-95. ISBN 978-1-85312-484-6

[2] HENSEL, Michael. *Performance-oriented Architecture – Rethinking Architectural Design and the Built Environment*. London: John Wiley & Sons, 2013. ISBN 978-0-470-97331-8

[3] NICOL, Fergus and PAGLIANO, Lorenzo. Allowing for thermal comfort in free-running buildings in the new European Standard EN15251. In *Proceedings of 2nd PALENC Conference and 28th AIVC Conference on Building Low Energy Cooling and Advanced Ventilation Technologies in the 21st Century*, Crete Island, 2007, p. 708-711.

[4] GOLANY, Gideon S. *Chinese Earth-Sheltered Dwellings – Indigenous Lessons for Modern Urban Design*, Honolulu: University of Hawaii Press, 1992. ISBN 978-0-824-81369-7

[5] GATES, Charles. *Ancient Cities – The Archaeology of Urban Life in the Ancient Near East and Egypt, Greece, and Rome*, London: Routledge, 2003, p.24. ISBN 978-0-415-01895-1

[6] Ibid

[7] HENSEL, Michael, and SUNGUROGLU HENSEL, Defne, GHARLEGHI, Mehran, CRAIG, Salmaan. Auxiliarity, Performance and Provision in Historical Persian Architectures. In HENSEL, Michael and GHARLEGHI, Mehran. *Iran – Past, Present and Future*. London: AD Wiley, 2012, Vol. 82 (3): p. 26-37. ISBN 978-1119-974505

[8] HENSEL, Michael, and SUNGUROGLU HENSEL, Defne. Extended Thresholds I Nomadism, Settlements and the Defiance of Figure-Ground. In ERTAS, Hulya, HENSEL, Michael and SUNGUROGLU HENSEL, Defne. *Turkey - At the Threshold*. London: AD Wiley, 2012, Vol. 80 (1): p. 14-19. ISBN 978-0470-74319-5

[9] HENSEL, Michael, and SUNGUROGLU HENSEL, Defne. Extended Thresholds II The Articulated Envelope. In ERTAS, Hulya, HENSEL, Michael and SUNGUROGLU HENSEL, Defne. *Turkey - At the Threshold*. London: AD Wiley, 2012, Vol. 80 (1): p. 20-25. ISBN 978-0470-74319-5

HERITAGE and TECHNOLOGY
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The underground city between design and survey: the greek hollow of Poggioreale

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Abstract
Naples has an infinite hypogeum and steeped in history, a city under the city where the events followed have left their indelible imprint from five millennia ago.
In the complex of tunnels and cavities excavated in the tuff and placed in the subsoil of the city are many especially the environments and the classic architectures, of greek and roman time: they began as a tuff resource to allow the greeks walls and the temples of the city of *Neapolis* that was gradually spreading and, at the same time, many areas were dug to create a series of hypogea.
The survey of the greek hollow, in Poggioreale area, adds an important wedge to the mosaic outlined so far the Naples' subsoil with the more ambitious goal of designing a total plan underground city; also the space survey has shown that the tuff was mined continuously according to an innovative technique, by inserting wooden poles inside natural crevices, so blocks of tuff were extracted more easily without damaging the structure of the quarry. After that the boulders were branded and on the walls of the greek hollow in Poggioreale you can see graffiti and symbols dating back to the IV century BC representatives probably, according to the archaeologists, the precise membership quarry.

Keywords: underground city, survey, greek hollow, Naples

1. The city under the city[1]
During the centuries the underground life of Naples was in ferment almost as much as that on the surface. The first artifacts of underground excavations date back to about 5,000 years ago, almost to the end of the prehistoric era. Later, in the 3rd century BC, the Greeks opened the first underground quarries to extract blocks of tufa in order to construct walls and the temples of their *Neapolis* and dug many environments to create a series of burial underground.
It was slowly shaping a real underground grid whose development most imposing happened in roman times, when the city was equipped with tunnels, such as the cave of Cocceio and the cave of Sejanus, and, most importantly of all, the network of aqueducts complex, fed by underground conduits from the sources of Serino, 70 km away from the center of Naples, while other branches of the aqueduct, of the Augustan age, came up to Miseno, to supply the *Piscina Mirabilis*, that was the water reserve for the roman fleet.
What little wide which allowed the passage of a man, the tunnels of the aqueduct branch off in all directions, with the purpose of feeding fountains and homes located in different areas of the upper city. At times, on the walls, there are still traces of hydraulic plaster, used by engineers of antiquity to waterproof tunnels.
In the early 16th century the old aqueduct and the many rain tanks were unable, however, to satisfy the water needs of the city that had spread like wildfire and it was thus that the wealthy Neapolitan nobleman Cesare Carmignano built a new aqueduct.
At the beginnings of the 20th century it was stopped digging in the subsoil for the water provisioning and it abandoned a net of burrows and cisterns extended for over 2.000.000 m² and spread throughout the city. During the Second World War, the underground city was further amended to accommodate the population during the bombing: about four thousand people populated the underground of the city, waiting for the war would allow the return to life. But the destruction by the war presented a scenario shocking to the population

abandoned the belly of the protective city. The fierce bombing had destroyed most of the city. Even the painful and laborious reconstruction of Naples, his belly vacuum had its part: the lack of means of transport was resolved by throwing debris into the ancient wells. Heaps of pieces of tuff reduced in the city, were rejected on the inside, exactly where, in the course of the centuries, had come out so that the subsoil continued to be used as landfill until the Eighties.
The miles of tunnels over which rises Naples twist today for new excavations for the construction of the new metro line to the point that the subsoil encloses and weaves five millennia of history. From here the study, synthesized in this work, which in the analyze individual underground environments in various moments and according to several purposes, identifies the need to rationalise the various underground spaces knowledge the wider lens in order to outline a map of the city under the city where the historical periods can be identified for each artifact.

1.1 The history of the underground's exploration

The study and investigations of the Naples' subsoil had beginning, in systematic and aware way, from 1950: "When to the sound of the siren of alarm, I see floods of my Neapolitans disappear in this underground city, my soul it turns a thought of gratitude to the Divine Providence that wanted to inspire to disclose me to Naples this other city that, with my job not compensated and of my initiative, I have made to know." In the last Memories of the 1943 of engineer Guglielmo Melisurgo it's described a precise study of the underground city that, later over one century, a representation alive and actual, as well as precious guide remains still, of that fantastic and mysterious underground world that, for first and with courage, he wanted to explore, palm palm. [1] In this regard the neapolitan journalist Carlo Nazzaro wrote in 1966: "Climbed from that trip to inferos made in the company of *pozzaro*, told it then with pleasant style by what vista and rigor as a scientist. A fascinating read that trip to Jean Valjean, a beautiful testimony, a valid document to mean either a little better the wheelies and the whims of the subsoil of Naples".
Melisurgo had the idea to explore the intricate network of water channels deep of the aqueducts *Bolla* and *Carmignano*, following the sudden collapses road and disruption in static buildings that began to occur with the activation of the aqueduct of Serino in 1885. The municipal administration, worried for the continuous applications of reimbursement from the citizens damaged by the facts, founded an errand of technicians that individualized the cause of the events in the infiltrations in the subsoil through the sewers, you build in masonry of bad invoice, and in the losses from the pipings of water entrance, especially through the joints and from the ramifications that crossed non solid subsoils, or made such by the aforesaid infiltrations.
The engineer Melisurgo however, while the municipal committee completed its investigations to little depth, he believed that the true cause pits to be sought in the underground city, whose topography was ignored. Taking advantage of then his charge of employee to a sector that would have been suppressed with the mass in regime of the new aqueduct, definite to start the enterprise of recognition of the subsoil, lasted two years with the help of a *pozzaro*. At the end of each exploration the engineer had the information were extrapolated to a plan called sewer, and his work is summarized in the book *Napoli sotterranea* published in 1889: the book documents the topography of a network of water channels deep in those years, using as a reference in the narration the streets and buildings present on the surface.
The author, in the introductory part, relates that he wanted to accompany this work with a drawing table, but in two years, 1883-1884, during which traveled the most of the channels, he couldn't detect planimetric data sufficient to draw up the entire map of the underground city. The burrows of the *Bolla* aqueduct, wishing to give a reading of stratigraphic channels of the underground city, are located on ground intact of the subsoil, the latter composed in the eastern part of sandy land crossed by an underground stratum inclined toward the sea, and in the western part of volcanic tuff in which they were sources of water to which you drew by wells said "spring-fed"; going up again toward the surface they were intercepted in order the zone occupied by sewers and wells, and then the surface of the ducts of Serino.
The affected area by deep-water channels beneath much of 19th century neighborhoods *Vicaria*, *San Giuseppe, San Carlo all'Arena, Stella, Avvocata, Montecalvario, San Ferdinando* and under all the *San Lorenzo* district, [2] and Northern extremes of *Mercato, Pendino, Porto* and *Chiaia*, while the thickness between the surface and deep water channels ranged from a few metres to over forty, and in this regard, Melisurgo explains: "Baring in mind the altimetric configuration of the city, the subsoil intercept, between the area occupied by the channels of deep water and the road surface, has a thickness or maximum height variable sections in *San Ferdinando*, *Montecalvario*, *Avvocata* and *Stella*, the middle is almost constant in section *San Lorenzo*, minimum, and variable sections in *San Carlo all'Arena*, *Vicaria*, *Mercato*, and *Pendino*. By way of curiosity, we will say that the two deepest wells in Naples are those of the Hospital of the Trinity and the district of *Pizzofalcone*, the latter then so close, that it is possible in the middle of the day, observe the firmament: not reaching at the bottom the action of sunlight". [1]
The area interested by the channels of deep water passed under big part of the 19th century districts *Vicaria*, *San Giuseppe*, *San Carlo all'Arena*, *Stella, Avvocata, Montecalvario*, *San Ferdinando* and *San Lorenzo*, [2] reaching the northern extreme of the districts *Mercato, Pendino, Porto* and *Chiaia*, while the thickness between the surface and the canalizations of deep water varied from few meters to more than forty, and

Melisurgo specifies: “Keeping in mind the city’s configuration altimetrica, the subsoil, among the zone occupied by the channels of deep water and the road surface, has a thickness or height maximum variable in the sections *San Ferdinando, Montecalvario, Avvocata* and *Stella*, medium and almost constant in *San Lorenzo*, variable sections and *San Carlo all’Arena, Vicaria, Mercato*, and *Pendino*. By way of curiosity, we will say that the two deepest wells in Naples are those of the Hospital of the Trinity and the district of *Pizzofalcone*, the latter then so close, that it is possible in the middle of the day, observe the firmament: not reaching at the action of sunlight”. [1]
The channels had variable section, some were rectangular in plan, bell-shaped with other ground floor, irregular, and hardly ever straights for lengths which exceeded 10 m, in some cases was not respected, the slope, and the height was variable, reaching up to 3 m; the main channel and most of the children were covered with plaster. You could access channels through wells placed in the street or through the pits or cellars of houses. There were different types of wells: the first were called “passing through”, and were adjacent and communicating with the channel, which could confine or less; in this type of wells could have clay pipes or small channels excavated in the tuff, which ticketing in another channel leading from the well to step into another pit, these were called “wells-channels”; seconds were called “isolated” and were at the head of a channel, which ended with them.
The canalization of the *Bolla* aqueduct was spoiled when, in the second half of the nineteenth century, was entered in many of its channels the water of *Carmignano* aqueduct, and extended the network of pipelines, which reduced the amount of water in the wells. The use of clay pipes planted near and inside the sewers to channel the waters of the *Bolla* aqueduct led to the pollution of the latter. These wells were hundreds, and through the reading of the text written by Melisurgo possible to know, beyond the qualitative behavior of the ducts of the *Bolla*, even the amount of wells that each branch went to feed.
The main canal, entering the town upstream of *Porta Capuana*, at an altitude of about 12 m a.s.l., developed along *via dei Tribunali* and *vico Zuroli*, considered by Melisurgo originating along with the channel up to *vico Zuroli*, and it cruised the greek part of the city. The continuation of the channel by *vico Zuroli* developed along *via San Biagio dei Librai* up to *via Paladino* was built later, and then the up to *Santa Maria la Nova*. The extension of the main channel up to the fountain *Medina*, where had a share of 9 m a.s.l., and the other branches that followed the guidelines for urban expansion are from a later period. [3]
Infiniti became in time the ducts and endless *tubulature* which led out from this main channel as the veins in the human body to distribute the water in the city, so that even if the main branch ended at via Medina, its branches, the first half of the 19th century, coming to the “real Villa”. [4]

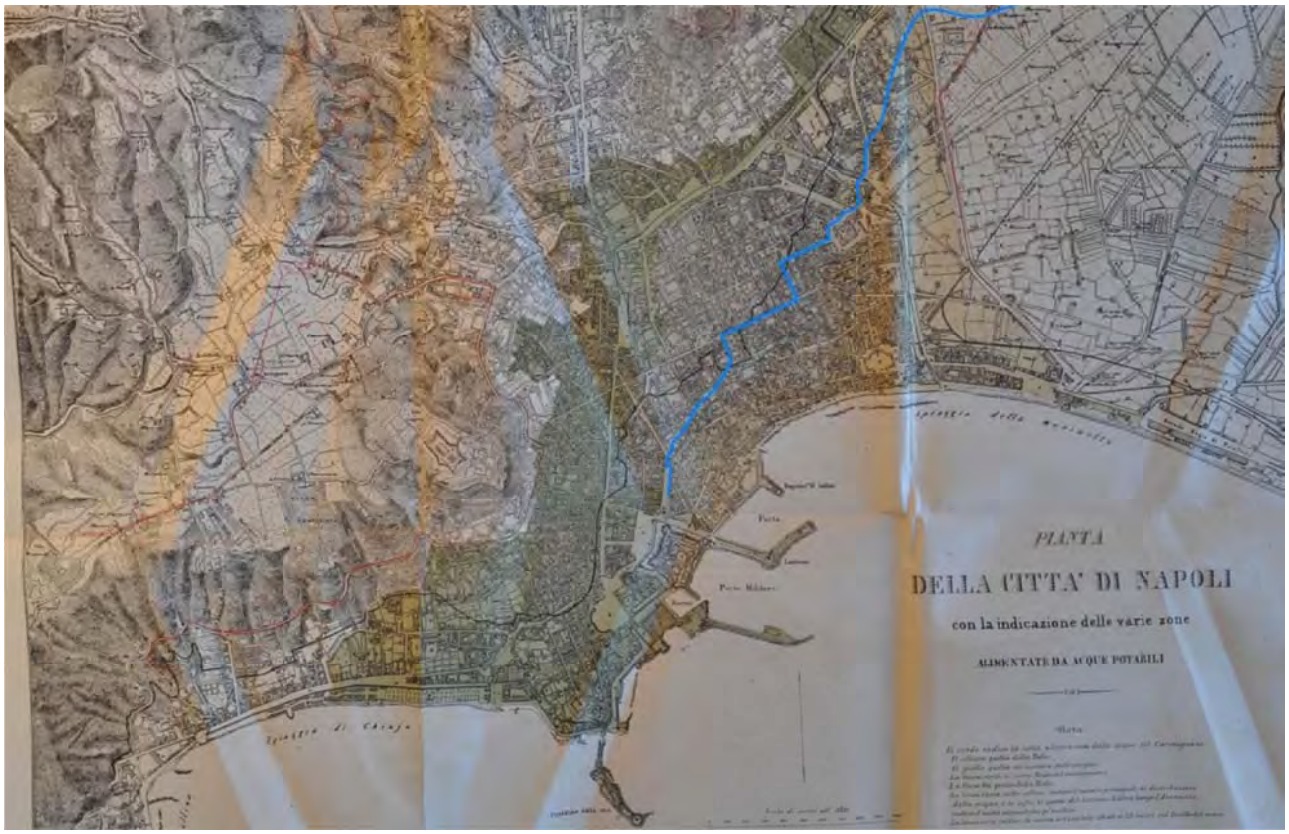


Fig. 1: Blue line indicates qualitatively the trace of the main channel of the *Bolla* aqueduct.

1.2 Toward the sketch of the underground city, from the layout of the aqueduct to the hollow

In 1667 the *Tribunale della Fortificazione, Mattonata ed Acqua* started the periodic census of the concessions of the water in the *Bolla* aqueduct to the fountains and the mills, they excluded the deep burrows that reached the wells, not concession subjects. In that year the census was compiled by the engineer Antonio Galluccio, therefore this document gives us some different information, and we could say complementary, with respect to those us by Melisurgo, who was busy of the network of pipes that deep stocked all the water wells. [5]

Another anonymous census and writing it also exists among 1666 and 1671, that it results to be analogous to the precedent. These works consist of different sheets which the concessions are schematically represented. Galluccio affirms here to have traced the *tofolature* [6] as it was able better on the base of the representations served him as some fontanaris of what, being underground, couldn't be seen. Thus, for example in the sheet 35v of the census of Antonio Galluccio is designed a small rectangle with the annotation "Public Fountain", which should match the fountain of *Formiello*, and that took its concession from the "Formal Real near the grades of *Santa Caterina a Formiello*"; to the sheet 37 outlined the *Scapillata dell'Annunziata* that was supplied by the ramification that it detached him from the "Formal Real in the road of the *Vicaria* of meeting the *vico della Pace*"; to the sheet 38 are annotated the fountains of the ex *piazza della Sellaria*, disappeared with the works of the improvement of end '800, that were supplied by the ramification born to the intersection among *vico Zuroli* and the *Vicaria Vecchia*; to the sheet 44 are signalled the fountain of *Spinacorona*; and to the sheet 45v the fountain of *Santa Lucia* which took its granting in *via Mezzocannone*.

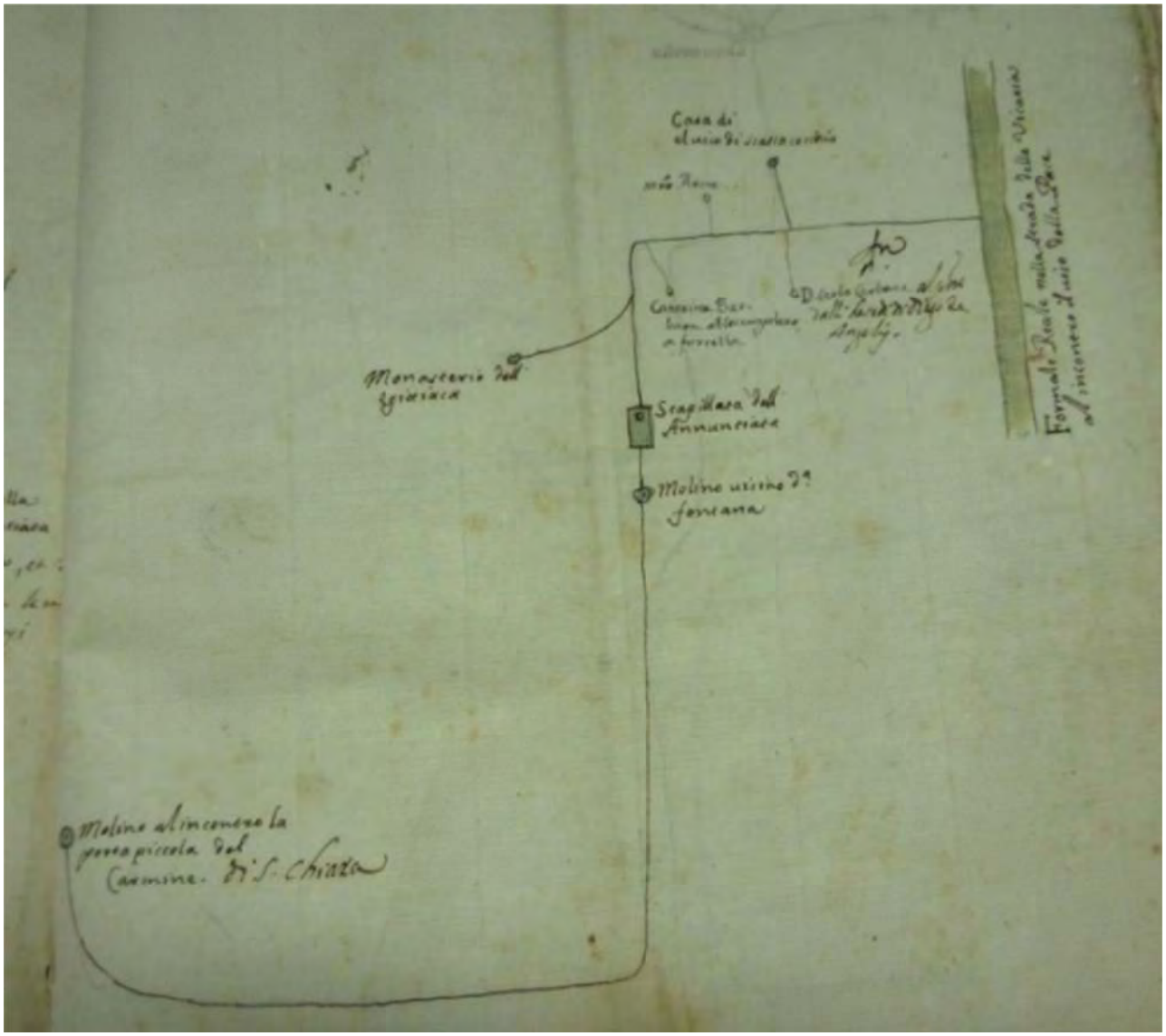


Fig. 2: Census by engineer Antonio Galluccio, sheet 37 (Archivio Storico del Comune di Napoli, fasc. n. 1830, *Acque-Relazioni di concessioni, bronzature ed altro*, 1633-1778).

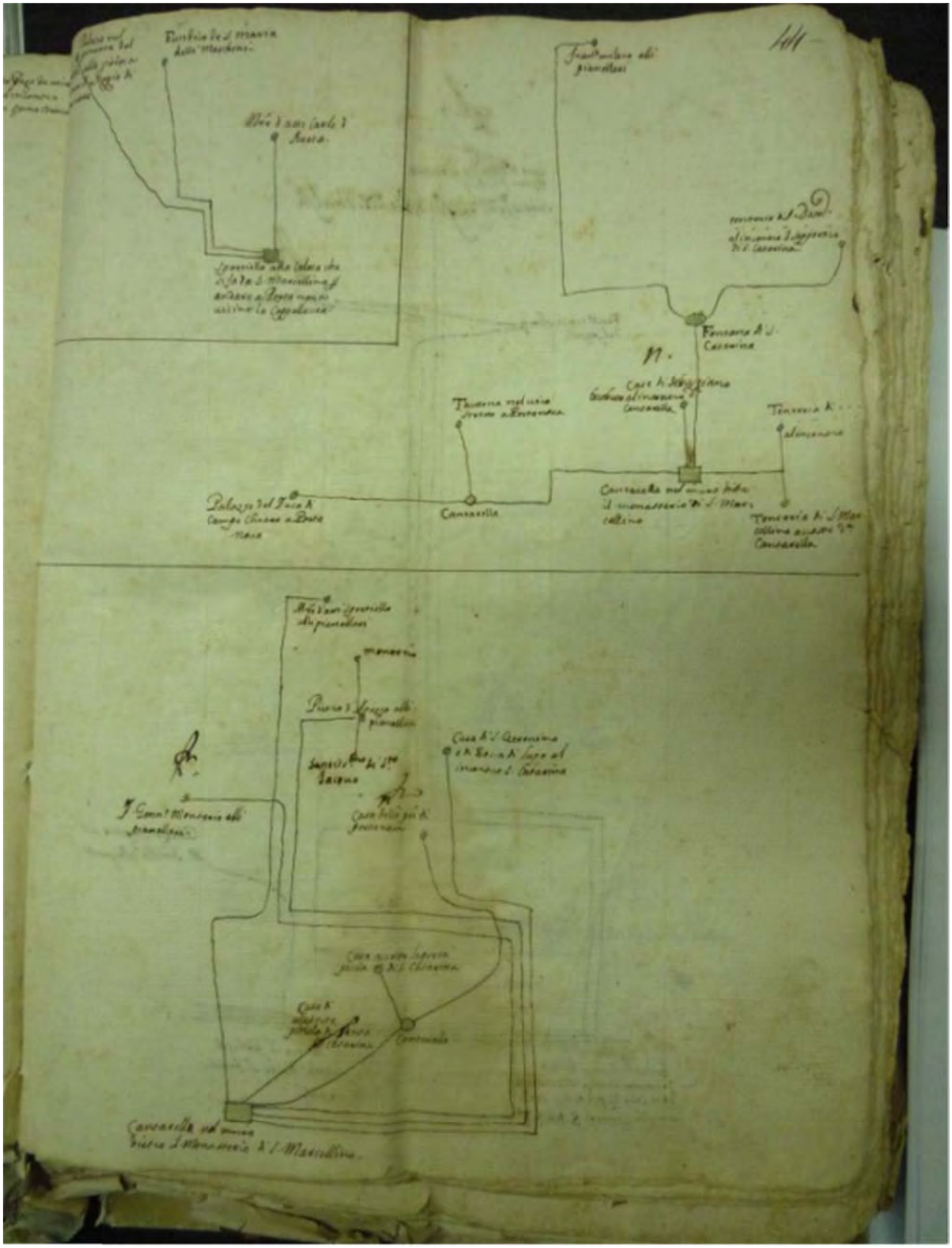


Fig. 3: Census by engineer Antonio Galluccio, sheet 44 (Archivio Storico del Comune di Napoli, fasc. n. 1830, *Acque-Relazioni di concessioni, bronzature ed altro*, 1633-1778).

2. Cavities 3d scan: the work into the greek hollow of Poggioreale[2]

The underground aqueduct paths bind numerous quarries: they began as tuff resource to enable the Greeks to build the walls of *Neapolis* gradually expanding.
For this reason, the tuff was mined continuously according to an innovative technique: were inserted wooden poles inside natural crevices, so blocks of tuff were extracted more easily without damaging the structure of the quarry.
After that the boulders were "marked": in a tank in particular, it is possible to see scratches and symbols that belong to the 4th century BC representatives note that precise membership quarry.
During the restoration and maintenance have been installed in figures in iron a scenic depiction a group of miners who works with the extraction of the tuff, always in the above tank.
Centuries pass, the quarries begin to empty, to the point that the Romans in the first centuries after the birth of Christ decide to take advantage of those who will be called "tanks" in an aqueduct that delivered water from the river Serino (the current area is in the province of Avellino, and then to 60 kilometers away) to the growing cities, according to a precise system of tunnels and grids.
You may therefore notice wells scattered along the way: on the vault of underground holes is not very large.
The same system was used to reach Miseno and provided water to *Piscina Mirabilis* for the fleet of the *Classis Misenensis*.
Located about 20 meters below the *Cimitero di Santa Maria del Pianto* in Poggioreale, the quarry in question was accidentally discovered in 1987 due to a failure of the square above. Consequently it was realized a modern access which partly intercepts the path of a conduit of the sixteenth century ending in turn in a tank, also dug into the same tufa.
The storage conditions of ancient quarry were immediately investigated by returning a quantity of information never before encountered with the same density. On the walls of the quarry are clearly visible both traits associated with the processing of the tuff, appeals and tracking activities of various kinds, and a myriad of symbols given probably the places of destination of the materials extracted or teams of quarrymen agents *in situ*.
As always the archaeological component was the first to be investigated more deeply, also because the metric control of the quarry, or more simply its topographic posed many problems related to the scarcity of day lighting and the dangerousness of the site. The development of modern instruments of survey allowed to fill this gap proceeding with the laser scanner survey that specifically could show its potential fully.



Fig. 4: The area of greek under the *Cimitero di Santa Maria del Pianto*.

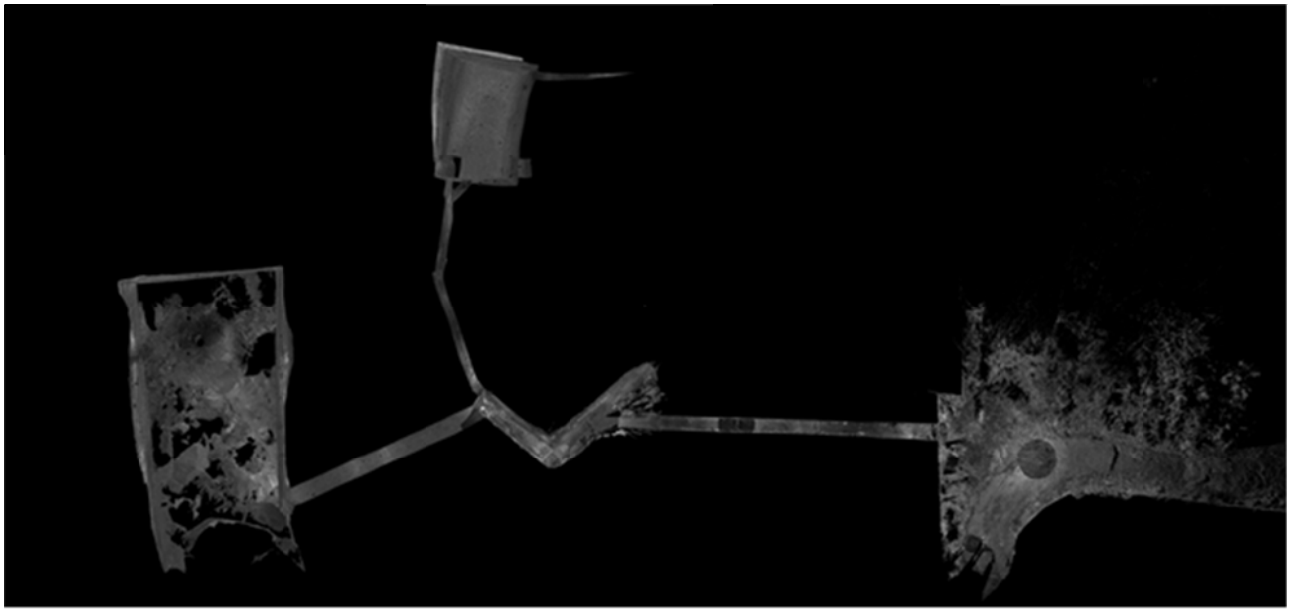


Fig. 5: From left: the greek quarry, the cistern later, and right outside the entrance to the site.



Fig. 6: From right: the greek quarry, the cistern later, and left outside the entrance to the site.

We used, about this work, a HDS Leica P20 terrestrial Laser Scanner which, through a sequence of 22 stations and a procedure of registration of the point clod through overlapping algorithm, allowed to re-create the correct relationship between the inside of the groove, the outer face corresponding to the current input and the square above corresponding to the churchyard of *Santa Maria del Pianto*.
The instrument has been working practically in the dark, but despite that, using the intensity map derived by reflectance of the materials, it was possible to create the images in black and white attached to this article and therefore get to read in a distinct manner the various marks left by the quarrymen that have made possible the connection of this quarry with the blocks used to build the Greek walls visible in most parts of the city of Naples.
The shape like a bell, classical for the quarries in this period, is now perfectly identified, but especially evident the level of landfill that is determined by the abandonment of the quarry and by the impressive collapse that is on the ancient west input.
The size approximately returned a hollow of 22 meters in length in the East-West direction, 13 meters high in the middle and a width at the actual base of about 11 meters.



Fig. 7: the East side, with a view to widening niche and bell-shaped section.

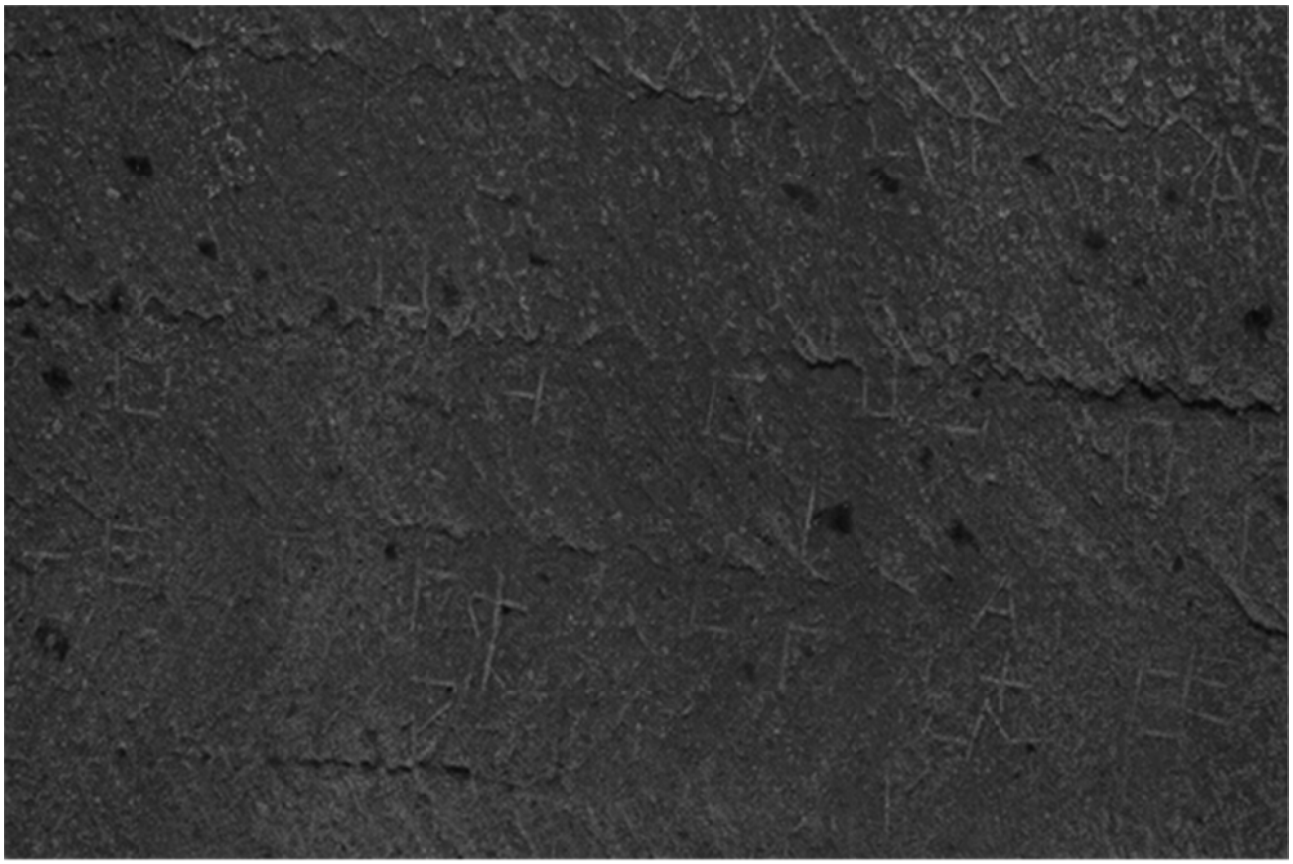
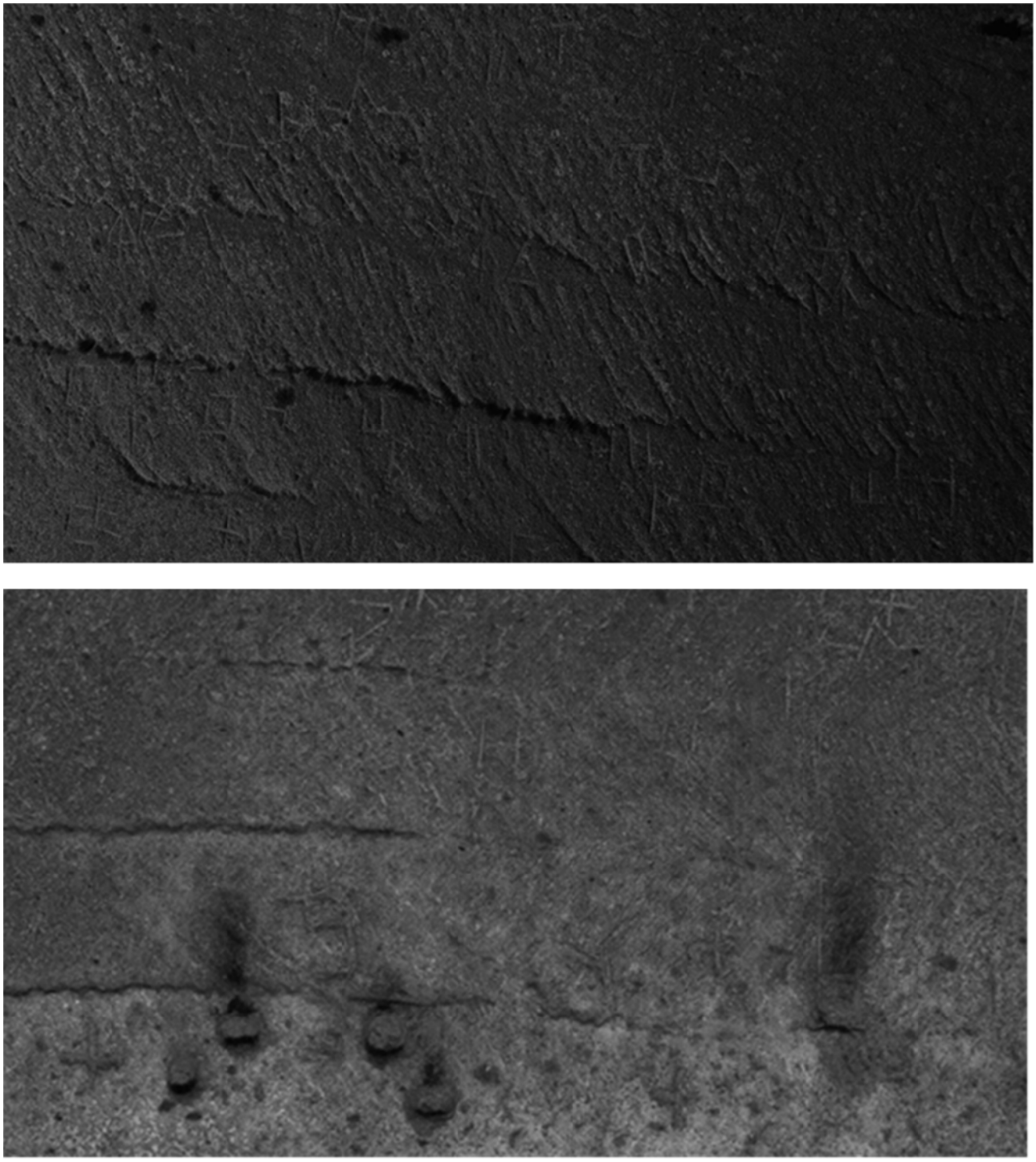


Fig. 8: hollow symbols present on the North wall.

On top of the Eastern front is identified a niche corresponding to an extension of mining activity, then stopped, which was already reconfiguring a new section of the excavation. On the fronts North and South there is the procession of the most often cited symbols whose interpretation willingly leave to others limiting ourselves to make them accessible metrically and to be fascinated by the complexity of a work language that comes to us from the past, but that is as complete and immediate and seems a prerequisite to an imminent resumption of mining.



Figg. 9-10: hollow symbols present on the North and South walls.

Bibliographical References

[1] MELISURGO, Guglielmo. *Napoli Sotterranea*. 1° ed. 1889. Napoli: Colonnese Editore, 1979.

[2] FIRRAO, Cesare. *Come migliorare ed aumentare le acque potabili della città di Napoli Progetto dell'Assessore Cav. Cesare Firrao presentato al Consiglio Municipale Convocato in seduta ordinaria nel Maggio 1867*. Napoli: Tipografia dell'unione, 1867.

[3] *Congresso scientifico degli italiani, Napoli e i luoghi celebri delle sue vicinanze*. Napoli: Stab. tip. di Gaetano Nobile, 1845, vol. I, p. 24-30.

SURNAME(S), Name. Chapter title. In SURNAME(S), Name. *Book title.* 3ª ed. City: Publisher, 2010, vol. 1, p. 200-250.

[4] ALISIO, Giancarlo. *Napoli e il Risanamento. Recupero di una struttura urbana.* Napoli: Edizione Banco di Napoli, 1980.

[5] STARACE, Francesco (a cura di). *L'acqua e l'architettura Acquedotti e fontane del regno di Napoli.* Lecce: Edizioni del Grifo, 2002.

[6] PUOTI, Basilio. *Vocabolario domestico napoletano e toscano*. Napoli: Stamperia del Vaglio, 1850.

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Strategies for the building stone and damage mapping applied to the historical center of Catania

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Abstract
The conservation and restoration of built heritage requires the application of a knowledge process established by the scientific community. This process should always be interdisciplinary and include: historical investigations, geometric and construction-technique surveys, degradation maps, in situ (pre-diagnostic phase) and in laboratory analysis. This paper describes an interdisciplinary approach applied by geologists, engineers and architects to the study of the portal of Villa Cerami, following the Fitzner method. The Villa is an important example of 18th century "villa urbana", located in the historical center of Catania, on the hill named "Sperone del Penninello". The access to the court is through the monumental portal that is an impressive example of local baroque.
Starting from the geometric survey of the monument, the diagnosis gave information about damage to the portal's stone in the meso-microscale range. The degradation map, constructed on the monument's façade, highlights the different weathering forms and follows the widely used Italian norm UNI 11182 classification together with the Fitzner formalism. This study provided useful information to identify the type and causes of degradation forms, to estimate the different damage indices and to program conservation measures of the portal.

Keywords: built heritage, stone material, diagnosis, conservation, restoration.

1. Introduction
The problem of the conservation and restoration of the historical centers requests knowledge of the effective state of deterioration, of the typology of the damage, of the intensity of the degradation and of its development. The degradation maps are the first step for identifying macroscopic pathological manifestations. The weathering forms are classified on the basis of Italian *UNI 11182* of 2006 [15] that provides purely qualitative and descriptive information. In the last decade of the 20th century, the scientific group of Fitzner [6, 7, 8, 9,10] developed a method, rarely used in the Italian context, to better define the monuments' forms of degradation, and to understand the causes. This method takes into account the interactions among micro-climate, material, shape, construction techniques and technological system. The study of the monument's degradation, carried out following the Fitzner method, consists of three phases. The anamnesis phase allows one to acquire information about the monument, such as position, art-historical portrayal, case history and utilization and environment. The diagnosis through in situ and/or laboratory analysis allows for the obtainment of useful information on the: type of building materials, material properties, state of deterioration, factors and processes of deterioration and need/urgency of preservation measures. The anamnesis and diagnosis data phases provide a valuable contribution to the conception, execution and control/certification of preservation measures and to the long-term observation and maintenance of

monuments. The point of strength of the Fitzner method is the multidisciplinary approach in the study of the monument's decay. In this framework with the aim to show the potential and applicability of this methodology we performed a pilot study on the portal of Villa Cerami, showing in the first work, the results of analysis in situ.

2. Anamnesis

"*Il restauro costituisce il momento metodologico del riconoscimento dell'opera d'arte, nella sua consistenza fisica e nella sua duplice polarità estetica e storica, in vista della sua trasmissione al futuro*" [4]. The anamnesis is aimed at acquiring and evaluating all existing information about the studied monument in order to understand its artistic and historical value. In restoration, this step of analysis represents the starting point to a correct planning choice; this means that complete knowledge of the monument refers to the recognition of artistic work with the scientific analysis of it. The historical value is evaluated on the basis of archival and historical information; the artistic matter of architectural work does not depend on its historical value but it depends on the expressivity of its image, so that history and art co-exist. For this reason the knowledge phase, in the architectural approach aimed at the monuments' restoration, consists of: historical analysis, formal and compositional analysis, knowledge of the material and its state of preservation. Instead, in the Fitzner method, used in this paper, the materials are studied in the diagnosis phase. Nevertheless the differences between the two approaches, the aim of anamnesis is the same: to point out the historical and artistic features of the monument, because the planning phase cannot start, correctly, without a critical point.

2.1 Historical information

The Villa Cerami, was built after the 1693 earthquake, which destroyed Catania, and it is an important example of 18th century "villa urbana" located in the historical center of the town, on the hill named "Sperone del Penninello". The prestigious ground was equipped with some buildings when, in 1724, it was acquired by Domenico Russo Scammacca, prince of Cerami. The first building was an antiseismic half-timbered construction with a single level [1]. Later, during the 18th century, the villa was expanded with new constructions: a second floor, a chapel, a large terrace with an elegant balustrade and a monumental staircase. In 1874 the prince of Cerami commissioned the refurbishment of the eastern side of the Villa to Carlo Sada (1849-1924), one of the more popular architects of the Catanian aristocracy of the time. He added a new flight of stairs to connect, from the inside, the first level to the second and created a new elegant façade. This refurbishment made the villa more refined and gave it more functionality. A new restoration by Stefano Bottari and Giacomo Leone was carried out in 1957, when the villa became property of the Catania University, still now siege of the Faculty of Law. On this time, part of the façade built by Sada was removed and the ground floor of the house was restored according to the original style. Behind the villa, were built by Salvatore Boscarino and Francesco Basile a new construction to be use as "seminario giuridico". This new modern fabric was designed to create a "discordant" contrast with the architectural context of the 19th century. The access to the court is through a monumental portal (fig. 1), studied in this work, which represents an impressive example of local baroque. Giovanni Rosso di Cerami, in his "Memories", attributed the portal to Gian Battista Vaccarini (1702-1768), the architect from Palermo who first applied the formal and cultural principles of the Baroque movement in Catania.
However, some documents certify that the portal was completed in 1726, before Vaccarini's arrival in Catania to contribute to the reconstruction of the town. Moreover, the comparison with other portals of the same period shows that the style is due to the movement of "lapidum incisores". In particular, having moved to Catania in the first decades following the earthquake, from Messina (the Amato family), Acireale and Palermo; these stonemasons were creators of most sculptural façades that characterize the monumental city.



Fig.1 Villa Cerami: the façade before the 1957.



Fig.2 Left: Villa Cerami portal; right: Villa Cerami façade.

2.2 Geometric-formal and structural-constructive description

The survey of the portal was achieved using direct methods and with the aid of programs of photo-straightening. The two-dimensional data were considered sufficient for the purpose of locating and measuring the areas affected by the pathological conditions. The research, in fact, in this first phase, has the objective the exact determination of the areas affected by the deterioration and the identification of its nature. Subsequently, the study will continue with the testing of the method even with volumetric data; these will be acquired through laser scanner. The measures will have to be quantified in the range of 0-3 cm to evaluate both the gaps of the material losses, both the thickness of the biological deterioration of the coating layers superimposed on the stone surface. However, the survey, although two-dimensional, has made both the geometrical restitution of the image possible (including decorative and constructive details, harmonic proportions and compositional relationships between the parts) and the quantification of the degradation micro and macro scale.

The composition of the 18th century portals of Catania seems to have Mannerist matrices closely related to the architectural episodes of the "Cittadella" in Messina [14]. This configuration is repeated as a rule in most of the entrances of palaces and convents. The shape, despite being generally simple and stuck in reproducible and not very creative geometric patterns, still managed to ennoble and revive the sober and compact prospects of 18th century buildings with a lively and original sculptural repertoire. The bas-reliefs, in fact, create chiaroscuro effects that enrich not only the expressiveness of the portal but also that of the prospectuses and the urban context.

The portal of Villa Cerami is the prospective background to a Baroque street rich in remarkable religious buildings (via Crociferi) and expresses the pomp of a princely property. The ashlar archway with a keystone relief blends with sculptural motifs that enrich the entablature. The shelves and vertical scrolls elongated instead of capitals, the stone pine cones and the sumptuous summit shield, articulate the linear and geometric composition, leading back to the mannerism of Michelangelo. Similar patterns are found in Catania in the west portal of the Benedictine monastery, in the portal of the convent of Carmine, in Gravina Crullyllas palace and in Bruca palace.

Regarding the construction system, the supporting structure is constituted by a round archivolt with ashlars and a keystone relief. Behind the arc there is a barrel vault that defines the upper vestibule that leads into the courtyard of the villa. Arc and piers are framed by a second system consisting of trilithic piers richly carved with low and high reliefs and an entablature whose role is essentially figurative. The frame closes the composition and protects the underlying stone. Above the frame the stone pine cones, the spirals and the large noble family shield try to jag the compact and blocked pattern of the whole.

3. Diagnosis: multidisciplinary approach aimed at degradation form recognition

For a complete and scientific monument damage diagnosis is needed to combine in situ investigation, laboratory analyses and weathering simulation. On the basis of in situ observations, in this work the

monument mapping, the determination of damage categories and the calculation of damage indices were performed. During the monument mapping we analyzed lithological types and weathering forms. With regard to the lithological map (tab. 1), the portal was built with whitish-gray oosparites with “lumachella” levels (fig. 2a-b) attributable to the Mt. Carrubba Formation [11] from the iblean area and widely used in the historical buildings of Catania. These calcarenites have a low porosity and rare microcavities filled with a spatic cement of secondary recrystallization. The portal’s basement is made with typical Mt. Etna vacuolar basalts, with plagioclase and pyroxene phenocrysts and microcrystalline gray groundmass (fig. 2c). This lithotype was widely used in the historical center of the city mainly of buildings’s basements.
The degradation map on the monument’s façade highlights the different weathering forms. For the mapping, we report the widelly used Italian norm UNI 11182 classification [15] together with the Fitzner formalism. In particular, Fitzner’s approach is based on a hierarchical structure of the classification scheme divided into 4 levels [6,7,8,9,10]. In the first level four different degradation groups are described: loss of stone material; discoloration/deposits; detachment of stone material; fissures/deformation. In the 2nd level the main degradations are shown, further specified in the 3rd level by means of individual weathering forms.

		Calcarenite	Basalt
Lithotypes	**Provenance**	Capo St. Croce	Mt. Etna
	Description	Whitish-gray, lowporosity, remain of fossils and oolities	Black-grey, vacuolar, porfiric
	Stratigraphy	Mt. Carrubba Formation	-

Tab. 1 Main features of building’s materials.



Fig. 3 a,b) Calcarenites from Fm. Carrubba; c) Mt. Etna vacuolar basalts.

Finally, in the 4th level a quantitative estimation of the single weathering form's intensity is performed. Damage categories were established based on: i) intensities of weathering forms; ii) proportion of degradated stone parts with respect to total structural element (e.g. dimension stone); iii) historical and artistic value of the structural elements. Fitzner, in his method, includes six damage categories, each of these is indicated by an increasing number: 0-no visible damage; 1- very slight damage; 2- slight damage; 3-moderate damage; 4- severe damage; 5- very severe damage.
On the basis of this classification scheme we performed a registration, description and photo-documentation of the monument’s degradation forms with the aim to estimate its frequency and intensity. These data were calculated on the 2 D prospectus of the monument. Tab. 2 shows the recognized eight main degradation forms in the portal, and their damage category. Below is a description of all the degradation forms on the portal.
The *loss of stone material* occurs in some parts of the monument. Its main recognized weathering forms are:

- **back weathering (W):** *uniform loss of stone material parallel to the stone surface*.
  In particular, the cornice of the portal and the abacus of the capital are affected by back weathering due to loss of crusts (cW). This is a uniform loss of stone material parallel to the original stone surface due to detachment of crusts with adherent stone material. The estimated depth of this back weathering is variable. In fact, in some parts of the monument it is in the range of 0.5-1 cm (frequency: very rare; intensity: equal to two and damage category equal to one) while in other parts it shows a depth about of 1-3 cm (frequency: rare; intensity equal to three and damage category equal to two).
- **relief (R):** *morphological change of the stone surface due to partial or selective weathering*. In the portal’s arc some bugne and some decorative elements of the pilasters are affected by rare alveolar

weathering (Ra); the depth of voids is around 0.5-1 cm (intensity equal to two and damage category equal to one). The bases of the columns are affected by relief, with rounding of edges or notching / hollowing out (Ro) in the range of 0.5-1 cm (frequency: rare; intensity equal to two and damage category equal to one) and 1-3 cm (frequency: frequent; intensity equal to three and damage category equal to two). Weathering out dependent on stone structure (tR) interests more parts of the portal (columns, key of arc, cornice etc.) rarely with a depth in the range of 0.5-1 cm (intensity equal to two; damage category equal to one) and frequently in the range of 1-3 cm (intensity equal to three; damage category equal to two). In the lower parts of the pilasters there are reliefs due to anthropogenic impact in the form of scratches (aR); the depth of these is in the range of 0.5-1 cm (intensity equal to two; damage category equal to one) and 1-3 cm (intensity equal to three; damage category equal to two).

- **break out (O):** *loss of compact stone fragments*. In particular, the lower parts of monument are affected by break out due to anthropogenic impact, such as acts of vandalism (aO). This degradation form sometimes involves a volume minor of 10 cm^3 (intensity: rare; damage category equal to one) and very rarely in the other part of the monument involves volumes about of 10-125 cm^3 (damage category equal to two). Furthermore, there is a break out due to natural causes, such as intersection of fractures (nO); the involved volume in this case is minor to 10 cm^3 and the damage category is equal to one. Finally, on the top of the portal, the lack of a pinecone stone was interpreted as a break out due to unrecognizable causes (oO) (category of damage equal to three).

Intensities of characteristical weathering forms and their frequenty								
LEVEL I-GROUP OF WEATHERING FORMS								
GROUP 1: LOSS OF STONE MATERIAL								
LEVEL II		LEVEL III	LEVEL IV					
MAIN WEATHERING FORMS			INTENSITIES					
			1	2	3	4	5	5
Deph of the black weathering (cm)			<0.5	0.5-1	1-3	3-5	5-10	10-25
BACK WEATHERING	W	cW	-	very rare	rare	-	-	-
Damage category			1	1	2	3	4	5
Deph of the rilief (cm)			<0.5	0.5-1	1-3	3-5	5-10	10-25
RILIEF	R	Ro	-	very rare	rare	-	-	-
		Ra	-	rare		-	-	-
		tR	-	rare	frequent	-	-	-
		aR	-	very rare	very rare	-	-	-
Damage category			1	1	2	3	4	5
Volume of break out (cm3)			<10	10-125	125-500	500-1000	1000-2500	>2500
BREAK OUT	O	aO	very rare	very rare	-	-	-	-
		nO	rare	-	-	-	-	-
		Oo	-	-	-	-	-	-
Damage category			1	2	3	3	4	5

Intensities of characteristical weathering forms and their frequenty				
LEVEL I-GROUP OF WEATHERING FORMS				
GROUP2:DISCOLORATION/DEPOSITS				
LEVEL II		LEVEL III	LEVEL IV	
MAIN WEATHERING FORMS			INTENSITIES	
Mass of deposits			low	high
SOILING	I	pI	very frequent	-
		aI	frequent	-
Damage category			1	2
CRUST	C	diC	frequent	very rare
Damage category			2	3
BIOLOGICAL COLONIZATION	B	Bi	-	rare
Damage category			1	2
COLORATION	D	Dc	-	rare
Damage category			1	2
LEVEL I-GROUP OF WEATHERING FORMS				
GROUP4: FISSURES/DEFORMATION				
LEVEL II		LEVEL III	LEVEL IV	
MAIN WEATHERING FORMS			INTENSITIES	
number of fissures			low/small	high/large
Fissures	L	tL	frequent	very rare
Damage category			2	3

Tab. 2 Intensities and frequency of weathering forms and damage category.

The discoloration/deposits involves several parts of the monument. The main recognized weathering forms were:

- **soiling (I):** *dirt deposits on the stone surface*. The soiling by poorly adhesive particles from the atmosphere (pI), mainly grey to black deposits of dust, soot, fly ash etc., is frequent in some parts of the portal and shows a low intensity and a damage category equal to one while in other parts it shows a high intensity and a damage category equal to two. The lower parts of the pilaster strips are affected by the soiling due to anthropogenic impact (aI) as paint and graffities (frequent low intensity and a damage category equal to one).
- **crust (C):** *strongly adhesive deposits on the stone surface*. The dark-colored crusts (diC) were recognized; these are compact deposits, grey- to blackish, which change the morphology of the stone's surface due to the deposition of pollutants from the atmosphere (E.g. gypsum crust with impurities). Generally this weathering form shows a higher intensity in the sheltered parts of the monument probably because they are less exposed to rain being gypsum water soluble. The intensity of this degradation form is rarely high and shows a damage category equal to 3 while frequently it is low with a damage category equal to 2.
- **Biological colonization (B):** *Colonization by microorganisms or higher plants.* In particular, the microbiological colonization by microflora and bacteria occurs below the frame of the portal and rarely shows a high intensity and a damage category equal to two.
- **Discoloration (D):** *Alteration of the original stone color*. The basaltic plinths's pilaster strips are affected by the alteration of the original stone's color (Dc) due to oxidation of iron. This phenomena rarely shows high intensity with the damage category equal to two.

Furthermore, in some parts of the monument, frequent small *individual fissures* (L) due to structural features of the stone (tL) (damage category equal to two) were recognized.
The histogram in fig. 4 shows the percentages of the different degradation forms: the main one is the soiling by particles from the atmosphere (pI), probably because of the portal's geographical position located in a high urban traffic zone of Catania.

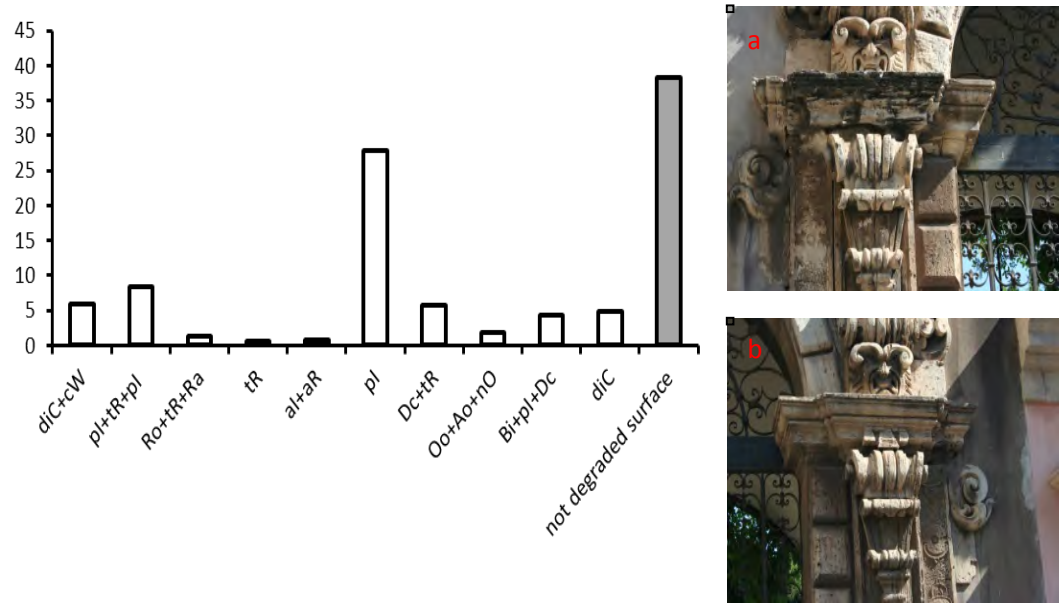

Fig.4 Left: histogram with percentages of the degradation's forms; right: abacus of portal's capitals in the left side (a) and in the right side (b).

In the monument, the intensity of the degradation forms depends on several factors, such as micro-climate, microstructure of material, shape of the building stone etc. For example, the abacus of capitals, made with the same material, shows a different intensity of degradation form (black crust), probably due to a different exposure, or/and to the presence, on the left side of a parking lot for scooters. In detail, the damage map in fig. 5 and 6 shows how the same degradation form has different intensities and then different damage categories associated in the same monument.

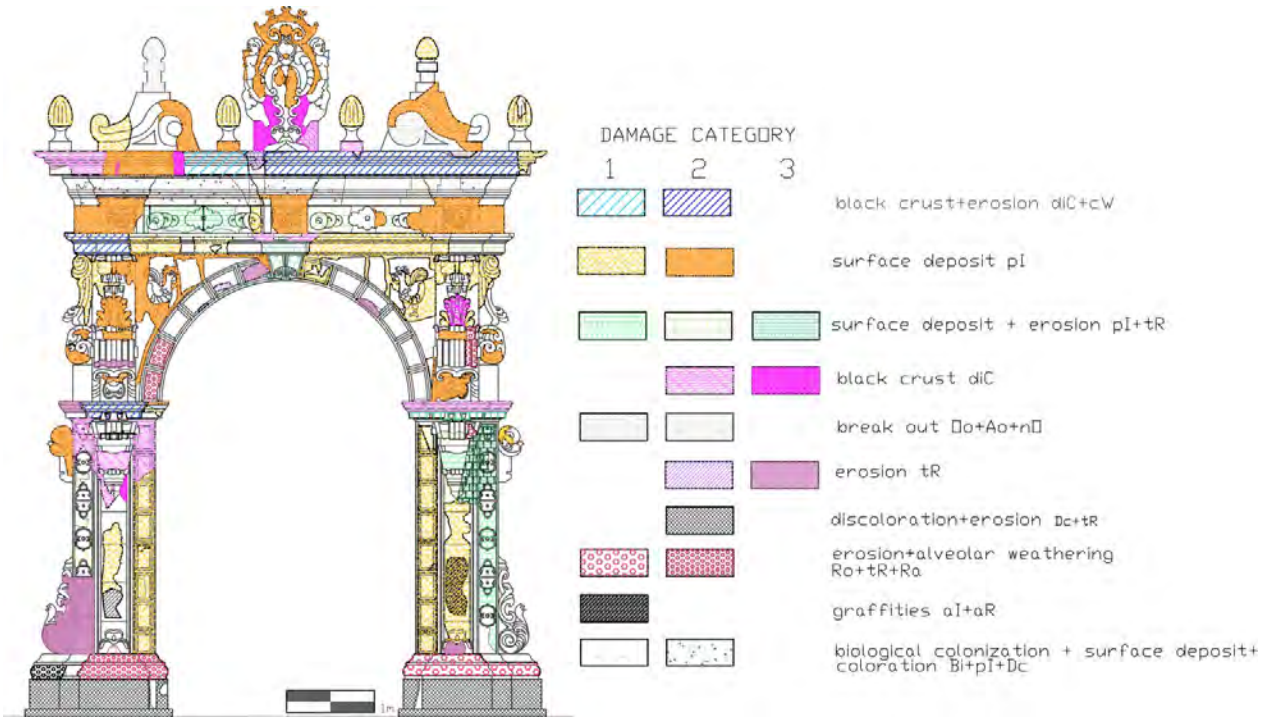

Fig. 5 Degradation map with damage category.

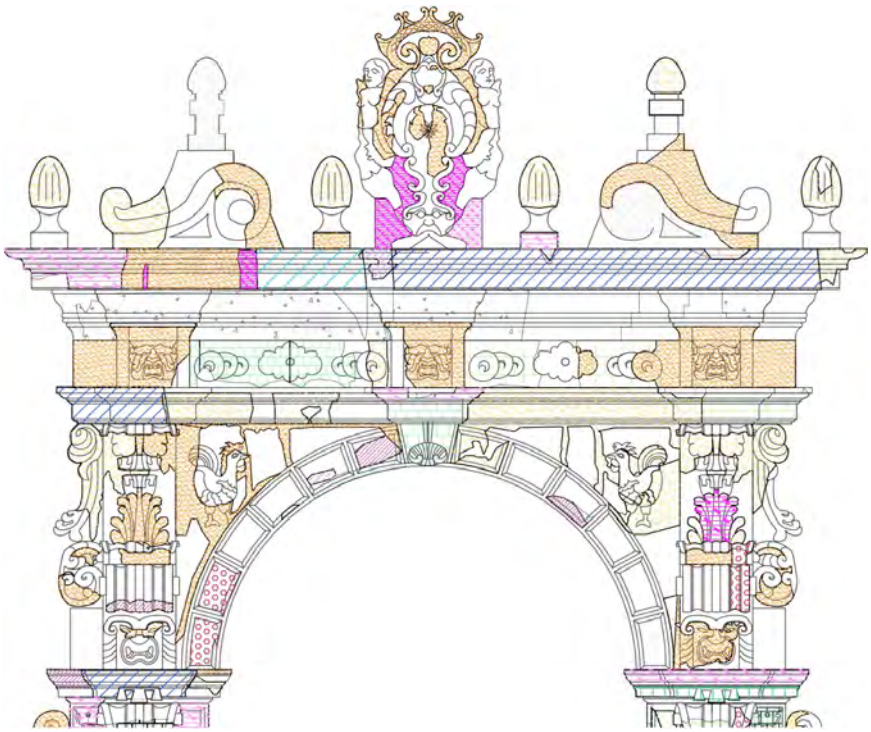

Fig. 6 Portal's details.

With the aim to perform a conclusive quantification and rating of degradation damage, the damage indices (linear and progressives) of the degradation forms were calculated with two equations [10]:

$$DI_{lin} = \frac{(A * 0) + (B * 1) + (C * 2) + (D * 3) + (E * 4) + (F * 5)}{100}$$

$$DI_{prog} = \frac{\sqrt{(A*0)^2 + (B*1)^2 + (C*2)^2 + (D*3)^2 + (E*4)^2 + (F*5)^2}}{100}$$

A = Area (%) – damage category 0
B = Area (%) – damage category 1
C = Area (%) – damage category 2
D = Area (%) – damage category 3
E = Area (%) – damage category 4
F = Area (%) – damage category 5

$$0 \leq DI_{lin} \leq 5$$
$$0 \leq DI_{prog} \leq 5$$

In particular, the linear damage index provides an average damage category, while the progressive damage index emphasizes the proportion of higher damage categories; both indices must be ranged from 0 and 5. The calculation of the damage indices (fig.7) allowed us to obtain an objective and whole evaluation of the total state of damage to the monument.

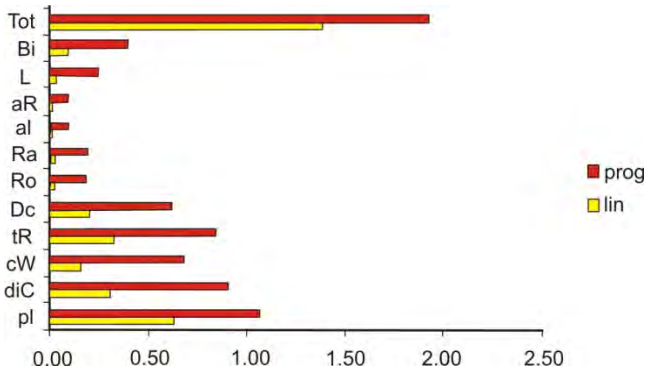

Fig. 7 Calculated damage's indices. Prog= progressive; lin= linear

The data (indices average total linear equal to 1.50 and progressive equal to 2) suggest slight damage to the monument, mainly due to its position in an urban environment rich in various polluting agents. Actually, the villa is unfortunately placed at the heart of the historical center of the town, suffocated by public and private transports.

4. Therapy: signs for conservation and restoration

"E' irraggiungibile *lo stato antico della materiala*, noi potremo al massimo perseguire il migliore e più sano *stato attuale della materia"* [4, 13].

The decay causes are not easy to remove since they depend on the surrounding environment. The impact of smog may be diminished by the creation of a car-free zone around the villa. We propose to render milder, where possible, the causes of decay and to proceed with interventions aimed at the conservation, and at protecting the building materials, including the layer that tells the time of the past, from environmental aggressions.

The interventions could be of three types: conservation, consolidation and restoration, and replacement. The conservation includes all operations of polishing that are necessary not to go back to original chromatic tone of the stone, but only to remove the pathologies that could compromise the material. For this reason there is the need to remove the pathological agents (such as black crust, deposits of polluting substances and bacterial colonies) that compromise the physical and formal feature of the materials.

In particular, we propose polishing interventions through the application of atomized water with diluted biocide products; in the areas where the black crust is more difficult to remove it could be necessary to use laser equipment. Desalination poultices could be useful to remove the salts which otherwise would reform, in a short time, to trigger new pathologies.

The treatments of protection should have the following requirements: minimum influence on the optical properties of materials; stability to chemical pollutants and radiation, water resistance, vapor permeability, reversibility, and, above all, compatibility. The traditional method, regularly used by the craftsman of the Sicilian baroque, was the whitewash with lime milk aimed to protect and lighten up the natural colour of the stone. This method may not be efficient enough against the action of acid rainwater; which, moreover, interferes with the microstructure of the consolidated stone material with respect to the organic products that, instead, maintain their protective function only on the surface without varying the physical aspect of the original coating. Materials with organic components may ensure more extensive protection, forming a hydrophobic film that is also easily reversible; but is it more important to preserve the material or the image

of the material? [12]. The portal, throughout the years has not shown strong increases of the degenerative process, so a slight traditional whitewash would ensure and would give a good protection and a greater compactness to the limestone surface. Finally, the use of the nanoparticles protective such as *titania* should be considered. Laboratory tests carried out on Noto, Comiso and Modica stones highlighted the good performances in term of self-cleaning action and protection against water and salts [2,3].
Consolidation and restoration will be performed exclusively on the elements that have either totally or partially lost their original form because of erosion. In the case of alveolarization, the gaps will be filled up with a lime mortar and aggregate, made of a dust of the same material. The fine cracks and fissures could simply grout with lime mortar end aggregate; when macro-lesions, corrupt the block's static nature, they could be reinstated with organic adhesives or, in severe cases, resewn with bars in fiberglass. The gaps do not affect the aesthetic unity of the artwork and therefore their replacement will not be necessary. In fact, the portal, if seen in its entirety, does not give the sense of a fragmentary nature yet. The elements that have been completely lost, such as the crowning stone pine cones on the left side and some sculptural details of the piers, surely constitute severe material gaps but do not interfere with the whole image. Therefore, since in “il restauro deve mirare al ristabilimento della unità potenziale dell’opera d’arte” [4] and since in our opinion this unit has not yet been compromised, the intervention should be limited to simple conservation and protection of the material and the image that are still intact. These scientific-technical operations, arising from the preliminary critical analysis, will therefore preserve this piece of history of the early 18th century for the present and future generations.

5. Conclusion

The restoration’s plane depend by critic recognition of the art work. This recognition is done through different stages that make up the knowledge process of the architectural object to be restored. The acquired data through surveys (anamnesis) have led to the understanding of the degenerative phenomenon (diagnosis), providing the clinical picture to correlate to the proper design selections. Each stage, governed by the restoration architect, was supported by geological and engineering skills. The case study of the stone portal of Villa Cerami shows how these skills can be integrated into the process prior to the technical-scientific project operations. The integrated approach is certainly the way that makes each task oriented towards the conservation and restoration of cultural heritage possible and complete. The study performed in this pilot work provides useful information to identify the type and causes of degradation forms and to program conservation measures of the Portal. However, for a complete understanding of the monument’s state of damage an additional detailed investigation will be needed, such as laboratory analysis and 3D reliefs. However, a careful data analysis allowed us to estimate the intensity of decay and then the categories of damage. The main degradation form recognized is the soiling by particles from the atmosphere due to the portal’s position, located at the heart of the historical center of the town and then is subject to the urban traffic rich in carbon monoxide and various polluting agents. Nevertheless the recognized highest category of damage shows a value equal to three and calculated data (indices average total linear equal to 1.50 and progressive equal to 2) indicating a slight damage to the monument which has not yet compromised the work’s integrity. In fact, the proposed restoration should simply focus on the conservation and protection of the portal’s matter aimed to conserve the image of it. This preliminary report is encouraging and may be extended to the main monuments of historical centers with the aim to plan the correct restoration projects, and give the priority of interventions.

Bibliographical References

[1] BASILE, Fabio, MAGNANO DI SAN LIO, Eugenio. *Orti e giardini dell’aristocrazia catanese*, Sicania, Messina, 1996.

[2] BERGAMONTI, Laura, ALFIERI, Ilaria, LORENZI, Andrea, MONTENERO, Angelo, PREDIERI, Giovanni, BARONE, Germana, MAZZOLENI, Paolo, PASQUALE, Stefania, LOTTICI, Pier Paolo. *Nanocrystalline TiO2 by sol–gel: Characterisation and photocatalytic activity on Modica and Comiso stones* Applied Surface Science 282, 165–173. 2013.

[3] BERGAMONTI, Laura, ALFIERI, Ilaria, LORENZI, Andrea, PREDIERI, Giovanni, BARONE, Germana, GEMELLI, Giada, MAZZOLENI, Paolo, RANERI, Simona, BERSANI, Danilo, LOTTICI, Pier Paolo. *Nanocrystalline TiO2 coatings by sol-gel: photocatalytic activity on Pietra di Noto biocalcarenite.* Journal of Sol-Gel Science and Technology accettato 2015.

[4] BRANDI, Cesare. *Teoria del Restauro,* Einaudi ed., Torino, 2000 (ed. originale 1963).

[5] CARBONARA, Giovanni. *Avvicinamento al restauro. Teoria, storia, monumenti*, Liguori, Napoli, 1997.

[6] FITZNER, Bernd & HEINRICHS, Karlheinz. Damage diagnosis on stone monuments – weathering forms, damage categories and damage indices. In: *Prikryl, R. & Viles, H.A. (eds.):Understanding and managing stone decay. Proceeding Internat. Conf. "Stone weathering and atmospheric pollution network (SWAPNET)". Prague*: Publisher 2002, p. 11–56.

[7] FITZNER, Bernd, HEINRICHS, Karlheinz & LA BOUCHARDIERE, Dominic. Damage index for stone monuments. – In: *Galan, E. & Zezza, F. (eds.): Protection and conservation of the cultural heritage of the Mediterranean cities: Proceedings of the 5th International symposium on the conservation of monuments in the Mediterranean basin*. Sevilla: Publisher 2002, p. 315–326.

[8] FITZNER, Bernd, HEINRICHS, Karlheinz & LA BOUCHARDIERE, Dominic. Diagnosis of weathering damage. – *In: Moormann, E.M. & Versluys, M.J.: The Nemrud Dag Project: second interim report*: BABesch 78 Publisher 2003p. 159–166.

[9] FITZNER, Bernd. Assessment of weathering damage on stone monuments. *In: Akasheh, T.S. (ed.): First International Conference on Science and Technology in Archaeology and Conservation*. Granada:Publisher 2004, p. 171–207.

[10] FITZNER, Bernd, HEINRICHS, Karlheinz & KOWNATZKI, Ralf 1995. *Denkmalpflege und Naturwissenschaft, Natursteinkonservierung* I. Weathering forms – classification and mapping*. Berlin: Publisher 1995, p.* 41-88.

[11] LENTINI, Fabio, GRASSO, Mario, CARBONE, Serafina. Introduzione alla Geologia della Sicilia e guida all'escursione. *Conv. Soc. Geol. It. "Sistemi Avanfossa - Avampaese lungo la Catena Appenninico – Maghrebide"*, Naxos-Pergusa, 22-25 Aprile1987.

[12] MUSSO Stefano, TORSELLO Paolo, *Tecniche di Restauro Architettonico*, vol. II, in Carbonara G., Collana del Trattato di Restauro Architettonico, Utet, Torino, 2003.

[13] PHILIPPOT, Paul. *Le probleme de l'integration des lacunes dans la restauration des peintures* , in Bulletin de l'Institut Royal du patrimoine artistique, II, 1959, pp. 5-19.

[14] RESTUCCIA, Franca. *Catania del 700' dai disegni al linguaggio delle ricostruzione*, Documenti 16 del Dipartimento di Architettura e Urbanistica, Università degli Studi di Catania, Gangemi ed., Roma, 1997.

[15] UNI 11182 (2006), Beni culturali materiali lapidei naturali ed artificiali descrizione della forma di alterazione tratto termini e definizioni.

HERITAGE and TECHNOLOGY
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The invisible roads of contemporary businesses

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Abstract
At what time of mercantile history to the idea of a product packaged to meet human needs has replaced the encompassing concept of a man educated to comply with a particular status symbol? It is in the idea of globalization that you can frame this radical change, fruit of a process more than of a particular event. The reflections presented in this article, which are the summary of a larger work which involved more scholars and two PRIN, try to highlight a truth intuitively understood by most people: globalization has forever changed the practice of the trade. The demonstration of the thesis goes through the comparison between the two systems of trade, apart in time and antithetical in the culture, and, for this, particularly illustrative. The two different realities will be compared with respect to three levels of analysis. Starting from the shops for retail sale, then through the issue of commercial buildings and their relationships with urban settings, you finally come to the networks of regional trade relations. On the side of the tradition we place the shopping streets of the North African territories, on that of globalization we put the architectures of the Italian shopping centers. Both represent two clearly definable contexts respect to the exposed thesis. This clear evidence has determined both the choice and the juxtaposition.

Keywords: Market, trader, trade, shopping center

Introduction
At what time of mercantile history to the idea of a product packaged to meet human needs has replaced the encompassing concept of a man educated to comply with a particular status symbol? It is in the idea of globalization that you can frame this radical change, fruit of a process more than of a particular event. Transformation that has influenced the modern dynamics of trade to the extreme limit consisting of the dematerialization of the exchange spaces in the specific agora of virtual worlds. This demarcation highlights how the recorded change release completely the organization of commercial structures from models of human settlement of the area related to the localization of goods, whether food, manufactured goods or technology products. We will try to prove this thesis through the contraposition of two systems that differ greatly. On the one hand some traditional commercial roads of the North African territories, on the other the modern system of Italian shopping centers. The comparative analysis shows a clear transformation from an optimized system on issues of production and logistics (the merchants roads) to another in which the dynamics of settlement of commercial activities, organized on the concept of catchment area can be represented as an invisible network of graphs (the international ways of finance).
The reflections presented in this article are the summary of a larger work which involved more scholars and two PRIN, try to highlight a truth intuitively understood by most people: globalization has forever changed the practice of the trade. If on one hand the impetus for the exchange remains one of the most important keys to understanding the contemporary social dynamics, globalization has transformed a system of exchanges between individuals or social groups in an “impersonal" system of trade flows regulated by centralized and codified procedures whose main purpose is that to optimize profits through, for example, reducing business costs.
The demonstration of the thesis goes through the comparison between the two systems of trade, apart in time and antithetical in the culture, and, for this, particularly illustrative. The two different realities will be compared with respect to three levels of analysis. Starting from the shops for retail sale, then through the issue of commercial buildings and their relationships with urban settings, you finally come to the networks of regional trade relations. On the side of the tradition we place the shopping streets, on that of globalization we put the architectures of shopping centers. Both represent two clearly definable contexts respect to the exposed thesis. This clear evidence has determined both the choice and the juxtaposition.

The system of the shops in the three study cases of Rabat, Kairouan and Nefta

The area of the sale, in traditional markets, is the point at which, physically, supply and demand meet. This is the place where the merchandise becomes the protagonist. Every possible strategy is put in place to present in the best way the product: the stalls expose the goods, and, leaning toward the street, attract wayfarers. The shop windows, where present, usually exhibit the most precious goods. Shades and umbrellas, finally, identify and define the spaces of negotiation. The goods is the engine of all. Whether it is inside the shop windows or on market stalls, the product is exposed according to practical criteria (the distribution on the counter) but also in order to glorify sight, touch and smell. The architecture - the front of the buildings, moldings, balconies, cornices - disappears during the day to regain the prominence of the commercial space at night, once folded shades, disassembled mobile equipment, closed the shutters of the shops. The examined examples are Rabat: Rue des Consuls; Kairouan: avenue Alì Belhouane; Nefta: rue Chaffai Cheriff (being all three the result of a long campaign of surveys by Francesca Fatta, Sebastiano Nucifora, Anna Petino e Agostino Urso). The comparison of the three study cases makes possible the generalization of the mechanisms of sale on which commercial activities are organized separately or considered as a global phenomenon. The market recognizes the goods as the only reliable protagonist.

Rabat: Rue des Consuls, part of the Rabat medina. Rue des Consuls looks like an almost straight road axis, oriented in a direction south-north, separated into two parts by the rue Souika. The southern part of the road, which is accessed past the Bab el Mellah, is mainly used for the sale of spices, food and handicrafts organized with precarious and mobile stalls, according to the logic of maximum flexibility. As you head north commercial space is more structured. Makeshift installations are replaced by architecturally defined spaces characterized by sequences of doors and portals in richly decorated wood. The shops, placed on causeways axis road, sometimes occupy part of the public space using removable structures, some other times predispose their windows obtaining places on which to present and preserve the best goods. Places are sometimes enriched by moving wings of the fixtures on which is exposed a further quantity of goods. Across the street you notice the absence of advertising signs of great visual impact, such as illuminated signs, emphasizing the concept that good merchandise is the best among the possible advertising.

Kairouan: avenue Alì Belhouane. Located in the heart of the city, the avenue Alì Belhouane maintains, as in the other study cases, a fixed pattern: the extension of the area of trade, although limited to working hours, goes beyond the physical limit of the shop through the use of stands. Once again, to the mobile structures are added, for the exposition of the goods, the inner doors of the frames which, properly removed and hung up, serve both as exhibitors of products and as filters between the store and the space in front of it. Also in this case, for the sale of products of greater value, the commercial strategy prefers a pattern of greater guarantee to the seller. As in Rabat, the important goods is placed inside the shop windows, which are often finely decorated to draw attention and even to act as a filter between the object and its potential buyer. In discrepancy with the study case of Rabat we are in the presence of commercial architecture characterized by a greater typological homogeneity. As a general rule, each store is composed of a fixed part, a system composed of an entrance and a window, and a mobile part, the external stand. The latter, according to the commercial activities, specializes in forms at the same time ingenious, functional and beautifully presented. Once again little or insufficient attention is given to the advertising signs. The ability to attract the customer is entrusted both to a sophisticated product presentation and to the proverbial friendliness of the local merchants. Once again, during the night and when the businesses stop, architecture regains its urban stratified and complex space.

Nefta: rue Chaffai Cheriff. Among the three, the shopping street of Nefta is certainly the most humble.

Placed on the northwest edge of the Place de la Liberté, it appears to the customer slowly, as you approach to its shops. The market space is quite moderate and it is composed of two orthogonal paths, the first of which, the one tangent to the square, is about fifty meters long. The intersection of the two main shopping streets is underlined by an old hotel, which is the building of major interest among all. The entire complex, excluding hotel, consists of a floor above ground level. All shops, directly connected to the road, have quite regular modules. Their compositional rhythm is further emphasized by an equal number of accesses among them homogenous in shape and color. If possible, a greater visual unity is achieved through the exclusive use of the brick as exterior facing. The almost total absence of advertising signs and shop windows makes the exercise of trade even more direct. The only object that stands between seller and buyer is the stall on which you expose the few available goods.

The streets of the market between Morocco and Tunisia

Usually placed in the medinas of their cities, the shopping streets, together with the places of worship, are the main engines of development. Representing these architectures in relation to the respective cities can often determine whether the logic of foundation but also to suggest the subsequent dynamics of transformation. Finally, size and complexity of commercial space often implies an equivalent level of welfare, of social development and cultural progress, present or past.

Rabat: Rue des Consuls. Integrated to the medina of Rabat, Rue des Consuls looks like a nearly straight road axis, oriented in a direction north-south, parallel to the river Bouregreg. The road, positively characterized by the quality of its architecture, qualifies as one of the key points of the entire medina. At the urban level, are evident the relationships between the Rue del Consules, the ancient city walls, the access doors and the main places of worship. Examining the details, the way is orthogonally crossed and divided into two parts by the rue Souika which represents a significant and invisible border of demarcation. The latter, in fact, separates the southern area from the northern one that is, between the two, the most important and structured one. Going in a northerly direction, the functional integration of the road to the surrounding urban context is compositionally underlined by the alternation of small shops in places specialized in handicraft production, the Kaisarie, once great fondouk used as shelters and warehouses for merchants.
Kairouan: avenue Alì Belhouane. Even in this study case there is a clear relationship between the urban medina, the shopping street and the main places of worship. Once again we are in the presence of a linear urban axis which, in this example, implies a serial and commercially specialized tissue. The ordered sequence of small cells, at the urban level, identifies the homogeneous tissue at Al Assouek. The shopping area, though compact and perfectly integrated in the medina, contrasts sharply with the residential typology with which it relates. Though in a globally homogeneous tissue, the change of structural space of commercial buildings stands out for differences compared to traditional Islamic residences. Aspect that stands out most in the northern area than in the southern one that, between the two, is the most fragmentary. The level of complexity and quality of the exchanges in the medina of Kairouan, trade center of absolute importance in the Tunisians territories , is emphasized in the middle portion of the commercial axis by the presence of a wooden roof painted in blue. This superstructure, useful shades from the summer heat, underlines and highlights the most relevant part of the entire trading system.
Nefta: rue Chaffai Cheriff. The shopping street, in this study case, is located in the ancient district of Ouled Chrif, the more structured and compact one in Nefta. The rest of the city, in fact, is marked by numerous voids that, in the tradition of the town, suggests the presence of numerous families of tribal origin. Ouled Chrif is physically separate from the modern city by two mutually perpendicular axes. The first is the avenue Bourguiba, oriented along the west-east direction, which represents the main pole of urban aggregation. It is around this road which concentrates most of the public buildings. The second, characterized by green palm trees and by the blue of the irrigation canals, connecting the corbeille (source water) with the oasis. Circumnavigate the neighborhood is an experience that allows you to frame the medina as a compact housing, almost introverted, which turns his back systematically to the palmerie. Its permeability is however guaranteed by numerous roads, sometimes hedged sometimes not, which follow one another being meandering and seemingly devoid of prevailing direction. The real barycentre of the neighborhood, place de la Liberté, it is the only urban void noteworthy, the result of a renovation of the historic center operated by the French at the time of the Protectorate. To the north-west of the square, preceded by a small place, is the entrance to the first part of the market. At the other end is positioned an abandoned hotel. Finally, from the latter begins the second part, perpendicular to the first, which ends heading west crossing the margin of the same district at a small square in front of the mosque of Sidi Zmourtine. Finally, looking at the planimetry of the entire district, you immediately notice the obvious contrast between the court houses and the street market. In the first you experience the city's traditional Arabic characters defined as islands surrounded by roads on which overlook the blind passages that lead to the heart of housing. In the second, the street market, the reasoning is reversed. In most cases, the system of the shops, without any mediation, interfaces directly with the road.



Fig. 1: Maps of Rabat (Anna Petino); Kairouan (Sebastiano Nucifora); Nefta (Agostino Urso)

The ways of the trade in the Western Sahara

The gold road, the salt route, the route of the slaves: it is worth crossing a hostile, inaccessible and desolate place - the sahara desert - only in exceptional circumstances, where the dangers of an improbable journey are consistently rewarded by great gains. How to cross, however, this sea of stone and sand? Were necessary some support bases, the oases, man-made for this purpose. Vital centers but also metaphorical harbors of ancient routes that cross the sea of the Sahara. They are at the same time the primary source of supply in the desert and precious nodes of a commercial network that for centuries has linked the shores of the Mediterranean sea to sub-Saharan Africa. If the Sahara is considered as the sea, the caravans are its ships. And there are ships built for large distances but also ships of "coasting". We take for example, in the case of Tunisia, the caravans that starting from the sub-Saharan territories headed towards the Mediterranean Sea and then in the direction of Tunis. The track crossing the desert contemplated some necessary stops such Douz, Gabes and Kairouan. Douz, formerly known as the navel (Douz as sorra), is configured as barycentre of a secondary clearing network. Products of lower quality like food or craft items replace slaves and gold, caravans reduce their size and, thus, the distances traveled. Douz commercial network covers an average radius of about 600 km which, it will be a case, corresponds to the distances between Douz and the cities of Tunis, Tripoli, Ghadames, Ain Salah. We can definitely say that on the examined territories are structured hierarchically organized commercial networks and mutual functional relationship. The dynamics that determine them are ultimately derived from factors such as the importance of the goods, their production area, the dynamics of the exchange, the orography of the area and the location of the oasis.

Rabat: Rue des Consuls. Rabat, Morocco's capital, is a city that faces the sea, the Atlantic Ocean, and that rests on the bend of a river, the Bouregreg. Founded by the Phoenicians around the third century BC, it very quickly becomes a focal point for trade so much for the Mediterranean routes and for the trans-Saharan ones. Passed the Phoenicians, then the Romans, then the Muslims, even the pirates and even the French. The city undergoes many domains but it maintains consistently a vocation to trade. From the city passed gold, slaves, food and even fine fabrics and handicrafts. Depending on the domination and on historical periods prevailed one or the other merchandise and with time they built a network of increasingly branched paths. By land are important those tracks whose caravans, going towards the South, cross the Atlas Mountains in order to trade in salt and slaves. A legend says that the Moroccans crossed the desert to get to Timbuktu, the walls of which, it was said, were built in massive gold. The story instead tells us that these trades related to the "white gold", the salt extracted from the salt pans of Taoudenit. About the slaves, the strong commercial link between Rabat and Sudan is testified by the Souk el Ghezel (located in the far north of Rue des Consuls) - Today the wool market - once a place used for the sale of slaves.

Kairouan: avenue Alì Belhouane. The importance of Kairouan, in the Tunisian territorial context , is highlighted by two fundamental aspects: geographic location, cultural and spiritual importance. Kairouan is the fourth holiest city of the entire Islamic culture. From a geographical point of view, the centrality of the city is emphasized by its position as a crossroads between two major caravan routes. The first directrix, the east-west one, within the limits of the state, connecting the Mediterranean Sea with the massif of the Aurés. Then placed in a broader context it connects the outer fringe of the Muslim world. The second directrix, the northern-south one, starting from the city of Tunis, passes through its territory, crossing Kairouan, Gabes, Douz, and the Grand Oriental Erg before going into the territories of the Niger. Gold and slaves are the most valuable goods, those that before any other move the caravans along this trans-Saharan path. Kairouan has always had a strong commercial vocation and for this, in its history, it has played a dual role: as crossroads of the major trans-Saharan paths and as barycentre of a portion of the territory included roughly in the triangle whose vertices are positioned in Sousse, Sfax and Kasserine. This second network of businesses has been traditionally fueled by a prosperous manufacturing sector (textiles, carpets, ceramics, leather and pottery) which joins the commercialization of a wide variety of agricultural products and foodstuffs.

Nefta: rue Chaffai Cheriff. The city, which as some others has remote and uncertain origin, was established as a rest and restoration point where the caravan routes met the natural water spring. As Erodoto tells us, the logic of settlements followed based schemes of displacements, from encampment to encampment, lasting a maximum of ten days of walking, travelling by camel or dromedary. Once again the development of the city center has been favored by two factors that recur cyclically in these territories: movements and exchanges both commercial and religious ones. In spiritual terms Nefta boasts the presence of 24 mosques and 100 marabout. In terms of trade the urban center is organically connected to the network of cities that

gravitate around the Chott el Djerid, the great salt sea of Tunisia. Yet, Nefta like many other towns in the region, was a Phoenician, Roman, Byzantine, Arab, Ottoman colony, and was finally under French control before conquering the independence together with its own nation. In terms of the settlement, the city is perfectly in relation to the desert with which it coexists. Nefta, like all cities of the Chott, adopt an urban plant characterized by parallel streets oriented in function of the prevailing winds and then in causal relationship with the palmerie. The city, being the last outpost of the Chott el Djérid on the Algerian side, is divided into two parts by the avenue Habib Bourguiba. The road collects many interesting aspects: it separates the new town from the old one; it appears as the main axis of aggregation of public functions; it belongs to the track that, tangent to the salt desert, connects proceeding from the Algerian border, the city of Herzouan, Nefta, Tozeur, Kebili, Douz. This, finally, stands as intermediary node between the commercial circuit just described and one of the most important track of the trans-Saharan Tunisia.



Fig. 2: Planimetric schemes of Rabat (Anna Petino); Kairouan (Sebastiano Nucifora); Nefta (Agostino Urso)

Marketing: the new science of trade

Reggio Calabria, the town. An international brand, Auchan City. Two commercial structures comparable in size. Two different owners. The first architecture is located in the northern part of the city, close to the historic center. The second, set in a more peripheral area (the populous district of Sbarre), is located along its main driveway, the avenue Calabria Avenue. The first, yet, is a restored building obtained by reconfiguring an old FIAT automobile plant. The second building is a new project built on a vacant lot. Comparing the two structures, in light of the presence of a single tenant, allows to draw some interesting conclusions. The first concerns the formal relationship between the definition of the architectural envelope and design of interior spaces. In both cases you can see that the outer case looks like a simple, basic, hermetically shielded structure. It appears as a continuous wall surface where the only relevant openings are the main entrances and the emergency exits. The second observation concerns the fact that the sales areas of the two plants have distribution patterns virtually identical, although both cases are affected by the presence of different design constraints. The last observation concerns the parking arrangement. In the first case, the one of the restored building, parking lots, although separated from the commercial activities, occupy a part of the building complex. In the second case, that of the project, the parking arrangement has a classic solution: they are allocated in the entire underground floor. The lesson that we can draw is quite clear: the presentation of goods in the retail space has priority over any possible compositional logic. Within a unified space for the shape, the spaces of trade are organized as an aggregation of micro perspectives each of which aimed at the capture of a specific social target . Multiplying the micro scenes exponentially increases the ability to capture the customer as well as any possible increase of the same retail spaces. In spite of touch and smell, the packaging prevails on the product, on its real look, on its natural color, on its texture. Gone are the days of bargaining, of fumes and perfumes sometimes intense, sometimes sweet and delicate. In perfect order and in absolute silence each individual package defends its formal perfection, perched on always ordered, organized and rigorous shelves . From the care of the product we passed to the care of the customer. This is the key to understanding such a radical change. Be realized means wearing simultaneously the clothes of the manager, of the intellectual and of the sportsman, activating a whirlwind of experiences that lead to an emotional hypertrophy that anesthetizes the mind. The result of this media

bombardment produces a new figure, the consumer, that is by definition a compulsive individual who does not buy any more what he needs, but what guarantees to him the apparent acquisition and preservation of a status symbol. The final slogan is: to buy, buy, buy.

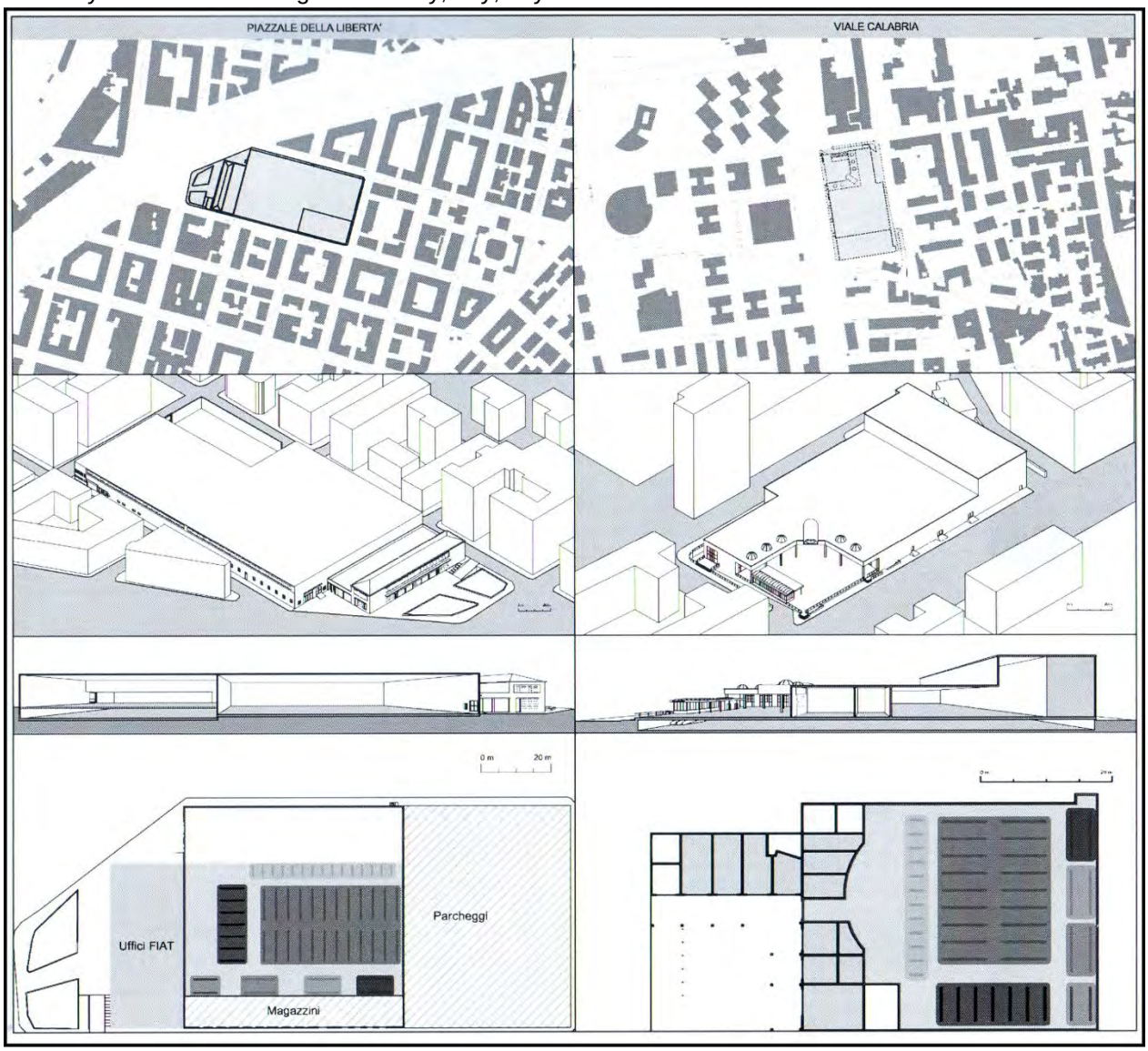

Fig. 3: Plan comparison between two Auchan city

The city and the shopping center

The image is by its nature, still, complete and perfect. It is the result of an act that in the present, orphan of the past and unable to look to the future, does not evolve or involve. It can only be used and replaced. In this context, the need to produce architectures characterized by a deep figurative value, but also manifest symbol of a trade group, subvert so much the way of conceiving the project as a way of understanding and interpreting the figure of the designer. Indeed, the need to assemble a three-dimensional system of signs, of which the immediate recognition is guaranteed presupposes a transience , if not a contradiction of the decorative, functional, spatial and figurative elements, having these to be quickly updated or replaced to maintain unchanged the affection to the brand or the product. The architectural design, in spite of the building type, turns into an overlapping of functions in constant becoming, without the beginning or the end, tenaciously oriented to the control of a permanent state of design and construction. How far from the "spontaneous" architectural stratification of the streets of the market! The shopping centers, regardless of the location or the urban context in which they are located, are essentially artifacts as impeccable on the technological level as approved and standardized on the formal one. They are autonomous and

decontextualized islands , indifferent to any form of dialogue with its context, apart from the logistics-infrastructural point of view. The approach is always the same: to a simplification of the architectural envelope and a separation from the external environment usually contrasts a multiplication of the interior spaces and their qualitative connotation that is extremely varied and rich. Rather than integrate with the urban context, it appears as its representation in a reduced scale. On the one hand the contemporary city has produced a fragmented and incoherent universe in which the urban space becomes a fluid, variable, unstable and mobile mass. On the other hand it has produced the philosophy of the shopping center which fits perfectly the figurative description of the contemporary city. A dynamic space in which the perception of reality is experienced in terms of a dual relationship: a constant physical transformation of the urban environment and its equivalent intangible images, increasingly complex, increasingly stratified. Powerful appears the image of the hypertext as a possible system for arranging activities. The project, in fact, beyond the architectural qualities of its compositional system, is organized according to a topological structure of graphs whose nodes are all accessible through endless paths, each of which is at the same time point of arrival and of departure for new activities. The shopping center, looks like a labyrinth, but its strong tendency to the ordered use of images, at the same time powerful and clear, produces interest and curiosity while avoiding the unpleasant feeling of disorientation.

Brief history of shopping centers

The modern history of shopping centers originated in the United States, the prime mover of Western culture after World War II. From the first Mall designed by Victor David Gruen, in Minnesota in 1957, much time has passed. If on one hand it is clear the paternity of the American type, on the other its next graft in Europe has produced a wide range of original solutions. It is at the beginning of the 60 buildings that we are witnessing to the first building result of a synthesis between the US model and European trade architectures : the department stores and shopping arcades. Are the problems of congestion and accessibility of urban areas to suggest a rethinking of the entire retail commercial distribution network. The intent is to encourage the use of the car and at the same time a more balanced and rich concentration of goods and services for leisure. Thus, in later times, develop two design strategies. The first assumes the design of the suburban shopping center. Therefore, once consolidated the first model, concurrent to the evolution of an ecological thinking on the issues of recovery and reuse of architectural, states a trend to the conversion of crumbling structures in the heart of the city producing important examples of urban requalification. All models of the main European countries, it can be demonstrated, have comparable dynamics of development. Choose the Italian case, therefore, allows once again to exemplify the dynamics about a wider context. In Italy the phenomenon of globalization began with clear delay as regards most Western countries, probably because of the Municipal Commercial Plan (planning instrument regulated by Law 426 of 1971). Only some time later, in the period between 1988 and 1992, following the French and German models, they began to plan and regulate the opening of shopping centers. We remember, for importance, the center Bonola, in the Gallaratese neighborhood in Milan and Cinecittà 2, located in the hinterland of Rome. In 1991, then, opens Curno with the first Media World Store at that time an unknown brand, today a market leader. It is only between 1993 and 1997 that consolidates a real urban integration policy of the shopping center to the development policies of the territory. Among the many structures designed in this context include the Centro Leonardo in Imola and the Grande Mela in Sana (in triveneto) that proposes the first experiment of integration between the shopping center, the multiplex cinema and the games room. But it is with the construction of the shopping center Gigli di Campi, in Prato, which, for the first time in Italy, the commissioning is addressing to regional customers. These are also the years in which the design of the first shopping centers in Southern Italy began. A little later, between 1998 and 2002, the social debate, from long time focusing on the issues of recovery and reuse of architectural heritage, induces the government to intervene in the dynamics of localization of trade architecture, through the provision of economic incentives or town planning facilities. The aim is to recover the particularly degraded urban areas. A striking example is that of Casalbertone, in Rome, that provides a boost to the reactivation of the regional economy through restructuring and conversion of an entire industrial area. Among the new proposals by the big brands of particular interest is the construction of the first Factory Outlet centers among which, at a European scale, we point out that of Serravalle. The final turning point, a law reorganization, coincides with the enactment of Decree Law No. 114 of 1998 (the so-called Bersani law), which simplifies the acquisition of new business licenses. Noteworthy is the project of Orio Center, directly connected to the Bergamo airport. It was the first shopping center to get to open on Sundays in Italy. The next innovation is the testing of the commercial type of Liesure Centre, yet another invention designed to enlarge the number of customers. It is in the period between 2003 and 2008, that investors yet dissatisfied raise further the target. Proliferate, thus, new shopping centers of regional dimension among which the Parco Leonardo in Fiumicino, the shopping center Vulcano Buono (Renzo Piano) and Etnapolis (designed by Massimiliano Fuksas). A lot time has passed from the design of the first

shopping centers. The tastes have evolved and cultural patterns of outdated architectures have become obsolete. The time of their renewal arrived. The examples of Curno shopping centers and of Carousel in Carugate, in addition to the Giulia one in Trieste are paradigmatic. Recent experiments noteworthy are the business parks and Factory Outlet centers, shopping centers models that emphasize a greater extent, a strategy aimed to dimensional gigantism. From these realizations derives an observation: the design of commercial structures of greater size, which corresponds to an ever wider catchment area, pursues the strategy for exponentially increasing the volume of trade carried out. And so we come to the present day in which the global crisis interrupted this policy of expansion. The trend that follows seems to direct the work of the experts towards production of quality projects related to issues of environmental sustainability and urban regeneration.
The foregoing reasoning allows us some concluding reflections. The Italian network of shopping centers is developed according to a model in which appear first architectures of medium or small size. Only at a later time we proceed to the design of commercial exercises of greater size. The system, in this stage, reaches its maximum level of development which corresponds to a complex hierarchical structure of the commercial network: there is an interregional one, a regional one and finally, the local one. Then when we shift the focus from the dynamic of location of shopping centers to the forms of organization of the respective properties, the ultimate mystery is revealed : the entire management of the now globalized businesses appears indifferent as to the size of the commercial network that its distribution on the territory. Looking at the whole system from the right perspective allows to notice two important aspects. The first is the realization that the entire global market is managed by an ever smaller number of actors. The second relates to the speed with which was transformed the structure of trade. Little more than fifty years have been enough to impose a single model of trade, whose organization is perfectly suited to every place, culture or social model.

The invisible network: the Retail Real Estate

We described how, in the architecture of shopping centers, is felt the presence of images obsessively homogenizing whose reading leads immediately to the stereotype of "total consumer". This result is pursued with conviction by a commercial network whose purpose is to optimize all the strategies needed to maximize profits. The financialization of the management of shopping centers, therefore, appears as an integrated system of skills, among which that of the architect is not even the most incisive. On top of the pyramid lays the investment companies and individual owners. Next, there are the developers, divided into traditional and professional ones. It is then the turn of the specialized companies, classified in Retail Companies, in Management Companies and in Companies providing services. Further down, in this hierarchy pyramid, are at the Tenants / Renters. Finally, at the bottom, you can identify the Consortia or Associations of the Operators. Let’s proceed with order. The first two categories are those who have the responsibility to define the nature, the placement and amount of investment. In them are normally present players of international level such as "institutional investors", typically made up of sovereign wealth funds, insurance companies, investment funds, financial companies and pension funds. Among the actors playing is anyway the category of Developers, whether traditional or professional, the one that establishes the investment strategies. Other key players in the financial structure, are the companies that are involved in various ways in the process of implementation and management of the architectural work. This is for us the most interesting level to which belong the architectural and engineering professionals. Usually, these companies are divided into three categories: the marketing companies, management companies and utility companies. Each of them is related to the merchandising mix. The circle is completed by the two categories which can be defined, consumers apart, as the final users of the shopping center: the Tenants / Renters and the Consortium or Association of operators. The opening of a new shopping center, in a nutshell, is reduced to a very complex analysis which occurs step by the step. The first consists in the determination of the area of influence (isochronous) of the structure, usually assessed in a distance equal to about forty-five minutes travel time by car. This is the portion of territory which assess the quantity and quality of potential consumers. In the same area, then it is important to evaluate the extent of possible competitors. Both estimates are determined by evaluating at the same time the number of municipalities involved and the disposable income of the resident population. Being this first phase completed it is then necessary to go on for further investigation. You must assess the level of market saturation. This is the data which determines the degree of crowding and competition ongoing on the territory. Then, the effect of overlap (the overlapping), becomes a business risk far more appreciable than competition between different brands. This observation suggests further statistics evaluation necessary to estimate the strength of the single competitor. The importance of the individual competitors is measured with respect to the totality of the centers included in the catchment area, broken down until the smaller unit reference (the size of the district). Increasingly sophisticated analysis, based on the discipline of geomarketing, inevitably open the market to operators of high capacity and experience, able to impose their own structures. Autonomous organizations whose work focuses on statistical analysis necessary to meet the demands previously made. Retail Real Estate is the name that describes the set of these companies. International operators which are configured as the protagonists of the commercial scene.

In Italy, for example, we can cite the case of Cogest Italia that manages a total of 36 structures, some of which are located in the provinces of Turin, Trieste, Macerata, Padua, Perugia, Cagliari, Verona, Pisa, Siena, Agrigento, Caltanissetta, Reggio Calabria and Catanzaro. We can also mention the case of the Italian Shopping Centers (ICC) which in addition to Etnapolis, one of the largest shopping centers in Italy, manages a total of ten of them including VeronaUno (Verona), Palladio (Vicenza) and Grand'A (Cuneo).

A study case: Calabria

Going further down the scale, we try finally to represent, through three synthetic maps, a model of development of shopping centers at a regional level. The case of Calabria. Starting from a study carried out by the Department of Economics of the University of Calabria (the PIT 22 - Area of the Straits) the first map identifies and defines the catchment areas in which are the 14 centers included in the census in the region in 2011. The second map, then, tells the size and distribution on the territory of the shopping centers. The understanding of the data that will be exposed necessity, however, of a brief introduction related to the classification of the types of commercial buildings. Distinction made by the National Council of Shopping Centers which proposes a possible organization with respect to the categories of size, of location and of type of use. The three categories are:

1 *Size* • Neighborhood shopping center: GLA lower than 5.000 sq.m.; • Shopping Center of small size: GLA 5.000 – 19.999 sq.m.; • Shopping Center of medium size: GLA 20.000 – 39.999 sq.m; • Large shopping center: 40.000 – 79.999 sq.m; • Regional shopping center in an extensive area: GLA over 80.000 sq.m .

2 *Location* • Urban location: represented by the central areas with high commercial density.• Peripheral location: or in semi-central areas or the edge of the urban area with a limited commercial density; • Suburban location: it has generally a provincial attraction, in areas with low commercial attraction, but well linked by roads.

3 *Type of use* • Single type of use: when it is inserted into a building intended only to be used as shopping Centre;

Multiple type of use: when it is added to a multifunctional building such as a residential one, a directional office, a public office, an hotel etc.

Returning to our investigations, then, the data indicate the presence of the main type of medium shopping center with suburban location and type of single use. Fifty percent of the shopping centers included in the census fall into the category just described. Of the other fifty percent, three have a gross leasable area (Gross Leasable Area) ranging from 10,000 sqm and 20,000 sqm, the last four, mainly urban, have a GLA of less than 10,000 square meters. Of the fourteen activities included in the census, The Fountains is the only retail park built to date in Calabria. The final map, the historical one, tells the temporal development of the regional system of shopping centers. From this it appears that, once the phase of colonization of the market has passed, the new projects aim to expand its catchment area through specialization of commercial formats to maintain high levels of profitability in the territories in which keeping faithful the customers. Thus it is arranged a supply of goods and facilities increasingly rich and specialized. It reproduces, in a smaller scale, what we previously described as a model of Italian commercial development. We try to draw, at this point, some final remarks. The first concerns the regional system of infrastructure. It is immediately apparent that the two main traffic routes - the A3 and the SS 280 - form the backbone of the regional distribution system of the shopping centers. The first connects Calabria with the rest of Italy and links, at the same time, the city of Cosenza, Lamezia Terme and Reggio Calabria. The second joins Catanzaro with Lamezia Terme and its airport, the most important of the region. We come, then, to the location of three of the most important regional structures, the Commercial Park Le Fontane and the shopping centers I Due Mari and Vibo Center. They are positioned on the axis determined by the city of Vibo Valentia, the airport of Lamezia Terme and the district town of Catanzaro. Action, this, which shows quite clearly a mainly economic logic of placement. In fact, although the synthesis historical map tell us that the positioning of the first shopping centers occurs in the province of Cosenza, the potential money flows direct elsewhere the development of architectures of greater size. The transformation of the airport of Lamezia to an International airport does not seem extraneous to this phenomenon. All shopping centers, finally, in their positioning are always subordinate to the presence of at least one of two key factors: the proximity to large urban agglomerations and a quick connection to the main roads.

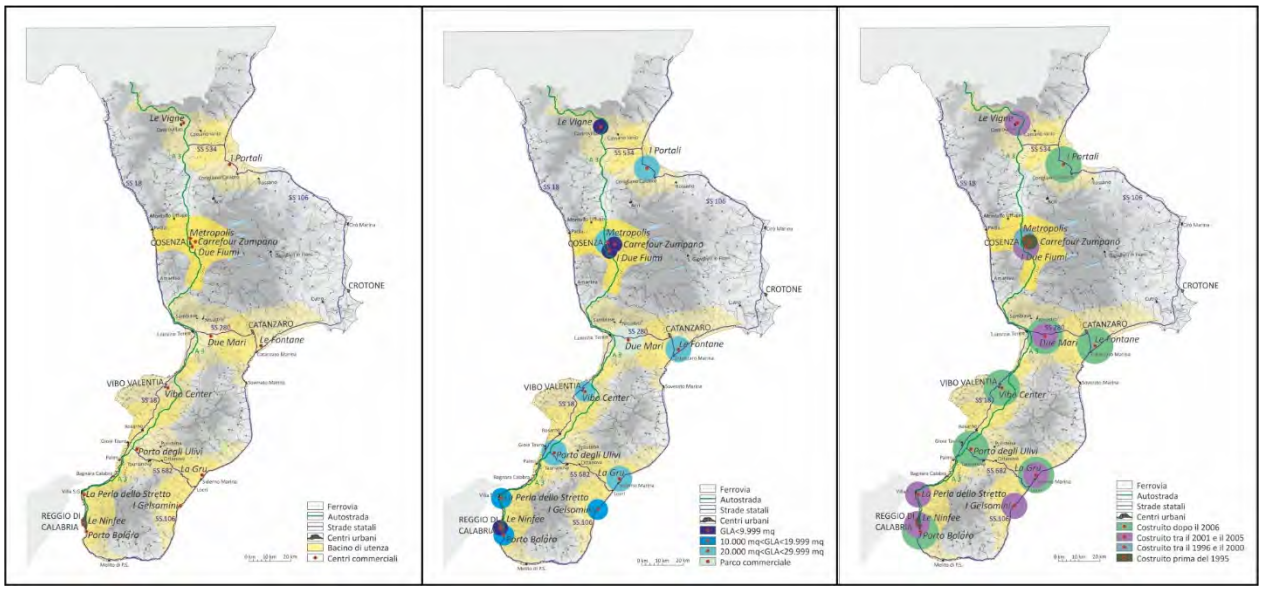

Fig. 4: Calabria. Shopping centers: 1 – Chatchment area; 2 – Gross Leasable Area; 3 – Historical map

Bibliography

[1] BRUNETTA Grazia e MORANDI Corinna. edited by *, Polarità commerciali e trasformazioni territoriali. Un approccio interregionale* , Città di Castello (PG), Alinea publisher, 2009. Commercial polarities and territorial transformations. An interregional approach.

[2] GRUEN Victor, *Centri per l'ambiente urbano*, Paderno Dugnano, Gorlich Editore, 1975, Centers for the urban environment

[3] SECCHI Roberto, *L'architettura degli spazi commerciali*, Roma, Officina Publisher, 1991, The architecture of commercial space

[4] TRONCONI Oliviero, edited by, *I centri commerciali, progetti architettonici, investimenti e modelli gestionali*, Repubblica di San Marino, Maggioli Publisher, 2010, The shopping centers, architectural plans, investments and management models

[5] AMENDOLA Giandomenico, edited by, La città vetrina, I luoghi del commercio e le nuove forme del consumo, Napoli, Liguori Publisher, 2006. The town window, the places of commerce and the new forms of consumption

[6] HOAG John D., *L'architettura Islamica*, Milano, Electra, 1989, The Islamic architecture

[7] BRAVIN Alessandra, *Marocco, città imperiali, castelli di terra e oasi del sud*, Prato, Polaris, 2006 Morocco, Imperial cities, ground castles and oasis in the south

[8] SARRO Adriana, *La Multiculturalità nelle Città del Mediterraneo. Ricerche e progetti per le Città di Tunisi, Kairouan, Touzer e Nefta,* Palermo, Grafill, 2005, The multiculturalism in the Mediterranean cities. Researches and projects for the Cities of Tunis, Kairouan, Touzer and Nefta.

[9] AA.VV., Ifriqiya, Tredici secoli d'arte e d'architettura in Tunisia, Milano-Tunisi, Electa-Déméter, 2000, Ifriqiya,Thirteen Centuries of Art and Architecture in Tunisia

[10] FUSANO Florindo, *La città islamica*, Bari, Laterza, 1984, The Islamic city

HERITAGE and TECHNOLOGY
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Fragments and memory of landscape: preservation of some fragile architectures

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Abstract
The interest in the land has encouraged studies and restoration projects aimed at the enhancement of the architectural heritage contained in it, but excluded assets that just lent themselves to actions of new functions: a network of small buildings that together with natural and urbanized areas, form a territorial system in which the architecture is bound by ties of interdependence: Italian buildings for the production of wine as the "palmenti" for grape pressing, the Galicians "horreos" for storage cereals, the "pigeonniers" of the Pyrenees, small buildings, mainly rural character. Such architectures are now vulnerable since, ill-suited to host functions economically attractive. Based on these considerations, we suggest actions to value based not so much on the new functions the same as their "reviving": that is, their conservation through the sole use as a symbol of collective memory and historical evidence of cultural processes of contexts and rural landscape.

Keywords: cultural landscape, fragile architecture, conservation, enhancement.

1. About fragments and memory of landscape*

The increasing interest on the territory as large and complex cultural heritage on the one side has promoting studies and restoration projects aimed to the enhancement of the architectural heritage contained in it but, to the other hand, it has also excluded assets which doesn't lent to speculative actions of re-functionalization [1].
Nowadays we could consider these assets like fragments of a system of architectures, which connotes the landscape creating a singular cultural vision which represents the memory of the places where daily life has left indelible traces.
A network of small buildings which forms a territorial system in which architecture is linked to unique natural and urbanized areas by close ties of interdependence. In the past, this had the role to represent a society that looked to the future by inventing new systems of production, of trade, of communications, which accelerated the evolution process of entire European contexts.
From this base arose an area vision as a scenario of productive and social actions. Today, through the permanence of some architectures, it adds value to the landscape, but at the same time shows aspects of vulnerability.
The Galicians "horreos" are an examples of those, that made up a widespread network to keep and trade wheat and cereals, from the hinterland to the Atlantic coasts. The "pigeonniers" of the French regions of the Pyrenees: a system of communication through the construction of small rural buildings, in which pigeons lived during their continuing movements. The "palmenti" and the wine crops' organizations of many Italian regions, for example of Basilicata, Piemonte and Valle d'Aosta.
Nowadays these architectures are vulnerable because they are not adapted to accommodate economical attractive functions and they do not suggest other solutions except to be preserved

because they are historical rural complex systems fragments, in contrast to valorisation strategies that impose an increasing tourist exploitation of the cultural heritage.
According to these considerations, the essay aim to propose actions for conservation and enhancement of the “horreos", “pigeonniers” and “palmenti" not based on the introduction of new functions, but focused on their "reanimation": this means their only conservation through the use as a symbol of collective memory and historical testimony of cultural processes, linked to specific landscape contexts [2].
Actually, according to the latest conservation theories it’s not always possible re-functionalizing all the architectures. However this does not result in exclusion from strategies of exploitation but it suggests actions aimed to the conservation of asset without changing types and meanings: in one word the "essence" of the same architecture and different reasons for which it was created.
So, a more conservative and more "cultured" approach takes over. It just provides the "reanimation" which allows insiders (but only to those who really know the meaning of this expression) to safeguard a fragile heritage without completely destroying or modifying the function, but committing the role of economic engine to what surrounds these most vulnerable elements.
In this way it is possible to apply greater and more complex enhancement strategies where the cultural landscape represents the engine for the conservation, as in this case. Therefore, the re-functionalization of some buildings that may be changed with radical transformations compensates the impossibility to find a function for the small size architectures but with great cultural value.
In many cases this does not happen and a phenomenon that can be called "cultural aberration" take place. This because of such operations, seeking to enhance and re-functionalize each architecture (which is ascribed cultural value), in order to put it in economic and tourist circuits, produces "collateral effects" that can be defined as anti-cultural and anti-historical: the transformation of the original function, in these cases, empties the object of its real “essence” and the territory is deprived of cultural and documental value, that it acquires with the presence of even traces of agrarian life of a society.
In this sense, cases of restoration and renovation of old driers are best known to the criticism: from the simplest to the most complex of which often remain only the outer casing [3].
These interventions deserve accurate reflections starting from the substantial differences that exist between the assets that are considered cathedrals because they have large dimensions and often, starting from a simple wooden construction, they offer now more modern shapes (developed at the end of XVIII century).
The literature on this subject is abundant; however some of these examples do not represent the symbol of the rural attitude of a territory, but the utopia of an industrial class organized in order to exploit social and natural resources.
But there are also examples of dryers in which are still present rural architecture’s characters and they are widespread in territories with homogeneity aspects both from the landscape point of view and the anthropic one. Unfortunately many of them, at best transformed into homes, have lost their cultural character becoming simple mechanisms of an economic and real estate perverse dynamics.
Therefore, we will analyze only few rural architecture which have conserved their original character and are already part of a process of "reanimation" of individual architectural elements. In most cases, they have been protected, and nowadays they represent one of the strengths of the enhancement of the broader Italian, French and Spanish landscape contexts.

2. Fragile architectures in French and Italian landscape: "pigeonniers", “topie” and "palmenti"

In the region of Midì Pirenneis and especially in the Tarn’s departments, the departments of the Garonne, of the Lot and of the Haute Garonne one, the "pigeonniers" strongly characterize the landscape helping to establish the rural culture of large territories. These «appartienent aujourd’hui à notre patrimoine régional jusqu’à servir même d’enseigne à tout ce qui concerne l’art et le le tourism de nos département» [4] also represents one of the objectives of the preservation of a rural land. This even though they are located in isolated contexts and do not offer opportunity to be preserved except as an historical sign of their original function.





Fig. 1, 2, 3. Midì Pirenneis: examples of "pigeonniers" and the particular of a stone pillar

This attitude distinguishes the French protection politics from many others (the Italian one for example) in which everything should be not necessarily attributable to economic profits and tourist attractiveness.
In fact studies conducted on "pigeonniers" identify as urgent an action in the area which may identify and catalogue different types especially in relation to the context and the time in which they were built; this in order to enhance, rather than the value of "real estate", the cultural one, linking it with the ancient agricultural traditions.
From this study we may known and understand the characters which on the one hand join all of these buildings, for the original purpose, on the other hand they show different characteristics of form, material and decoration in relation to autochthonous realities: for example "pigeonniers" on stone pillars or on arches; a polygonal structure, a square or cylindrical tower; "pigeonniers" or Gaillacois or Gariotte; and still "pigeonnier-balet" and “pigeonnier-porche”.
However, all have common features: building materials (stone, brick, wood), "trellis" construction type or "dry walls" and the use of "mushroom" stone pillars in those where the dovecote is raised off the ground. But the similarities are found especially inside, where elements appear to shelters of cane or clay for pigeons and all are covered by wood structures and roof tiles.



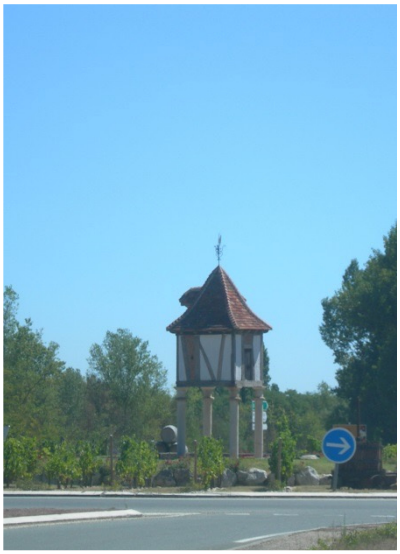

Fig. 4, 5, 6. Garonne e Lot: some “pigeonniers”; the last is inserted in a roundabout

On the top of the roof it always appears ceramic decorative designs, most of which represent doves. However, despite these architectures are considered regional heritage, in some cases there is a less of attention on the restoration operations, during the substitution of the elements that compose the artefact: this practice goes against the value of the architecture because the value of spontaneity given by retrieval of raw materials in the area.
Moreover, the desire to show the type only for tourism purposes means that in some cases they appear as "cultural fetishes" until they become just furnishing of medians. It is the main risk of "pigeonniers"; this is the most obvious manifestation of what can be called "cultural aberration".
Equally interesting in Italy appear the rural architectures related to the cultivation of the vine, the grape harvest, the production and storage of wine.
If in regions such as Piemonte and Valle d'Aosta, for example, traces of entire winemaking landscapes are preserved, whose past is represented by the clear division of the fields and by the organization of the vineyards, in Basilicata are still preserved traces of all production process [5].
In the first case there are elements still surviving, the "topie", built with local stone and used to support those screws and proceed to the general organization of the vineyard. These are monolithic stone elements or compositions of stone and brick with conical shape that still represent entire portions of the landscape, or they can be identified as fragments, within the territory that today is densely modified by the mankind and transformed due to the construction of extended industrial and commercial complexes.
In this case, they represent the only trace of the past: the historical memory of a territory which drew economic and social benefits through the well-organized process of cultivation, production, sales of agricultural products.



Fig. 7. The landscape between Piemonte and Valle D'Aosta, characterized by the system of "topie" for the cultivation of the vine.

Nowadays, they can only be preserved through operations of “reanimation", because their texture would not allow a different using from the original and it does not recommend valorization actions that are not related to the agrarian value of a land [6].

The "palmenti" are also interesting as historical memory of the rural landscape; they are present in some areas of Basilicata and in particular at Pietragalla. In this case there is such a concentration of these rural architecture that appears almost like a village.
They are about small architectures built with local stone and leaned to the slopes of the hill whose use was related mainly to the grape harvesting and pressing.
The singularity of this architectural construction is given by the relationship between these buildings (often placed against each other and under different ownership), by the construction techniques and materials used to produce them, but especially by the system in that they were an integral part: the vines in the flat area of the territory now are totally disappeared; the "palmenti" for the collection and grape pressing, the "rutte", that are the cellars or natural caves where the wine was kept; the paths between the farms for carriage with wagons or beasts of burden of agricultural products.
Nowadays, it is not conserved much of this and "palmenti", certainly the most evident fragment of this "agrarian system", are currently abandoned and assaulted by speculative building, or even destroyed to make way for industrial facilities or shopping centers.
Even in Pietragalla, the lack of attractiveness of this agrarian system discourages protection actions. The result is the non-use of this heritage for tourism or business purposes. However, this should not stop the "reanimation" and the preservation of an irreplaceable testimony of agricultural matrices of that territory [7].



Fig. 8. The "palmenti" in the agrarian territory of Pietragalla, with the modern buildings on the background

3. Spanish "hórreos" and "cabazos"

With the Decree 449 (February 22, 1973), concerning the vernacular architecture, were laid under the protection of the state granaries over a hundred years old existing in Galicia and Asturias: «All the buildings known as "hórreos" or "cabazos", in the regions of Asturias and Galicia, which have an antiquity no less than a century, remain under the protection of the state, which will prevent all interventions that alter the character or will can cause the demolition» [8].

However, this decree was not very incisive, although represents the first step towards the preservation of "spontaneous architecture" having cultural value.
Explaining the conservation of the barns, Plinio noted that «there are people who build barns, with brick walls almost a meter thick (...), in other places, on the contrary, the wooden barns are built on pillars» [9].
Galicia could be one of the places that Plinio spoke about; its hórreos match the description of the Roman naturalist, except that most of them are built of stone. In the more sophisticated cases, they remember ancient sarcophagi raised from the ground or small temples.
But the best value, in my opinion, is that the "hórreos", perfectly inserted into the landscape, represent the most important expression of Galician vernacular architecture because they have intelligent solutions concerning functionality, forms and proportions; the wisdom and genius with which local materials were exploited: granite and wood are present in large amounts in the territory.
As already expressed in 1964 for the exhibition "Architecture without Architects" the Galician stone barns are examples of spontaneous architecture, because of their perfect construction [10].



Fig. 9. Combarro: examples of "horreos" located along the coast

In addition, the essay suggests to that their value is in the fact that they are still cleverly inserted in urban and regional contexts, so much that the landscape it is strongly characterized; they have a high historical value related to the productive activities of Galicia; the barns assume an important position in urban centers, as the case of Combarro; in the end, they have a high level of recognition in the area.
So they represent the balance between nature and built, they do not need to be re-functionalized, and their development strategies should ensure the only "reanimation" in respect of the vocation of places and features (of matter, form, function) that retain them [11].
However, although they are considered regional heritage, they are disappearing: some are in a state of disrepair; others are voluntarily destroyed; others sold to be disassembled and to be inserted in different contests: these are the cases in which "hórreos" decorate gardens and homes in Madrid or Ibiza [12].




Fig. 10, 11. Combarro: examples of "horreos" located in the hinterland

Also in this case of re-functionalization we bump into a "cultural aberration" in which the architectural element loses all meaning and especially the relationship with the territory. Moreover it was decided to put a stop through other laws such as the Plan de Ordenazion del Litoral of 2010 which protects the regional Galician coastline with architectural and landscape value.



Fig. 12. Carnota: example of "horreo" particularly interesting for the size

However European laws make clear that all the landscapes, as well as having an interest in the local communities, represent a great value for the Europe, and the need to protect them. It means to preserve the quality of these areas through conservation actions which it maintain significant aspects through the preservation of the natural autochthonous elements and spontaneous architecture present in them.
Only in this way these fragments forgotten by the system of global valorization can renew and strengthen the interrelationship between the territory and the landscape. They become points of accumulation of the memory of centuries, of historical events, of economic and social processes of one people or an entire society.



Fig. 13. Combarro: another example of "horreos" located along the coast

Bibliographical References

* This section: *About fragments and memory of landscape,* was written by Emanuele Romeo.
** This section: *Fragile architectures in French and Italian landscape: "pigeonniers", “topie” and "palmenti",* was written by Riccardo Rudiero.

*** This section: *Spanish "hórreos" and "cabazos",* was written by Emanuele Morezzi.

[1] AGNOLETTI, Mauro. *Paesaggi Rurali Storici - Per un catalogo nazionale*. Roma-Bari: Editori Laterza, 2011, pp.5-191.

[2] DALLA COSTA, Mario. *Il progetto di restauro per la conservazione del costruito storico*. Torino: Celid Editore, 2000, pp.165-169.

[3] IENTILE, Rosalba; NARETTO, Monica. *Conservare per il paesaggio*. Savigliano: L’Artistica Editrice, 2006, pp.1-21.

[4] DE VIVIES, Bertrand. *Les Pigeonniers de Midì Pyrènèes*. Albi: Editions APA POUX, 1994, p. 2.

[5] GIUSTI, Maria Adriana; ROMEO, Emanuele (edited by). *Paesaggi culturali*. Roma: Aracne Editrice, 2010, pp.5-22.

[6] DEVOTI, Chiara (edited by). *Montjovet. Caso-studio per un modello di schedatura dei borghi alpini*. Torino: Celid Editore, 2005, pp.9-14.

[7] LABELLA, Angelo. *Il paesaggio agrario della Basilicata nella storiografia nazionale e regionale dell’ultimo ventennio*. Potenza: Calice Editori, 2010, pp.11-50.

[8] CASTRO ALLEGUE, Francisco (edited by). *Código del Patrimonio Cultural Gallego*. Santiago de Compostela, 2005.

[9] PLINIO IL VECCHIO. *Storia delle arti antiche*. Libro XXXVI. Milano: Biblioteca Universale Rizzoli, 2000, p. 22.

[10] RUDOFSKY, Bernard. *Architecture without architects : a short introduction to non- pedigreed architecture*. New York: Doubleday, 1964, p.114. RUDOFSKY, Bernard. *Le meraviglie dell' architettura spontanea: note per una storia naturale dell' architettura con speciale riferimento a quelle specie che vengono tradizionalmente neglette o del tutto ignorate*. Bari: Laterza Editori, 1979, p. 14.

[11] LLANO-CABADO, Pedro. *Arquitectura popular en Galicia. Razon y construccion*. Santiago de Compostela: Edicions Xerais de Galicia, 2006.

[12] GONZÁLES-VARAS, Ignacio. *Conservación de bienes culturales. Teoría, historia, principios y normas*. Madrid: Ediciones Catedra, 2006.

HERITAGE and TECHNOLOGY
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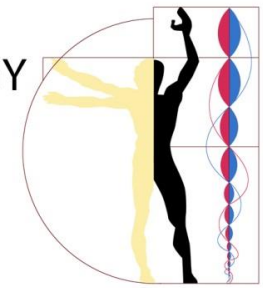

Development of the urban-rural network in the metropolitan area of the Strait of Messina through the recovery of the historical and cultural obsolete heritage.

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Abstract
Reggio Calabria and Messina have always shared history, culture and traditions. Nevertheless, they currently are two cities "in a conflict", that do not communicate with each other. Therefore, the aim of this research is to implement an integration plan between the two municipalities; to promote their social and touristic development through the expansion of communication network between town and country, and by the restoration of the many unused buildings. The basic idea starts from the assumptions of the economic growth that these towns could achieve if they put together their own infrastructure, institutions and the entire landscape and cultural heritage. Community will be involved in this process by encouraging the private sector to renovate historical and valuable properties in order to put them back in the new cultural and touristic system. In this way, both public and private sectors would develop mutual benefits from this collaboration. The main objectives of the project are: the recognition and mapping of historical buildings, the establishment of a digital archive for their classification, the preparation of management, redevelopment, protection and reuse plans, the study of access strategies to EU and national funds to engage the community and encourage citizens to restore historical properties, the promotion of an integrated tourism-information-communication networks approach, sustainability and social utility and the increase of the attractiveness of the area.

Keywords: Strait of Messina, metropolitan area, redevelopment, participated process, economy.

1. The current situation of the territory, landscape, city (1) *

Almost three quarter of world population lives in urban areas. The *city* is the place where problems arise, but also where you will find solutions; it is a breeding ground for science, technology, culture and innovation and has a key role in human development. Change - the condition to which it is generally subjected the state of the world - has taken today tumultuous, chaotic, often disturbing trends, that impose the establishment of new alliances to be able to govern. The European model of urban development, based on industrial growth, is now obsolete. Europe is no longer at the stage of steady economic growth; the economic crisis has had serious effects on the cities, especially small-medium ones who have not great resources.
We are also witnessing a urban sprawl which leads to a *dispersion of the population* in the territory then public services become much more difficult to ensure. *Natural resources* are subject to overexploitation, public transport networks are becoming insufficient and they are increasingly being replaced by private ones with a consequent excessive increase in pollution levels. This *sprawl* is leading also to negative phenomena such as the waterproofing of lands and then the threat to biodiversity and the risk of flooding and water shortages.
In such a difficult context it is therefore necessary to redefine the concept of territorial and urban transformation: *new international and national strategies* (research the characteristics of the cities, integrated and comprehensive approach that includes nature, economy, politics and culture, promote the development of medium-small cities and rural areas, improving building energy, sustainable mobility), *new governance*

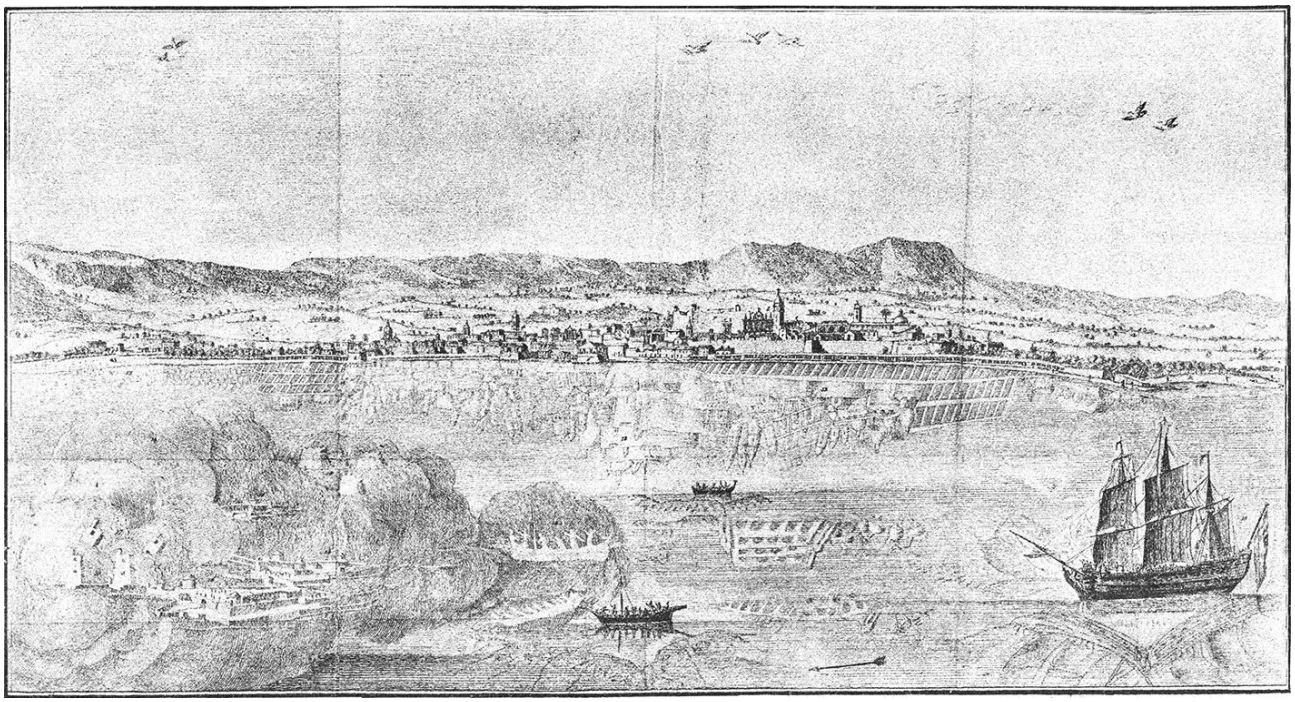

Fig. 1: View of the “Fata Morgana” phenomenon, drawn by Mario Baratta

models (targeted approaches on land and people, encourage the participation of citizens public decisions). The designer should relate to the problems of urban and territorial organization, analyzing them with a totally different mindset than in the past. The new kind of plan looks at the environmental quality, the reorganization and qualification of the settlement system and the modernization of systems of economic activities and related communication networks. Every city has different types of development so these must be pandered; this means that the European development has to be integrated with sustainable local economy models.
Sustainable urban development and ecological definitely passes through the **compactness**, i.e. to avoid land consumption and urbanization dispersed on the territory preferring the restoration of the existing buildings rather than new construction; socially, economically and productive **mixed** cities, avoiding single-purpose districts but favoring the coexistence of different social classes and activities in the same district so citizens can have services closer to themselves; **citizen participation** the city decisions; reuse of existing urban fabric recovering degraded and discontinued areas, reusing the existing buildings and redeveloping public and green spaces; **smart mobility**, with the strengthening of public transport, the establishment of new services such as car sharing and the creation of intermodal nodes; the design of eco-neighborhoods.
This paper is looking for a method that enhances, in entrepreneurship, the creative imagination of the young people through the screening and constant monitoring of solid experience. In expectation of new alliances between public and private, we want to propose new and purposeful collaborations between cultural foundations and entrepreneurial institutions. Combining established tradition and innovation projected towards the future, we try to describe the concept of a *new entrepreneurial culture* in order to achieve a more significant economic development in the Strait of Messina area. To achieve these aims it is exposed a "method" of intervention that starts from the construction sector and involves citizens and institutions - it extends the cultural concept of restoration to the new challenges on urban territory, proposing two priority objectives: the enhancement of the ancient buildings and the recovery and revitalization of degraded suburbs.

2. The case of the metropolitan area of the Strait of Messina [(1)]

The idea of an integrated area between Reggio and Messina has an important historical and cultural basis and, although they are now part of two distinct regions, actually the Strait of Messina has always been historically a single business and politics entity. We propose, therefore, to plan an intervention of development of the urban-rural network in the metropolitan area of the Strait of Messina through the recovery of the historical and cultural obsolete heritage and, consequently, lead to the strengthening of tourism that can provide a strong input for the economic development of urban and rural areas. The '"Metropolitan Area of the Strait of Messina" is the wide urbanized area that includes the towns of Messina, Villa San Giovanni and Reggio Calabria although, in the broadest sense, means all the territory between the two provinces of Reggio Calabria and Messina. The prospect of integrated development between Messina

and Reggio Calabria stem from multiple factors, both positive and negative. The basic idea starts from the positive development and economic growth that Reggio and Messina would have if they put together their own infrastructure, first of all, the ports of Milazzo and Messina, the institutions and the entire landscape and cultural heritage. We must not, however, underestimate the negative current situation, the causes of the underdevelopment of Reggio and Messina, and the differences that separate the two towns. The first step would be to establish a single public entity that begins to operate to bring the two realities in an increasingly compact way in all sectors: transport, trade, tourism, with their great industrial and commercial potential. Especially one of the means for the enhancement of the Strait can be the strengthening and encouraging the tourism and cultural sector thanks to the recovery of existing heritage of buildings, including private, and the strengthening of the exhibition spaces, connecting infrastructure, the creation of consortia and the study of a targeted planning. Tourism and culture are strictly connected and they have to walk together: tourism does not exist if the cultural element is not adequate and has not an excellent level.
Culture is not just museums. A typical sentence of inhabitants of Reggio is: “in Reggio we only have Riace bronzes”. They were wrong. It is true that the bronzes are a heritage with a global significance and that the National Museum of Ancient Greece - in which they are exposed - is one of the most prestigious archaeological museums of Italy, but it is also true that they, themselves, are not able to tow the whole tourist request of the territory. To date, the cultural heritage is minimally exploited, just think of all the archaeological assets locked up in warehouses or left open to the elements. All this material is not only important from a historical point of view, but it would be able to fill entire museums that may be located at strategic points so as to increase the areas of interest. *Reggio Calabria, the Ionian side, the area Grecanica, the Tyrrhenian coast, the Costa Viola, the Locride* - in Calabria - *Messina, Taormina, the Aeolian Islands, the Alcantara Gorges, the Peloritani, Nebrodi Park, the archaeological sites of Tindari and the many natural reserves* - in Sicily - are beauties that, connected in the right way, would lead to a very high tourist flow. And if we add to these elements those peculiarities such as agricultural, consist of a huge building heritage and gastronomic traditions worthy to be discovered, we would lead to be able to count on a invaluable capital. The recovery of rural buildings should be placed in a context of redevelopment of the campaign and repopulation of the small villages that recognize in tourism their raison d'etre. Then, we will add to the cultural "active" heritage (museums, churches, convents), the agricultural heritage. Community must be involved in this process by encouraging the private sector to renovate historic and valuable properties in order to put them back in the new cultural network. These will become part of the local economy thanks to the restoration and enhancement of the ancient structures, agriculture equipments and local crafts (cellars, mills, oil mills, ovens, etc.), that may be included in educational, cultural and recreational tours - "Museum of memory" and "schools of local tradition". Public and private sectors would develop, therefore, mutual benefits through their collaboration in a common sector, exploiting their potential to the achievement of objectives not only commercial but also cultural and social.

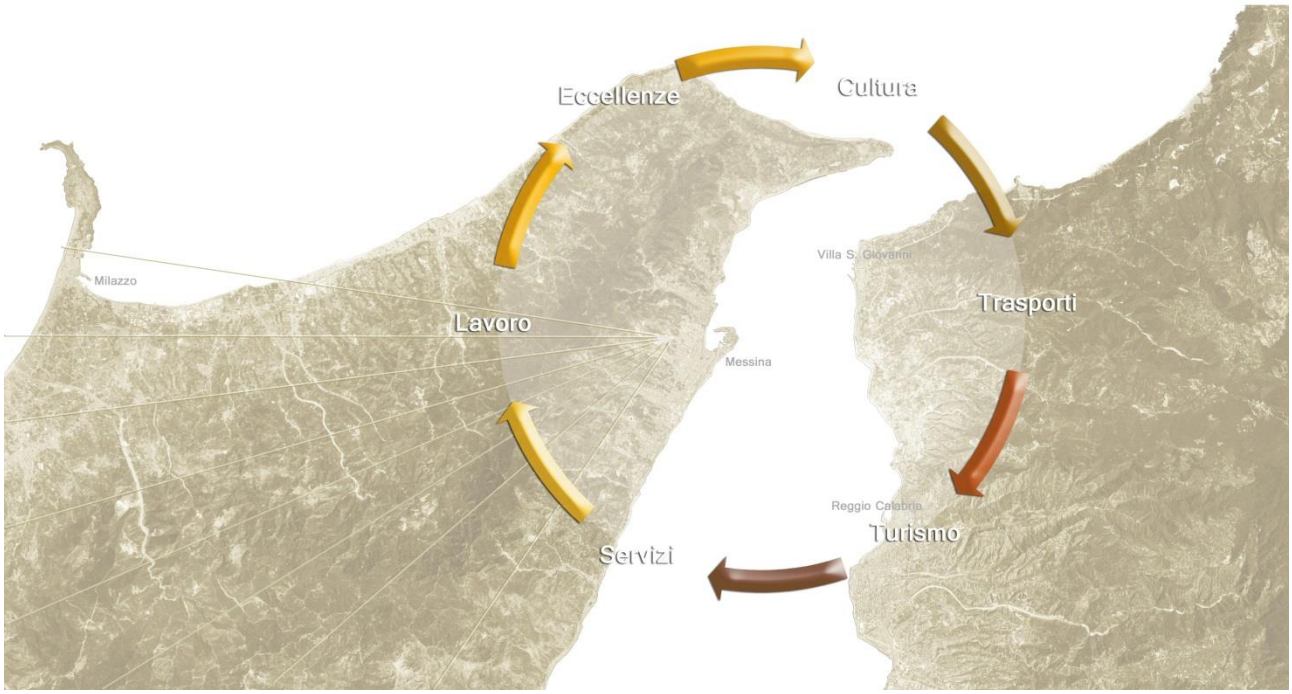

Fig. 2: Strengths of the Strait

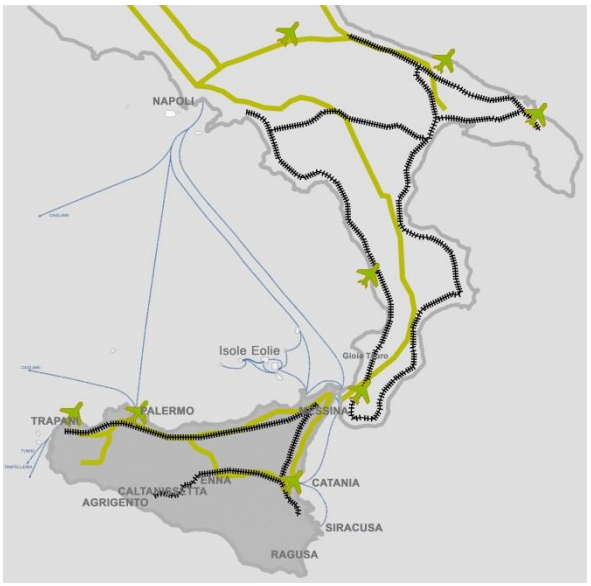

Fig. 3: Study of the motorway, rail, sea and air connections in the Southern of Italy

3. Academic literature, laws, initiatives [(2)]

The theme of this research is widely reflected in both the scientific literature and in numerous initiatives promoted by the institutions concerned, including municipalities, and Universities. Going into detail, the project consists of three parts: 1) mapping of architectural heritage and study of their formal and structural characteristics; 2) the redevelopment of the existing strategy in accordance with the new parameters of sustainable architecture and Italian and European energy certification; 3) strategies for community and institutions involvement.

3.1 Academic literature

The academic literature on this subject has been very prolific. In the research about Sicily and Calabria, and in the studies of the historical buildings we can find very interesting books and papers. Very important are the writings of M. Lo Curzio (*The architecture of Gino Zani for the reconstruction of Reggio Calabria / L'architettura di Gino Zani per la ricostruzione di Reggio Calabria*), A. Marino, O. Milella (*The celebrated catastrophe. Architecture and town in Reggio after 1908 / La catastrofe celebrata. Architettura e città a Reggio dopo il 1908*), M. Giovannini (*The maps of Reggio / Le carte reggine*), D. Colistra (*Reggio Calabria architecture and city / Reggio Calabria l'architettura e la città*), S. Valtieri (*December 28, 1908: the great reconstruction after the 1908 earthquake in the Straits / 28 dicembre 1908: la grande ricostruzione dopo il terremoto del 1908 nell'area dello Stretto*) and the book *For an Atlas of Calabria - Territory, historic settlements, architecture and cultural heritage / Per un Atlante della Calabria - Territorio, insediamenti storici, architetture e beni culturali*. In particular, the Atlas of Calabria analyzes and stores the historic centers and architectural artifacts, specifically ecclesiastical buildings and the volume edited by Professor Valtieri investigates, in a systematic and interdisciplinary modality, ways and outcomes of the Great Reconstruction in the Straits, using materials of the period and archival documents mostly unpublished.
From large scale research, you get to more specific volumes such as M. Fiorillo (*Metamorphosis of a city / Metamorfosi di una città*), which analyzes the building fabric and the transformations of the city of Scilla. Particularly for the Metropolitan Area of the Strait is important to mention F. Di Paola (*The town in parts - urban projects for the Metropolitan Area of the Strait / La città per parti – progetti urbanistici per l'Area Metropolitana dello Stretto*) and *The Short Century (1908-2008) - Proceedings of the conference / Il secolo breve (1908-2008) - Atti del convegno*.

3.2 Laws and protocols

The debate about the Strait has turned more and more into the new millennium, sensitizing the institutions that are committed to establish new regulations and protocols. It is important to mention:

- **D.Lgs n.42/2004**, amended by D.Lgs n.156 e 157 del 2006, about cultural heritage and landscape;
- **Statement UNI 11182/2006** which replaced Nor.Ma.L 1/88 about the relief of the state of conservation of stone surfaces, providing a definition of the main forms of alteration, accompanied by a photographic description to which follows the definition of the causes that led to the degradation;
- **Consolidated Housing D.P.R. 380/01 art. 3, paragraph 1, letter c)** on interventions aimed at preserving the building structure and to ensure their functionality through a systematic set of works that, respecting the typological, formal and structural elements of the building structure itself, allow use destinations compatible with originary.
- **Memorandum of Understanding for the area of the Strait between the Province of Reggio Calabria and the Province of Messina** in the 18 May, 2004;
- **L. 24 march 2014 n° 8** "Establishment of the free associations of municipal and metropolitan cities", approved by the Regional Assembly of Sicily.
- **ITACA Protocol** - assessment tool for energy and environmental sustainability of buildings approved on 15 January 2004 by the Conference of Regions and Autonomous Provinces. The Protocol, developed by the Interregional Working Group for Sustainable Building, with the technical and scientific support of iiSBE Italy and ITC-CNR, is based on the international evaluation instrument SBTool, created as part of the research process Green Building Challenge. Parallel to the national version, during the years, regions have been developed different versions of protocols that

implement specific regional policies. It is a tool that measures the level of quality of the building and its impact on the environment through a series of parameters that create an overall judgment on the intervention. It provides the basis for reworking the design ideas within a grid code, according to the criteria of environmental sustainability, from the conception to realization. The protocol is divided into criteria that describe, in a schematic way, the entire production process of the building: from the site of construction and consumption of resources, up to the maintenance manual. The protocol uses a rating scale ranging from -1 to 5 in which the 0 defines the minimum acceptable performance. The 0 level indicates the building practice that respects currents laws and regulations, while level 5 requires performance considerably advanced than those in force. It is applied in all the national territory; many regions have adopted and implemented the protocol. ITACA differs uses and types of intervention.

- Protocols Casaclima, LEED, SB10, SB100, inbar.

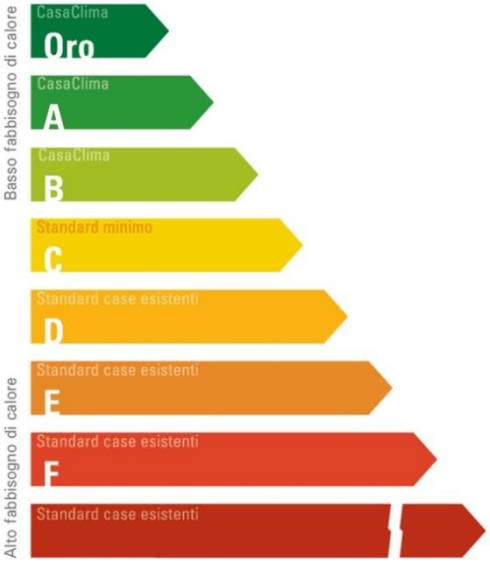

Fig. 4: Casaclima protocol

3.3 Initiatives and thematic workshops at the municipal level

In recent years, based on these regulations, it were organized many important seminar and debate such as the *Strait Area Laboratory / Laboratorio Area dello Stretto,* jointly organized by the University Mediterranea of Reggio Calabria dArTE Department and by the University of Messina. It was aimed to develop the main issues related to the creation of the integrated area of the Strait of Messina and in particular the role of cultural and economic aspects for the formulation of a sustainable regeneration context of the territory.
As for the single city of Messina, however, from 2012 were organized a series of thematic workshops called Pi.Co. in order to involve the citizens about the basic needs of the community. The Pi.Co. - Shared Plan / Piano Regolatore Condiviso is the process by which the City of Messina involved citizenship and many operators, State, region, and many others, for the preparation of the new urban planning instrument. The Administration has organized several meetings and debates open to all in order to incorporate suggestions to know in a direct way the Municipal reality. From these initiatives are born Laboratories "Environment and Landscape" and "Denied Areas" in order to study the weaknesses of the "city system" and to find shared solutions. These initiatives are a good starting point to determine the needs of the community and to study strategies.

4. Methodology and intervention strategy [(2)]

The recovery and integration represent a bet so demanding as essential in a country like Italy, rich in tradition and could contribute to the revival of the construction sector, tourism and the entire green economy. The strategy aims to achieve the objective of the protection and rehabilitation of built heritage focusing on the historical and cultural architectural heritage of the metropolitan area of the Strait. This trend, in addition to promoting the attractiveness of the area, is able to create a support to the diversification of the economy thus improving the quality of life and levels of employment.
The specific objectives to be pursued are:

- Creation of a database through the recognition and mapping of the historical buildings: museums, churches and convents, urban, rural houses and workshops.



Fig. 5: Scheme of the relationship in the EU and at the national and metropolitan level

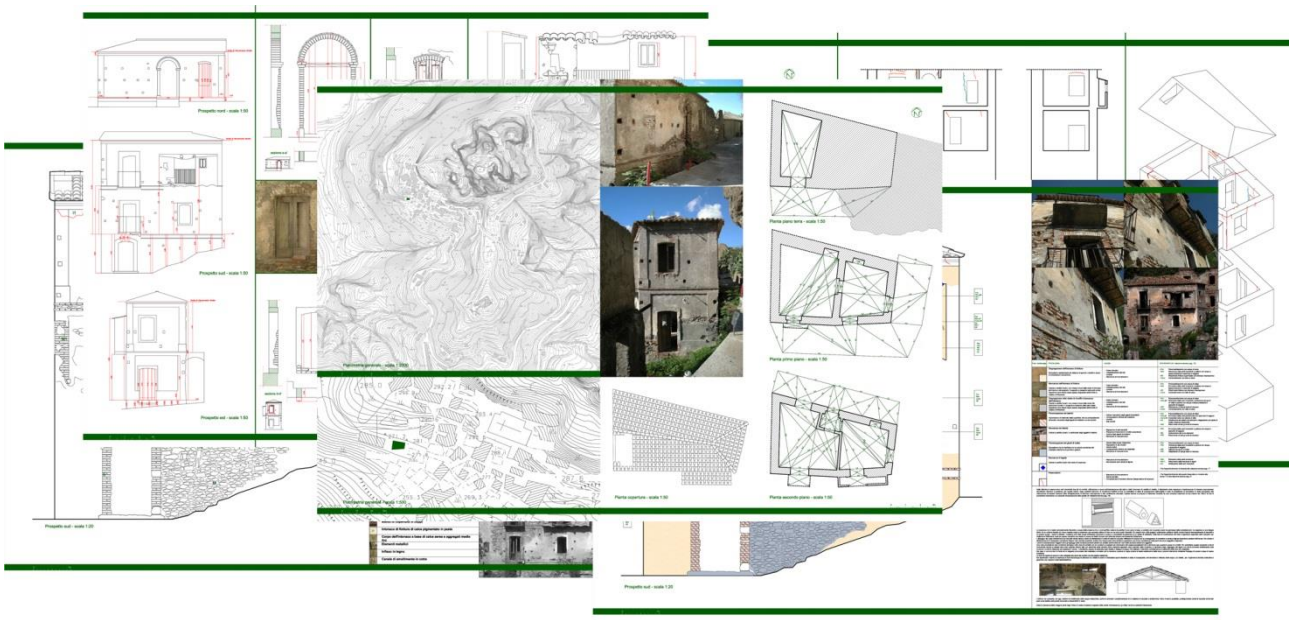

Fig. 6: Example of cataloging of historic buildings

- Preparation of management, redevelopment, restoration, protection and exploitation plans for this buildings.
- Study of access strategies to EU and national funds to engage the community and encourage the private sector to renovate historic and valuable properties, in order to put them back in the new cultural network.
- Promotion of an integrated tourism-information-communication networks that allows to recognize the structural weaknesses of the metropolitan area of the Strait and lead to the reinforcement and connection of accommodation facilities, hotels, airports, stations and improve the attractiveness of the territory.
- Sustainability and social utility.

4.1 Documentation and filing of existing buildings

The first phase to be implemented is the **mapping of architecture and environment**. This is of fundamental importance because this level allows to know the main conditions of the cultural heritage, so it is the first step in the study of appropriate solutions. This mapping is the basis for the creation of a geographic information system based on the integration of historical sources (registers and censuses), current sources of information (registry, land registry, censuses), academic sources (books and magazines), direct surveys, for the identification of the actual number of housing units, to the valuation of the most significant archaeological and the static condition of the buildings. The mapping process, already at an advanced stage, involves the identification of the buildings of historical and cultural importance through the development of type cards that show the location, floor plans, cadastral, history, elevations and sections, structure, maindegradations and materials. These sheets allow to have an overview of the structural characteristics of the buildings in order to study the standard recovery strategies that can be used for redevelopment punctual interventions.

4.2 Strategy of redevelopment of the existing buildings in accordance with the new parameters of sustainable architecture and Italian and European energy certifications

The second phase involves the actual **rehabilitation of the architecture and environment**. Recovery of archaeological hidden, design of new museums that could accommodate the new discoveries and ones that are not yet exposed because closed in deposits. **Restoration projects** through the existing reliefs of shapes and geometries, assessments on the structural characteristics, the study of the construction techniques, the nature of the construction materials, workmanship, useful to reconstruct the local customs, especially in a social and geographic area, like that of the Strait, highly subject to seismic phenomena.

The existing, especially the rural dwellings and rural laboratories, will be placed in a context of agricultural development through the creation of craft museums, laboratories of citrus processing, and recovery of small farms that can exploit the many land, now abandoned, and encourage people to return to live the campaign.

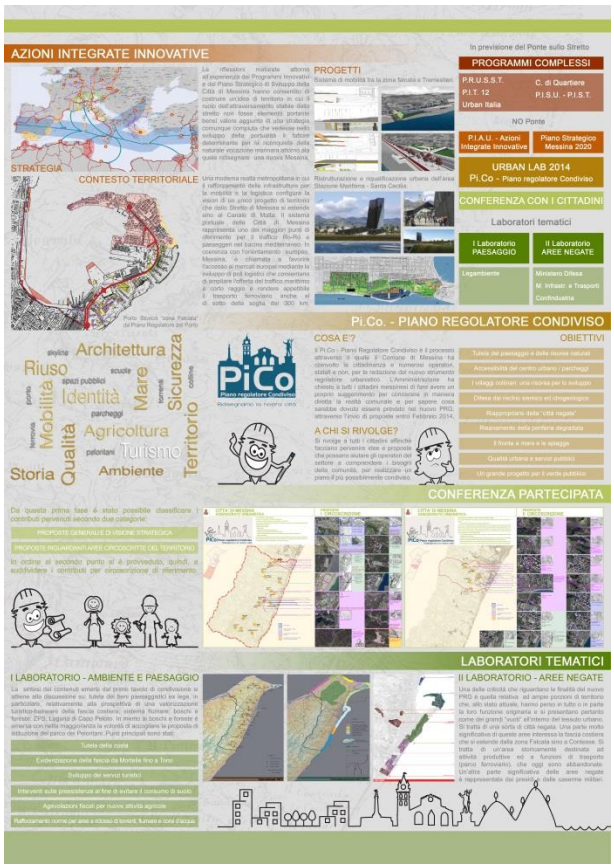

Fig. 7: Summary panel of thematic workshops Pi.Co of Messina (2014)

The improve of energy efficiency in buildings will be one of the major focus of the restoration and will certainly have to consider the current legislation and energy objectives that have been set in both the European and national level. The intervention should be mostly aimed to mitigate the impact of climate changes.

Cities, in fact, produce most of the greenhouse gas emissions; they consume over 60% of global energy production and they are not properly protected by natural and human risks. This leads to a profound reflection on the modern meaning of the project and should lead to a technological culture of environment and territory. The search for a new type of design leads to analyze the different levels of intervention - territory, city, architecture - placing in the concept of *techne*, i.e. to build with responsibility, a new interactive and procedural characteristic to interpret the relationship between nature and artifice.

Entrust to the project, transformative by definition, the task of preserving, it is not a contradiction; we have to consider the environment as a synergy between nature and human, a structure in constant evolution, which may change according to its intrinsic characteristics but that should not be upset by inappropriate interventions. The designer must take possession of a new ethics and develop a new *modus operandi* on the environment.

Sustainable architecture designs and constructs buildings able to limit the impact on the environment. It is a real cultural approach to the project. The principle of sustainability is based on the following principles: the awareness of the finite resources of the planet, the use of resources must not exceed their regeneration capacity, the input of pollutants do not exceed the environment's ability to metabolize them, the use of non-renewable resources should decrease gradually until it was replaced by renewable resources. Sustainability is also the search for constructive solutions that maximize the comfort of the users, ensuring, however, that future generations will be able to enjoy the same result. These principles are applied to the building throughout its life cycle: the extraction of the material and its transport, processing and transport to the construction site, the construction of the building, the period of use of the building, with installations and maintenance components, the divestment.

The building consumes energy, the management aspect is therefore one of the most critical. A solution is the study of solutions that minimize the presence of cooling and heating. An important example is the *passivhaus* that obtains the heat for heating from solar radiation, household appliances and by the occupants. The energy needed to balance the thermic budget is procured by thermal systems as heat pump, solar panels, etc; the shell is insulated and ventilation is used to control energy recovery.

The main points for the reduction of energy consumption are: 1) **bioclimatic approach** (site, sunshine, shade, wind), 2) the **insulation of the building** resulting in a reduction in energy requirements, 3) the use of **renewable energy** sources (biomass, geothermal, solar, micro wind), 4) **system efficiency**.

Fundamental are also the rational use of water resources, the use of bio-ecological materials, criteria of short chain, recycling and reuse.

For the success of this project, then, we will have to implement a constant research on materials, technology and manufacturing techniques that are important to design solutions that make the historic buildings lower impacting on the territory.

4.3 Strategies for community and institutions involvement

In order to implement a such important plan, the community must be involved in the work program. We will implement the process of participatory planning involving the collaboration of the various figures of the community (citizens and social groups, administrators and technicians), through moments of elaboration of ideas and needs. Within this context, the private sector must be an active part of the decisions in order to assess their interest. Thanks to the development of a public-private partnership, the government and local authorities on the one hand and the private sector on the other hand will be able to realize a joint project with

mutual benefits. The citizens must be enabled to obtain funding for the restoration of their historic buildings and they will be part of the profits arising from the inclusion of these assets within the public sector, in order to increase tourist interest points and to hold the attention to the touristic and cultural sector.
This planning depends, of course, from the **access to European funds**, in particular, for the period 2014-2020. The enhancement of environmental and cultural heritage is, in fact, the subject of significant investments for protection and renovation, in order to promote enterprise and employment. The **national cofinancing** is added at the European contributions, mandatory for European cohesion policies, for the Community funds.
This plan is, furthermore, subject to the increment of attractiveness through the creation of structured packages, communicable and salable in tourism sector in their different expressions and studying a variety of offerings to be disclosed with promotion campaigns to the national and international touristic points in order to enhance the new cultural network by increasing the level of quality of, and organizing a significant calendar of cultural, sporting and fair events.
In anticipation of what, we want to structuring a plan for integrated tourism that lead to the reinforcement of the hospitality network, supported by a common policy. thanks to the involvement of the sectors of urban planning, transport, public works, cultural heritage, the Area of the Strait will be capable of addressing different types of tourism as cultural, environmental, congress.

5. Conclusion: objectives and expected results [(2)]

The project aims to use a multidisciplinary approach to integrate historical and economic analysis of the territory, the search of local materials, the use of traditional building techniques and the development of new techniques that are put in an existing context.
The plan aims to provide a beginning point in order to create a program of extensive planning, going to affect more and more areas of the territory.
In this way the plan, in collaboration with the stakeholders, allows a conscious exploitation of the territory, of its architectural heritage, its historic buildings and its rural areas and, at the same time, thanks to the use of new technologies, the intrinsic characteristics of Sicily and Calabria will not be distorted.
This will lead to a process of urban regeneration that will trigger a virtuous circle that will include the area of the Strait in its entirety, with a positive influence for the other productive sectors too.

* paragraphs marked by [(1)] were written by Alessandra Maniaci
paragraphs marked by [(2)] were written by Gianfranco Salemi Scarcella

Bibliographical References

[1] AA.VV., *Per un Atlante della Calabria - Territorio, insediamenti storici, architetture e beni culturali,* 1ª ed. Roma, Gangemi Editore, 1993

[2] AA. VV., *Il secolo breve (1908-2008) – Atti del convegno*, 1ª ed. Reggio Calabria, CSd'A, 2009

[3] COLISTRA, D., *Reggio Calabria l'architettura e la città*, 1ª ed. Reggio Calabria, Jason Editrice, 1998

[4] DI PAOLA, F., *La città per parti – progetti urbanistici per l'Area Metropolitana dello Stretto*, 1ª ed. Reggio Calabria, CSd'A, 2007

[5] FIORILLO, M., *Metamorfosi di una città*, 1ª ed. Reggio Calabria, Gangemi Editore, 2013

[6] GIOVANNINI, M., *Le carte reggine*, 1ª ed. Reggio Calabria, Jason Editrice, 1995

[7] LO CURZIO, M. *L'architettura di Gino Zani per la ricostruzione di Reggio Calabria*, 1ª ed. Roma, Gangemi Editore, 1986

[8] MARINO, A., MILELLA, O., a cura di, *La catastrofe celebrata. Architettura e città a Reggio dopo il 1908*, 1ª ed. Roma, Gangemi Editore, 1988

[9] VALTIERI, S., *28 dicembre 1908: la grande ricostruzione dopo il terremoto del 1908 nell'area dello Stretto,* 1ª ed. Roma, Clear, 2008

[10] REPACI, A., *Il recupero del fronte a mare del centro urbano di Messina*, Thesis, Reggio Calabria, 2015

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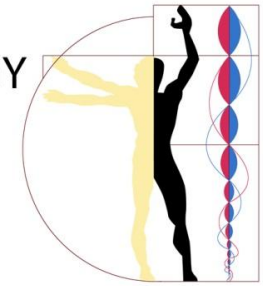

Revisiting residential architecture in the city of João Pessoa, Paraíba, Brazil

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Abstract
This article presents the digital methods employed in the approach and documentation of the residential architecture produced at the city of João Pessoa, in the state of Paraíba, Brazil between the eighteenth and the first half of the twentieth centuries. Founded in 1585, the city retains actual examples of residences proper to its various historical periods, making it possible to study how houses designed according to eclectic, neocolonial and *Art Déco* languages were planned, and to understand the different levels of production – the house for the elite and the popular house. Facing the scarcity of historical documentation about that architecture, though recognizing its value as city memory and heritage, digital resources for the registration and study of such residences are used by means of models produced from architectural surveys undertaken in existing residential units. Concerning those models, aspects such as location within the property, spatial configuration, access and volumetric shape are taken into account making it possible to make comparative studies and to understand the changes applied to those residences. That is the main objective of the present paper.

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Keywords: residential architecture, documentation, city of João Pessoa, digital models.

1. Introduction

This article deals with an experience that resulted from teaching and research on History of Brazilian architecture, more precisely about the residential architecture produced in the city of João Pessoa, State of Paraíba, Brazil, between the eighteenth century and the first half of the twentieth.

By attaching traditional investigation procedures – literature, documents and field survey – to digital modeling resources, the final objective of the work is to present a repertory of three dimensional models used for the study and registration of the residential architecture that has decayed by poor conservation and antiquity. The investigation research has been developed for three years, being based on research and teaching in the undergraduate course of Architecture and Urbanism at the Federal University of Paraíba, more specifically at the Project and Memory Research Laboratory (LPPM).

The research entitled “Profile of residential architecture in João Pessoa: history, form and way of living” has been coordinated by the authors of this article, being linked to an Institutional Programme of Scientific Initiation (PIBIC), addressed to undergraduate students interested in investigation. The main object is the residential architecture produced at João Pessoa, seen from a historic perspective, since there is evidence of changes in the way of living by the existence of residential typologies proper to different times if one goes through the streets and avenues within the city.

As to the teaching activities, the experience comes from the disciplines linked to History of Brazilian Architecture, where students search to explain the spatial configuration and building systems of

edifices through the elaboration of 3D models. This exercise resulted from the verification that photographic images did not provide conditions for students to comprehend volumetric shape, plan configuration and structure of the houses. Therefore graphic programme resources have been applied for the construction of those models, thus going beyond the limitations of traditional teaching methods.

In order to best understand the city of João Pessoa and expose results from the study of its residential architecture, this paper has been structured in three major topics that will be presented as follows.

The city

Before addressing the residential architecture produced in João Pessoa during the period in question, it is important to understand the historic context within which it was born and to explain the process of expansion and urban change that happened up to the first decades of the twentieth century. In order to best place the description to be made, a map of the city from 1940 has been used so as to indicate the different areas that will be referred to in the course of the present paper (Figure 1).



Figure 1 – Plan of João Pessoa, produced by *Departamento Estadual de Estatística* in 1940. The areas and spots that are crucial for the study are indicated above the image.

Source: SOUSA e VIDAL, 2010.

A – Upper and Low Towns

B – Tambiá

C – Trincheiras

D – Solon de Lucena Park and surroundings

E – Epitácio Pessoa Avenue and surroundings

1 – Sanhauá River

2 – Lagoon at Solon de Lucena Park

3 – Torre

4 – Epitácio Pessoa Avenue

5 – Tambaú Beach

Originally established by the Sanhauá River, the city entered the twentieth century still maintaining characteristics inherited from the colonial period, when its occupation was restricted to two sectors set apart by different site topographies: the Upper Town – administrative, religious and residential center – and the Low Town – where commercial and port activities where set (area A). During three centuries, one-storey houses and two-storey dwellings with equal front compositions characterized the place.

Some natural barriers made it difficult for the urban grid to expand, in particular the Irerês Lagoon, located to the East of the main streets of the Upper Town. Those barriers were crucial for the setting of two paths for city expansion in the end of the nineteenth century: Tambiá and Trincheiras, which consolidated as important suburbs after the establishment of the tramway in 1896 (areas B e C). Wealthy families searching for better ways of living moved towards those urban routes, thus leaving the antique and crowded areas of the city condemned by the new sanitary codes. In greater lots, those families built charming dwellings that reflected the status of a bourgeois society enriched by the cotton culture whose desire for modernity was expressed by both the eclectic and the neocolonial, or even the *Art Déco* languages, which had a close coexistence in João Pessoa.

Whilst those architectural languages were introduced, the city changed to meet the sanitary ideas, the need for circulation and the desire to make it beautiful, thus diminishing the traditional image of the past. As best argued by Guedes (2006), the changes of urban space were few up to the first decade of the twentieth century, though between 1910 and 1920 they were more frequent due to the public income generated by the cotton culture, which represented more than a half of the State of Paraíba revenue.

In1913, the sanitarian engineer Saturnino de Brito was hired by the government to project a drainage plan complementary to the water supply system inaugurated the year before. The project included the urbanization of the Irerês Lagoon and the occupation of the area located between the suburbs of Tambiá and Trincheiras (area D). The project was not totally executed due to both the economic crisis resulting from the 1915 drought and the cotton culture decline. Notwithstanding it represented a mark of public power change, as the State started investing in an effective planning towards city expansion.

The plan of urbanization of the Lagoon area was readdressed in 1932, through a project by urbanist Nestor de Figueiredo, who wished to link the “existing city” to the “future city”, result of his proposal for the expansion of João Pessoa urban grid (VIDAL, 2004). In his planning the Irerês Lagoon was urbanized and called Solon de Lucena Park, thus attracting the most imposing residences built at the time and representing an irradiation point for the streets that defined the city growth towards seaboard and to new suburbs such as Torre.

Nevertheless Epitácio Pessoa Avenue had already been initiated in 1920, attempting to link the city to Tambaú Beach, where there was a fishermen community and wealthy families enjoyed the summer vacation. Up to the 1940’s the sides of the avenue had been occupied in a disperse way but that evidence changed as soon as the avenue was paved for the first time in 1952. From that time onwards the avenue was quickly valorized and new suburbs were established in its vicinity, some of them originated from official dwelling schemes by State Government (COUTINHO, 2004). By means of those incentives that city area started attracting medium and medium-high classes seduced by urban services and by the proximity to the seaboard (area E).

That was the city in the midst of the twentieth century, where the residential architecture produced during those past fifty years passed through great changes thus blending late eclectism to all the expressions that characterized the period: *Art Déco*, neocolonial and the first versions of modern architecture. It is precisely that architectural production the aim of the present research.

2. The research

The investigation is based on two solid justifications: the abandon, mutilation and destruction of many examples of residential architecture located in city areas considered (and protected), as “historic centre”, and furthermore the loss of that repertory without its being properly studied. Therefore, while the problem is exposed, the proposition to develop the research is best justified, attempting to register that specific architecture that reflected the organization of society and its changes throughout time.

Methodologically the main reference used is the book entitled *Quadro da Arquitetura no Brasil* by Nestor Goulart Reis Filho, where the author identifies the characteristics that differentiate each period of production, from the colonial period doubled dwellings up to the radical change in the way of living attained by the modern city. The book has been used as a basic reference up to now, thus directing the methodology of this research as it considers the following aspects: the evidence of society and its way of living; the formal expression that met both the aesthetic component and the redefinition of spatial configuration according to actual needs; the result of modern building systems and the qualified professionals that dealt with it; and the response to urbanistic conceptions and spatial mutations that occurred within the city.

Once defined the method and the parameters for analysis, the results obtained in the research are exposed, beginning with the difficult task to study the residential architecture from colonial period since most of the units have disappeared and the documentation about it is very scarce.

In a general sense, it is known that this architecture has not differed much from what historiography has identified as a colonial house: doubled, built in narrow and long lots, aligned over the front border, and covered according to two gables – one directed to the street and the other to the back of the lot, the so-called back yard. The programme for the houses was very limited, being composed by living-room, bedrooms, family room and kitchen. The circulation occurred by means of a longitudinal side corridor that extended from the entrance door to the back of the edifice. As Reis Filho (1987, p. 22) best stated, Brazilian villages and cities "had streets with unified aspect" defined by residential houses that little differentiated from one another, some being one-storeyed and others two-storeyed (Figure 2). The details from those examples will be presented through the digital model.

Only in the first decades of the nineteenth century the first expression of architectural change emerged: the high-basement house. According to Reis Filho (1987, p. 33), that house came to be a "new type of residence", characterized as "a transition between the old two-storey dwelling and the one-storey house".

At the end of the nineteenth century and beginning of the twentieth the local society was attracted by the eclectism, an architectural language recurrent in the main Brazilian urban centres. In the meantime sanitarian ideas steered the formation of an urbanistic thinking within Brazil, guiding the modernization of cities from principles of sanitation, circulation and embellishment. That rhetoric shaped architecture, and the houses had to be adequate to the same sanitary principles that molded urban modernization, imposing the construction of houses set with front and side backing, making lighting and ventilation possible. Those procedures completely broke the old dwelling scheme of doubled houses erected over the lot front line, thus consolidating evident differences between city antique areas and the new suburbs created in the beginning of the twentieth century.





Figures 2 and 3 – Colonial period two-storey house and eclectic "small palace".
Source: Laboratório de Pesquisa Projeto e Memória / UFPB. Photo: Maria Berthilde Moura Filha, 2010.

Those changes can be perfectly noticed in João Pessoa if one takes into account the remaining architecture in the streets of Tambiá and Trincheiras. In those localities, houses were progressively released from their lot borders, turning into real "small palaces" – term created by Lemos (1985) to qualify the imposing residential edifices erected at the time. To that new procedure of construction of houses within the lot and their new spatial configuration was added the society will to follow the European architectural models that best expressed progress and civility (Figure 3).

With the proximity of the commemorations for the Centennial of the Independence, the cultural and artistic expressions recurrent in Brazil start being questioned as well as the possibility of an art and architecture being produced in a national context, without foreign interferences. In that sense, it was unquestionable the contribution of Ricardo Severo and José Mariano Filho: the former, a Portuguese civil engineer who defended the Lusitanian component in the production of an essentially Brazilian architecture (PINHEIRO, 2011:35); the latter, responsible for the diffusion of the new formal language,that attracted architects for incursions in the rich colonial heritage from the cities of Minas Gerais, among whom stood Lúcio Costa, important name for Brazilian modern architecture (ATIQUE, 2010: 209).

Nevertheless Lusitanian-Brazilian neocolonial was not the only architectural version that marked the production of residential buildings in the first half of the twentieth century; another language of neocolonial roots also was consolidated in theational context – the so-called Mission Style, Originated in the region of Spanish colonization within the United States and generated by the same nationalist feeling that guided the movement in Hispanic countries, the language had other versions that were named according to their specific characteristics such as: Mexican Style, Californian Style, or simply Hispanic-American (ATIQUE, 2010: 223). It was brought to Brazil by Edgar Vianna, architect graduated from the University of Pensilvânia (BRUAND,1987: 57), who first introduced elements of that architecture in Rio de Janeiro, following a policy of "good-neighborhood" between Brazil and United States at the time.

In Brazil Mission Style was absorbed mainly by the medium-high class that erected edifices set in big lots located in the new routes of expansion within the cities. Those buildings were generally two-storey and were highlighted by a diversity of covers and the presence of a circular or poligonal tower where a helicoidal staircase was set. Gothicizing arches and false chimneys and fountains equally composed the Mission Style architecture, inspired in the composition of the twenty-one Franciscan missions established in the region of California, Texas and New Mexico during Spanish colonization.

Those versions were accessible by means of almanacs and catalogues specialized in residential projects, some of them from American origin, others already published in Brazil, such as Luiz Muzi's edition entitled *Arquitetura e Construções* dated 1946. According to a similar process of divulgation another architectural typology was consolidated as a modern dwelling prototype in Brazilian cities – the bungalow. Of Indian origin (WILSON, 1910:3) and largely reproduced in California after having visited England, the bungalow had a great acceptance in Brazil, due to both the economic factor (as the construction had one storey, was simple, informal, and characterized by apparent materials); and its component of functionality and comfort (as it was an edifice provided with tall gables and varandas, which were adequate solutions for tropical countries).

In the city of João Pessoa, the above mentioned neocolonial languages had great results, following their turnouts in the big Brazilian cities at the time. The Lusitanian-Brazilian neocolonial had examples both in traditional city areas and in the routes for city expansion such as Monsenhor Walfredo Leal Avenue, where a residential house provided with indicators of the language (volutes, pinnacles, curved front) still remains (Figure 4).

The Hispanic-American neocolonial in turn was present both in pre-existing areas that underwent an urbanization process, as the outer ring of Solon de Lucena Park, and in newly-opened routes such as Odon Bezerra Avenue, at Tambiá (Figure 5), or Capitão José Pessoa Avenue, at Jaguaribe. In all the cases the residential edifices were of great quality, attending an economically privileged social class.

The bungalows, in turn, were set in smaller lots, constituting less ambitious dwellings, proportional to the social class of their owners. Though they were provided with morphological elements proper to the magazine models from which they were copied. Located in the city centre, Diogo Velho Street still presents remaining units of the language (Figure 6), as well as José Peregrino Street (Figure 7), both provided with morphological quality.





Figures 4 and 5 – Examples of Lusitanian-Brazilian and Hispanic-American neocolonial.
Source: Laboratório de Pesquisa Projeto e Memória / UFPB. Photo: Ivan Cavalcanti Filho, 2012.





Figures 6 and 7 – Examples of bungalows.
Source: Laboratório de Pesquisa Projeto e Memória / UFPB. Photo: Ivan Cavalcanti Filho, 2013.

It is important to stress that the three languages applied to residential use totally met the modern proposal of habitableness. The minor programme that ruled those medium-class houses was practically the same: terrace, living-room, dining-room, three bedrooms, dinette/kitchen, garage and service sector (at times detached from the main body of the house). The volumetric proposition guided the typological identity of the construction.

Between the 1930's e 1950's, it was the *Art Déco* that highlighted the city landscape, being present either by the renovation of old façades, searching to modernize them, or by means of projects of new edifices. Without escaping from the formal resources that characterized the language throughout Brazil, the *Art Déco* in João Pessoa also made use of staggered compositions, aerodynamic shapes, and the repertory of marquises, balconies, ornates in high and low relieves representing geometric forms or simplified floral themes (CORREIA, 2010).

As an architectural language that expressed modernity, the *Art Déco* was diffused and conquered popular taste, being present in all suburbs that composed the city from the second quarter of the twentieth century. In the elegant suburbs it followed projects of architects, thus attending modern codes for construction that proposed edifices detached from their lot borders, provided with discrete volumes including cylindrical elements and entrance terrace over which stood a solarium (Figure 8). According to that scheme the language was produced at Trincheiras and Tambiá, whilst at Torre and Jaguaribe, the house owners reproduced characteristics of easy execution: façades composed by strips in relief, staggered platbands, and simplified ornamentation (FARIAS, 2011).

Finally, following the history of João Pessoa city, modernism came through the professional activity of architects such as Acácio Gil Borsoi, from Rio de Janeiro, and the local Mário di Láscio (Figure 9), who were present with projects of modernist houses located in areas of expansion in the middle of the twentieth century, or were held responsible by the first skycrapers within the city, amongst which stand João Pessoa Building, an emblematic reference planned by architect Ulysses Burlamaqui in 1957, but only concluded around 1962.





Figures 8 and 9 –*Art Déco* and modernist houses.
Source: Laboratório de Pesquisa Projeto e Memória / UFPB. Photo: João Araújo Leite, 2013.

From what has been argued, it becomes evident how the residential architecture at João Pessoa was produced up to the first half of the twentieth century, being structured according to a diversity of languages all based on one spatial matrix – the one that unconditionally met the requisites of modernity, comfort and good living.

3. The digital models

Amongst the produced models, the construction of the one-storey house produced during the colonial period was the one chosen. Though altered, some exiguous examples still remaining in the main streets of the High Town and Low Town were taken as references – those located at Rua Nova, Rua Direita (today General Osório and Duque de Caxias) and Rua da Areia.

In that case, considering the most antique houses within the city, the challenge to reconstitute how those dwellings were like in the past can be compared to the act of sewing a crazy quilt. Before the difficult task to understand those residential units, they were studied according to the only viable way: by selecting examples that are still provided with characteristics from the residential architecture proper to the seventeenth and eighteenth centuries, and by analyzing them in the light of the data obtained from the scarce documentation and the historiography of Brazilian architecture.

Thus, considering the information gathered for the composition of the residence, a house located at General Osório Street was selected. Though altered, its façade still addresses the colonial house pattern, being composed of one door and two windows. Not by chance the house is inserted in one lot that was proper to colonial towns, having a narrow front and a considerable length. From that selection the data started being gathered – the façade composition was obtained from graphic and photographic survey whilst the lot dimensions were got from the city plan ceded by the municipality and the disposition of the gables from the building itself (Figure 10 and 11).





Figures 10 and 11 – Façade and cover of the house located at General Osório Street.
Source: Laboratório de Pesquisa Projeto e Memória / UFPB. Photo: Maria Berthilde Moura Filha. 2014.

Once defined those data referring to outside aspects of the house, the model started being built, observing the dimensions of the property and of its façade as well as its openings and frames. The closures of doors and windows with double sheets, the external with latticework and the internal with blind board both resulted from information obtained from historiography (VAUTHIER, 1981; RODRIGUES, 1979) The plat band, typical from the end of the nineteenth century, was also replaced by a cornice solution proper to colonial houses – the *beira sobeira* (CORONA e LEMOS, 1989). The volumetric mass and the disposition of the cover were both defined from data obtained in the building itself and through the literature, as it offered parameters of dimensions for the elaboration of the wooden structure that supports the thatched roof (VAUTHIER, 1981).

Considering the internal configuration of the house, the chosen building little contributed for the model due to the changes it has undergone. Therefore, it was from the relation between the façade composition and the type of floor plan described in the literature that one could pursue an idea of what the house interior was like.

In João Pessoa most of the one-storey houses that still exist have one door and two windows in their façades, corresponding to the floor plan type characterized by a corridor adjacent to one of the side walls. Those units where then known by the historiography as “half-dwelling”, where all rooms were linked at the side by one corridor (CORONA e LEMOS, 1989, p. 318).

As to those referred rooms, they composed a very simple programme of needs, being limited to a living-room, the bedrooms, the family room and the kitchen, as stated above. Concerning that programme, it is important to register what the French engineer Vauthier stated about the houses at Recife, "Hence, those who have seen one Brazilian house, have seen almost all of them" (VAUTHIER, 1981, p. 37)

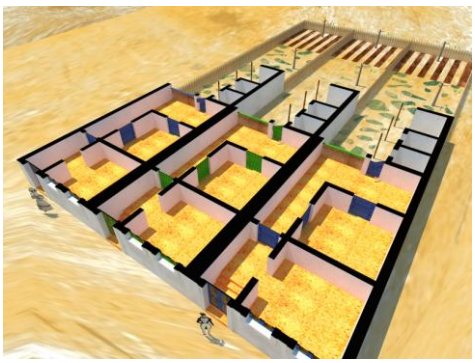
That statement is reiterated by Reis Filho and Lemos, who were unanimous to attest that, as houses were doubled and erected within narrow and long properties, the disposition of rooms could not vary too much and “the floor plans, let to the taste of the owners, were always very monotonous” (REIS FILHO, 1987, p. 24).

From that data and the plan schemes made for the study of residential architecture in other Brazilian realities, one can establish an association with the few physical records available from the house in question at João Pessoa.

Bound for the man and his guests the living-room took advantage of the windows that opened to the street. Concerning the use of that room for the purpose of “some artisan workshop or even a shop” (LEMOS, 1996, p.32), there is no evidence in the case of João Pessoa. The bedrooms that came afterwards opened to the corridor or between themselves in case they were too many. At last came another space basilar for the quotidian of the family – the varanda or family room that opened to the back yard to get natural lighting and ventilation. That was the space where women spent most of the day in their home tasks, in companion with the children and maids. Beyond those stood the *puxada* with the kitchen and other service spaces, equally directed to the backyard (Figure 12 and 13).

In general the back yards were of fundamental importance to the quotidian life of the population during the colonial period, as they were bound for the raising of animals and the cultivation of products for subsistence by means of vegetable gardens and orchards (Figure 14 and 15).





Figures 12 and 13 – Digital model of façade and spatial configuration of a colonial house, based on the data obtained from literature and from the residential building located at General Osório Street.
Source: Laboratório de Pesquisa Projeto e Memória / UFPB. Modeling: Alexandre Magno do Nascimento Segundo e Gilson Frreira de Barros Filho. 2015.





Figures 14 and 15 – Digital model of the setting of the house within the property and view of the back yard, based

on the data obtained from literature and from the residential building located at General Osório Street. Source: Laboratório de Pesquisa Projeto e Memória / UFPB. Modeling: Alexandre Magno do Nascimento Segundo e Gilson Frreira de Barros Filho. 2015.

Therefore, amongst information available *in loco* and conjectures about a house that has lost much of its original configuration, the one-storey house type that was most recurrent in the old João Pessoa city was reconstituted. The veracity of the model cannot be confirmed, but it can be certainly used as a proximity to a distant reality as well as an exercise of thinking about built space, materials and building systems from the past.

5. References

ATIQUE, Fernando. *Arquitetando a boa vizinhança*: Arquitetura, cidade e cultura nas relações Brasil-Estados Unidos 1876-1945. São Paulo: Pontes Editores, 2010.

BRUAND, Yves. *Arquitetura contemporânea no Brasil*. São Paulo: Ed. Perspectiva, 1987.

CORONA, Eduardo e LEMOS, Carlos. *Dicionário da arquitetura brasileira*. São Paulo: Artshow Books, 1989.

CORREIA, Telma de Barros. O *Art Déco* na Arquitetura Brasileira. **Revista UFG**. Julho 2010. Ano XII, nº 8. p. 14-18.

COUTINHO, Marco Antônio Farias. *Evolução Urbana e Qualidade de Vida: O caso da Avenida Epitácio Pessoa.* Dissertação (mestrado). João Pessoa, 2004.

FARIAS, Fernanda de Castro. *Arquitetura em transformação, cidade em expansão: o Art Déco na João Pessoa de 1932-1955.* João Pessoa: UFPB, 2011. Dissertação do Mestrado em Arquitetura e Urbanismo – PPGAU.

GUEDES, Kaline Abrantes. *O ouro branco abre caminhos: O algodão e a modernização do espaço urbano da Cidade da Parahyba (1950-1924).* Dissertação (mestrado). Natal, 2006.

LEMOS, Carlos. *Alvenaria Burguesa*. São Paulo: Nobel, 1985.

LEMOS, Carlos. *História da casa brasileira*. São Paulo: Contexto, 1996.

PINHEIRO, Maria Lúcia Bressan. *Neocolonial, modernismo e preservação do patrimônio no debate cultural dos anos 1920 no Brasil.* São Paulo: Editora da Universidade de São Paulo/FAPESP, 2011.

REIS FILHO, Nestor Goulart. *Quadro da Arquitetura no Brasil*. São Paulo: Ed. Perspectiva, 1987.

RODRIGUES, José Wasth. *Documentário Arquitetônico*. Belo Horizonte: Ed Itatiaia; São Paulo: Ed. da Universidade de São Paulo, 1979.

SOUSA, Alberto; VIDAL, Wylnna. *Sete plantas da capital paraibana, 1858-1940*. João Pessoa: Editora Universitária da UFPB, 2010.

VAUTHIER, Louis Léger. Casas de residência no Brasil. In. *Arquitetura Civil I*. São Paulo: MEC – IPHAN - FAU/USP, 1981.

VIDAL, Wylnna Carlos Lima. *Transformações urbanas: a modernização da capital paraibana e o desenho da cidade, 1910 -1940.* Dissertação (Mestrado). João Pessoa, 2004.

WILSON, Henry L. *The Bungalow Book*. New York: Dover Publications, 1910).

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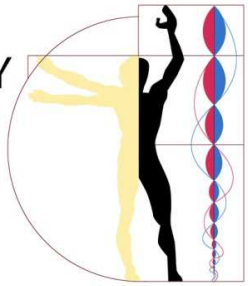

Development of a database using GIS technology: study and intervention in vulnerable neighbourhoods

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Abstract
The aim of this study is to apply criteria of urban management linked to geographic information systems for the regeneration of vulnerable neighbourhoods. It focuses for this purpose on affordable housing developments in the form of estates built in Zaragoza (Saragossa) during the nineteen fifties and sixties, which have developed certain aspects of physical and social obsolescence over time.
The methodology consists of the design of databases using graphics software in order to visualise the data on a map of urban land surface characteristics. The method proposes the following steps:
1. Background information on the studied housing estates.
2. Study and collection of indicators, standards and specifications that regulate and guarantee interoperability of the mapped information in Spain and the rest of Europe, in order to ensure dissemination and suitable reuse.
3. Obtention of basic map, and processing to adapt to the previously defined graphic standards and criteria using geographic information systems (GISs). For the purpose of distribution and in anticipation of further processing of the information obtained, free, open source GISs will be used.
4. Incorporation and configuration of the mapped data as a database to house the graphic or alphanumeric information generated for study.
5. Completion of adjustment and debugging of the entire database, increasing its versatility and functionality.

Keywords: GIS, affordable housing, Zaragoza, Indicators

1. Introduction
In the wake of the fratricidal Spanish Civil War that took place between 1936 and 1939, there was an urgent need for the construction of housing, particularly in industrialized parts of the country where the exodus of population from rural areas was aggravating the housing shortage. Although Zaragoza was spared widespread destruction of its housing stock [1], it was strategically located among Spain's main industrial hubs, which made it an important destination for inward migration. When the shortage of dwellings reached a critical level, the population was forced to turn to self-building and the creation of informal settlements. As a solution, a series of measures was put in place, not only in Zaragoza but throughout Spain, for the construction of housing estates under the auspices of the national institute of housing, the *Instituto Nacional de la Vivienda (INV)*. Many of these estates, built in a very short space of time and with poor quality construction, were developed in the form of self-sufficient neighbourhoods as a short to medium-term solution to the problem. However, the levels of comfort with which they were designed far from satisfied today's minimum standards, resulting in high levels of deterioration in these spaces, some of which have even been found to be a state of total neglect. As explained by N. Cervero [2], these dwellings have been subject to premature ageing, while the type of

resident and style of habitation has also evolved. In spite of the differences in type [3] and design [4], of these estates, and in the entities responsible for their development [5], they all present the same problems, which makes it logical to study them as a whole, from the viewpoint of evaluating different means for their rehabilitation or intervention.
The current master plan for Zaragoza, dating from 2001, classifies these housing estates as *Conjuntos Urbanos de Interés* or conservation areas. In 2004 Zaragoza City Council, through its housing organization *Sociedad Municipal Zaragoza Vivienda (SMRUZ)*, established the methodology for in-depth analysis of the physical and social situation of the city's districts and neighbourhoods, and put into practice a long-term intervention with criteria for innovation, connection and environmental sustainability. Four pilot interventions were later carried out in order to verify the effectiveness of the intervention model.
This study aims to shed light on this subject from the perspective of urban management and geographic information. Before commencing, we describe the 21 estates classified as conservation areas, which were the object of a design competition held by SMRUZ [6], out of the 26 such areas classified in the Zaragoza master plan. These are ordered chronologically in order to analyse the evolution of these types of developments.

2. Description of the conservation area estates

Dating from 1945, the *Augustín Gericó* Estate was the first to be built. It was developed by the *Montemolín* Board of Religious Works and Zaragoza City Council for 95 families in the *San José* district.
The *Picarral* Estate was built in 1949, developed by the Municipal Institute of Housing of Zaragoza, in the *Arrabal* district. The 120 dwellings have a reduced floor space of 40–50 m^2, with priority given to bedrooms over living areas. Their construction involved the erection of load-bearing walls perpendicular to the façade and timbrel (masonry) vaults. There is little doubt that the shortage of building materials, such as iron, characteristic of the period in which they were built, led to the use of traditional techniques and a large, unskilled workforce.
The *Parcelación Damán* Estate was also built in 1949, but for profit by a private developer, *Obras y Construcciones Damá*n. This development in the *La Jota* district consisted of 191 terraced, single-family dwellings standing on small individual plots. It was built to provide access to the city for the rural population.
The *Vizconde Escoriaza* Estate was built in 1950, also on private initiative although not for profit. The estate was developed to house workers of the prosperous company, *Tranvías de Zaragoza*, owned by the family after whom the estate was named. The estate was built in the Las Fuentes district, and consisted of 124 dwellings in apartment blocks located in rows along the edge of the plot, leaving an interesting open space in the centre, where a church was erected.

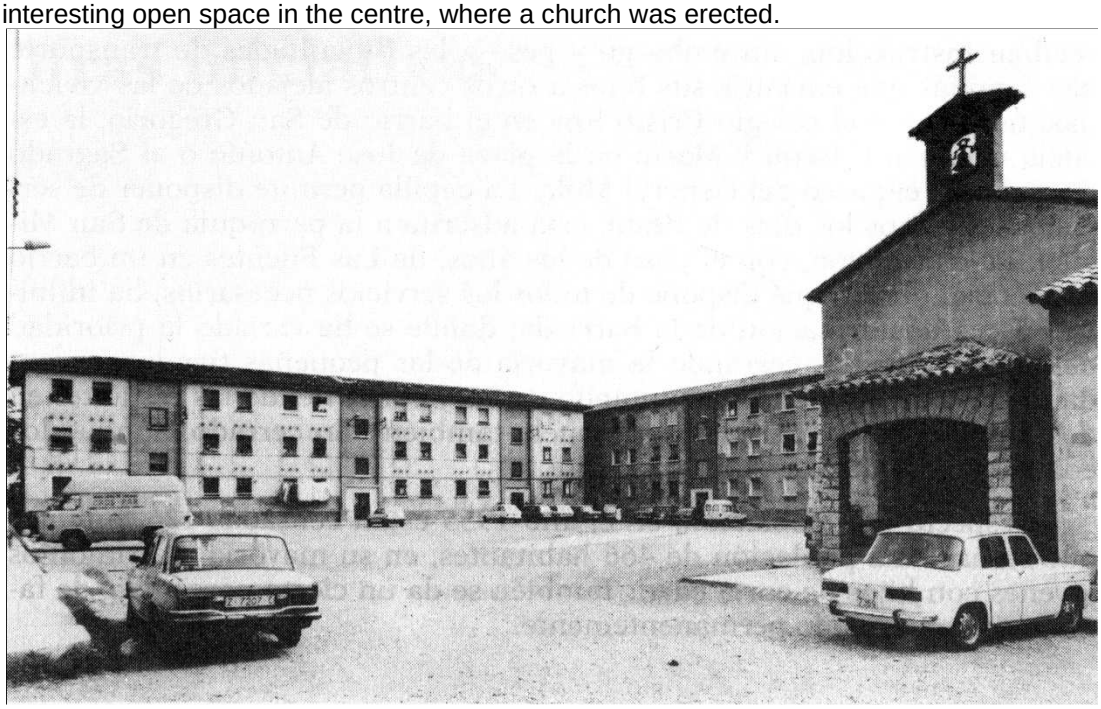

Fig. 1: View from the open internal space (MARTÍ NASARRE DE LETOSA, A. *La vivienda obrera en Zaragoza: 1939-1947*. Zaragoza: Ayuntamiento de Zaragoza, 1994. Cuadernos de Arquitectura 64).

The *Puente Virrey Tejar* Estate, built in 1953, was given its name owing to its location in the *Calle del Tejar*, to distinguish it from the other estate located in the same area of the *San José* district. The small estate comprising 46 homes was privately developed by the company *Hijos de Dámaso Pina*.
The *Arzobispo Domenech* Estate was built in 1954 in the *Oliver* district to house 256 families. It was the first to be built in the city by the most prolific of developers, *Obra Sindical del Hogar y de Arquitectura (OSH)*.
The *Hogar Cristiano* Estate, in the *Delicias* district, was completed in 1955 and financed by the private not-for-profit developer of the same name.
The *Venecia* Estate was completed in the same year as the previous one and was also developed by *Hogar Cristiano*. The estate is located in the *Torrero* district and comprises 124 terraced, single-storey, single-family houses standing on small individual plots. Its design is reminiscent of a rural settlement.
The *San Jorge* Estate was built in the Delicias district in 1955 in two phases, consisting of 248 and 210 dwellings, respectively. It was also developed by *Obra Sindical del Hogar y de Arquitectura (OSH)*.
The *Coronel Roig* Estate was built in the same year and by the same developer as the previous one. In addition to its smaller size, 96 dwellings, its location is quite particular, as it was built in the outlying rural district of *Casetas*, some 15 km from the centre of Zaragoza.
The *Girón* Estate was built in the *Las Fuentes* district in 1955 and 1957 in two phases, also by the developer *Obra Sindical del Hogar y de Arquitectura (OSH)*. It is a high-density estate containing 790 dwellings. Phase 1 was laid out in rows of mostly parallel apartment blocks, with undefined uses given to the open spaces; while Phase 2 occupied a smaller surface area but its greater height solved the problems arising in the former. A large square was created where a church was built.
The *Torrero* Estate was built in the district of the same name, with Phase 1 completed in 1956 and Phase 2 completed in 1966. It consists of 112 dwellings located in blocks of different heights.
The *Casta Álvarez* Estate was built in 1956-1957 in the *Las Fuentes* district and was developed by *Obra Sindical del Hogar y de Arquitectura (OSH)*, in this case to house 285 families.
The *Fray Julián Garcés* Estate in the Torrero district was built in three phases between 1957, when Phase 1 was completed, and 1967, when Phase 3 was finished. It was also developed by *Obra Obra Sindical del Hogar y de Arquitectura (OSH)* to contain a total of 648 dwellings laid out in a north-south direction, allowing them to face both east and west.



Fig. 2: Current view of one of the blocks on the *Vizconde Escoriaza* Estate.

The *Teniente Polanco* Estate was built in 1958 in the *Arrabal* district by the same developer as the previous one. There is little doubt that the construction of the estate's 264 dwellings was responsible for driving growth in the area surrounding the old *Estación del Norte* (North Railway Station).
The *Puente Virrey Rosellón* Estate was built in 1958 in *Rosellón* street of the *San José* district. As with the *Augustín Gericó* Estate, it was developed by the *Montemolín* Board of Religious Works and Zaragoza City Council.
The *Santa Rosa* Estate was built in 1958 in close proximity to the *Vizconde Escoriaza* Estate. It was also developed by the Escoriaza family, but this time for profit.
The *General Urrutia* Estate was built in 1960 in the *Oliver* district to house 288 families. It was developed by *Obra Sindical del Hogar y de Arquitectura (OSH)*.
The *Alférez Rojas* Estate was developed in 1960 in two phases by *Obra Sindical del Hogar y de Arquitectura (OSH)*. It is located in the *Delicias* district and bounded by the thoroughfare *Vía Hispanidad*. It is undeniably one of the most interesting estates of its kind in Zaragoza, according to F. Aguerri [7] from an urban development perspective as it incorporates the parameters of the Modern Movement like no other. The blocks consist of two parts, slightly offset along their longitudinal axis, which according to C. Diez and L. Pérez [8] gives their layout an organic nature. The design of the blocks vary between a ground floor + 2 upper storeys and a ground floor + 4 upper storeys, with a staircase for every two apartments per floor. This estate is also one of the most significant by size, given that it contains 656 dwellings.
The *Aloy Sala* Estate was completed in 1961, built on private initiative in the *Tenerías* neighbourhood of the historic centre of Zaragoza to house 686 families. It is located near to the confluence of the Rivers Huerva and Ebro. It is laid out in a configuration of perpendicular linear blocks running parallel to the two rivers. The design of the standard block is a ground floor + 9 upper storeys, through which the evolution over the years in the buildings of these estates towards high rise can be observed.
The *Balsas de Río Ebro* Estate was built in 1964 in the *Arrabal* district by *Obra Sindical del Hogar y de Arquitectura (OSH)*. This was the most ambitious housing project undertaken with the construction of 1250 dwellings, in addition to a school, market and church. The dwellings are laid out in linear rows of blocks with a ground floor + 4 upper storeys, with a scattering of tower blocks with a ground floor + 11 upper storeys.

3. Definition of indicators

These highly homogeneous and socially consistent residential spaces have in a number of cases remained isolated, cut off from the urban grid. Their development as a process parallel to that of the city, combined with the obsolescence in their construction, have led to public spaces being neglected and a gradual loss of residents, factors which, with the passing of time, have turned them into highly vulnerable residential and social spaces. Unlike other types of operations that have focused on the creation of areas of opportunity for the purpose of generating profit, triggering processes of gentrification [9], the type of comprehensive rehabilitation implemented in Zaragoza has been designed as a participative process centred on improving existing conditions. In order to ensure the success of the operation, the main objective is considered to be that of prioritizing reuse and rehabilitation of heritage buildings without separation from the urban space they form, and without losing sight of the need to integrate them into the city [10]. Hence the need to evaluate these complexes and to treat them as a whole by applying a system in which the scale of buildings and their layout are both present.
With regard to the aspect of urban planning, the benchmark reference documents used for this evaluation are those that provide a strategic framework with principles, aims, guidelines and measures, the effective application of which enables progress to be made towards greater urban and local sustainability. Examples of these are the *Libro blanco de la sostenibilidad en el planeamiento urbanístico español* (White Book on Sustainability in Spanish Urban Planning) [11] edited by *Ministerio de Vivienda* (Spanish Ministry of Housing) in 2010 and the *Estrategia Española de Sostenibilidad Urbana y Local, EESUL* (Spanish Strategy for Urban and Local Sustainability) [12] requested by *Ministerio de Medio Ambiente, Medio Rural y Marino* and *Ministerio de Vivienda* (Spanish Ministry for Environment, Marine and Rural Affairs and Ministry of Housing**)** in 2011, which focus on balanced regional development. Their criteria adhere to the model of compact, complex, efficient and socially cohesive city defended by Salvador Rueda and his team at the *Agència d'Ecologia Urbana de Barcelona* (Urban Ecology Agency of Barcelona), and which are used to produce certifications that evaluate the quality of urban fabric. These technical instruments include voluntary specifications that are not currently incorporated into legal frameworks, given that these have until now focused on new growth areas and not on the treatment of consolidated urban areas [13]. The most widely used handbook for performing this specific analysis is the *Guía metodológica para los sistemas de auditoría, certificación o acreditación de la calidad y sostenibilidad en el medio urbano* (Methodological Guide to Systems for Auditing, Certification and Validation of Quality and

Sustainability in Urban Areas), edited by *Ministerio de Fomento* (Spanish Ministry of Building Development) in 2012, which allows neighbourhood-scale diagnostic analyses to be made [14].
Unlike the situation existing in urban planning, in which certifications are still a novel concept, building certification has solid foundations, and reference can be made to the requirements of the *Código Técnico de la Edificación* (Building Code) or evaluation documents such as the *Informe de Evaluación de Edificios* (Building Assessment Report). This document, accompanying the Spanish Rehabilitation, Regeneration and Urban Renewal Act 8/2013 of 26 June, enables evaluations to be made on the soundness of buildings, basic conditions of accessibility and energy efficiency, and serves as a guide to the requirements for any intervention. There are also studies that advocate a change in the construction industry in order to meet new environmental challenges, such as those produced by the Working Group on Rehabilitation (GTR) [16], and guidelines for measuring the quality of different construction systems [17].
Based on these guides and certifications, which aim to apply environmental and sustainability targets to urban planning and construction, we have extracted relevant aspects in order to create a diagnostic analysis of the estates, to which others have been added that are necessary owing to their specificity. The particular conditions of these estates in a number of cases do not allow general analyses to fit the particular aim of the study, while in others, the values they deal with come into conflict with their specific characteristics. Consequently, it is important when choosing these to have a critical eye and clear conscience regarding their final purpose. This enables the design of indicators or dimensions that are easy to measure and interpret, which provide models produced by the different patterns of urban development, environmental factors, construction method and building type. These allow data to be visualized that can be interpreted by means of comparison with minimum and desirable benchmark values. Their function does not consist of the reduction of reality to a numerical values; rather, they provide an interpretive tool that displays an initial panorama and assists in the decision-making process.
In order to perform a complete examination of the estates, the indicators cannot operate as stand-alone statistical data; they must respond to a series of inter-related patterns. Their comparative analysis allows the urgency with which action should be taken to be gauged, in addition to observation of their evolution and evaluation of different policies and strategy. In this way, the impact of the decisions taken can be assessed and possible alternatives considered by means of simulations with different patterns. Consequently, this diagnosis of degree with which a relevant unit of land fits the sustainable city model will allows the following to be substantiated:
- Living conditions, understood as the set of factors that determine the way in which inhabitants live in their urban, social and domestic environment.
- Efficiency, which depends on both the energy consumed by resources that guarantee good function of the space, and the amount of exchange and communication that guarantee urban diversity can exist in it.
The indicators with the task of assessing living conditions and efficiency of the estates can be grouped according to the following variables:
- Morphology and social profile. This variable describes the intensity of land use, the relationship between different uses made of the land (residential, non-residential, public open space, private open space, empty plots, roads and parking) and the social profile of the populations based on demographic and socio-economic data, degree of connection with the neighbourhood and social unrest.
- Public space. First, this variable analyses roads, determining the ratio of space devoted to pedestrians and vehicles, and in relation to the buildings surrounding them, by means of dedicated parking spaces. Second, it studies pedestrian space, according to the public open space per inhabitant and distinguishing between the amount of spaces devoted to green areas, leisure and pedestrian transit.
- Urban complexity. This variable assesses the balance between activity and residence, in order to study the ratio between the two uses, and analyses the type of facilities on each estate; the diversity of uses given to the ground floor areas of the residential buildings, in order to ascertain the proportion of dwellings, open space and commercial premises; occupation of the residential buildings, as a function of the existing housing mix with regard to free-market housing, owner-occupied dwellings and rented dwellings, and the proportion of unoccupied dwellings; and the configuration of residential buildings in order to ascertain the variety of existing building types.
- Typological conditioning factors. This variable studies the adaptation of type of dwelling to present-day standards; transit areas and common areas within apartment blocks, by means of the maximum number of dwellings per core, and accessibility provided to common spaces and actual dwellings.
- Bioclimatic conditioning factors. This variable studies the suitability of dwellings according to the minimum hours of direct sunlight; differentiation in façades according to orientation; the percentage of openings in relation to total façade surface area and elements regulating the entry of direct sunlight.
- Construction-related conditioning factors. This variable takes into consideration the suitability of foundations and structure; the hygrothermal performance of façades, taking into account condition,

transmittance and thermal bridge of roofs, façades and internal walls; the performance and efficiency of electrical, mechanical, and energy installations; active use made of resources; and energy efficiency of buildings.

4. Database with GIS technology as a means of dissemination

In order for the study to become effective, it requires a suitable means the correct dissemination of results. For this purpose, an accessible and easy-to-use method should be used to enable rapid searches and fast and intuitive viewing. In order to fulfil all the requisites set out, and also owing to the nature of the project, it was decided that a map viewer would be created. This would enable two tasks to be performed simultaneously: the identification and geolocation of all the estates in the study, which would allow the estates to be placed into context with their surrounding areas, and to provide a visual appreciation of the urban fabric into which they are integrated; and dynamic, intuitive and simple access to the results.

Differences in the nature of the results obtained will entail the need to consider different ways of accessing and viewing them. In order to consult a certain type of document, it will be necessary to provide access through links that lead to pop-up windows with this information, as would be the case of videos, three-dimensional imaging and technical specifications, among others. The data that can be mapped will also be available for viewing directly through the viewer in the form of themed maps that provide a visual expression of the corresponding indicators, allowing their rapid comprehension.

The process of associating data to georeferenced geometries will be performed by means of a free and open-source geographic information system (GIS) on the computer desktop, allowing public access to the applied methodology, for the purpose of creating a realistically reproducible and exportable model in terms of both technical requirements and affordability. In this case, a decision was made to use QGIS [18], an official project by Open Source Geospatial Foundation (OSGeo), which guarantees quality, and which can be installed on the most widely used operating systems (Linux, Unix, Mac OSX, Windows and Android), in addition to being a widely disseminated and easy-to-use tool that is undergoing significant development. A storage system known as shapefile will be used to provide vector data as it is able to store the location of specific geographic features and their associated attributes [19]. Despite its creation by a private company (ESRI), this system has become a de facto standard, and is accepted under current cartographic standards in Spain [20].

As benchmark geographic information, the building layer of the Harmonized Topographic Basemap (HTB) 1:5000 for the locality of Zaragoza will be used, with the European Terrestrial Reference System 1989 (ETRS89) and a flat representation of the mapped area by means of Universal Transverse Mercator (UTM) conformal projection [22] Northern UTM, spindle 30, with access for downloads provided by the Infraestructura de Datos Espaciales de Aragón (Spatial data Infrastructure of Aragon), which guarantees quality, and therefore interoperability.

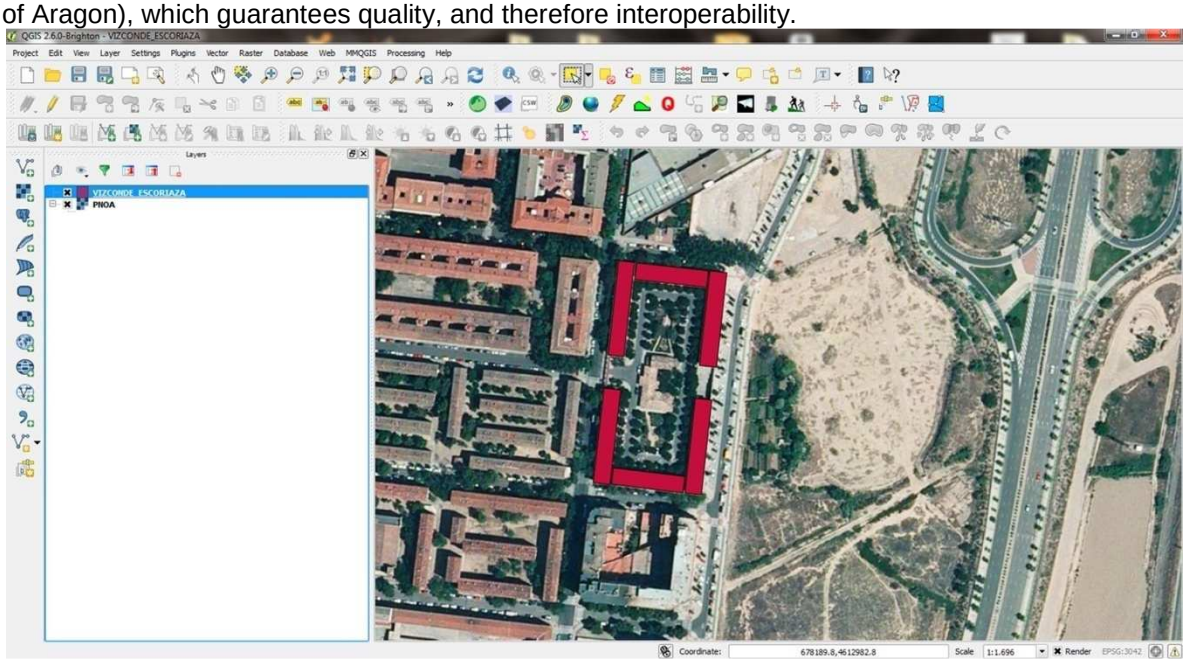

Fig. 3: Geographic view of the *Vizconde Escoriaza* Estate over a Web Map Service (WMS) layer from the Spanish National Aerial Photography Programme (PNOA) in QGIS.

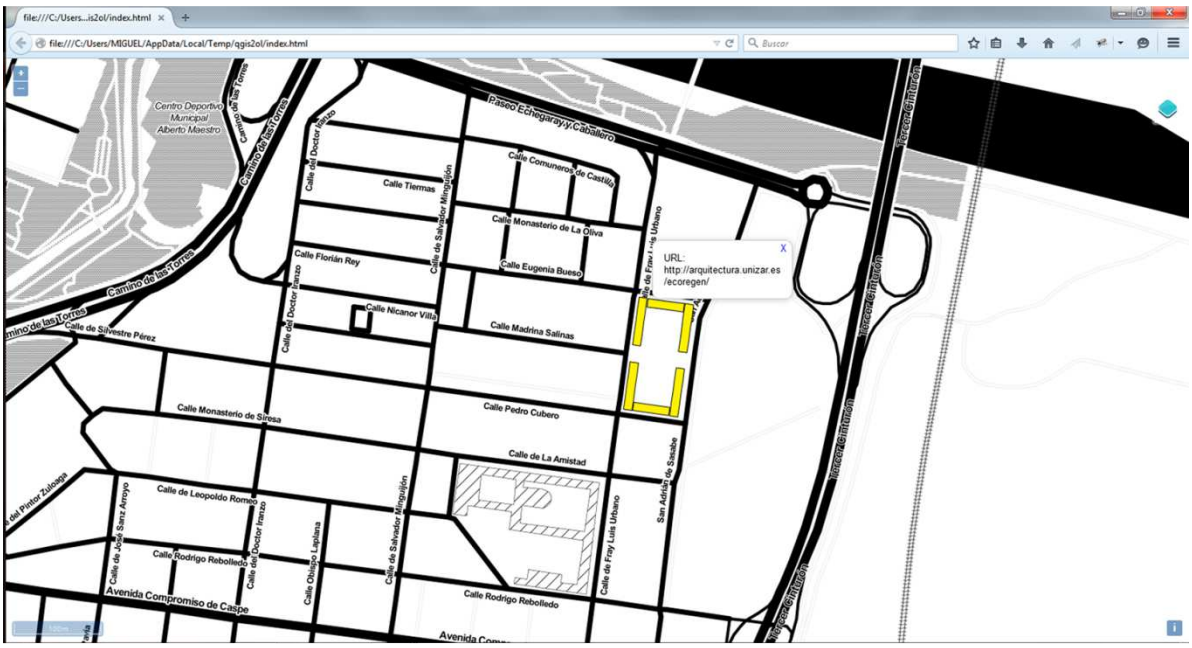

Fig. 4: Map viewer created from the OpenLayers3 mapping library, with the location of the *Vizconde Escoriaza* Estate.

The vectors used will be those corresponding to the buildings included in the study, with selection and correct symbolization performed using the desktop GIS, which will subsequently be converted into a suitable format for representation in the map viewer. Coherent with the idea of public access to the process, it was decided that an open-source library should be used to create an interactive map for incorporation into the project website, in our case OpenLayers3, which will mapped information as vectors to be included [23] based on a tile layer from a Web Map Service (WMS) server [24]. This will enable an ortho-image to be viewed as a background, allowing the vectors to be contextualized without slowing down viewer operation.
In order to enable the representation of geographic image processed by QGIS in the map viewer, a plugin [25] will be used to allow the project to be exported while retaining the applied symbols and to add other functionalities that will be of use when it comes to providing intuitive access to the information. The simplification of the process through the use of free and easy-to-use tools makes it possible for the results to be updated in a straightforward manner, and more interestingly, for the creation of a methodology that is accessible, even for users without previous experience in the development of web mapping applications.

Acknowledgements
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Citations and Bibliographical References

[1] During the conflict, Zaragoza was located inside the area under the control of the eventually victorious side.

[2] CERVERO, Noelia. The role of the integral restoration of neighborhoods in the recovery of suburbs. The intervention in "El Picarral" Area, Saragossa. *E-rph*. December 2013, No. 13, pp. 1-15.

[3] The dwellings come in the form of single-family homes and multi-family housing (apartment) blocks, with a linear arrangement of apartment blocks or in the form of perimeter blocks. Types vary according to whether they were built to provide ultra-cheap homes, affordable social housing or average housing.

[4] The variety of styles is only shown in façade details, and these can either be in a regional style, with the typical horizontal brickwork found in palatial Aragonese-style buildings dating from the

Renaissance, or in a style that was more widespread throughout Spain, with façades completely covered in a cement render.

[5] Developers included the public entities *Obra Sindical del Hogar y de Arquitectura (OSH)*, a branch of the only legal trade union in Spain which carried out development work for the *Instituto Nacional de la Vivienda (INV)*; the Municipal Institute of Housing of Zaragoza; and the armed forces. There were two types of private developments: those built by not-for-profit organizations such as *Hogar Cristiano* (religious) and those built by important industrialists to house their employees, as is the case of the *Vizconde Escoriaza* Estate; and for-profit developments such as the *Parcelación Damán* Estate and the *Aloy Sala* Estate, which were named after their developers.

[6] RUIZ, Luis Gerardo, RUBIO, Juan. *Nuevas propuestas de rehabilitación urbana en Zaragoza.* Zaragoza: Zaragoza vivienda, 2006. p.28.

[7] AGUERRI, Fernando. La evolución de Zaragoza 1940-1960. In MARCO, Ricardo, BUIL, Carlos (Coord). *Zaragoza 1908-2008. Arquitectura y urbanismo*.. Zaragoza: Demarcación de Zaragoza COAA, 2010. pp 199-248.

[8] DIEZ, Carmen, PÉREZ, Lucia. Grupo Alferez Rojas. In MONCLÚS, Javier, LABARTA, Carlos, DIEZ, Carmen, AGUSTÍN, Luis. BERGERA, Iñaki (Coord). *Paisajes Urbanos residenciales en la Zaragoza Contemporánea*. Zaragoza: Prensas Universitarias de Zaragoza, 2012. pp. 50-53.

[9] *Estrategia Española de Sostenibilidad Urbana y Local (EESUL)*. A working document coordinated by the Spanish Ministry for Environment, Marine and Rural Affairs and the Ministry of Housing, in collaboration with the *Red de Redes de Desarrollo Local Sostenible* (Network of Sustainable Local Development Networks) and different department of the Spanish government, and with assistance from the *Agència d'Ecologia Urbana de Barcelona* (Urban Ecology Agency of Barcelona) and *Observatorio de la Sostenibilidad en España* (Sustainability Observatory in Spain). 2011, p. 19.

[10] FARIÑA, José and NAREDO, José Manuel. *Libro blanco de la sostenibilidad en el planeamiento urbanístico español*. Madrid: Ministerio de Vivienda, 2010, p. 31-32.

[11]http://www.fomento.gob.es/MFOM/LANG_CASTELLANO/_ESPECIALES/SIU/SOTENIBILIDAD_URBANA/Libro_blanco/

[12]http://www.fomento.gob.es/MFOM/LANG_CASTELLANO/DIRECCIONES_GENERALES/ARQ_VIVIENDA/SUELO_Y_POLITICAS/SOTENIBILIDAD/

[13] The importance of this urban dimension when dealing with the proper functioning of inherited immovable assets was reflected in Spanish law by the *Rehabilitation, Regeneration and Urban Renewal Act 8/2013, of 26 June*.

[14] RUEDA, Salvador (Coord.). *Guía Metodológica para los Sistemas de Auditoría, Certificación o Acreditación de la calidad y sostenibilidad en el medio urbano*. Madrid: Ministerio de Fomento, 2012.

[15] http://www.gbce.es/es/pagina/informe-gtr

[16] DE LUXÁN, Margarita, et al. *Actuaciones con criterios de sostenibilidad en la rehabilitación de viviendas en el centro de Madrid*. Madrid: EMVS, 2009.

[17] INSTITUTO CERDÁ. *Guía de la Edificación Sostenible*. Madrid: IDAE, Ministerio de Fomento y Fundación Privada Istitut Ildefons Cerdá, 1999.

[18]Quantum GIS Development Team, <2015>. Quantum GIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org

[19] *ESRI Shapefile Technical Description: An ESRI White Paper*. Redlands, CA: Environmental Systems Research Institute, Inc., 1998.

[20] Ministerial Order of 20 February 2014, issued by the Minister of Territorial Policy and Land of Aragon, through which the agreement adopted by the Government of Aragon in its meeting held on 8 February 2014 was gazetted, approving the Mapping Standards of Aragon.

[21] Spanish Royal Decree 1071/2007 of 27 July, which established the ETRS89 as the official geodetic reference system in Spain.

[22] BTA, 2008: Especificaciones y Diccionario de Fenómenos de la Base Topográfica Armonizada 1:5 000 (BTA) v1.0. Comisión de Normas Cartográficas – Consejo Superior Geográfico. January, 2008.

[23] The GeoJSON vector format will be used, supported by OpenLayers3.

[24] This is a service defined by OGC (Open Geospatial Consortium)

[25] Export to OpenLayers, plugin created by Víctor Olaya available for download from the official QGIS accessory repository.

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Development of indicators to graphically and geometrically define state subsidised residential blocks in Zaragoza. Spain. Geometrical exposure to sun.

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Abstract
During the 1950's and 60's a large number of state subsidised housing was built in Spain in order to tackle the needs of growing populations in cities who had emigrated from rural to urban environments after the Spanish civil war.
Over time these residential areas now occupy central zones or newly central areas within consolidated cities, but they are a far cry from meeting the minimum standards of quality and comfort, with this paper discussing how to study and establish indicators for intervention from the point of view of exposure to sun.
Exposure to sun, or the hours that housing receives direct sunlight influences how energy is captured for heating and hot water, energetic sustainability and reducing the costs of housing whilst avoiding some of the families who live in this kind of subsidised housing reaching levels of energy poverty.
The paper explains the importance and characteristics of solar exposure, how to acquire geometrical data of residential buildings, how to simulate exposure to sun of the façades and to obtain three-dimensional graphs with the results, thus permitting decisions to be made for intervention based on scientific fact.

Keywords: Geometric exposure to sun, State subsidised housing, Zaragoza, Energy refurbishment.

1. Introduction: description of the heritage object
This paper describes the work carried out within the framework of a research project for refurbishment of residential buildings of heritage interest in Zaragoza [1]. These buildings, numbering a total of 21, were constructed after the Spanish civil war by the National Housing Institute, in reply to the strong exodus of the population from rural areas and the growing need for housing in the Aragon capital. With interesting designs, from an architectural and town-planning point of view, they obeyed the prevailing rationalist guidelines of the 20th century. The current General Urban Development Plan for Zaragoza of 2001, includes these residential buildings in the list of Urban Interest Buildings. Nevertheless, owing to their rapid construction and low cost materials used, all the buildings are in a poor state of repair and require comprehensive refurbishment, whilst respecting their historical value and at the same time affording optimum living conditions for their current inhabitants [2]. Since 2004 the City Hall has been fostering a study of the physical and social situation of the neighbourhoods to carry out long-term urban intervention through the Municipal Urban Refurbishment Society of Zaragoza (SMRUZ) employing criteria of innovation, connection and environmental sustainability.

For this paper the case study of the buildings known as the *Alférez Rojas* buildings was chosen, comprising 19 housing blocks built in 1960 to the southeast of the city on sloping land. The blocks are distributed parallel to the contour curve and therefore face different directions but always approximately north - south. Each block measures between 40 and 60 metres in length, and width just over eight metres. Most of them feature a split of around five metres on the longitudinal axis, dividing the blocks into two sections with different heights (four and five storeys). The homes, with three bedrooms, are accessed via stairwells leading to two homes on each

floor. There are no lifts. The blocks are built from face brick and the roof is a double pitch roof made from ceramic roofing tiles. [3]



Fig. 1: Alférez Rojas residential buildings. Aerial photograph


Fig. 2: Alférez Rojas residential buildings. View from the east

2. Objective: geometrical exposure to sun study

Our work centred on the exposure to sun of the buildings, which is a very important aspect for analysing energy performance of buildings, as required to design refurbishments guidelines.

According to energy analysis in housing standards, the criteria for passive architecture design are as follows:

The impact of solar radiation on the enclosure, each construction element above ground level receives solar radiation which depends on several factors: shade obstructing radiation, absorbency, and above all, the direction the building faces. Impact of wind on the enclosure. Solar shading. And solar reflectivity [4].

In order to be able to control these factors, it is necessary to monitor the position of the sun at all times during the day and year, and its inclination regarding the exposed plane. In order to do so, it is necessary to produce shadow graphs, based on the characteristics of shade patterns. Owing to the fact that shadow moves in the exact opposite way to the sun, the shadow graph can determine the position of the sun at all times in relation to its shadow.

There are different types of shadow graphs, but the most widely used are: Shadowgrams and Cotangent Diagrams, through which L. Kuttner, J. Grobler and H. E. Beckett have developed very useful systems for solar measurement. The shadow graphs developed by Aladar Olgyay (1953), University of Texas, can be applied at any latitude and are one of the benchmarks currently in use today.

To be able to measure over shadow graphs, stereographic solar diagrams need to be drawn up for the specific latitude where measurement of solar incidence is to the take place, employing the following procedure: Firstly a universal template should be drawn of the solar orbit over the celestial vault, with the same diameter as the vault as the diameter established for the drawings. The horizontal stereograph of the sun's trajectory should then be drawn as follows:

1. Position the horizontal plane on the universal solar orbit template so that the N-S axis forms 41º39' (latitude of Zaragoza).

2. From the centre of the vault, draw a perpendicular straight line to the horizontal plane. The intersections of this straight line with the apparent contour of the vault will be the zenith and the nadir for 41º39' latitude.

3. From the nadir, the higher extreme of the orbit for 21st June is projected on the horizontal plane and the projection point is transferred to the circumference cast on the horizon. The same process is carried out with the two orbit cut-off points with the horizontal plane. The projection of the orbit will be the circumference that passes through these three points.

4. This procedures is carried out with the main orbits.

5. To draw the projections of the circumference for the time zone, the N and S poles of the vault are drawn from the nadir, since these two points pass through all the circumferences of the time zone. It is then necessary to define a third point for each circumference, which is the intersection point of the time circumference with the horizon plane. Since the circumference of the time zone is drawn on the universal template of solar orbits according to eclipses, these projections are not used to locate the third point, as the intersection on the straight line with the eclipse could lead to graphical inaccuracy if the homology is not used. What we do is find the straight intersection between the horizon plane and the plan containing the time relevant time circumference. This is very simple since both planes are projecting, the stereographic projection of said straight is the same straight as it belongs to the horizon plane, the intersection of the straight with the horizon circumference will give us the third point of the time curve. A time zone with circumferences every quarter of an hour has been used.

Finally, to know the location of the sun at any given time, we only need to find its correct position on the horizontal diagram of solar trajectories, making the relevant aforementioned adjustments between the official time and the solar time and afterwards we only need to superimpose the universal diagram to measure the solar coordinates in order to find the height and azimuth [5].

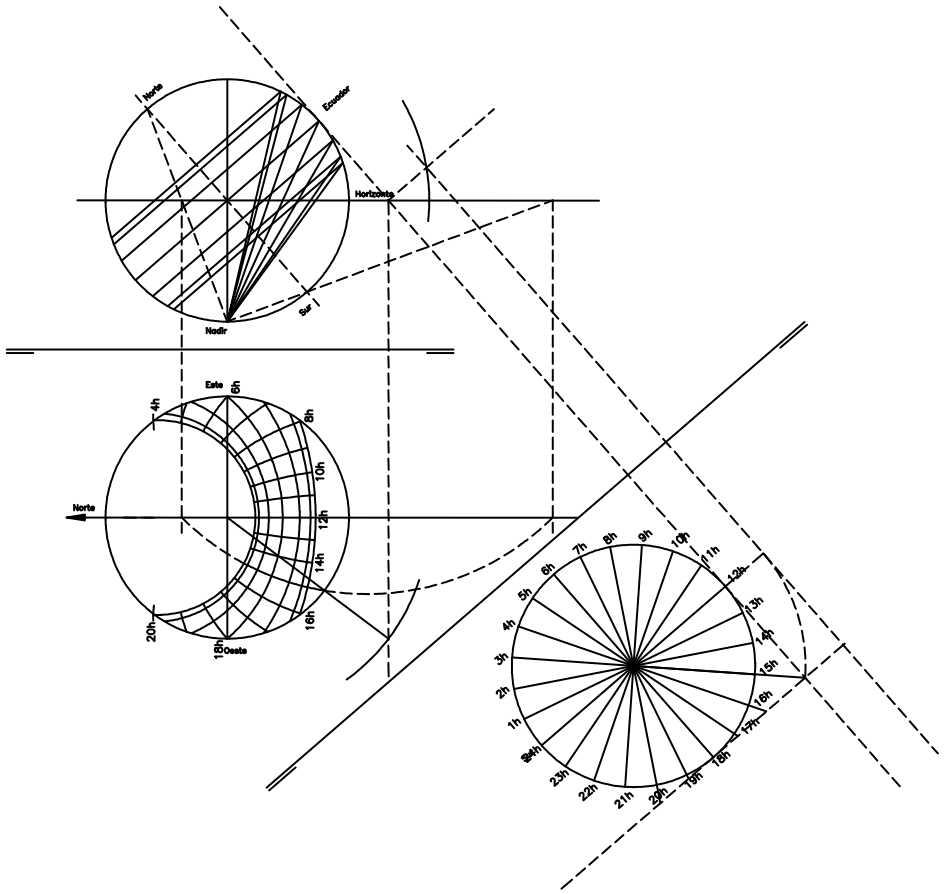

Fig. 3: Geometric drawing of the different solar positions through the day and year for the latitude of Zaragoza.

Although this drawing is accurate obtaining comparable values that can be transferred to scientifically based indicators helping with decision making can be tedious, regarding the incidence of sunlight and shadow diagrams on the residential building, which is why we resort to a method using a computer generated graph, which is both easily reproducible and permits simultaneous viewing of daily values.

3. Procedure: 3D modelling and digital solar exposure calculation

To analyse residential buildings, and more specifically the Alférez Rojas buildings discussed in this paper, we have produced three-dimensional digital models using standard architectural representation tools. The objective of these models is not only reproduction or visual analysis, but also to perform simulation processes from which we can extract relevant numerical data. On the one hand we have produced models that can be called constructive, and that have focussed on the buildings from an isolated viewpoint, dealing with their construction characteristics. In order to do so we used BIM technology, more specifically *Archicad* software [6]. When compared to conventional 3D CAD technology, BIM affords the advantage of modelling differentiating between construction items comprising the building (walls, roofs, windows, etc.) and assigning them materials, which in turn can be assigned physical and thermal properties. Since the residential buildings we are dealing with in this case are based on standard building styles, which are repeated without any significant variations, we have centred our work on reconstructing this model in detail, reproducing the construction design and accurately assigning the materials actually used in the buildings.

These construction models however do not include the town-planning component of the residential groups: geo-localisation, topography, facing and design of public areas. To so this we have developed other model types that we will call town-planning types which have been produced using the software *Sketchup* [7]. This 3D CAD tool has the advantage, compared to other alternatives, of having a free version, which is very quick and simple to manage, and mainly because it has a large number of third party plug-ins that multiply its possibilities. In our case, we are particularly interested in the possibilities related to geometric solar exposure analysis. Mc Minn [7] proved the success of using *Sketchup* for analysing solar exposure on buildings in combination with the *Radiance* tool, by importing / exporting files. Nevertheless, the graphic results produced show still simulations, and not an analysis over a time range (during a day or year, etc.). In our case, the objective is to study solar exposure over time, in order to assess if there are any vulnerable parts of the buildings owing to lack or excess of prolonged exposure to sunlight. This vulnerability would be the consequences of site conditioning facts (topography, surrounding buildings) and the design of the buildings

(facing and layout of the blocks, heights, façade design, etc.). Based on this information measures can be taken to minimise or mitigate any possible deficiencies.

We can take an approach to that information using shadow simulations in *Sketchup*, which works as a virtual heliodon. This will enable us to produce video animation by frame transitions, recording the sunlight at different hours and days throughout the year, thus showing how shadow evolves through a given period. This is, however, a mere reproduction from which it is not possible to extract data.

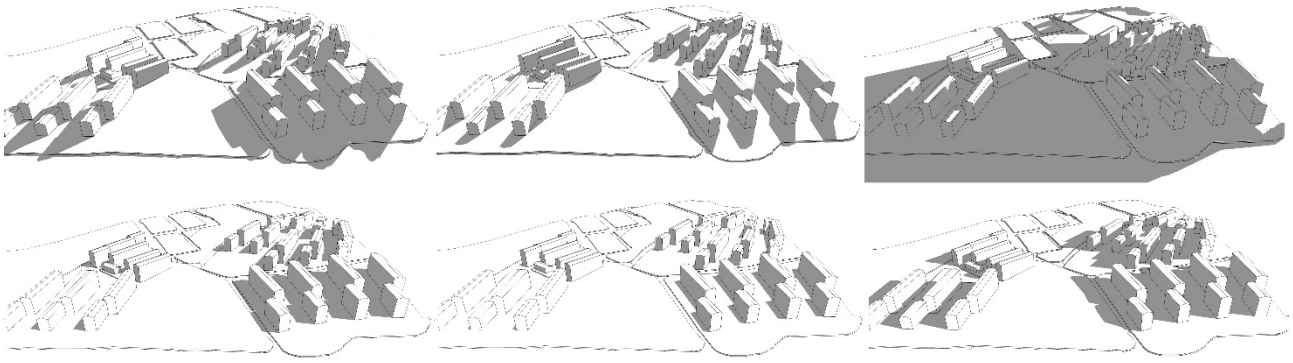

Fig. 4: Schematic modelling of the buildings in *Sketchup* and reproduction of solar exposure on different days and at different hours in a year, seen from the west. From left to right and top to bottom: 21st March at 8h; at 12h; 21st June at 8 h; at 12h; 21st December at 8h; at 12 h.

Torres et al. [8] conducted a study on the solar exposure received by a building of heritage value throughout a year. They used unspecified CAD software to produce a large number of images that were overlapped to graphically synthesise the results on what they called a "shadow map". The result is an image in a scale of greys. Quantification of the level of grey is associated with the factor F (solar obstruction factor) and its equivalence in hours sunlight / year. We have used this procedure to create our own shadow map for the Alférez Rojas buildings taken from the representative images shown earlier, with the result being as follows:

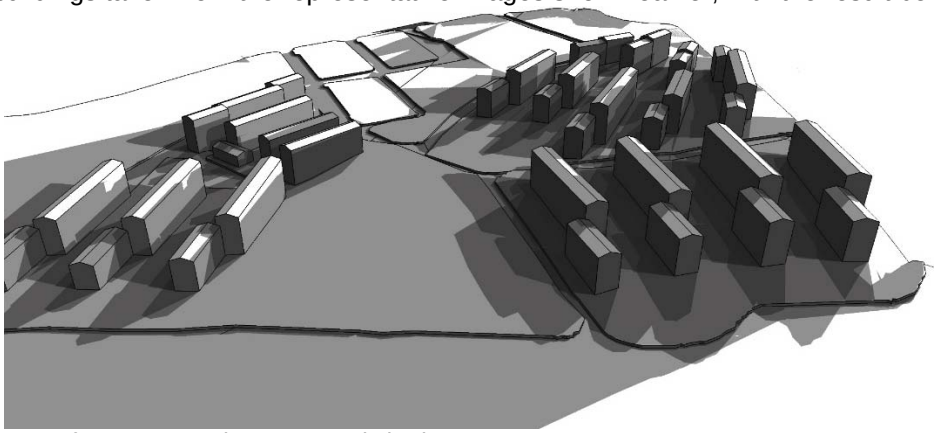

Fig. 5: Sum of images for reconstructing an annual shadow map.

Our objective, however, is to produce graphic documents of this type in a direct manner without resources to digital image processing by taking advantage of the third party technologies brought to us through *Sketchup*. We have used two tools to achieve this: *Shadows Analysis* [9] and *Sunhours* [10], both integrated in the modelling programme as plug-ins.

The first, *Shadows Analysis*, measures and graphically displays the number of hours a surface is in shade during a period of time never exceeding one day. This tool permits defining: the day of the year measurement is taken; the range of hours to compute; the precision in minutes (between 1 and 30) and the size of the resulting image. For our analysis we chose a time range between 7 and 18 hours and accuracy of 10 minutes. With these parameters we made three calculations for 21st March, 21st June and 21st December. The results are shown as follows:

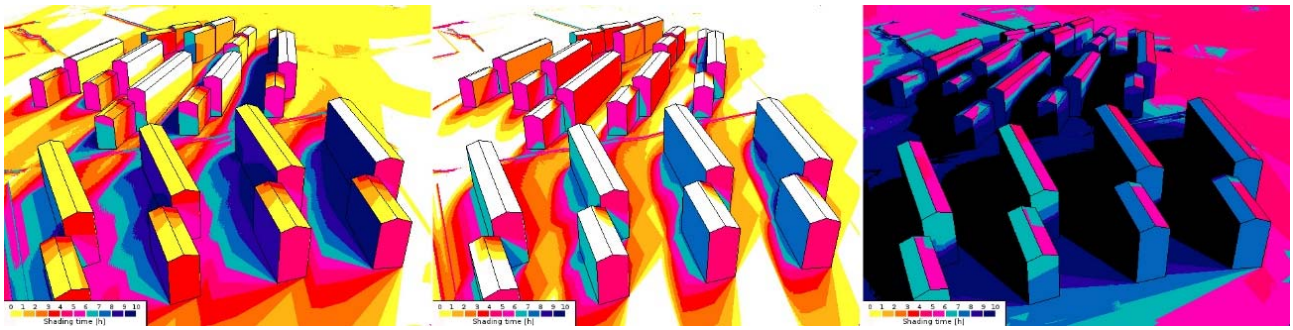

Fig. 6: Alférez Rojas residential buildings. Shadow calculation results using the *Shadows Analysis* extension over a time range of 11 hours. From left to right: 21st March, 21st June and 21st December.

The limitations of this tool are: firstly the measurement can only be for a maximum of one day, and it is therefore necessary to carry out several calculations in different months if we want to produce an annual picture. Secondly, the measurement result is in number of hours of shadow, which means that the chosen time range has a major influence on the end result. If the chosen range is over 12 hours, the results tend towards the blue range, which is misleading when analysing the graph results. Thirdly, the result of the calculation is shown on a bit map and not a coloured model, and we are therefore unable to browse it in 3D, and we need to make a new calculation for each required viewpoint. Even so, this calculation provides us with some very interesting information. We are able to see the points of the buildings with least sunlight. We can also see the shady areas in public spaces which are relevant in residential complexes such as this one for leisure and play activities.

The second tool we used, *Sunhours*, was more versatile in general and more suitable for our geometric solar exposure analysis. This tool measures and graphically displays the percentage of sun and shadow the surfaces on the model are exposed to. The process is rather slower than the previous case, since the surfaces need to be covered with a grid of cells, the sizes of which we are able to choose. The smaller the cell size, the more units there are and therefore the longer the calculation takes, since the plug-in actually measures the hours of sunlight on each vertex of the cells. Once all the grids have been positioned over the model, the calculation process can be executed, which requires a considerable amount of time (around one our in our case) until it is completed. The cells then change colour depending on the percentage hours of sunlight they are exposed to. The colour is conserved in the model even if we change the perspective, make changes to it or close and open the file again. The parameters to specify for calculation are, in this case: the time range or ranges to be computed, the days of the week; the period of the year when measurement is performed (solstices and equinoxes are displayed as special dates); and the accuracy in hours.

For our analysis we chose the same time range as in the previous case (from 7 to 18 hours), every day of the week for a complete year, and measurement accuracy of three hours. The disadvantages of this software were that in this case we did not obtain the information about the surface area of the public spaces, since the ground was modelled using the "sand pit" tool in *Sketchup* and it was not possible to apply grids to these areas when measuring. Another problem we encountered was that the grids were created coplanar to the surfaces, owing to which the colours were covered and are not visible if we do not delete or move the original surfaces. To resolve this, we resorted to a slight scaling process of the blocks, applying a scale factor of 0.999 from the centre of each volume, thus moving each façade back 4mm longitudinally and 3 cm each façade laterally, which is not a significant distance in town-planning terms but was sufficient to avoid superimposing of 3D plans. The advantage of this tool was that we were able to obtain a browsable graph model that synthesised the sunlight map throughout the entire year.

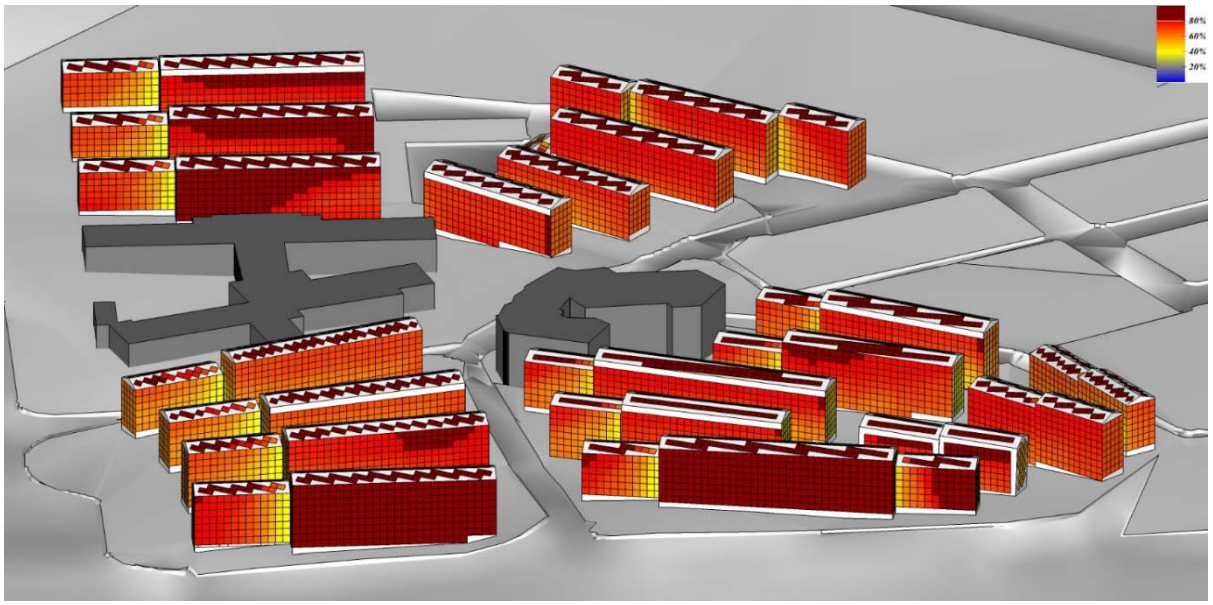

Fig. 7: View of the buildings from the south. 3D model processed using the *Sunhours* tool.

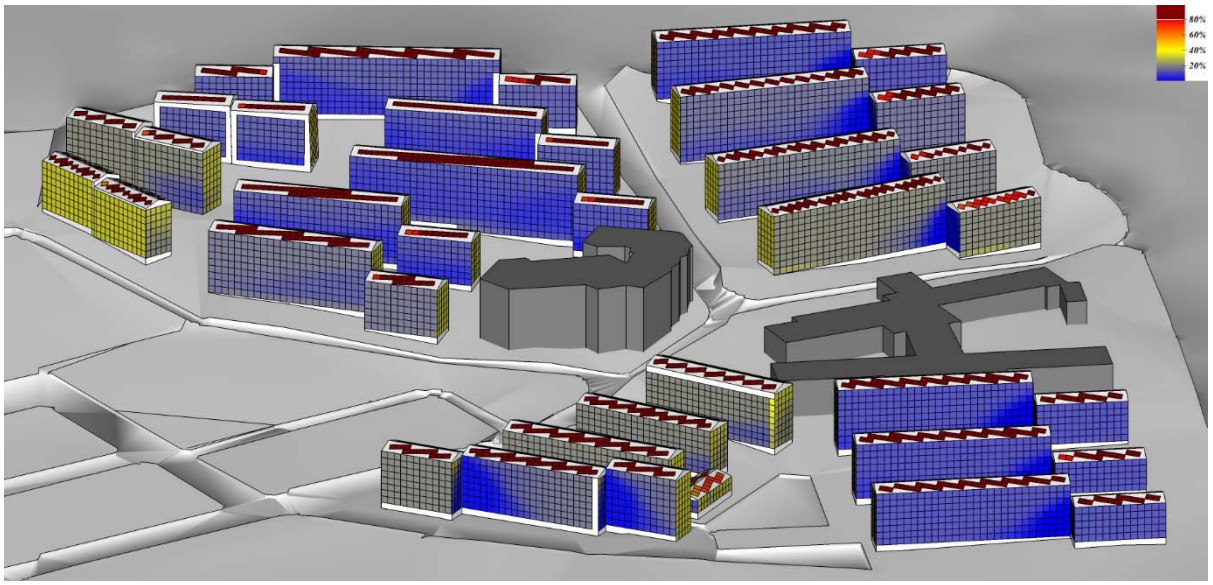

Fig. 8: View from the north.

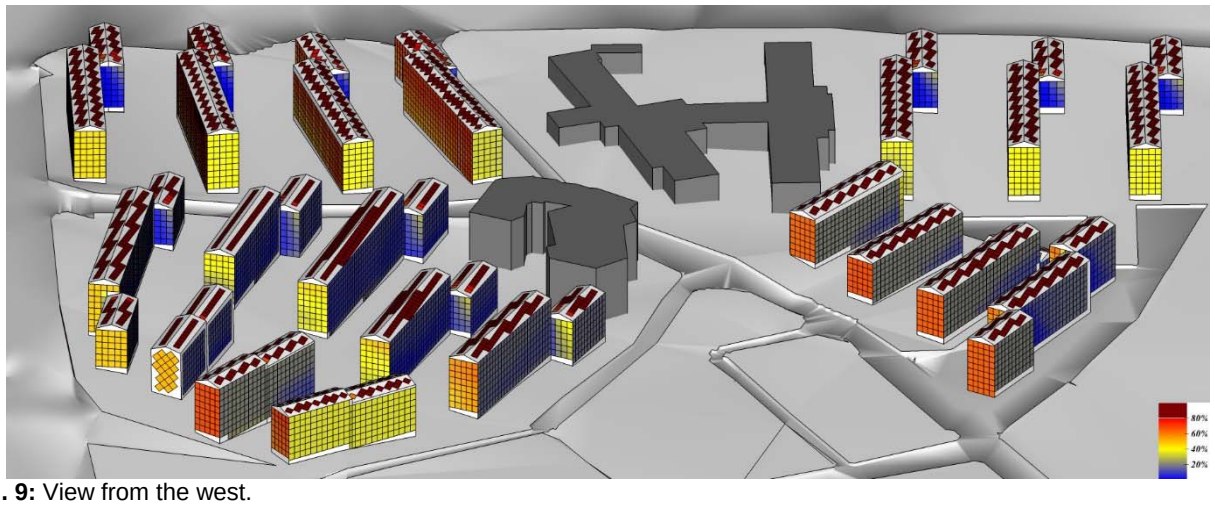

Fig. 9: View from the west.

4. Conclusions

The simulations show, as is to be expected because of the north-south orientation of the buildings, a big difference between the sunlight on the longitudinal façade and the other façade of each building. The shadiest area of the building blocks is the split, where there is a corner on the north façade that does not receive any direct sunlight throughout the entire day (the area in darkest blue in, see Fig. 7), and on the south façade the amount of radiation is also lower (the areas shaded yellow, see Fig. 6). Whether or not this split is a good design decision is therefore questionable. From a topographical point of view it could be an advantage to split the blocks, so as not to have to compensate for steep slopes in one single area. However, splitting the blocks on the vertical plane of the floors could have been considered, which would have maintained the linearity of the floor. For refurbishment purposes it would be advisable to increase the insulation in this area, both on the building enclosure and the windows, by installing double windows.

From the images the shade in public areas can also be seen. The areas between the blocks is, as can be observed in the images and also during the visit, very dark. This is another disadvantage of the design, particularly during the colder months, when the public areas are not really suitable for leisure and play areas. Nevertheless, they are good green (garden) areas, since there are currently leafy trees there. Because of the exposure to the sun it would be a good idea to keep these areas as green areas rather than leisure or play areas.

On the other hand, the radiation on the south façades is higher, and in this case there is a need to mitigate it, particularly on the upper floors. Since the blocks are listed buildings and their appearance must be maintained, overhanging solar shading items cannot be fitted, nor any that are very visible such as shades or canopies. We would have to search for components that could be integrated in the façade itself, in agreement with the original aesthetics of the buildings. The two blocks located to the far west (to the left in figure 7) receive the most uniform sunlight, with less contrast between the two sides. However, to guarantee aesthetic uniformity of the buildings we cannot deal with them on an individual basis, and we therefore propose using the same façade solution as for the rest.

As a final conclusion it can be said that the tools presented in this paper, used in combination with *Sketchup*, have served their simulation purposes and have permitted realistic analysis of exposure to sunlight of the residential complex. The use of these tools does not entail any major problems or usability difficulties. These tools are therefore presented as a good option to employ to analyse the remaining twenty residential complexes to study.

Bibliographical References

[1] National project "Integrated design protocol for the rehabilitation of state subsidised housing and the urban regeneration" inscribed within the Programme for R & D oriented to society challenges, call 2013, Spanish Ministry of Economy and Competitiveness.

[2] KURTZ, Fernando., MONZÓN, Marta, LOPEZ-MESA, Belinda. Obsolescencia energética y acústica en la vivienda social de la postguerra española en áreas urbanas vulnerables. El caso de Zaragoza. *Informes de la construcción*, December 2014, vol. 66, extra-2. doi: http://dx.doi.org10.3989/ic.14.062.

[3]http://www.zaragoza.es/pgou/edih/area22alferez.pdf.

[4] WASSOUF, Micheel. *De la casa pasiva al estándar Passivhaus. La arquitectura pasiva en climas cálidos*. 1ª ed. Barcelona: Gustavo Gili, 2014. 144 p. ISBN 978-8425224522.

[5] .AGUSTÍN HERNÁNDEZ, Luis. et al. Generación de gráficos de trayectorias solares como herramienta para el análisis bioclimático de un edificio. In AA.VV. *I Congreso Internacional Egrafia*, Rosario (Argentina), 2004.

[6] http://www.graphisoft.es/archicad/

[7] MC MINN, Terence. Open Source Software for Daylighting Analysis of Architectural 3D Models. In: CHAN, F., MARINOVA, D. AND ANDERSSEN, R.S. (eds) *MODSIM2011, 19th International Congress on Modelling and Simulation.* Modelling and Simulation Society of Australia and New Zealand, 2011, p. 3226-3232.

[8] TORRES BARCHINO, AM.; SERRA LLUCH, J.; LLOPIS VERDÚ, J.; HIGÓN CALVET, JL.; GARCÍA CODOÑER, Á.; SAIZ MAULEÓN, MB. Analysis of colours and sun exposure in the Towers of Quart in Valencia (Spain). *Informes de la Construcción*, September 2012, vol. 527, nº 64, p. 261-274. doi: http://dx.doi.org/10.3989/ ic.2012.v64.i527.

[9] http://www.deltacodes.pl/en

[10] http://www.sunhoursplugin.com/

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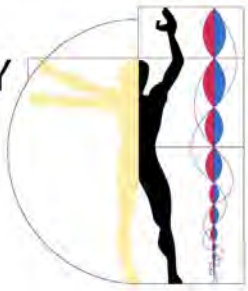

Integrated methodologies for documentation and restoration of Modern architecture: survey and representation of the "Casa das Canoas" by Niemeyer

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Abstract
"Casa das Canoas" in Rio de Janeiro, conceived by the Brazilian architect Oscar Niemeyer in 1953 in Canoas, Barra da Tujica, deep in the Tijuca Forest, was designed to make the house a part of the landscape. This is why Niemeyer designed the whole building around a large rock that was on the site and it was left there as the binding element of the whole project. The glass skin to minimize the visual separation between architecture and nature, the free, thin, flowing shape of the concrete roof and the curved shapes are the main features of this inestimable heritage, that is currently facing several problems of materials deterioration and lack of maintenance.
The relationship among the project design and the actual construction, the inclusion and integration of architecture in the natural landscape, material conservation' issues in this particular natural context and the need of documenting this famous architecture now in danger, led to a choice of survey technologies able to meet the problems of preservation of memory. Therefore the 3D laser scanner survey was aimed at knowledge, documentation, protection and enhancement of this important cultural heritage and the surrounding landscape. The digital survey campaign, including the external areas and the garden, has been integrated by a diagnostic survey in order to map the state of conservation and the main degradation issues.
The 3D survey will be a strong base for future conservation projects and it will preserve the memory of this extraordinary house.
Furthermore, the 3D laser scanner survey of Casa das Canoas is consistent with the digitalization of the Oscar Niemeyer Foundation Archive, one of the Foundation' priority in order to create a Niemeyer's drawings archive for researchers and academics.

Keywords: survey, representation, documentation, modern architecture, 3D laser scanner survey

1. Introduction
The integrated survey at Casa das Canoas in Rio de Janeiro, has been performed by the DIAPReM Center of the Department of Architecture of the University of Ferrara [1] in November 2014 with the aim of documentation, knowledge and preservation of one of the most important architecture by the Brazilian architect, Oscar Niemeyer. His ideologies in terms of society, politics and architecture and his style are expressed to the full in the architecture of the house at Canoas, which in itself was a remarkable achievement of Modernist architecture [2].
Four main research issues were focused: a detailed architectural analysis, the study of the relationship between architecture and sculpture, the relationship of architecture with the surrounded green landscape and the diagnostic survey, in order to document this great architecture and its state of conservation.
The research project was initiated under a relationship of experimentation and cooperation with the Foundation Oscar Niemeryer in 2013 to find a methodology of documentation aimed at defining conservative procedures of the architectures realized by the great Brazilian architect, after his death in 2012.
The project has been realized with the support of Ciro Pirondi, Director of the Escola de Cidade, San Paolo.

The work has been selected to be part of the CyArk 500 Challenge [3], CyArk's ambitious goal to digitally preserve 500 cultural heritage sites within the next five years. The Foundation and its partners are on a mission to save these cultural heritage sites digitally before more are ravaged by war, terrorism, arson, urban sprawl, climate change, earthquakes, floods, loss of maintenance and other threats.
The Casa das Canoas has been selected on the basis of the combination of three factors: level of risk faced by the site due to natural and human-induced threats, significance of the site in its local, national, and international context, and benefits of incorporating 3D documentation technology into the site's preservation, maintenance, and interpretation plan. The impact of digital preservation will be of immense cultural and social significance, and the resulting benefits of such documentation will contribute greatly to ensure heritage site will be available and accessible to future generations.



Fig. 1: Exterior view of the "Casa das Canoas" by Oscar Niemeyer; it is possible to perceive the relationship between architecture and landscape (Photo DIAPReM).

2. A masterpiece of Modernist architecture

Niemeyer chose to build his house between 1951 and 1953 [4] in Canoas, Barra da Tujica, a residential neighborhood located in the West zone of Rio de Janeiro. The location is surrounded by Tijuca Forest, a national park and fine example of Brazil's beautiful nature. In order to integrate building and surrounding Niemeyer modelled the whole building around a large rock that was situated on the site and it was left there as the binding element of the whole project. The upper floor of the house is characterized by distinctive elements of Modernist architecture (glass skin and concrete slab and steel) [5], and it is built around the rock, wrapping it and incorporating half of it in the interior and leaving the other half to freely flow into the pool outside. The result was a design that was Modernist in nature but which contradicted Modernism [6] on one of its main points about creating universal and reproducible architecture, which is disconnected from the site. The house is arranged according to the terrain and the feeling is that the architecture is following the contours of the site. The flowing shape of the concrete roof blends with the shape of the surrounding hills.
Das Canoas house was an innovation in Modernism not only in the context of architectural approach and landscape integration but also in the use of technology. One of the main feature is the free flowing horizontal concrete roof, quite thin so that it does not look too heavy over the glass skin of the living room and rests on small steel supports. This elegant structure projects over the glass skin and slopes slightly in order to provide sun protection. This innovative technological solution works together with the vast amount of vegetation around the house, in order to provide more shade. In this way climate consideration was brought into the range of techniques used by Modernism. Another technological challenge was to wrap the first floor in glass. The "glass walls" are structurally free as the roof is supported on steel columns placed both on the inside

and on the outside, depending on the roof curvature and the structural needs of the building. In order to achieve the flowing form of the walls, that do not always follow the shape of roof, glass panels of various sizes are used.

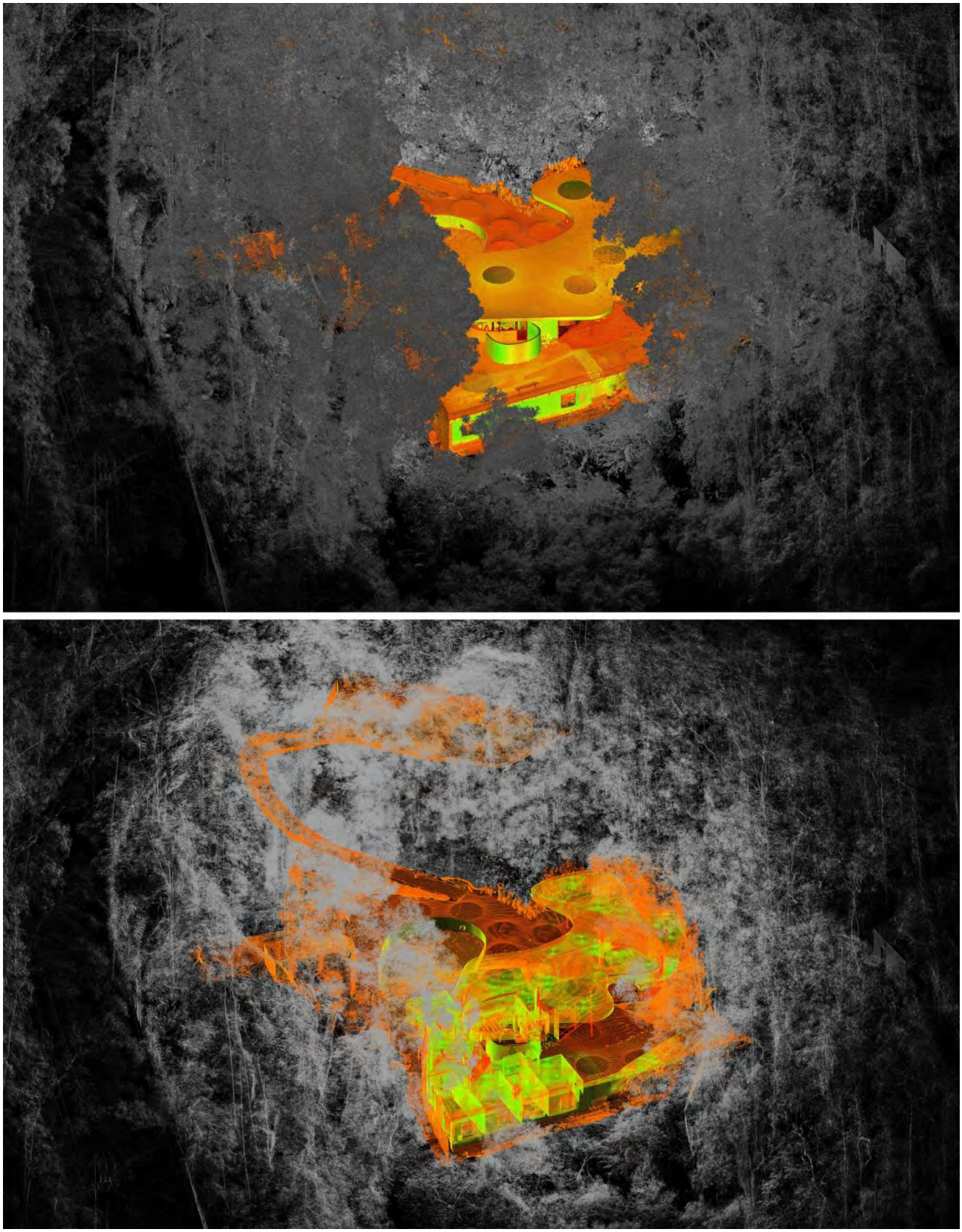

Fig. 2: Axonometric views; above the point cloud in the aerial view of the house immersed in the vegetation; below, the transparent visualisation of the building volumes.

2.1 *Non-compliancy* as a layout strategy

A substantial difference exists between the upper floor and the lower; while the glass gives a feeling of lightness and openness the occupants would feel exposed at night, so the private part of the house that accommodated the bedrooms, was positioned into the slope of the terrain, where the space feels enclosed, private and secured by the surrounding mass of soil. Windows in form prism ensured that enough daylight entered the bedrooms and that they were properly ventilated, while still protecting the privacy of the occupants. The problem with letting light in the bathrooms was originally solved through concrete grids used as skylights. The difference between the two floors consists also in the shape and layout of the spaces. The first floor was liberated and flowing, while the second was cellular and ordered. The first floor accommodates all the living areas that the family shares. It has a free oval shape and it is symbolically connected to the exterior and the lower floor through the use of the rock. The openness of the first floor has already been discussed. The achieved effect is due to the choice of a glass skin as the main construction element for the walls. The curved shape just strengthens the impression. However, the architect did not stop only at the shape and material of the walls. The interior of the house is also open. The living and dining areas flow into each other, forming a large free space that takes about two thirds of the whole floor area. The rest of the floor accommodates the kitchen, a toilet and the staircase leading to the lower floor. These rooms along with the rock on the other side of the staircase form a cellular layout. However, those closed spaces are pushed to one side so that they do not interfere with the plastic freedom of the living spaces [7].

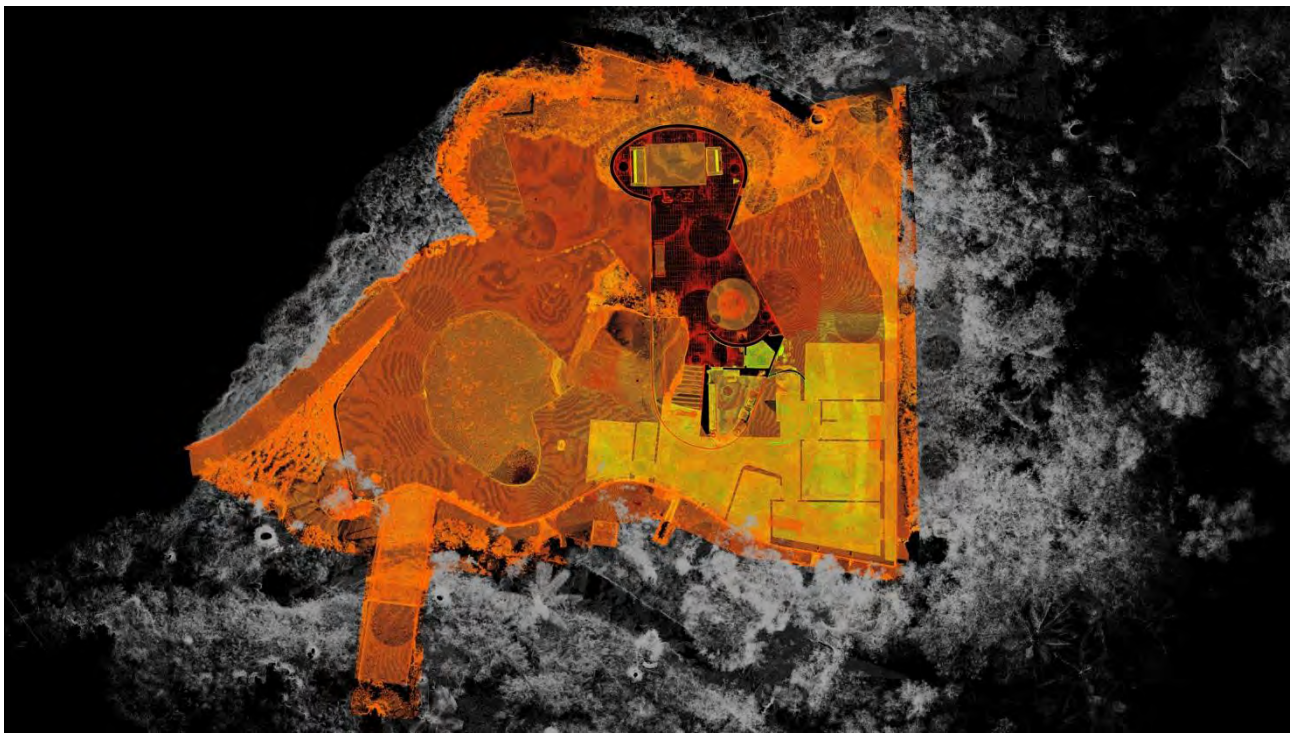

Fig. 3: Das Canoas House: ground floor and lower floor in the point cloud visualization and the overlapping of the two levels in transparency.

3. Research lines: documentation by means of the integrated survey

The documentation of the architectural masterpiece by Niemeyer has been intended priority to analyse the present condition and the state of conservation of the building, which currently suffers from a lack of maintenance. The integrated survey started from the architectural analysis: Oscar Niemeyer's ideologies in terms of society, politics and architecture [8] had formed a unique style, which he expressed to the full in the architecture of the house at Canoas, which in itself was a remarkable achievement of Modernist architecture. The "reading" of the architecture composition focused three main themes of investigation: the shape of the space [9] and its three-dimensional use, the study of the relationship between architecture and sculpture and the visual connections between interior and exterior, the relationship of architecture with the surrounded green landscape.

3.1 A *centrifugal* circulation path

The spatial organization of the house follows two different schemes for the upper and the lower level; to the freedom and transparency of the upper lower is counterpoised the closure and intimacy of the lower level.

In the upper floor the obstruction to the view is minimal; the main entrance is at the front side of the house, next to the pool, and leads the visitor into the living area which provides multiple views of the garden due to the glass walls. This part of the interior does not feel as an inside but rather as an extension to the outside. This effect is made even more obvious by positioning a second door on the opposite side of the house in a diagonal direction. It is almost as if the house is just a passage and not a permanent dwelling. There is a kind of axis being formed, which directs people to go through the house and continue their walk out in the open. The third entrance on the upper level is connected to the kitchen and it is a separate access to the back of the house.
The connection between the upper and the lower floor is a staircase carved into the rock. This is a key space within the house. It is designed in such a way that after having climbed up the stairs from the floor below, the person arrives at a very concise space, enclosed between the rock, the kitchen and the curved wall. This small volume opens up to the large living space, forcing the person to go there. On the other hand, when going down, this small space is able to draw the motion in the opposite direction.
The lower floor is strictly subdivided by straight walls and every free space is utilized by a wardrobe or a desk. Two similar bedrooms with a bathroom in the middle and the master bedroom is the simple arrangement of space in order to guarantee privacy to the family [10].

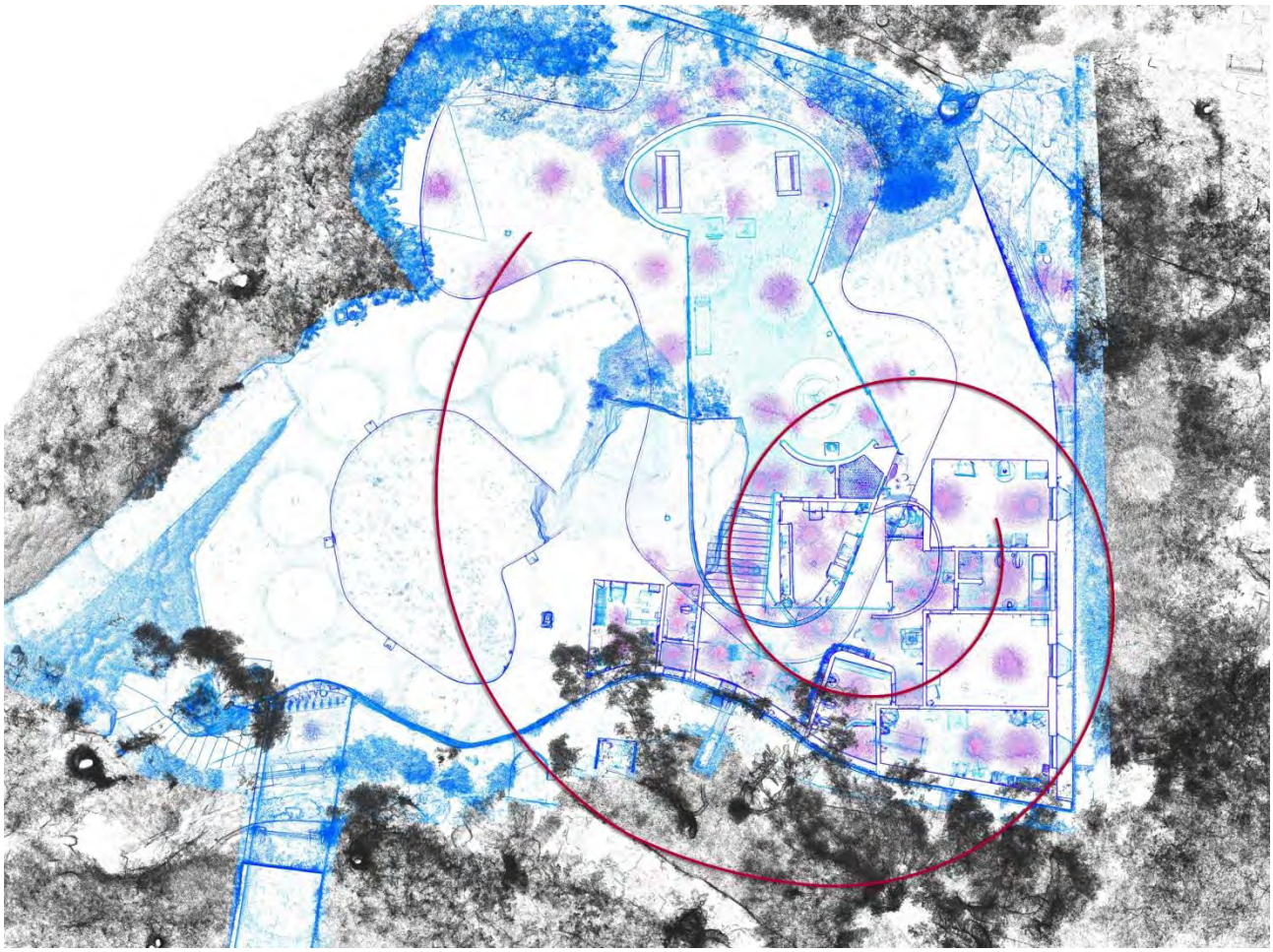

Fig. 4: Das Canoas House: scheme of the *centrifugal* circulation path: there is a kind of axis being formed, which directs people to go through the house from the deep inside and continue their walk out in the open, in a sort of spiral.

3.2 Architecture and art works

Another feature of Niemeyer's style [11] is the integration between architecture and art. This was a tradition that was followed by Niemeyer's friend Gustavo Capanema, who detailed the interiors with finishing, colours of the walls, and the furniture of his buildings. Even works of art were brought in at the right stage. The reason behind this was to promote Brazilian creativity and culture. Niemeyer adopted this idea and throughout his career he not only designed sculptural buildings, but he also insisted for the right sculptures and paintings to go with them. In the Casa das Canoas are placed sculptures by his friend Alfredo Ceschiatti. The artist reflected the liberated and plastic curves of Niemeyer's architecture into the sensual curves of the female bodies, which were placed around the pool.

Figures, busts and heads, for a total of five sculptural bodies outside and two inside, represent angelic female figures or sinuous bodies, which seem to guard the entrance and can be admired in the area outside the house; their positioning is also based on internal observation points.
For the first time a 3D survey with this level of detail (2 mm) allows to identify new ways of “reading” and cross interpretation, such as the triangulation perspective between the artwork placed by Oscar Niemeyer into the enclosed and not enclosed space. Thanks to the detailed data capturing it will be possible to identify the axes of relationship that develop from the placement and orientation of the female bodies to encourage to share the environmental and architectural experience.

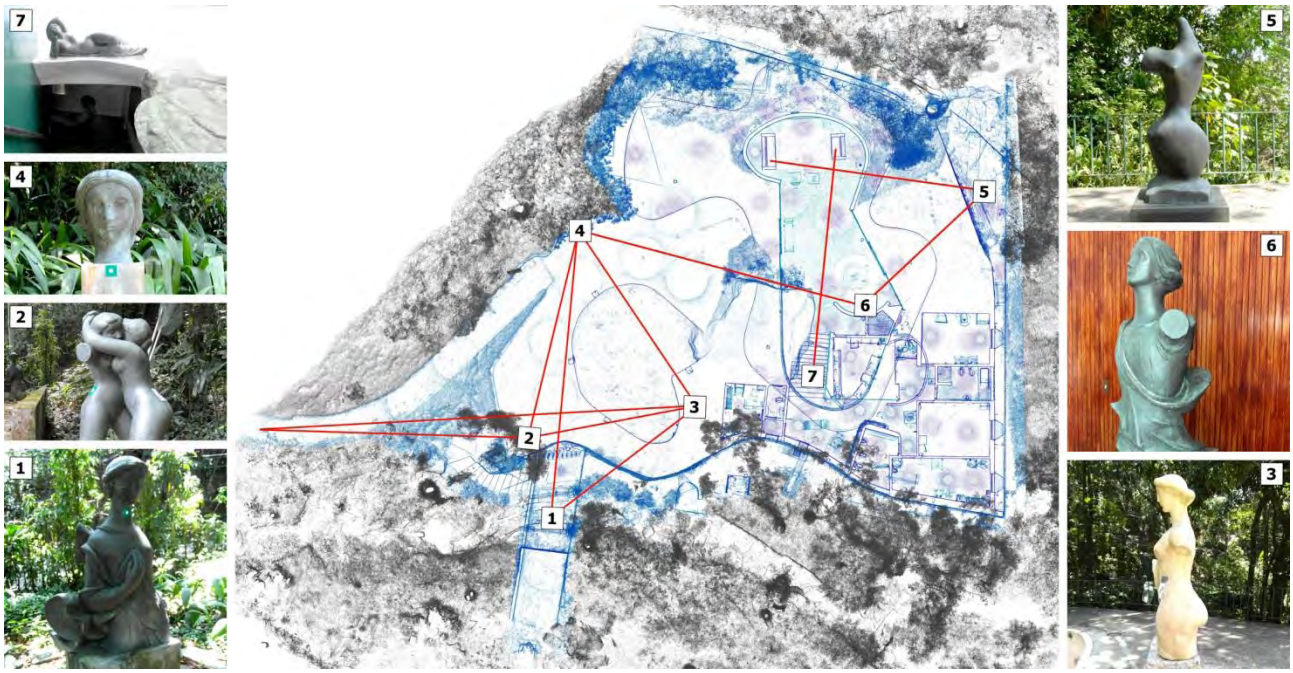

Fig. 5: Plan view in 3D point cloud. The yellow lines represent visual connections between the main observation points, from the inside and outside space: a triangulation perspective between the artwork placed by Oscar Niemeyer into the enclosed and not enclosed space.

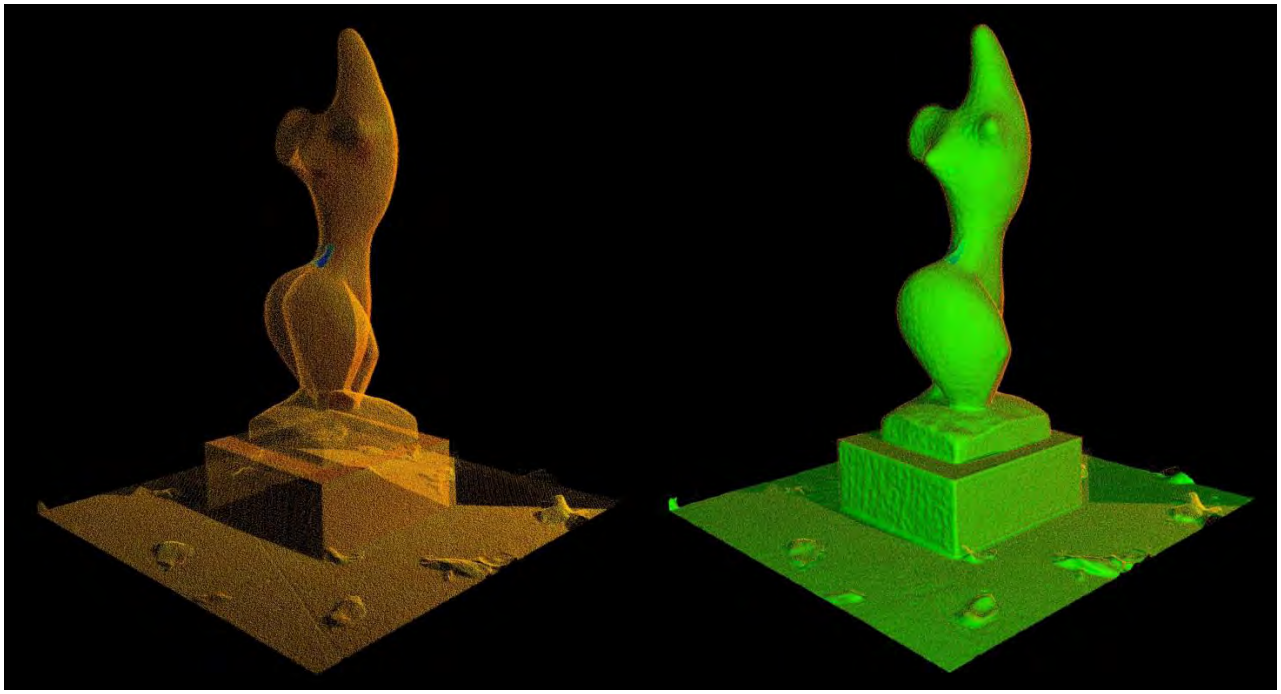

Fig. 6: Detailed survey of one of the sculptures placed around the house; on the left, point cloud model and, on the right, the meshed model.

3.3 Architecture and landscape

The strong unity between the outside and the inside, the natural and the artificial is expressed through the integration between the building and the surroundings, one of the driving forces of the design. It was not just about creating a beautiful setting around the dwelling, the architect wanted to make the house a part of the landscape.

The house at Canoas is surrounded by greenery from all sides. The winding paths in the gardens provided numerous routes for a walk and relax. The house itself had such a flowing shape that it was hard to distinguish it from the surroundings.

The project is designed to fit the topography of the site by exploiting the full potential in terms of peace and relaxation and contemplation of nature and, at the same time, let the vegetation enters and appropriates architecture, integrating with it.

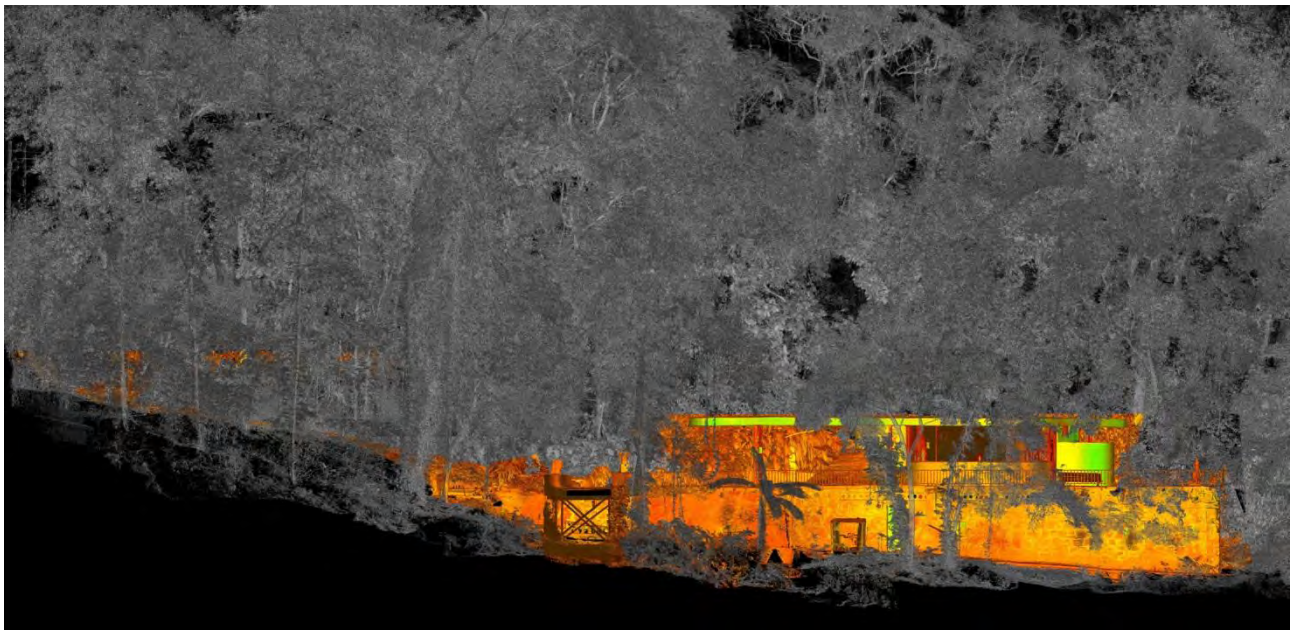

Fig. 7: The section of the point cloud shows the elevation largely covered by vegetation.

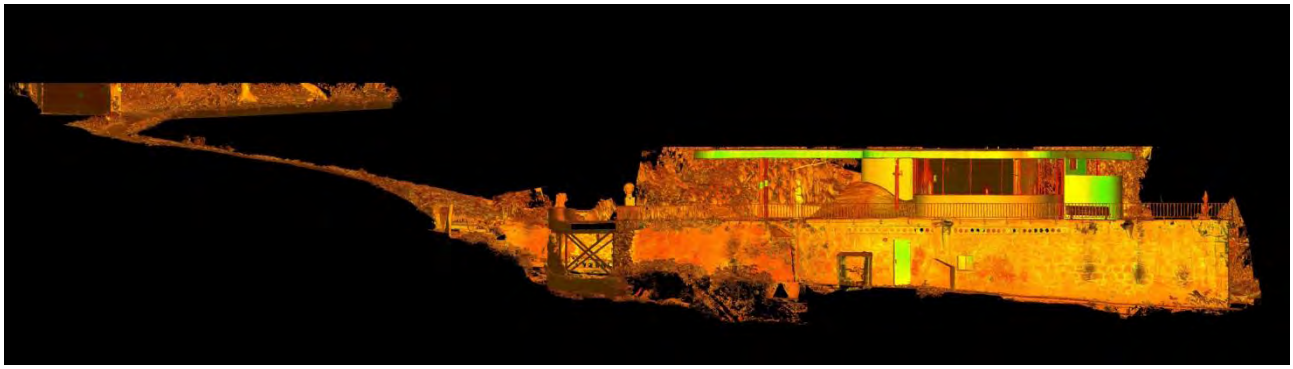

Fig. 8: The 3d laser scanner survey enables the processing of the points cloud in order to obtain from the model the visually free surface of the elevation otherwise not visible.

4. The integrated survey methodologies

4.1 3D laser scanner and topographic survey

An integrated survey methodology was applied in order to obtain set of data to be critically analysed [12] to examine in depth the research themes on the architecture by Niemeyer.

The integrated survey project involved 10 days on field working, about 8 hours per day. The total computed area for the 3D survey campaign included the external area of the house and the garden. This is because the landscape project was an essential part of the overall design process by Oscar Niemeyer and in order to study the effects of vegetation on the state of conservation of the building. The 3D survey has been performed with Leica C10 Laser Scanner (Lidar technology) with a medium resolution of 1 cm using green

and blue reflective targets for the scans registration [13]. The topographic survey will be performed with Leica Total Station TS06 plus 2". Topographical main connection to the network and framework, consisting of a polygonal closed or opened to bench marks at the ends and with polygonal rods with no longer than 80m. A detailed topographic survey (based on targets acquisition) composed of open polygonal with control points for the targets has been completed. The survey campaign has been documented by a detailed photographic survey.

Local topographic survey	
Total station	Leica TS06
Closed polygon	1
Polygon vertexes	7
Matched targets	53
Coordinate system	Local
3D Detailed survey	
3D Laser Scanner	Leica C10
Number 3D scan stations	128
Acquired targets	142
Point cloud coordinates	1.717.862.695
Average value registration point cloud model	2 mm
Work timing	9 days (about 75 hours)

Fig. 9: Table listing the main data of the instrumental survey campaign.

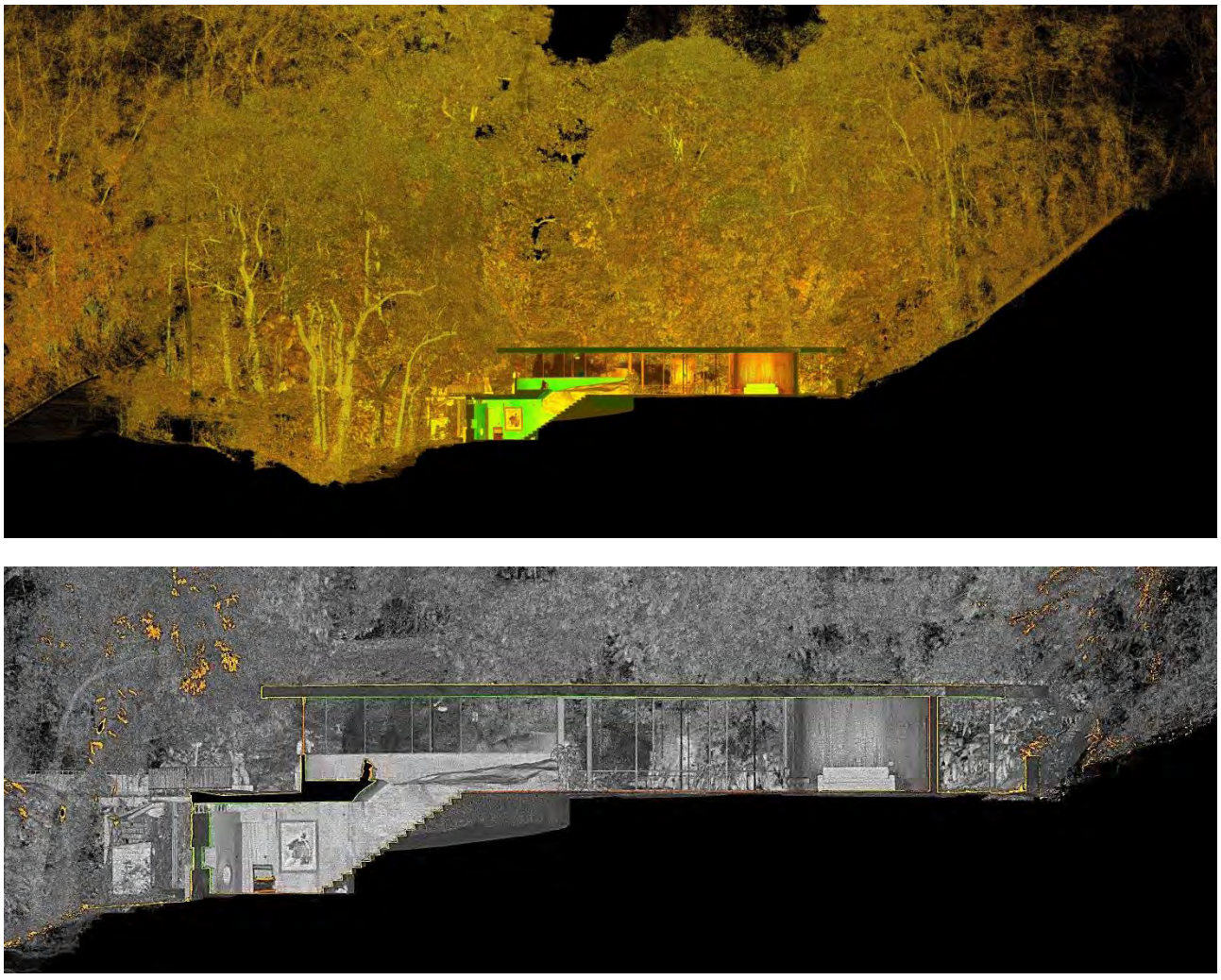

Fig. 10: Above, cross-section of the Casa das Canoas surrounded by impressive vegetation and, below, detail of the house section: it is possible to appreciate the amount of surveyed spatial coordinates and the level of detailed of the surveyed data.

4.2 State of conservation and diagnostic survey

The house is currently facing bad problems of materials deterioration and lack of maintenance. Main degradation issues are infest vegetation, that is growing very fast on external walls and on horizontal surfaces due to the local climate; structural, because part of the house is slowly moving towards the hill slope and cracks show that an intervention need to be urgently planned; big cracks cross the bedrooms ceiling and rain water is leaking inside the house, plaster is becoming very fast darker and weaker; swimming pool pavement shows cracks and deterioration and further analyses are required to better understand the causes of this problem; great geological instability of the slope subject to strong storms is a serious degradation factor.

The digital survey campaign, including the external areas and the garden, has been integrated by a diagnostic survey in order to map the state of conservation and the main degradation issues.

After a first general inspection of the overall building, a macroscopic analysis of deteriorations have been implemented on the basis of the nomenclature of the UNI Normal 1/88 recommendation. The result of the visual analysis will be related to the surface specifications surveyed by means of the 3D laser scanner and particularly through reflectance data [14].

The vegetation, deliberately integral part of the architecture, determines minor consequences, while the presence of humidity damages the state of conservation of the building, especially in the lower floor.

The presence of water is found primarily by infiltration (involving especially the conditions of the rooms of the lower area, on the back side).

Besides vegetation, the main degradations surveyed on external surfaces are:

- biological patina and biological crust;
- chromatic alteration
- surface deposit;
- incongruous interventions and extraneous materials;
- lacuna;
- deformation and detachment.

The main deteriorations on interior surfaces concern:

- ceiling cracks and infiltrations;
- lacuna and deformation of the plaster;
- stains for humidity and biological crusts.

Knowledge of the main deterioration causes as additional “level” of integrated survey will allow a precise mapping of the detected damages and will contribute to conservation actions.

5. Conclusions

The great opportunity to document and survey one of the most significant architectures by Oscar Niemeyer, developed in cooperation with the Oscar Niemeyer Foundation, has shown how the integrated methodology is able to reveal new aspects of the building and to analyze spaces and surfaces by means of innovative methods that have allowed to track intellectual avenues completely unexplored and unpublished.

The three-dimensional survey has proved to be essential to represent areas that would be otherwise impossible to analyze, for example elevations immersed in the trees, especially because of the surrounding landscape, and to find planimetric matches essential to understand the architectural “philosophy” on which Niemeyer has based the realization of the Casa das Canoas.

In the representative phase there is a motivational value, which makes the survey-representation a real project itself, with significant critical implications aimed at the determination not only of geometric precision but, especially in architecture, of visualization and conceptual representation of reality. The limitations of the data and representation models pose the borders of each possible ambition.

The 3D survey will be a strong base for future conservation projects and it will preserve the memory of this extraordinary house.

Furthermore, the 3D laser scanner survey of Casa das Canoas is consistent with the digitalization of the Oscar Niemeyer Foundation Archive, one of the Foundation’ priority in order to create a Niemeyer’s drawings archive for researchers and academics.

Bibliographical References

[1] Credits: DIAPReM Center, Department of Architecture, University of Ferrara - Scientific Responsible: Marcello Balzani; 3D and topographic survey: Guido Galvani; diagnostic survey: Federica Maietti; logistic support, international support for heritage and conservation: Luca Rossato, Denise Araujo Azevedo. Consorzio Futuro in Ricerca - Director: Stefania Corsi. Oscar Niemeyer Foundation, Rio De Janeiro. Supervisor: Ricardo Niemeyer; collaborator for coordination: Ciro Pirondi. Technical support: Leica Geosystems, Rio De Janeiro.

[2] WARCHAVCHIK, Gregori. *Arquitetura do Seculo XX e Outros Escritos*. São Paulo: Cosac & Naify editora, 2006.

[3] Web: http://www.cyark.org/about/the500/

[4] BOTEY, Josep Maria. *Oscar Niemeyer - Works and Projects*. (Translated by THOMPSON G.). Barcelona: Gustavo Gili, 1996.

[5] ANDREAS, Paul, FLAGGE, Ingeborg. *Oscar Niemeyer - A Legend of Modernism*. Berlin: Birkhäuser - Publishers for Architecure, 2003.

[7] ACAYABA, Marcos. *Residências em São Paulo: 1947-1975.* São Paulo: Romano Guerra Editores, 2011.

[8] TOMBI BRASIL, Luciana. *Ensaio sobre as resid. ncias unifamiliares*. S.o Paulo: Romano Guerra Editora, 2007.

[9] KOMAROV, Sergei. *Oscar Niemeyer - Architecture and Society*. (Translated by KONSTANTINOV N.). Moscow: Progress Publishers, 1975.

[10] NIEMEYER, Oscar. *The Curves of Time - The memoirs of Oscar Niemeyer*, London: Phaidon Press Limited, 2000.

[11] WEINSTRAUB, Alan, HESS, Alan. *Oscar Niemeyer Casas*. São Paulo: GG Brasil Editora, 2012.

[12] PAPADAKI, Stamo. *Oscar Niemeyer*. London: Mayflower Publishing Company Limited, 1960.

[13] KOLLER, David, FRISCHER, B., HUMPHREYS, G. *Research Challenges for Digital Archives of 3D Cultural Heritage Models*, in ACM Journal on Computing and Cultural Heritage, Vol. 2, No. 3, Article 7, 2009.

[14] MAIETTI, Federica, BALZANI, Marcello. *Development of integrated procedures for diagnosis of architectonical surfaces. Dimensional data and surface aspects,* in Proceedings of the International Workshop SMW08 *In situ monitoring of monumental surfaces*, 27-29 October 2008, Florence, Edited by Tiano P. and Pardini C. (ICVBC-CNR, Florence, Italy), Edifir Edizioni, Firenze, pp. 131-140.

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Three-dimensional morphometric database for visualisation and critical analysis of the San Sebastiano in Mantua by Leon Battista Alberti

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Abstract
Define a common methodology for the geometric memory surveying of all the architectures ascribed to Leon Battista Alberti and the creation of the related morphometric database was the challenge that led the DIAPReM center of the University of Ferrara to carry out an intensive survey campaign in collaboration with the Centro Studi Leon Battista Alberti since 2005. The integration of topographic techniques and three-dimensional laser scanners surveying methodologies allowed the creation of a 3D high-density morphometric database with possibilities of query, implementation and navigation, even on the Web, aimed at research, conservation and dissemination purposes.
The architectural interpretation of San Sebastiano in Mantua in relation to existing surveys is an example of Alberti's work critical analysis, implemented thanks to the generated models database. The methodological organization of the models allows to read previous surveys more accurately and to perform further analysis, like monitoring for building management and preservation, through a structured comparison logic. The same methodological framework was the key to analyze the morphology of S.Sebastiano starting from the drawing of Antonio Labacco.

Keywords: Survey, Leon Battista Alberti, San Sebastiano, Laser scanner 3D.

1. The Alberti project
In 1860 Jacob Burckhardt in the second section of his fundamental essay "The Civilization of the Renaissance in Italy"[1], starting from the idea of "state as a work of art" has suggested an interpretation of Alberti's architectures that, even if outdated, is full of a great charm. For the Swiss scholar Leon Battista Alberti embodies a "*multialtero* man", "a universal man", a personality with multiple aptitudes, and great "versatility". Humanist, writer, mathematician, theoretical of arts, scholar of architecture, keen observer of the events of his time, Leon Battista Alberti is a man of great modernity. It's no coincidence that Cristoforo Landino, in the end of the fifteenth century, get an extraordinary pictures of Alberti's peculiarities by the metaphor of the "chameleon" [2]: *camouflage*, experimentalism, the endless variety of linguistic stylistic and thematic registers. However, if the "variety" is the "code" of the fifteenth century, this "variety" together with the "experimental" and especially the idea that "bonae artes" are in "medietas" are still the "code" of our times. The metaphor used by humanists to express their concept of art and imitation is the ancient one of the bee [3]. This metaphor however makes clear only some stages of the process. It explains us that each work comes from other works, that any new text is an anthology of other texts, that the exploited works are pollen, while the end result is honey, a different and better product. Alberti over the metaphor of honey instead carries on and deepens the one of the "mosaic". The metaphor of honey has indeed the limit that, while admitting a process of transformation, it says nothing about that process, while the metaphor of the "mosaic" reveals largely the mechanism of creation. Alberti asserts that the culture of the past is like a temple, but the mission of the modern intellectual is to break it into pieces. The transformation of the materials of the past in mosaic tiles is thus the first stage of the new building. The second is to select in choosing between reuse materials, only what it's needed for the new building.

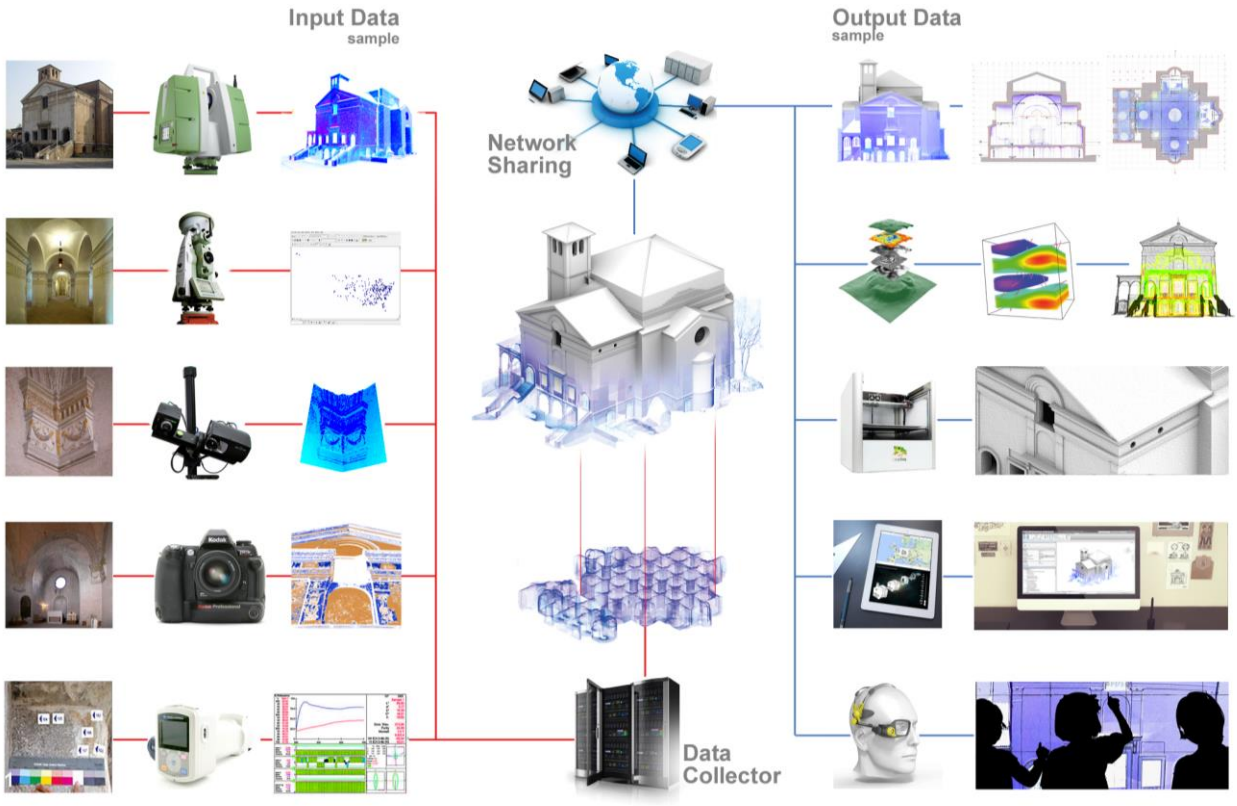


Fig. 1: Diagram of 3D databases of San Sebastian; the red lines describe the data acquisition processes by means of the integrated use different methodologies. By using a network sharing resource structured by a data collector local there are several opportunities of exploitation of the 3D database. The blue line describe the possible data output among: 2D Cad drawing, 3D Modeling, Bim, 3D printing, Virtual reality, Augmented reality and so on.

The third consists instead of assembling the tiles on the basis of a "concept" and "design" foreordained. In this context the project of collaboration between the Centro Studi Leon Battista Alberti Foundation and the DIAPReM Center, Department of Architecture of the University of Ferrara and the Consorzio Futuro in Ricerca was born [4]. Having found that Alberti's buildings, even if much studied, have surveys realized by different methodologies, it was decided to proceed to the survey of all Alberti's architectures using 3D laser scanner technologies and know-how of the DIAPReM Center [5].
Surveyed architectures to date are: the church of Sant'Andrea and the church of San Sebastiano in Mantua (internal and external), the church of Santissima Annunziata in Florence (internal and external), the church of San Martino in Gangalandi in Lastra Signa (internal and apse area), the bell tower of the Cathedral of Ferrara (internal and external), Tempio Malatestiano in Rimini (internal and external), the church of Santa Maria Novella in Florence (external and interior facades); the 3D survey of Palazzo Rucellai in Florence (facade and loggia) and the Tempietto del Santo Sepolcro in the Cappella Rucellai in Florence (internal) are scheduled [6].

1.2 The integrated survey methodology

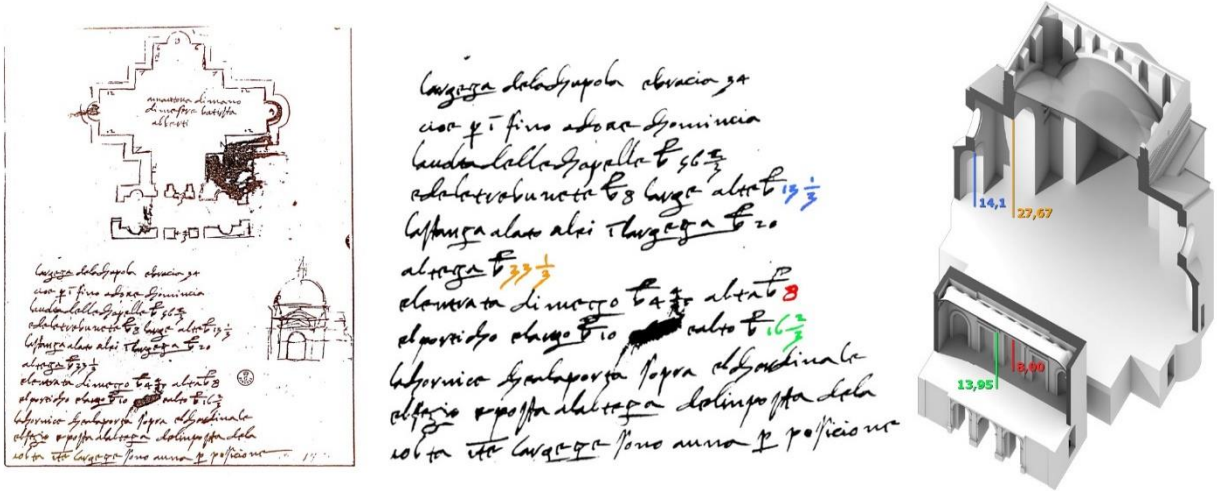
Survey the geometric memory of all the architectures attributed to Leon Battista Alberti by using the same methodology and instrumentation to generate a morphometric database "queryable" and navigable also bu Internet connection to support research, conservation and dissemination of cultural heritage may seem an ambitious aim [7].
The purpose of the research is to create a database structured at various levels designed primarily for the enhancement, for the use by researchers, restorers, art lovers up to the students. In the digital data base will be collected related topographic and photographic data, starting from the three-dimensional models obtained by 3D laser scanner survey (the overall database of the Alberti architectures includes today approximately 2.5 million spatial coordinates). An integrated three-dimensional survey aimed at the metric-morphologic analysis is a complex structure of hierarchical data where each information acquired by different technologies contributes, by its own specification, to the process of creating a descriptive-metric model which allows multi-scale analysis and representations of an artefact, of the context where it's placed and of surface's specifications. The complexity and volumetric articulation of the areas to be surveyed, due to the typological

variation of the Alberti' architectures, addressed the research towards the synergistic integration of different survey methodologies [8]:
1) the 3D laser scanner survey to obtain a 3D metric model;
2) the topographic method for scan registration and to identify an overall reference net for the triangulation system;
3) the photographic survey together with the topographic to acquire images for checking the current state of the architecture and decorations and to represent in photogrammetric mode the integration with the point cloud where, for logistical reasons, it was not possible to use 3D laser scanners.
Great attention has been placed on the methodology applied to integrate different procedures, on the accuracy of the scans registration (optimized by means of topographic methodology); it was necessary to realize a geometric net altimetrically related to connect the interior survey and the integrated photographic survey [9].
Simultaneously to the 3D laser scanner survey process, the main and secondary polygons have been realized. The main closed polygon determines the overall reference net, generating sets of survey points useful for the detailed survey; this has been the local reference system for interfacing GPS points and bench marks. This is a basic procedure because the use of the only laser scanner and of open polygons not allow to shape a comprehensive and coherent model without significant errors registration. For the choice of the acquisition instruments Time-of-flight laser scanners has been used on the basis of DIAPReM survey experiences; previous works have proved that these instruments are able to return a more homogeneous reflectance data for the characteristics of surfaces (also depending in weather conditions or the presence of humidity). This feature allows to obtain a metric-morphologic database accurate and homogenous and comparable for purposes of verification, analysis and research [10].

2. The San Sebastiano church: analysis and survey

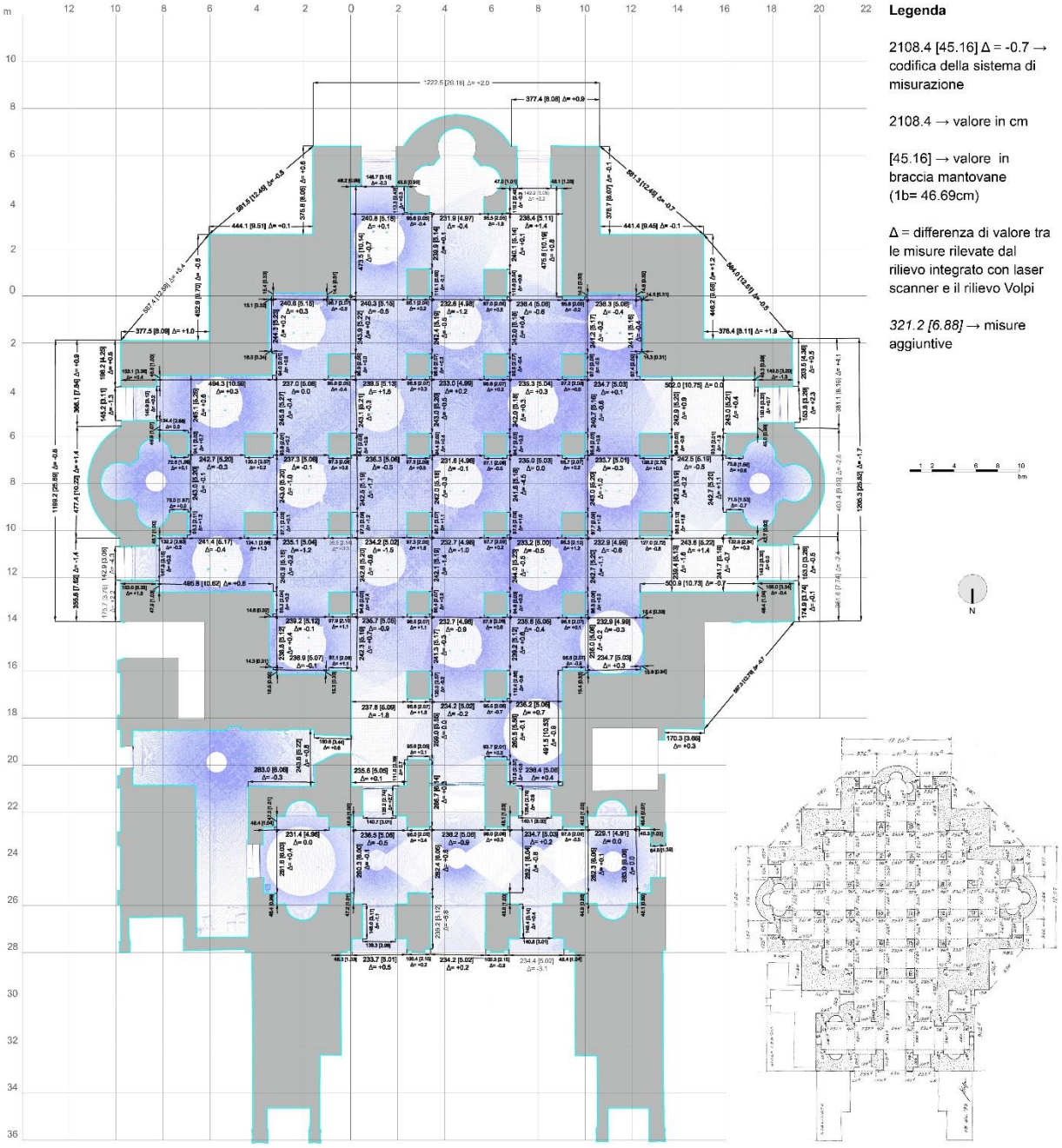
The church of San Sebastiano is the first building erected in Mantua based on design of Alberti, starting in 1460. The design of Antonio Labacco [Fig2] dated the early sixteenth century, which reproduces the plan of the church, assures the originality of the project with excellent reliability. The start of construction was immediately troubled probably for the inclusion of the lower floor underground, not included in the first project. Despite the substantial similarity distribution of the first floor with the drawing of Labacco, subsequent corrections show, in practice, the new way of Alberti to lead the construction site without the constant presence of the designer. The slowness in the works progress after the initial acceleration and the attention by Ludovico Gonzaga to the new church of Sant'Andrea left, when his death came, the San Sebastiano church still unfinished in many parts especially without the dome shown in the drawing of Labacco. As the completion by Lateran canons starting from 1488 has been faithful to Alberti indication is a problem still open. The restoration by Andrea Schiavi (1924-1925), in order to free up the building from adjustments, then heavily influenced his current appearance [11].

Fig. 2: The drawing of Antonio Labacco (on the right) [18] of the beginning of the sixteenth century, documenting the state closer to the building, the only evidence of the Alberti project of the Temple. The design was the basis of the dimensional checks of the research project. It is possible to see the comparison between the measures indication in the elevation explained in the text and the verification with the integrated survey. A BIM model obtained from the point cloud (on the left) has been used, as the graphical verification on medium measures.



Given the declared intention of Alberti [12] in seeking a numerically expressible order "*presiede alla natura tutta quanta*" the Volpi Ghirardini, to accomplish the iconometric analysis of San Sebastiano [13] begins first of all from the proportional study of the drawing by Antonio Labacco, and then he seeks verification and confirmation on the architecture of the Temple itself, and, according to Wittkower who reaffirms as the act of measuring is the substantial demonstration of proportions [14], Volpi asserts *"Per avvicinarsi a questa ricerca non possiamo usufruire dei disegni e dei rilievi sinora pubblicati o reperibili, perché o sono delle riproduzioni grafiche che non dichiarano la loro origine (….) o sono fatti con aggiustamenti che non conosciamo. Comunque questi disegni non esprimono quasi mai dei numeri, mentre la nostra ricerca và condotta unicamente su valori numerici ricavati in modo ragionato direttamente dall'edificio"* [15].

Fig. 3: Analysis of the metric "structure" of the "lower" church compared with the survey by Volpi Ghirardini, bottom right. The plan of the "lower" church, represented through the point cloud in transparency, is cut at a height of -3.307 meters from street level (original drawings in scale 1: 100). For processing the Volpi Ghirardini "Plan of the lower church: survey of the main measures" [18], the measures represent average values at heights between 0:00 and 1:50 from the floor of the temple.



These important considerations are shared in our project through different key elements such as the "numerical" value of the survey and not just the graphic representation, the orderliness and repeatability of measurement and not least the "nature" of the database that is at effect a digital metric-model made of hundreds of thousands of measures (the database of San Sebastiano, to date, has about 350 million three-dimensional points) [16]. This is a clear interpretation of the approach to the use of point clouds models as already treated by Professor Migliari [17].
Following again the iconometric test developed by Volpi, it is possible to find still many methodological similar to the work method set and approach to survey and measurement process, *"Ovviamente non si è misurato tutto, ma solo ciò che si è ritenuto degno di interesse, e su questo occorre spendere una parola. L'interesse per noi non consiste nel riprodurre l'edificio tramite un elaborato grafico, il più fedele possibile. Questo, eventualmente, è uno scopo secondario. Primario per noi è il tentativo di offrire a noi stessi e a chi vuole continuare nell'indagine una messe di dati numerici sui quali impostare corrette e verificabili ipotesi"* [15].
Research has therefore accepted this challenge, going to analyse, verify, compare these "variety of numerical data" to be ourselves part of this process of growth and study, as mentioned in the introduction in the humanistic metaphor of the bee.

2.2 Checking the Alberti proportions

"Durante il rinascimento, invece, la proporzione metrica fu il principio guida dell'ordine, e rivela l'armonia tra tutte le parti, e tra le parti e il tutto" [19].
Building the San Sebastiano, Alberti faces for the first time a project ex novo [20], and the first project of the Architect, which is very different from the present temple, is partially shown by the Labacco's drawing that point out the absence of the crypt, the central space covered with the dome and the presence of a double gable on the façade. The drawing is not a simple sketch, it shows dimensions in plan and elevation, measures in Mantuan arms that by the analysis of Volpi [13-18] are equivalent to 46,69 cm. Comparing the initial project with the current one, it's possible to note that large differences in heights due to the addition of the crypt.
The drawing by Labacco allows to understand how the Alberti studies the temple's measures and ratio; the height of the chapels is twice that of the narthex ($33_{1/2}$ - $16_{2/3}$) then the ratio is 1:2 between the façade and the main body of the building. It is possible to find the same ratio in the crypt, despite the remaking of the floor by the Schiavi, high 81/3 or half of the narthex, this may be evidence that the Alberti, even if only at a later time, also designs the crypt. Once established heights, the architect divides the internal space so as to reproduce between base and height the ratio of 3:5 that rules all the relations of the Labacco's drawing. An example is given by the distance between of the columns of the crypt equal to 5b then to the ratio is 5:$8_{1/3}$ equals to 3:5. Through the same method Alberti gets the height of the chapels, after insertion of the crypt, referenced to the height of the narthex $16_{2/3}$: x = 3:5, with x = $27_{1/2}$. It is possible to set another proportion, that Alberti uses, of 4: 5, the average proportion of 3:5, or (3+5):2=4. Relating all heights of San Sebastiano we have: $8_{1/3}$ (internal crypt), $13_{1/3}$ (internal *tribuna*), $16_{2/3}$ (inner narthex), $27_{2/3}$ (internal chapels), $34_{1/2}$ (extrados inner frame above vults), 46 (inside of the vault of the central square).

We Have:
$8_{1/3}$: $13_{1/3}$ = 3:5
$13_{1/3}$: $16_{2/3}$ = 4:5
$16_{2/3}$: $27_{2/3}$ = 3:5
$27_{2/3}$: $34_{1/2}$ = 4:5
$34_{1/2}$: 46 = 3:5

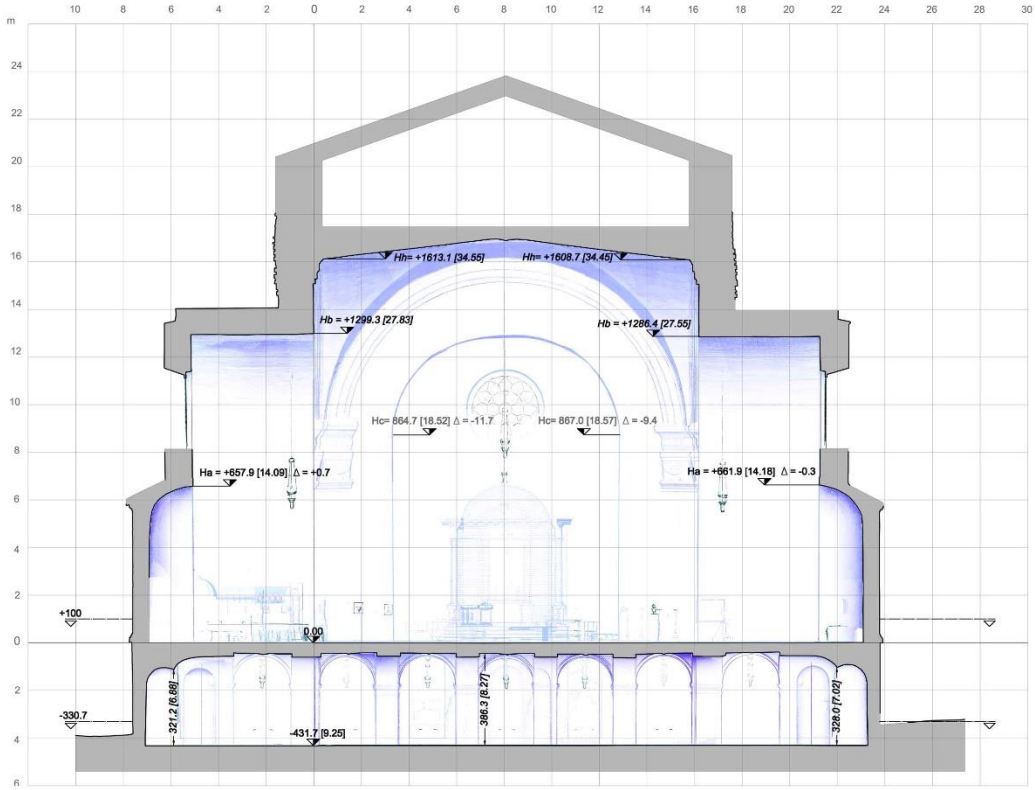
Starting from the verification of the ratio's analysis we can see that the Alberti searches for his "concinnitas" through the proportion [21].

3. Conclusios

"L'analisi dettagliata dei dati del San Sebastiano mostra una prassi progettuale matematicamente concepita, elaborate sulla base di rapporti molto connessi, frutto di un logica combinatoria ad incastro assai serrata." "Tutto porta ad affermare che il metodo progettuale dell'architetto si fonda su un sistema matematico, sovrainteso dall'armonia presente nella varietà dei rapporti offerti dalla natura." [22]. As might be predicted, in most of the measures analysed on the planimetric survey the variations are very low, in the vicinity of a centimetre; in those few cases where the variation increases is because measures are the sum of progressive measures. In elevation the variation slightly increases in proportion to the heights, excluding the base of the vaults of the HC arms where there are variation higher than a decimeter. This shows that it would be necessary

to perform a detailed analysis of all the heights of San Sebastiano to check where the variation become significant if the analysis of proportions is still correct according to the rules supposed for the crypt. Table 4 shows all the heights (Labacco, Volpi Ghirardini, integrated survey) that should be linked to each other by the proportions of 1:2, 3:5, 4:5, ratios derived from the analysis in historical criticism and checked on the basis of the data collected and analysed [23].
The characteristic of the discretionary of the survey made in 1993 by Volpi Ghirardini is actually its strength: the design of each measurement phase on which is based the space reconfiguration is structured through operating rules, which are based on the default choice and organized by levels, survey points, ratios and details. This allowed to check in projections systems of the upper and the lower church through morphological overlap that will be very useful for understanding the metric "structure" of the temple.
"Durante il rinascimento, invece, la proporzione metrica fu il principio guida dell'ordine, e rivela l'armonia tra tutte le parti, e tra le parti e il tutto" [19].

Fig. 4: Comparative analysis on the heights of the "higher" church relative to the survey by Vopli Ghiradini [14]. Section A-A^{I} with the Temple represented with the point cloud in transparency (original drawings in scale 1: 100). Below the diagrams of planimetric reference, on the right the scheme obtained by 3D laser survey, on the left the Volpi Ghirardini's one [17]. In the table the differential on highers of the church in reference to the drawing by Labacco, the survey bu Volpi and 3D laser survey.



Legenda

2108.4 [45.16] Δ = -0.7 → codifica del sistema di misurazione

2108.4 → valore in cm

[45.16] → valore in braccia mantovane (1b= 46.69cm)

Δ = differenza di valore tra le misure rilevate dal rilievo integrato con laser scanner e il rilievo Volpi

321.2 [6.88] → misure aggiuntive

Altimetria

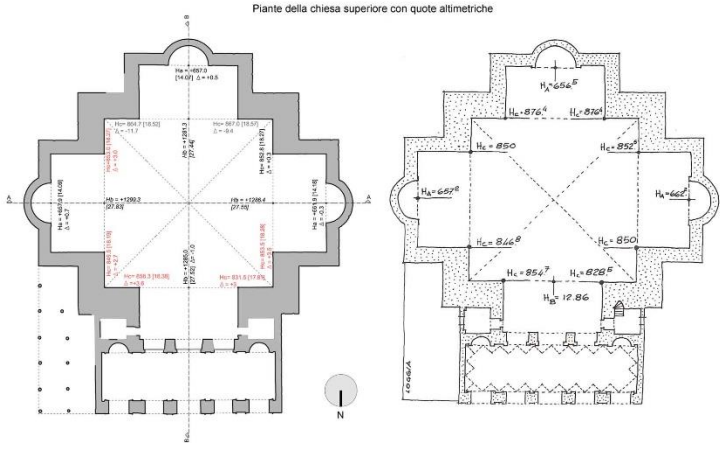
Ha = altezza in chive delle absidi

Hb = altezza in chiave dei bracci

Hc* = altezza d'imposta delle volte dei bracci

Hh = altezza in chiave delle cornici della crociera

* le quote Hc sono misure medie rilevate effetuando sezioni su tutti i bracci del tempio



Labacco		L.V. Ghirardini		Rilievo laser scanner 3d*	
Cupola					
altezza:	bm 56 2/3 cm 2642.6				
diametro:	bm 34 cm 1587.5	bm 34 1/2	cm 1609.9	bm 34 1/2	cm 1609.9
Cappella					
altezza:	bm 33 1/3 cm 1554.7	bm 27 1/2	cm 1286	bm 27 3/5	cm 1288
larghezza:	bm 20 cm 933.8	bm 20 1/3	cm 941.6	bm 20 1/5	cm 942.4
profondità:	bm 12 cm 560.3	bm 11	cm 513.6	bm 11 45/50	cm 510.3
Tribuna					
altezza:	bm 13 1/3 cm 620.9	bm 14 1/10	cm 658.3	bm 14 1/10	cm 658.9
larghezza:	bm 8 cm 373.5	bm 8 1/6	cm 380.9	bm 8 1/6	cm 381
Nartece					
altezza:	bm 16 2/3 cm 775,0	bm 14 47/50	cm 651.2	bm 14	cm 652.2
profondità:	bm 10 cm 468	bm 10	cm 468	bm 10	cm 465.5

* Le quote sono frutto di medie aritmetiche.

Bibliographical References

[1] BURCKHARDT, Jacob*. La civiltà del Rinascimento in Italia.* Roma: Newton Compton Editori, 2010. Translation of original book *The civilisation of the period of the renaissance in Italy.*

[2] "*Tornami alla mente lo stilo di Battista Alberto, el quale come nuovo camaleonta sempre quello colore piglia el quale è nella cosa della quale scrive*" q.v. *Proemio al commento dantesco*, Cristoforo Landino in CARDINI, Roberto. *Scritti critici e teorici.* Roma: Bulzoni, 1974.

[3] BOZZOLA, Sergio. *La lirica. Dalle origini a Leopardi*. Bologna: il Mulino, 2012.

[4] Credits:
Centro Studi Leon Battista Alberti Foundation, Mantua.
Scientific responsibles for the reserch project: Arturo Calzona, Francesco Paolo Fiore, Livio Volpi Ghirardini; collaboratrici: Federica Cerchiari, Veronica Ghizzi.
DIAPReM Center (Department of Architecture, University of Ferrara) and Consorzio Futuro in Ricerca. Scientific responsible: Marcello Balzani; team: Federico Uccelli, Guido Galvani, Daniel Blersch, Federico Ferrari, Paola Puma, Land Technology & Services S.r.l. Treviso, Piscitelli Flavia, Spenna Antonio, Roberto Carrara, Francesca Concas, Alessandro Grieco.
Public authorities involved: Superintendence for Architectural Heritage and Landscape for the provinces of Brescia, Cremona and Mantua, Municipality of Mantua, Diocese of Mantua, Banca Agricola Mantovana Foundation.

[5] BULGARELLI, Massimo. CALZONA, Arturo. CERIANA, Matteo. FIORE, Francesco Paolo. *Leon Battista Alberti e l'architettura*. Cinisello Balsamo: Silvana Editoriale, 2006.

[6] BONORA, Valentina. TUCCI, Grazia. *Rucellai Chapel by Leon Battista Alberti in Florence: a new survey aimed to the interpretation and promotion of the monument*. In *Documentation for Conservation and Development: New Heritage Strategies for the Future.* Firenze: Firenze University Press, 2006, pp. 117

[7] APOLLONIO, Fabrizio Ivan. GAIANI, Marco. FALLAVOLLITA, Federico. BALLABENI, Massimo. Zheng, Sun. *Bologna Porticoes Project: 3D Reality-Based Models for the Management of a Wide-Spread Architectural Heritage Site*. In AA.VV. *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection*. 5th International Conference, EuroMed 2014. Springer International Publishing, 2014, p. 499-506.

[8] DOCCI, Mario. *Metodologie innovative integrate per il rilevamento dell'architettura e dell'ambiente*. Roma: Gangemi, 2005.

[9] *The online journal computer science and information technology.* CARDONE, Vito. GIORDANO, Maria. *Computer Vision and Photo Scanning*. 2011, Vol1 n.3, p78-82.

[10] CENTOFANTI, Mario. BRUSAPORCI, Stefano. *Modelli complessi per il patrimonio architettonico-urbano.* Roma: Gangemi, 2013.

[11] *BORSI,* Franco. *Leon Battista Alberti. Opera completa.* Milano: Electa, 1996.

[12] "*nulla più in questo mi satisfa, nulla tutto quanto mi compreende e adopera, quanto le investigazioni e dimostrazioni matematice, massime quando io studi ridurle a qualche utile pratica in vita*" in L. B. Alberti ALBERTI, Leon Battista. *Profugiorum ab aerumna libri. (*in *Opere Volgari,* edited by GRAYSON Cecil). Bari: Laterza, 1966, vol.II, p.182
"*Natura emimoptima concupiscimus et optimis cum voluptate adheremus. Neque in toto corpore aut partibus viget magis concinnitas quam in se ipsa atque natura; […] Totam complectitur hominis vitam et rationes, totamque pertractat naturam rerum*". Cit. ALBERTI, Leon Battista. *De re aedificatoria*. IX, 5, p.815
ALBERTI, Leon Battista. *De re aedificatoria - L'arte del Costruire*. (Translated by GIONTELLA, Valeria). 1ª ed. Torino: Bollati Boringhieri, 2010.

[13] CALZONA, Arturo. VOLPI GHIRARDINI, Livio. *Il San Sebastiano di Leon Battista Alberti*. Firenze: Olschki, 1994, p. 219 - 272

[14] *“i rapporti irrazionali ponevano gli architetti del Rinascimento in un vero e proprio dilemma, poiché l’atteggiamento rinascimentale nei riguardi della proporzione era determinato da un posizione mentale nuova e organica rispetto alla natura; posizione da cui discendeva il procedimento empirico del misurare, e che tendeva a dimostrare che tutte le cose erano tra loro connesse dal numero”.*
WITTKOWER, Rudolf. *Principi architettonici nell’età dell’umanesimo*. Torino: Enauidi, 1964, p. 151. Translation of original book *Architectural Principles in the Age of Humanis.*

[15] CALZONA, Arturo. VOLPI GHIRARDINI, Livio. *Il San Sebastiano di Leon Battista Alberti*. Firenze: Olschki, 1994, p. 234-235

[16] Starting from the 3D point cloud morphometric model, have been identified all section plans and projection aimed at the complete description and extraction in 2D CAD format of all elements relating to this comparison study for planimetric analysis and volumetric section of the San Sebastiano church. It was also developed a three-dimensional BIM model of San Sebastian to further analyse prospective studies on the building volume and elevation measures of the complex.

[17] MIGLIARI, Riccardo. *Frontiere del rilievo. Dalla matita alle scansioni 3D.* Roma: Gangemi, 2001

[18] CALZONA, Arturo. VOLPI GHIRARDINI, Livio. *Il San Sebastiano di Leon Battista Alberti*. Firenze: Olschki, 1994, p. 272-273

[19] WITTKOWER, Rudolf. *Principi architettonici nell’età dell’umanesimo*. Torino: Einaudi, 1964. p. 152. Translation of original book *Architectural Principles in the Age of Humanis.*

[20] The clear references in San Sebrastiano are related to: the Syriac arch that Alberti resumes from the arch of Orange, probably seen in the trip to Provence, the pillared crypt recalls the ones of the Roman cisterns and finally the full plan is characterized as review of the Etruscan temple in a Renaissance mode and especially following the instructions in the De rea aedificatoria by Alberti for the construction of the temple, it is possible to understand the intentions of the architect to build a Christian church and the search for congruence between his literary work and the architectural one.

[21] TAVERNOR, Robert William. *Concinnitas in the architectural theory and practice of Leon Battista Alberti.* PhD. Thesis, University of Cambridge, 1985.

[22] VOLPI GHIRARDINI, Livio. *L'architettura numerabile di Leon Battista Alberti segno universale di ordine e di armonia.* Firenze: L.S. Olschki, 2001, p. 238. Serie Leon Battista Alberti e il Quattrocento.

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HERITAGE and TECHNOLOGY
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XIII International Forum Le Vie dei Mercanti

Aversa, Capri 11-12-13 June 2015

Restoration works and valorization strategies of the architectural complex of San Francesco in Amantea (CS)

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Abstract
The main objective of the conservation of cultural heritage is to preserve historical evidences in order that to allow future generations will can hand down the authentic values of all traces of past. However, it could be a daunting goal of the restoration project to bring back to its original aspect an important historical architecture dating from the 13thcentury, abandoned, which over the past two centuries has been subject to different environmental conditions. This is the case of the architecture of San Francesco of Assisi in Amantea, an important site Franciscan whose ruins are subject to a restoration project, difficult goal of returning an archaeological site of considerable architectural content, of great emotional impact and landscaped indisputable value.
The paper gives at the beginning a difficult stage survey that was conducted on the ruins of the complex, in order to know the characteristics of the historic site examined, to discover hidden architectural portions that were buried or covered with vegetation, in the detection of damage of the vertical masonry structures that still exist. Subsequently, static analysis on masonry structures and their strengthening were made to ensure a future use of the historical site placed in safe conditions especially to withstand seismic forces because the complex falls within in a seismic zone. The use of new technologies for structural rehabilitation, such as the use of FRP (Fiber Reinforced Materials), it was very importantforits safety.



Keywords: Cultural heritage, Restoration, Composite materials, Seismic strengthening.

1. Introduction
This work has as main objective to describe, accurately, the delicate surgery performed on the consolidation of masonry dome inside the complex. This project allowed to pursue a dual purpose: on the one hand it was necessary to the preservation of the dome that had, before its restoration, missing portions, lesions and the presence of weeds that compromised the structural integrity; on the other, it was necessary to implement policies to the use of the site. In relation to this second objective, today there are regulations requiring that a historic site, so that it can been joyed by visitors, must ensure safe safety margins especially in seismic areas[1].The important structural consolidation, built on the dome in 2007, guarantees both the conservation of the structure but also a better response to seismic actions. However, the safety margins associated with that intervention in its design phase are now changed due to the introduction of the new seismic norms. In addition to this structural intervention is part of a restoration project of the site, still unfinished, which aims not only to the preservation of the existing but also to the use of the same architectural park. Therefore, it will be important to investigate whether the work done, as well as representing an optimal practice of structural consolidation time to

preserve the element dome, is able to respect the safety checks specified by the new seismic norms, indispensable prerogative if the environment domed church will soon be open to the public, ensuring suitable conditions of safety to visitors. The important structural intervention is justified by the importance of the site in question, as highlighted during the grading geographical and historical, as well as analysis of the important architectural remains.

2. Territorial and historical frameworkof the Franciscan complex

The Franciscan complex of San Francesco of Assisi in Amantea is located on a small plateau below the area of the castle at the top of the Catocastro neighborhood between in habited nucleus and the watchtower "Civita" (Figs. 1, 2). The architecture responds to the locational logic of the first Franciscan complexes of the thirteenth century. In fact, it is located *"intra civitatem arcem propre"* [2], occupying a dominant and control position throughout the urban core of the city underlying. The religious complex was anciently reached through: the ancient *"San Francesco road"*, representing the main access road linking the complex in question with the under lying neighborhood of Catocastro; a secondary path that allowed access to the church by a side entrance of the complex, located along the southern front, coming from the neighborhood of Paraporto.



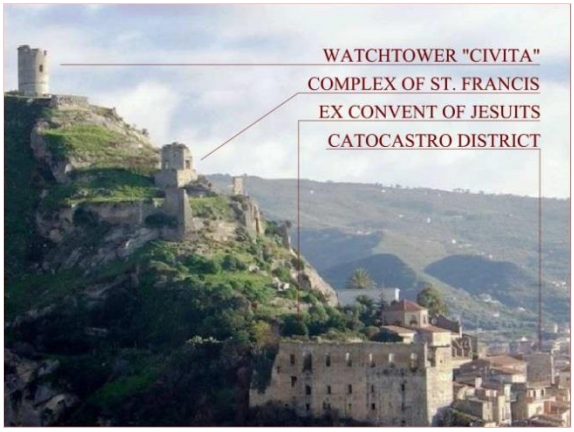


Fig. 1. View of Catacastro district from the sea
Fig. 2. View of the highest part of Catocastro district and its important architectures

The complex of St. Francis in Amantea was the second Franciscan cenoby of Calabria, after Protoconvento Castrovillari, and was founded between 1221 and 1264 by Blessed Peter Cathin of St. Andrew, a disciple of the Saint of Assisi[2]. Once in Amantea, the Franciscans took possession of a pre-existing religious site by now abandoned, which is the convent of San Basilio of Basilian monks of greek rite already they had abandoned and adapting it according to their needs[3]. The construction of the new architecture was performed in full compliance with the rules of construction resulting from the provisions laid down during the General Chapter of Narbonne (1260) [4]. Following the distribution of the first "familiar pits", the noble families of Amantea began building chapels of *jus patronato* within the church which had decorative elements of relief in connection with an internal gaunt and essential volume, able to reflect the humility the life of the Franciscan Friars[2]. The convent of San Francesco of Assisi was the head quarters of the Brotherhood of the SS. Rosario, constituted by the sailors of the city [5], which had its own private chapel inside the chapel, with a cupola, today visitable inside of the architectural site. The complex Minorite was concerned, over the centuries, many collapses, and part of the old factory convent fell to the ground following the substantial damage caused by the strong earthquake that shook there gion in 1638 [2]. Further damaged during the French siege suffered from Amantea between 1806-1807, the monastery, by now ruined, because of the Napoleonic suppression of 7 August 1809 it was closed permanently becoming the property of the Royal Property [2]. Since then, the important architectural complex went in exorably towards a process of abandonment that, in the course of just two centuries, tried to erase from the collective memory of the oldest religious building in the city.

3. Description of the ruins of the Franciscan complex

Since 2007 a major renovation work on the site of San Francesco is undergoing, which provided three successive phases. During the first phase has been performed the cleaning of the site, partially hidden by the vegetation, as well as the realization of excavations able to bringing the remains of numerous architectural environments, places once the ground floor of the complex (fig. 3). The second phase involved the safety of the rock wall on which was erected religious architecture, as well as the structural consolidation of masonry elements in elevation. The third and final phase, still ongoing, involves works related to the future use of the site (fig. 4).

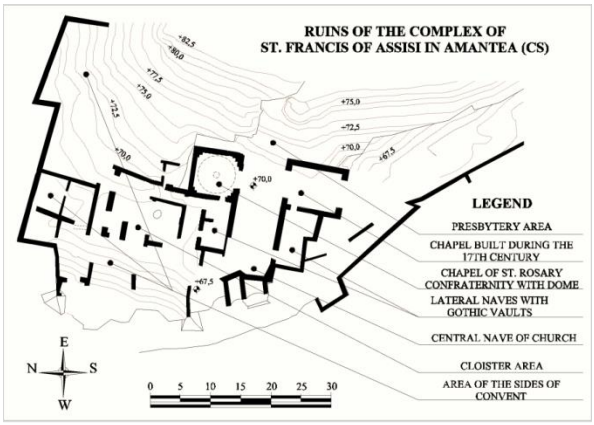




Fig. 3. Map of the ruins of the complex
Fig. 4. View of the ruins of complex from the ex Convent of Jesuits

The excavations carried out so far have identified clearly the typological Franciscan architecture in question. In fact, analyzing the architectural remains, it is evident that the complex was constituted by: the church, having the classic east-west orientation, which was placed on the south side of the complex; the convent, developed along three fronts around a small cloister quadrangle, located north of the church. The church contains many architectural traces that show the presence of the original single nave with a wooden hut and square presbytery, cross vaults, raised above the main aisle and introduced by a large triumphal arch of which have resurfaced the bases. The church, however, over the centuries has under gone notice able changes in the system characteristic with the introduction: two small aisles with cross vaults with ribs, characterized by the presence of votive altars with decorative friezes; two important chapels quadrangular form a transept. One of the two chapels, with a square plan, was the site of the oratory of the Brotherhood and is provided with a dome with lantern (fig. 5), set on an octagonal drum, and an altar with ornaments in baroque style (fig. 6). With cleaning and excavation carried out with in the aisles of the church have emerged: small pieces of painted wall decoration system, dating back to the XVth century (fig. 7); traces of numerous convent rooms arranged around the small cloister quadrangle, of which there are the bases of the pillars. Such environments interested in a large area, which makes it clear that the convent of San Francesco was an architectural site of some importance. Among the various remains of the convent are preserved pieces of barrel vaults two large hypogeal tanks to collect water.





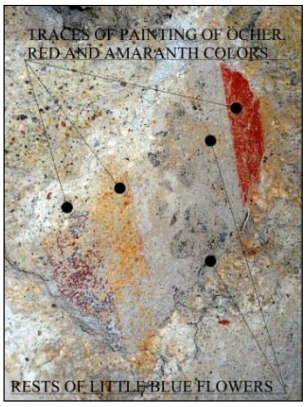


Fig. 5. The dome's intrados of the chapel of St. Rosary Confraternity
Fig. 6. The Baroque altar of the chapel of St. Rosary Confraternity
Fig. 7. Rest of parietal painting into one of lateral naves of church

With particular attention to the structure of the domed church, it is made up of stones of varying sizes arranged irregularly on rows sub-horizontal and interconnected through an abundant use of mortar, loose in many places. From a geometrical point of view, the dome-type under consideration is hemispherical, having a radius R=3.85 m, average thickness s=0.3 m, and is equipped with a small cylindrical lantern, having inner radius R_L=0.50 m, thickness s_L=0.20 m.

4. Static analysis of masonry dome

The masonry dome of the church was the object of a static analysis performed according to the theory of the thin membrane domed, under which it was considered equipped with the axial stiffness and

bending stiffness and shear-free [6]. In this analysis were considered, the forces in the tangent plane and the normal stresses in the section plane of the membrane divided evenly in the thickness [7]. Moreover, by virtue of the poor state of the original masonry dome, it is considered a linear elastic constitutive masonry, neglecting the plastic reserves that may have the same wall, so as to maintain a significant safety margin. The membranal analysis performed led to the evaluation of internal forces at the dome considering, in turn, applied the following loads: the weight of the snow load, wind pressure, seismic action. The values of stresses, generated inside the dome, were evaluated by varying the following angles: the latitude θ, is the angle that describes the generic points on the meridian, for which we have chosen a constant step of 10°; longitude Ψ, is the angle that describes the points on the generic parallel, for which we have chosen a constant step equal to 45° [6]. On the basis only θ, values of internal stresses generated by symmetrical loads (dead weight and snow load) were determined, while the values of the stresses due to asymmetric loads (the actions of wind and earthquake) were evaluated as a function of θ and Ψ. For symmetrical loads normal stresses S_1 and S_2 on the thickness of the generic infinitesimal element of area dA were calculated, while for asymmetric addition to S_1 and S_2, internal shear stresses T parallel to the thickness of the generic element dA were determined [6].
The internal stresses of the dome, along the meridians S_1 and along the parallels S_2, due to its own weight were evaluated using the following equations [8]:

$$S_1 = -\gamma_m Rs \frac{cos\theta_L - cos\theta}{sin^2\theta} - \frac{P}{2\pi R} \cdot \frac{1}{sin^2\theta}$$

$$S_2 = \gamma_m Rs \left(\frac{cos\theta_L - cos\theta}{sin^2\theta} - cos\theta \right) + \frac{P}{2\pi R} \cdot \frac{1}{sin^2\theta}$$

where: γ_m is the specific weight of the masonry of the dome, equal to 18 kN/m^3; R is the radius of curvature of the dome; s is the average thickness of the dome; θ_L is the latitude of engagement of the lantern of the dome, equal to 7.46°; P is the weight of the lantern, amounting to 13.26 kN; furthermore, the latitude θ takes values $\theta_L \leq \theta \leq 90°$.
The internal stresses S_1 and S_2 due to snow load were evaluated by the following relationships [8]:

$$S_1 = -\frac{qsR}{2}$$

$$S_2 = -\frac{qsR}{2} \cdot cos2\theta = -\frac{qsR}{2} \cdot (cos^2\theta - sin^2\theta)$$

where q_s is the snow load, estimated at 0.48kN/m^2.
The evaluation of the internal stresses at the dome due to wind action was performed by superimposing the partial internal stresses S_1, S_2 and T [6] produced:
- the wind pressure p_c agent directly on the dome, equal to 0.423 kN/m^2; in this case, internal strains were evaluated using the following equations [8]:

$$S_1 = -\frac{p_c R \cdot \cos\Psi \cos\theta}{3sin^3\theta} \cdot (2 - 3\cos\theta + cos^3\theta)$$

$$T = \frac{p_c R \cdot \sin\Psi}{3sin^3\theta} \cdot (2 - 3\cos\theta + cos^3\theta)$$

$$S_2 = -\frac{p_c R \cdot \cos\Psi}{3sin^3\theta} \cdot (3sin^2\theta + 2cos^4\theta - 2\cos\theta)$$

  with the longitude Ψ that varies from 0° to 360° in 45° steps;
- the wind pressure agent directly on the lantern p_l, amounting to 1.478 kN/m^2; in this case, the internal stresses generated by the action of p_l were evaluated using the following equations [8]:

$$S_1 = \frac{V}{sen\vartheta} = -S_2$$

$$T = \frac{F_t \cdot sen\psi}{\pi r} = \frac{(P - F_s) \cdot sen\psi}{\pi r}$$

where: V is the vertical component of the stresses on the tangent to the membrane at the height of the generic parallel m-m, located at latitude θ; F_s is the resultant of stresses S_1 agents in the points of the parallel m-m; F_t is the result of shear actions.

The internal forces due to the seismic action have been calculated on the basis of a system of equivalent static forces used to simulate the effect of the earthquake; such forces have been considered applied in the direction normal to the axis of symmetry of the system in correspondence of the various seismic masses in which it is possible to subdivide the construction under review. Seismic actions of the project have been defined from the basic seismic hazard of the site, as determined by the NTC/2008. Internal efforts to the dome, due to the action of the earthquake, were evaluated by overlapping partial internal stresses S_1, S_2 and T produced:

- by the action of the earthquake acting on the dome and simulated by the equivalent static force F_1, acting horizontally and applied at the foot of the lantern, using the following relationships [8]:

$$S_1 = \frac{F_1}{\pi R} \cdot \frac{1-\cos\theta}{sin^3\theta} \cos\Psi = -S_2$$

$$T = \frac{F_1}{\pi R} \cdot \frac{1-\cos\theta}{sin^3\theta} \sin\Psi$$

- by the action of the earthquake agent on the lantern and simulated by equivalent static force F_2, acting horizontally and applied to the top of the lantern, using the following relation [8]:

$$S_1 = \frac{V}{sen\vartheta} = -S_2$$

$$T = \frac{(F_2 - F_s) \cdot \operatorname{sen}\Psi}{\pi r}$$

where: V is the vertical component of the stresses on the tangent to the membrane at the height of generic parallel m-m; F_s is the resultant of stresses S_1 agents in the points of the parallel m-m.

Note the values of the internal stresses S_1, S_2 and T due to the single contributions of the load (weight, snow load, wind action, action of the earthquake) to vary the angles of latitude and longitude θ, Ψ, their combination, by referring to load combinations provided by the NTC/2008, both the SLU to SLE, was performed [9]. In this way, for each of the load combinations total stresses S_{1tot}, S_{2tot} and T_{tot} were obtained to vary from θ and Ψ. Subsequently the main stresses S_ξ and S_η, well as the principal stresses σ_ξ and σ_η, agents along the principal directions ξ and η, were evaluated by the following relationships [6]:

$$S_\xi = \frac{S_{1tot} + S_{2tot}}{2} + \frac{1}{2}\sqrt{(S_{1tot} - S_{2tot})^2 + 4 \cdot T_{tot}^2}$$

$$S_\eta = \frac{S_{1tot} + S_{2tot}}{2} - \frac{1}{2}\sqrt{(S_{1tot} - S_{2tot})^2 + 4 \cdot T_{tot}^2}$$

$$\sigma_\xi = \frac{S_\xi}{s} \quad \sigma_\eta = \frac{S_\eta}{s}$$

The maximum values of the principal stresses, evaluated on the dome, were reported in table 1: for each combination maximum values of the stresses σ_ξ and σ_η were identified, both compression (negative sign) and tensile (positive sign). From the results obtained for the different load combinations, that for which there were distributions of stresses, the seismic combination along the principal directions ξ and η was the heaviest one.

For this combination of load, in order to make independent strength checks from the longitude Ψ, the evaluation of the envelope diagram for both the main stresses (fig. 8) than for the principal stresses was obtained (fig. 9). This allowed, with varying latitude θ, to evaluate the maximum of stresses inside the dome independently of longitude Ψ considered respect to the direction of the earthquake.

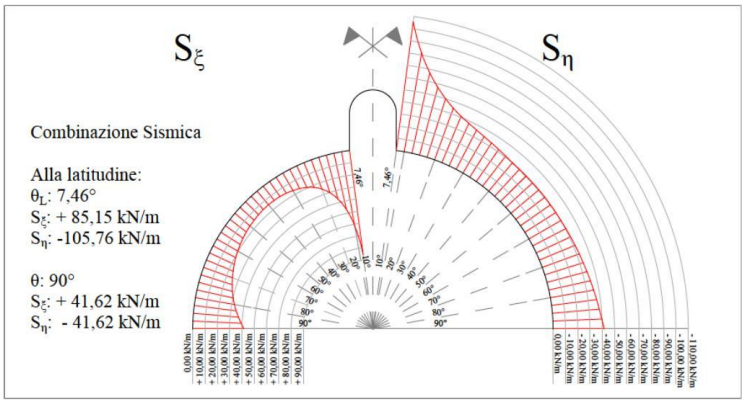


Fig. 8. Evolved diagram of main efforts S_ξ e S_η acting into the dome

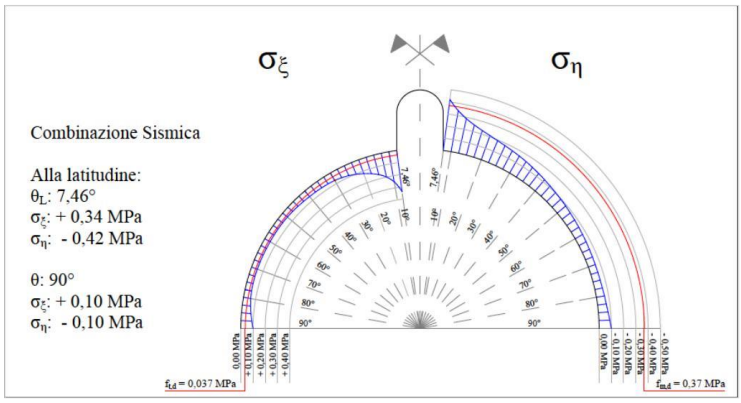


Fig. 9.Evolved diagram of main stress σ_ξ e σ_η acting into the dome

Finally, the following strength checks were carried out on the masonry dome [6]:

$$\left|min\left(\sigma_{\xi-compr.MAX};\sigma_{\eta-compr.MAX}\right)\right| < \left|f_{m,d}\right| \quad \text{(compression check)}$$

$$\max\left(\sigma_{\xi-traz.MAX};\sigma_{\eta-traz.MAX}\right) < f_{t,d} \quad \text{(tensile check)}$$

where:

- $f_{m,d}$ is the design value of the compressive strength of the masonry, assumed equal to 0.37 MPa and evaluated as prescribed by Circular 617/2009;
- $f_{t,d}$ is the design value of the tensile strength of the masonry, assumed equal to one tenth of $f_{m,d}$, and then equal to 0,037 MPa.

The results of the strength checks carried out are shown in table 1.

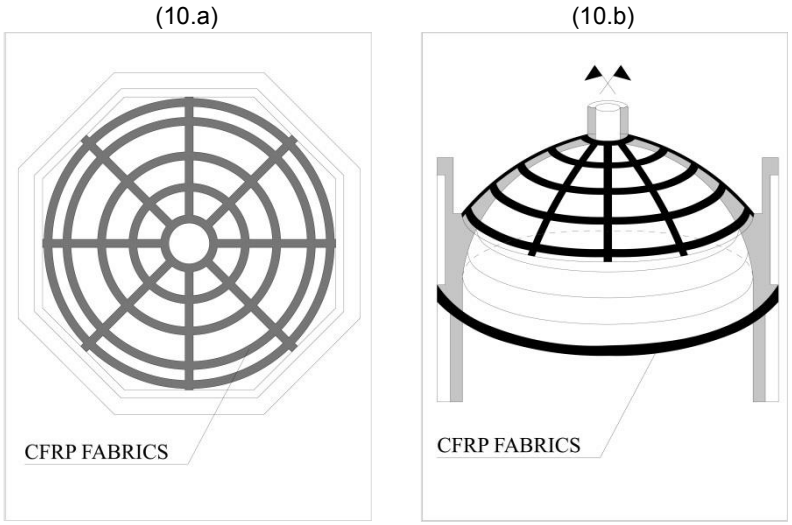
LOAD COMBINATION	$\sigma_{\xi\text{-compr.MAX}}$ [MPa]	$\sigma_{\xi\text{-traz.MAX}}$ [MPa]	$\sigma_{\eta\text{-compr.MAX}}$ [MPa]	$\sigma_{\eta\text{-traz.MAX}}$ [MPa]	$\left\|min\left(\sigma_\xi;\sigma_\eta\right)\right\| < \left\|f_{m,d}\right\|$	$\max\left(\sigma_\xi;\sigma_\eta\right) < f_{t,d}$
1.Fondamentale	-0,041	0,082	-0,201	-	TRUE	FALSE
2.Fondamentale	-0,039	0,102	-0,216	-	TRUE	FALSE
3.Caratteristica	-0,031	0,061	-0,151	-	TRUE	FALSE
4.Caratteristica	-0,029	0,074	-0,161	-	TRUE	FALSE
5.Frequente	-0,027	0,05	-0,131	-	TRUE	FALSE
6.Frequente	-0,027	0,053	-0,136	-	TRUE	FALSE
7.Quasi perm.	-0,027	0,049	-0,13	-	TRUE	FALSE
8.Sismica	-0,001	0,341	-0,423	-	FALSE	FALSE

Table 1. The maximum values of stress and the strength check for the different combinations of load

5. Structural consolidation of the dome

The consolidation of the masonry dome provided for the classical confinement operation realized by the application of innovative materials [10]. On the extrados of the dome was realized by means of a grid tissue CFRP (figs. 10.a, b) applied to predetermined distance, both along the parallels and both along the meridians. The intervention by FRP reinforcement systems, arranged along the circumference near the base of the dome, serves to counteract the extension of the cracked area and mitigating the increase of the impost thrust [11].

The procedure for the execution of the intervention included the following steps: cleaning and restoration of masonry dome, to obtain a smooth surface; realization of a layer of regularization, thickness 3-5 cm, in order to consolidate the interface application; drawing up of the epoxy resin with subsequent impregnation of the unidirectional tissues of consolidation in carbon fibers; realization of a protective layer in lime mortar, thickness of 5 cm (figs. 11.a, b, c). The realization of this intervention had several goals: to increase the cohesion between the parties well as structural strength and stiffness; to confer to the masonry a given tensile strength; to improve the seismic response without significantly increasing seismic masses.



Figg. 10.a,b. Representations of the structural intervention carried out with CFRP fabrics


Figg. 11.a,b,c. The dome of complex, before and after the execution of intervention of strengthening

To test the quality of such an intervention, it is necessary to carry out the evaluation of the following quantities.
a) Specific energy fracture Γ_{Fd} [N/mm]. It was estimated through the following relationship [11]:

$$\Gamma_{Fd} = \frac{k_b \cdot k_G}{FC}\sqrt{f_{bm} \cdot f_{btm}}$$

where: k_G is a correction factor equal to 0.012 mm; FC is the confidence factor of 1.35 [12]; f_{bm} is the average value of the compressive strength of the resistant elements of the masonry, equal to 2.67 MPa; f_{btm} is the mean value of the tensile strength of the resistant elements of the masonry, equal to 0.267 MPa; k_b is a correction factor of geometric type, equal to 1.155, estimated as [11]:

$$k_b = \sqrt{\frac{3 - \frac{b_f}{b_h}}{1 + \frac{b_f}{b_h}}}$$

with $b_h = b_f+2•t_r$, b_f is the width of the fabric and t_r the average thickness of the layer of regularization.
b) Optimal length of the anchor design l_{ed} [mm]. This length can be calculated with the following relationship [11]:

$$l_{ed} = min\left\{\frac{1}{\gamma_{Rd}\cdot f_{bd}}\cdot\sqrt{\frac{\pi^2\cdot E_f\cdot t_f\cdot \Gamma_{Fd}}{2}}; 150\ mm\right\}$$

where: γ_{Rd} is a correction factor equal to 1.25 for masonry of limestone; E_f is the modulus of elasticity of the FRP reinforcement; t_f is the thickness of the FRP; f_{bd} is the design value of the maximum shear stress of adhesion, equal to 0.058 MPa, estimated as [11]:

$$f_{bd} = \frac{2\cdot\Gamma_{Fd}}{s_u}$$

where s_u is the ultimate value of the slip between FRP and support, assumed to be equal to 0.3 mm in the case of walls of limestone.
c) Value reduced stress design of FRP in respect of the posting of end $f_{fdd,rid}$ [MPa]. Referring to a debonding from the support involving the superficial layer of the masonry and for anchoring lengths equal to the optimal one led, the stress f_{fdd} may be determined by the following relationship [11]:

$$\mathrm{f_{fdd,rid}} = \frac{1}{\gamma_{f,d}}\cdot\sqrt{\frac{2\cdot \mathrm{E_f}\cdot\Gamma_{\mathrm{Fd}}}{\mathrm{t_f}}}\cdot 0{,}15$$

where $\gamma_{f,d}$ is the partial factor equal to 1.5.
d) Stress design of FRP in respect of intermediate debonding $f_{fdd,2}$ [MPa]. It can be estimated with the following relationship [11]:

$$f_{fdd,2} = \alpha\cdot f_{fdd} \quad \text{with} \quad \alpha = 2{,}0$$

e) Maximum strain in the reinforcement system at the time of incipient debonding from the intermediate masonry support ε_{fdd}. It can be estimated using the following equation [11]:

$$\varepsilon_{fdd} = \frac{f_{fdd,2}}{E_f}$$

f) Maximum strain due to FRP in the design ε_{fd}. This deformation is estimated as [11]:

$$\varepsilon_{fd} = min\left\{\eta_a\cdot\frac{\varepsilon_{fk}}{\gamma_f}; \varepsilon_{fdd}\right\}$$

where: ε_{fk} is the value of the characteristic strain at failure of the reinforcement; η_a is the environmental conversion factor; γ_f is the partial safety factor of 1.1. The values of the characteristics of the tissue reinforcement CFRP and of the aforementioned quantities are shown in table 2.

CHARACTERISTICS COMPOSITE		SIZES OF STRENGTHENING SYSTEM	
t_f [mm]	0,16	Γ_{Fd} [x10^{-3} N/mm]	8,67
b_f [mm]	200	l_{ed} [mm]	150
E_f [GPa]	230	$f_{fdd,rid}$ [MPa]	15,79
ε_{fk} [%]	1,9	$f_{fdd,2}$ [MPa]	31,57
t_r [mm]	40	ε_{fdd}[x10^{-4}]	1,37
η_a	0,85	ε_{fd}[x10^{-4}]	1,37

Table 2. Characteristic values of the intervention of consolidation realized

This intervention of consolidation was made in 2007, before the new seismic code, the NTC/2008, came into force. Therefore the design phase, approached by the designer in 2006, had the objective of satisfying the verification prescribed by the standards then in force. Today, however, it is necessary to check whether the structure of the domed roof of the chapel respects the security levels set by the new seismic code, so that the same construction can be considered safe; this will be apparent shortly fundamental prerogative of the church so that this environment may be open to the public.

To carry out this important test using the results obtained by membranal analysis, approached respecting the new seismic code NTC/2008, and those obtained by determining the characteristic quantities of the strengthening system, were utilized. Therefore, the assessment of the current security level of the dome will be strengthened by carrying out the following two checks [11].
1) Tensile check of the composite. It is made by comparing the maximum principal tensile stress $\sigma_{\xi\text{-}max}$, evaluated previously on the dome and 0.34 MPa, with the failure stress of design f_{fd} of FRP, it can be estimated as:

$$f_{fd} = E_f \cdot \varepsilon_{fd}$$

The check, largely satisfied, from having to perform is the following:

$$\sigma_{\xi-max} \leq f_{fd}$$

2) Check towards the debonding from the masonry support. It is carried out by comparing the maximum strains of the masonry ε_{md}, associated with maximum tensile stresses σ_ξ evaluated for individual combinations of load, with the value of the maximum strain attributable to the FRP at the design ε_{fd}:

$$\varepsilon_{md} = \frac{\sigma_\xi}{E_m} \leq \varepsilon_{fd}$$

where: σ_ξ represents the maximum tensile stress calculated on the masonry for the various load combinations; E_m is the modulus of longitudinal elasticity of the masonry, equal to 870 MPa. The different values of ε_{md} and debonding check, performed for the various load combinations, are shown in table 3.

LOAD COMBINATION	$\sigma_{\xi\text{-traz.MAX}}$ [MPa]	ε_{md}	ε_{fd}	$\varepsilon_{md}<\varepsilon_{fd}$
1.Fondamentale	0,082	9,43E-05	1,37E-04	TRUE
2.Fondamentale	0,102	1,17E-04	1,37E-04	TRUE
3.Caratteristica	0,061	7,01E-05	1,37E-04	TRUE
4.Caratteristica	0,074	8,51E-05	1,37E-04	TRUE
5.Frequente	0,05	5,75E-05	1,37E-04	TRUE
6.Frequente	0,053	6,09E-05	1,37E-04	TRUE
7.Quasi Permanente	0,049	5,63E-05	1,37E-04	TRUE
8.Sismica	0,341	3,92E-04	1,37E-04	FALSE

Table 3. Values of ε_{md} and check for the debonding from the support

For all load combinations, less than seismic one, the check towards the debonding from the masonry support is satisfied. Also, considering the results of seismic combination, the crisis of the FRP system is concentrated, for different values of longitudes Ψ, within the high zone of the dome for values of latitudes between θ_L=7.46° and 20°. In this zone of the dome near to the lantern, the potential debonding of the reinforcement is due to the establishment of a flexural-type stresses and no longer of a membrane-type stresses, because here there are major effects produced by the out-plan actions [11]. To ensure the reliability of the confinement system in the seismic condition of project and then to prevent its debonding from the support, the consolidation intervention realized already could be improved through the use of mechanical anchorage devices, applied in the thickness, on FRP tissue pasted on the critical zone of the dome, near the base of the lantern. With the add of these devices, the reinforcement system made on the dome could ensure the full structural safety for all load combinations expected from the new seismic rules on constructions, and this would allow the use in safety conditions of this environment of the San Francesco church.

6. Conclusion

The results obtained show how the construction of a grid of fabrics FRP reinforcement, applied on the extrados of the dome, is a good intervention for ensuring seismic safety of masonry vaulted structures, as well as their structural preservation. Moreover, it is now indisputable role of FRP materials in the context of the consolidation and improvement of the seismic response of masonry structures belonging to the historical heritage, due to their extreme strength, their lightness and their durability [11].
In conclusion, it was decided to analyze the important design practice interesting masonry dome of the complex of San Francesco of Amantea as engineering important moment in a long experience of restoration that regarding the area of the ancient architectural site. This remarkable restoration is

returning, slowly, to the complex of San Francesco a new life thanks to the excavations carried out, which allowed to discover the remains of the convent rooms, as well as the consolidation of masonry structures. Now, it is hoped that this important restoration will follow the public opening of the site, so that many people can enjoy its beauty and its landscape value [13] guarantee an inevitable emotional experience.
The last part of the restoration in progress provides, in fact, the creation of a path that allows to safely visit the site also passing inside the dome. As shown, just the execution of small devices on strengthening system extrados so that the dome, already established, can be considered safe even against seismic eventuality.

References

[1] Direttiva del Presidente del Consiglio dei Ministri 9 febbraio 2011, *"Valutazione eriduzione del rischio sismico del patrimonio culturale con riferimento alle Norme tecniche perle costruzioni di cui al D. M. del 14 gennaio 2008"*, alla G.U. n. 47 del 26 febbraio 2011, Supplemento ordinario n. 54

[2] Tedesco Alessandro, "*Testimonianze dell'architettura francescana nel territorio amanteano"*, Calabria Letteraria Editrice, Soveria Mannelli 2008

[3] Turchi Gabriele,"*Storia di Amantea"*, Periferia Editore, Cosenza 2002

[4] Spanò Attilio, "*Scritti d'arte sul francescanesimo meridionale"*, Rubbettino Editore, Soveria Mannelli 2010

[5] Archivio di Stato di Cosenza, "*Statuto della Confraternita del SS. Rosario"*, 1777

[6] Olivito Renato, "*Statica e stabilità delle costruzioni murarie"*, Pitagora Editrice, Bologna 2009

[7] Como Mario, "*Statica delle costruzioni storiche in muratura",* Aracne Editrice 2010

[8] Odone Belluzzi, "*Scienza delle costruzioni"*, Zanichelli Editore, Bologna 1980

[9] D. M.14 gennaio 2008 *"Norma tecniche per le costruzioni"*- G.U. n. 29 del 4 febbraio2008, Supplemento Ordinario n. 30

[10] Olivito Renato, Tedesco Alessandro, Gattuso Caterina,*The complex of S. Bernardino in Amantea: study of structuraldamage and degradation of materials*, atti del convegno A.I.E.S. 2014, Napoli

[11] Documento CNR DT 200 R1/2013 "*Istruzioni per la progettazione, l'esecuzione ed il controllo di intervento di consolidamento statico mediante l'utilizzo di compositi fibrorinforzati"*

[12] Ministero delle Infrastrutture e dei Trasporti, Circolare 2 febbraio 2009, n. 617, *"Istruzioniper l'applicazione delle «Nuove norme tecniche per le costruzioni» di cui al D. M. 14 gennaio 2008*", G.U. n. 47 del 26 febbraio 2009, Supplemento Ordinario n. 22

[13] Ministro per i beni e le attività culturali – D. L. del 22 gennaio 2004, n. 42 *"Codice dei beni culturali e del paesaggio"*

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Realistic 3D view as a form of interpretation and presentation of historic gardens

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Abstract
Realistic 3D view or 3D visualization is used as a working tool to materialize a figurative interpretation of our ideas in many sectors. Over time this tool has become an integral part in the creation of any kind of project documentation or design. We achieve the final output in photorealistic quality by selecting the correct software, using detailed 3D models of vegetation elements (e.g. topiary trees) and textures (e.g. foliage) in high resolution. This tool offering unique opportunity to view historic gardens which disappeared in the past and in our opinion it represents suitable tool for interpretation and presentation of cultural heritage. To achieve the final output it is necessary to develop an authentic 3D computer model depicting a particular historical situation in the development of the studied area. As a basis for the 3D model we use the digitized historic maps in a vector format. The historical garden's design we can modify by using special software that simulates the growth of vegetation elements during season or during particular historical period. The outputs of this model are realistic video outputs or animation. This paper presents our method for creating the model and realistic 3D view step by step on example of historical Palffy Garden in Bratislava, which was founded around 1660 and disappeared during the first half of the 20th century.

Keywords: 3D visualization, 3D view, historical garden, interpretation

1. Introduction and overview of the issues
Historical gardens are confirmed as an important part of the cultural heritage. Unfortunately, many of the historical gardens have gradually disappeared and they are documented in different historical documents such as maps, engravings etc. The new technologies provide opportunities to recover the gardens in 3D realistic models. The usage of these new technologies was domesticated in the reconstructions of historical monuments, for example there is an access to a virtual model of The Jerusalem Archeological Park on the internet [1]. This model was constructed for the Israel Antiquities Authority by Lisa M. Snyder of the Urban Simulation Team at UCLA following the reconstruction plan of Jerusalem Archaeological Park. The 3D scenes are widely used for reconstruction of the historical landscapes; for example authors de Boer et al. [2] used the 3D virtual technology reconstruction of the 17th century rural estate of Palace Honselaarsdijck and its surrounding landscape (in Netherlands). King's Visualisation Lab [3] was commissioned by the Royal Botanic Gardens, Kew, to reconstruct, using computer-based 3D modeling, two important periods in Kew's history focusing upon the years 1763 and 1882. Pokladek et al. [4] dealt with Geo visualization of the Garden Kingdom Of Dessau-Wörlitz. The changes in landscape of the Garden Kingdom were shown from the initial situation at the end of the 18th century up to the present in three dimensional, virtual scenarios. The authors remarked that the heterogeneity of the cultural/historical matters and the size of the area require an adaption and further development of the existing range of methods. An entire analysis and presentation of the historical development of the Garden Kingdom based on virtual landscape scenarios shall be made accessible through the interdisciplinary collaboration of landscape planners, monument preservation experts, geocomputer scientists and cartographers. The usage of these technologies-so common in the contemporary architecture- is not so frequent in the displaying of small objects, when a higher punctuality is necessary, especially, in organic elements – plants. One of the few examples is a work of authors Toth, Spalazo [5] who presented a 3D model focused on the vegetation elements at the example of Villa Io

Zebrino in Genoa. The 3D model was used as a basis for the restoration project as well as a means to reveal architectural patrimony to the public. They did not visualize the whole garden and they chose only three parts of the garden with formal and informal vegetation. Heritage Technology Ltd [6] reconstructed the structure and environs of a medieval manor house Gawthorpe Hall near Leeds using 17th century artistic sketches. The garden was visualized too; however, the solution of the garden is very simple. The main aim of our research was to create a 3D realistic model of a historical garden in a good detailedness based on available historical documents. The extinct Palffy Garden in Bratislava (Slovakia) in a baroque style was chosen as a model area. Gardens of this period were characterized by a rich decoration, rich ornamental flower beds, cut trimmed trees (topiary) etc. As all the elements of the selected area are atypical and designed in a particular historical style, there was need to model them separately, following the pattern. For these reasons, the modelling and visualisation is a time-consuming procedure.

2. History of Palffy Garden

The Palffy Garden was situated on the north eastern slope of the Castle Hill, approximately in the area between today´s Zámocká Street, Palisády Street and Kozia Street and it was a part of the spacious Pavol Palffy Residence. Pavol Pálffy was in the position of chairman of the Austrian-Hungarian Chamber of Commerce and he led a reconstruction of the Bratislava Castle. He was assigned for that position by the Austrian-Hungarian parliament in 1630. He used the presence of excellent architects and artists that were collaborated at the reconstruction of the Bratislava Castle also for building his palace and garden. The appearance of the palace and the garden right after the finish was illustrated in a copperplate, made by J. Ledentnau in 1663. The garden had a geometric ground plan and cross-axial disposition. During the 18th century, the garden has changed its form to the baroque style. On the map of the city - the Marquart plan from 1765 (fig.1), we can see an axially sectioned huge baroque garden – site area was 50 300 m^2. The main compositional axis crosses the northwest-southeast direction, which results from its location on the slope, where the terrain falls to the northeast. The height difference of the garden reached almost 30 metres. The highest point of the garden is covered by a terrace with four floral beds with a central circular area and the second, a lower terrace, is designed similarly. On the main axis there was even the third terrace, the largest and the lowest-lying that was divided into 10 rectangular flower beds. All the flower beds were bordered by higher greenery, probably cut hedges of box tree (*Buxus sempervirens*). The southern part of the garden was covered by three terraces; however, these terraces were decreasing to the north. This part of the garden was probably created by fruit trees.

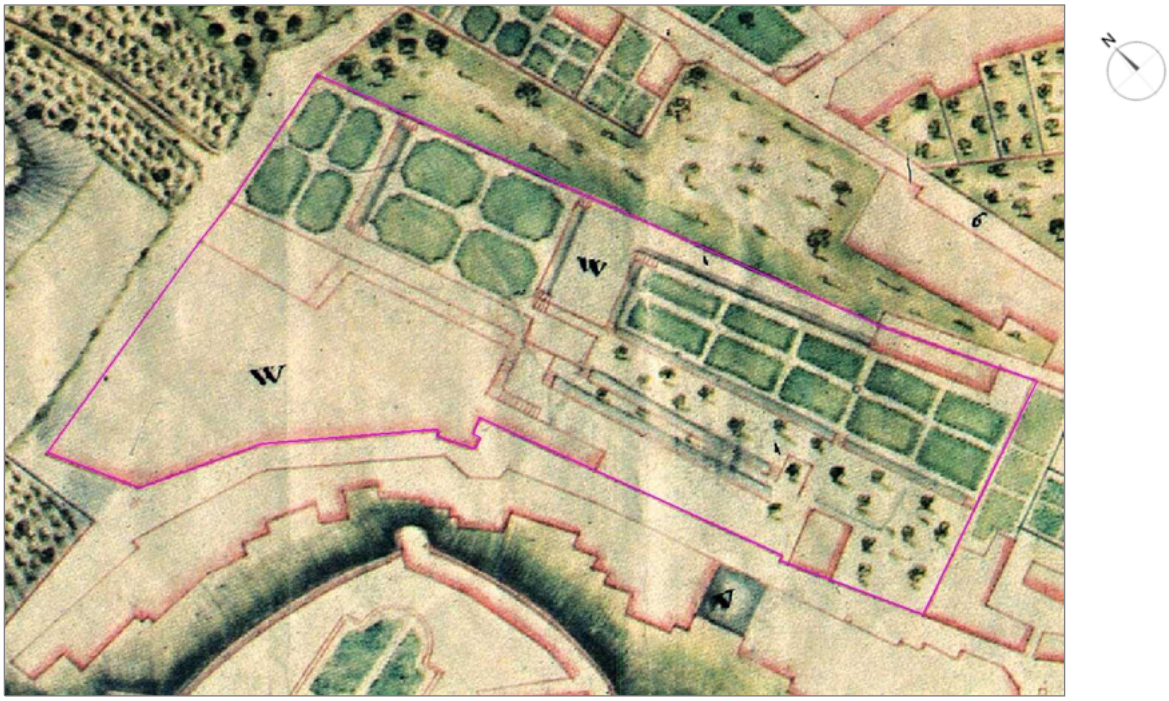

Fig. 1: The Palffy Garden in the baroque style on the Marquart plan from 1765.

Further development of the garden we can see in the J. L. Neyder plan of Bratislava from 1820 in the approximately scale 1 : 3600 (or on A. Lanz engraving of this map – fig. 2). The composition of the garden was significantly changed. Axial disposition was preserved but the regular maintenance was only on the third decorative terrace. The decorative terrace is divided into six flower beds with two central circular parts. On

the southern part of the regular garden is an orchard or a bosket, the trees are planted in three rows. The rest of the garden consists of a freely regulated area in a romantic spirit, divided by the paths to larger and smaller spaces covered by trees. Free grasslands are linked to the highest situated circular flower bed by a double row alley that follows its floor plan. The condition of the garden in the middle of the 19th century is documented in a plan of the Anton´s Palffy mansion with garden, where area is bordered from the south by the Zámocká Street, from the north by at that time emerging Zochová Street and a moat that ends on the Palisady Street. In the place of the lowest terrace with ten flower beds, is preserved a hint of the original axial division of the Baroque period. The Palffy Garden was parcelled in 1873 and it was gradually built-up. This development is documented in the cadastral map of the years 1895-1896 and from the present (fig. 3). The palace was demolished and preserved is only a part of the two-storey building of the garden wing from the whole complex. Today, the garden is reminded only by a few courtyard or small gardens surrounded by the buildings,however (fig. 4), the area retails the original terraced structure (fig. 5).



Fig.2: The Palffy Garden rebuilt in a natural-landscaped design on the A. Lanz engraving from the year 1820

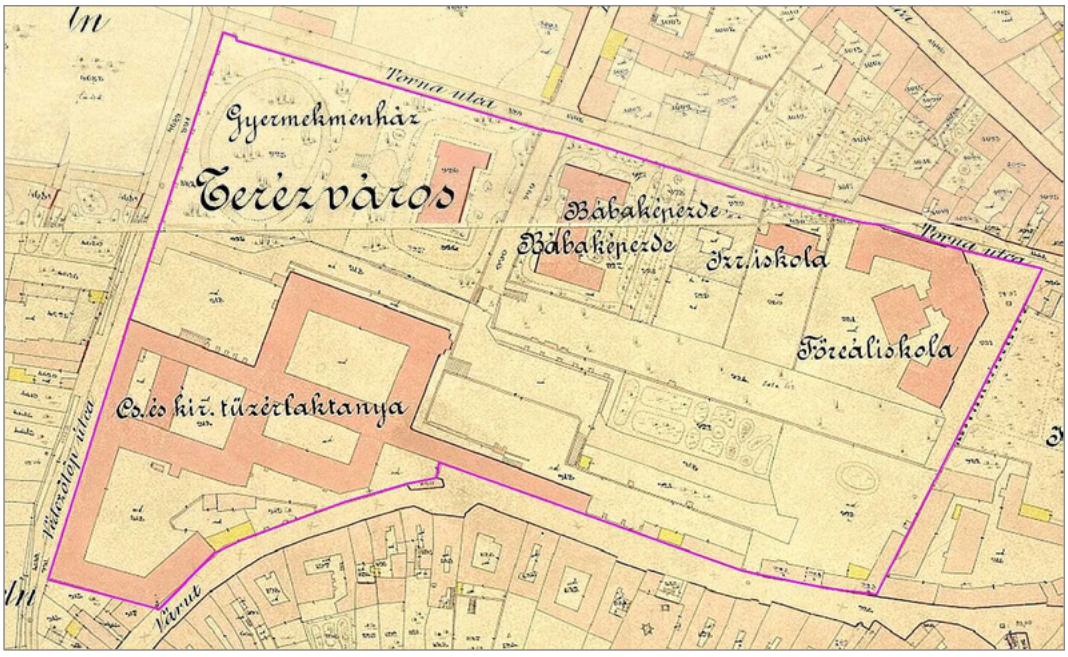

Fig.4: The Palffy Garden on the cadastral map from the year 1895

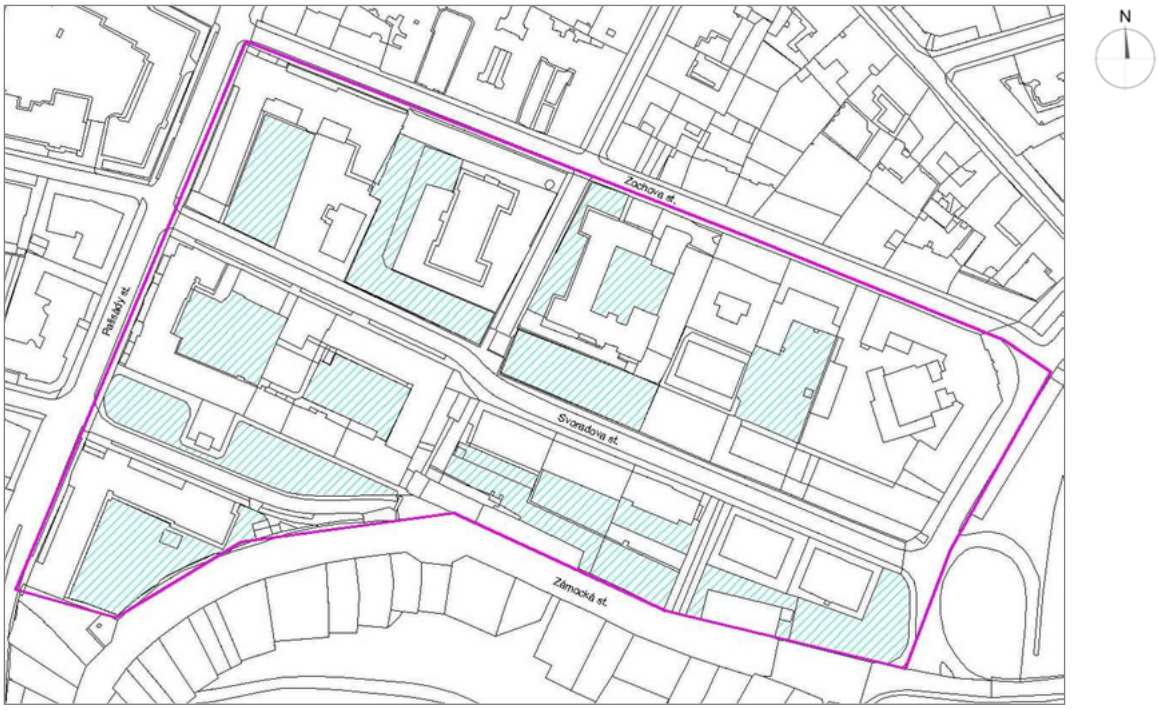

Fig. 4: The Palffy Garden on the present map. The green colour shows unbuilt areas.



Fig. 5: Two pictures which documented terraced structure of the previous garden site

3. Methodology and research methods

The methodological approach was conceived from several interrelated steps that are graphically represented in the diagram (fig. 6).

3.1 Preparatory Phase

In this phase there were gradually collected all the information about The Palffy Garden and information about the baroque gardens in general. The foundation was the floor plan of the garden from the city plan

from the year 1765. The author of the plan is Michael Marquart. The map was created in 1765, it is hand-painted, coloured map drawn on a paper. It consists of four glued parts and the map dimension is 1239 x 845 mm. We worked with facsimile that was made of the original and it is printed on a paper with the dimensions 972 x 658 mm. In contrast to the present good known standard, the map is oriented to the north-west, not to the north. The scale is given in fathoms – the one Viennese fathom is 1,896484 m, so the map scale is 1:1896. The working procedure follows the habits of the original cartographic displaying. Ornamental gardens are illustrated with a saturated green colour. Buildings were explained by the alphabetical symbols and these symbols were explained in the legends [7]. Our research object is symbolised by the letter "W" and in the legend is listed as the Palffy Hoffund Garten - The Palffy Residence with garden. We monitored the further development of the garden on the above mentioned maps from the years 1820, 1857 and 1895.

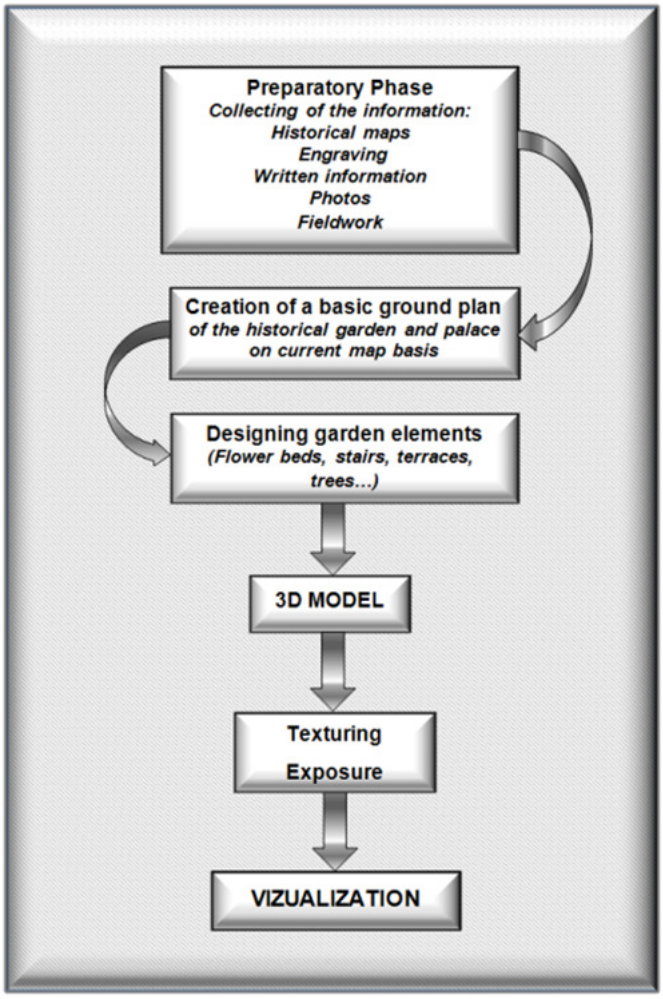

Fig. 6: The diagram of the methodological process

3.2 Phase 1: Creation of a basic floorplan

The aim of this phase was to create a basic floor plan of the historical garden and palaces on a current map. As was already mentioned, the fundament was Marquart plan from the year 1765, from which we derived the basic compositional solution of the garden, flower beds and the other elements. Found uncertainties were confronted with the later map data, which were more or less comparable to the current map view. Although, the garden went through the various development stages and the styles were changed, always has been respected terrace layout. For example, the map from 1895 in scale 1:2880 shows remnants of the original retaining walls, which was proved to be useful for redrawing of the original conditions. The division of the original garden area was created exactly at the point, where 2 systems of the terraces meet-the first from the direction west-east and the second from north-south. During the parcelation, at the end of the 19th century, there was established a street in this area. The terrain research was also very useful; it provided an actual and authentic vision about the height and spatial parameters in the garden area.The result was a floor plan of the palace and gardens, drawn in the current cadastral maps. The garden is essentially divided into two parts – the northern, representative part, and the southern that is created by fruit trees. The representative part consists of 4 terraces descending from west to east. They are separated by the abutment walls, grassed

slopes and they are connected by the staircases. The part of the garden with fruit trees is designed similarly; however, the abutment walls are shorter and higher.

3.3 Phase 2: The garden design creation

The aim of this phase was to create a garden design itself that means the bed ornaments, stairs, terraces, trees ...). We used the historical visual materials from Bratislava and also from other Baroque gardens. We were inspired by floor plans, design of the flower beds etc. Written information directly about the Palffy Garden gave us the work from Matej Bel[1] "*Notitia Hungariae novae historico geographica*" (Historical and geographical knowledge of present Hungary), where were described counties of Upper Hungary (the northern part of the Kingdom of Hungary - part of Austro-Hungarian Monarchy, present-day Slovakia) in the different volumes. The first volume and the first half of the second volume was focused on Bratislava county –there was also a description of the Palffy Garden. Further information can be found in the travelogue "*Reisendurcheinen Theil of Königreichs Ungarn im Jahr 1763 undfolgenden Jahren*" by Gottfried von Rotenstein. The visual about baroque gardens in Bratislava was shown particularly in an engraving by Martin Engelbrecht from the year 1735. It shows a part of the garden of the archbishop's palace near the summerhouse with flowerbeds and complex ornamental decorations. The flower beds are lined by the trees that are cut into the geometric shapes. On the engravings there are shown also garden visitors, beautifully dressed, and there are visible also gardeners at work. The result was an overall design of the garden. In the representative part, the basic shape and the location of the flower beds corresponds to the historical foundations. We derived the design from the habits, for example shapes of the cut ornaments were inspired by the flowerbeds from Belvedere Garden in Vienna (Austria). The ornament is not created only by live materials such as lawns and box trees (*Buxus sempervirens*) but also by materials such as clay, maul and white marble pebbles with different colours to achieve the desire contrast. The used was ground brick or tile in orange colour tone, fine marble gravel in white colour tone. Pavements and other areas are created by decomposed granite in grey colour tone.

<u>The species composition</u>

There was very important to create so called “planting scheme” for the visualisation of the garden for the need of proper placement of a particular vegetation type in 3D scene. A huge inspiration for species composition was Schloßhof garden castle in Austria for us, which is located only 2 km from Bratislava. The chateau Schloßhof is considered as a one of the most impressive architectural complexes of the European Baroque Period. The complex of palace, gardens and farm with an area of over 50 hectares was established at the end of 20´s of the 18th century as a representative rural and hunting lodge for Prince Eugene of Savoy [8]. It presents an appropriate inspiration due to geographical proximity and almost the same time establishment of gardens. For example low cut hedges are made of box trees (*Buxus sempervirens*), this species were used very often in baroque gardens for low hedges and ornaments. Flower beds were rich, with a wide range of species, for example Begonia, Senecio, Coleus, Tagetes, Cleome, Calendula and many others. Fruit trees were also an important part of plantings, we know from written information that there were growing apple trees and also citrus trees. A part of the trees in parterre was cut to low forms. The cut architectural shapes of trees were created from for example yew trees (*Taxus baccata*) or also from box trees (*Buxus sempervirens*).

3.4 Phase 3: 3D Model and Visualisation

Bitmap basis of historical map was redrawn in the program McNeelRhino in 3D to the curves and lines. The modelling of the most important volumes and surfaces or the transformation from 2Dto 3D was processed also in that program. After that, basic NURBS model was exported through the polygon model in Autodesk 3D Max Design, when began the process of mapping and defining the surface properties of materials such as colour, shine, transparency, surface roughness, etc... For every object in the scene there was created a separate material or texture with high resolution in a material editor. The term “scene” we mean a file of all the added elements, lighting and encourage, which form a whole entity. The scene is created from 13 textured polygon vegetation elements that were transformed on a historical basis and deployed in the garden space. The VraySun was used as the main source of the light for scene lighting. The light source is defined as a spherical object providing global illumination, realistic shadows and the warmness of the light is changing according to azimuth. The lighting is related to the virtual camera setting, which simulates the principles of real cameras such as exposure, sensitivity, depth of field, vintage, and so on. The rendering, thus generating a final view output on the basis of pre-set values was carried out by using the rendering plug-in module V-ray for 3D Max. On the picture outputs there were applied the final adjustments after rendering (post-processing) with increased contrast, colour saturation and shadows highlighting.

[1] Matej Bel (1684 –1749) – Slovak origin scientist, encyclopedist, philosopher, educator, pastor

4. Results and conclusion

The visualisation of the Palffy Garden in its baroque design is the first phase of our research that is focused on the interpretation of the landscape architecture works. In our opinion, the presented model is made with sufficiently realistic parameters and it met our expectations to be a good interpretation element (fig. 7-10). During that phase, we verified the proposed methodology and we choose the appropriate software tools. We consider the 3D modelling as a very suitable tool for the presentation of the cultural heritage, especially in extinct objects.

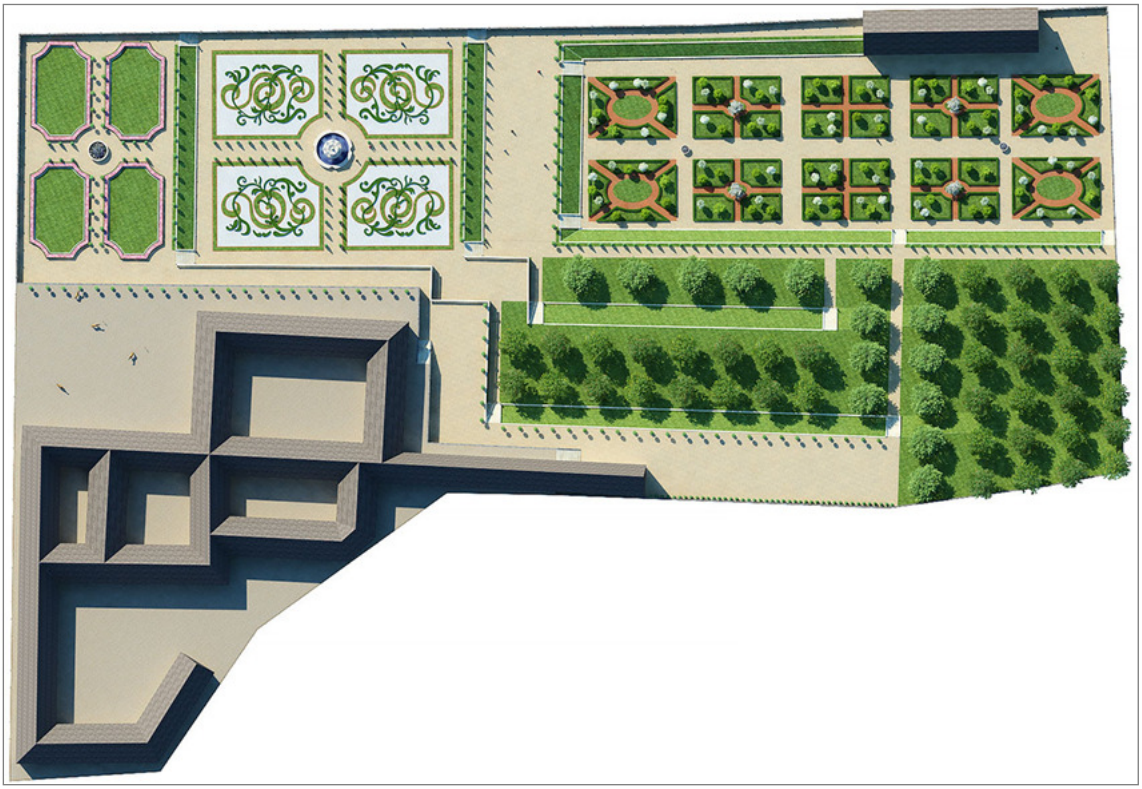

Fig. 7: The garden ground plan



Fig. 8: The Picture of the whole garden from the north-east



Fig. 9: The picture of the whole garden from the west



Fig. 10: The detail of the garden ornamental parterre

Even Ramzi, Jorgensen [9] point out that computer supported visualizations could serve as a common and efficient language, facilitating communication about multifaceted environmental planning issues. Our research is at the beginning and we will continue with the visualisations of other extinct gardens to introduce those gardens to the professional as well as to the public. Regarding to the Palffy Garden, there was preserved even one more map, Koffler Map from the year 1787. There is a different floor plan division and the flower beds are illustrated in more details. In the near future, we plan to visualise the garden on the basis of that map.

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Bibliographical References

[1] The Jerusalem archaeological park – http://www.archpark.org.il/panorama.shtml

[2] BOER de, Arnoud, BREURE, Leen, SPRUIT, Sandor, VOORBIJ, Hans. Virtual historical landscapes. In Research in Urbanism Series, Exploring the Visual Landscape, Vol 2 (2011), p. 185-203.

[3] King's Visualisation Lab - http://www.kvl.cch.kcl.ac.uk/kew.html

[4] POKLADEK, Michael, THÜRKOW, Detlef, DETTE, Christian, GLÄSSER, Cornelia. Geovisualization of the Garden Kingdom Of Dessau-Wörlitz. In E. Buhmann, S. Ervin, & M. Pietsch (Eds.) Proceeding of Digital Landscape Architecture. 2 Anhalt University. 2012. p. 472-481

[5] TOTH, Anna, SPALAZO, Davide. Historical – virtual reconstruction of the Italian Garden. Imaging the past of Villa lo Zerbino. New Urban Languages, Conference Proceedings, Milan, 19-21 June 2013, 10 pp.

[6] HeritageTechnologyLtd – http://www.heritagetechnology.co.uk

[7] HUDÁKOVÁ Hedviga. Bratislava - mapa z roku 1765. Bratislava: Slovenská kartografia. 1988. 16 pp.

[8] http://www.schlosshof.at/cms-sl/index.php?page=der-barockgarten#

[9] RAMZI, Hassan, JORGENSEN, Karsten: 3D-History in gardens and landscape. ECLAS Conference 2009 - Landscape and Ruins – https://www.academia.edu/4294726/3D-HISTORY_in_gardens_and_landscape

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Augmented reality for the understanding of cultural heritage. The case study of the monument of Giuseppe Sirtori in Milan

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Abstract
The technological solutions, made available today, offer opportunities of great interest for the detection in the field of cultural heritage; instrumentation for the survey and advanced multimedia representations for objects of archaeological, artistic, architectural.
These processes have led, especially in recent years, researchers of different scientific disciplines studied the matter, dissolving the problems and identifying possible solutions created by the growing need to create new relationships and new systems for the exchange of information, in addition to a technology that can overlay multiple data together.
The study presented in this article will be an experimentation of augmented reality technologies applied to cultural heritage. Technology that allows to represent the three-dimensionality of an object framing a picture and provide additional information localized in three dimensions. As a case study will be presented the process of developing from survey to the display through the mobile application of the statue of Giuseppe Sirtori in Milan.

Keywords: augmented reality, scanner laser, prototyping, Unity 3D

1. Introduction
The systems of survey and three-dimensional visualization systems allow to know the cultural heritage. The development of the technologies of representation today allow more control and interactivity of the objects investigated by increasing the ability to create relationships between the information collected during the study. Database and hardware ever more efficient are used to manage large amounts of data during both the steps of querying and editing, both in the phase of representation.
These tools so evolved contrast, unfortunately, with the reality of dissemination entrusted, today, to the hard copy, preventing or limiting the interactivity of the end user. Texts written, sheets detailed and images are two-dimensional information that can be transmitted. Point of views of the research team are critical to the understanding of the objects studied, but at the same time are reductive and limit the considerable effort employed to collect the initial data.
This aspect is the focus of the research presented in this article that proposes a system of interaction with cultural heritage. The study examines the survey of a statue and offers a visualization system capable of interacting with the hard copy showing, in the three dimensions, some of the range of information available during the phases of survey and diagnostics.
The project aims to address this issue by using the technique of augmented reality. System that provides the union of real vision and computer-genereted virtual object coexisting in the same place.
Augmented Reality is the system able to add textual and graphical information to reality framed by a hardware device. This type of display can be considered a research field of Virtual Reality (VR), defined as "a computer generated, interactive, three dimensional environment in which a person is Immersed" [1]. Typically this VR system is designed for the use of immersive systems such as Head Mounted Display (HDM), where the user is completely distant from the real world and he is immersed in a virtual world. Sensors placed within the system HDM allow the user to copy the real movements in the virtual world created. Taking into consideration the definition proposed by Milgram [2] we can define a continuum where

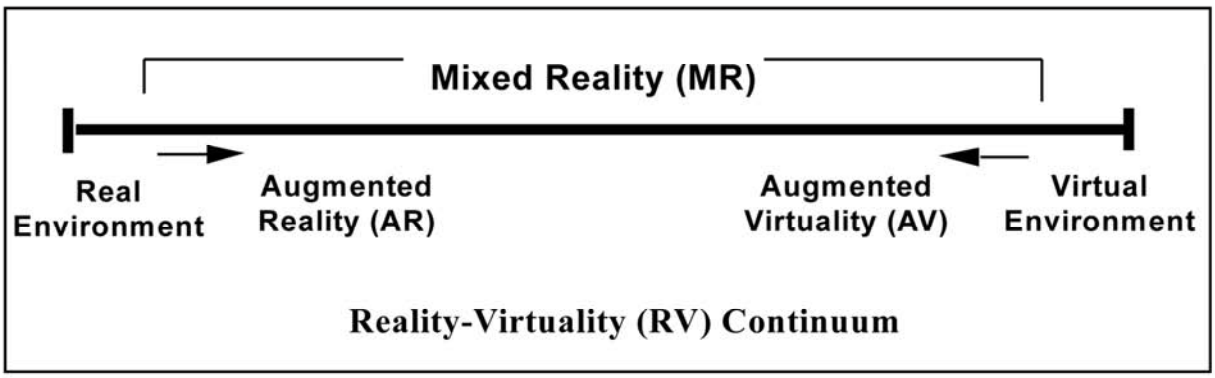

Fig. 1: The Mixed Reality Continuum defined by Milgram [2].

the Virtual Reality and the Real World are the ends. Within that space you can find the Augmented Reality that is located closer to the Real Environment and Augmented Virtuality which has features closer to the Virtual Environment.
From this definition of virtual representation, the project studies how to build an AR application able to show the results of the survey of the statue of Giuseppe Sirtori in Milan.

2. The statue of Giuseppe Sirtori: relief and 3D reconstruction

The case studies analyzed is the statue of Giuseppe Sirtori in Milan located in the Public Gardens Indro Montanelli. Created by the sculptor Enrico Butti, the monument was completed in 1892 and was placed under indication of the sculptor, in the space where it still stands today near the Villa Comunale. The monument consists of a base a truncated pyramid made of red gravel, above which there is placed the bronze statue of General. On the sides of the pedestal are four plates in bronze, showing various battles.
The relief of the monument was performed using laser scanner. Data were acquired with laser scanner Z + F Imager 5006h. This type of scanner is a phase shift and allows to reach an accuracy of about 3 mm, an error which can not be considered for the final result of this relief. The material produced will be a 3D model manageable within a application for mobile devices. The small size for display within a mobile device does not allow you to appreciate details too small.
The process of work was therefore to perform scans around the statue through eight scanning stations. To facilitate the operations of registration of point clouds were positioned some plans target on stone base. The point cloud acquired were then processed within the software Leica Cyclone 8.1 where these were aligned and clean by elements that do not belong to the monument.

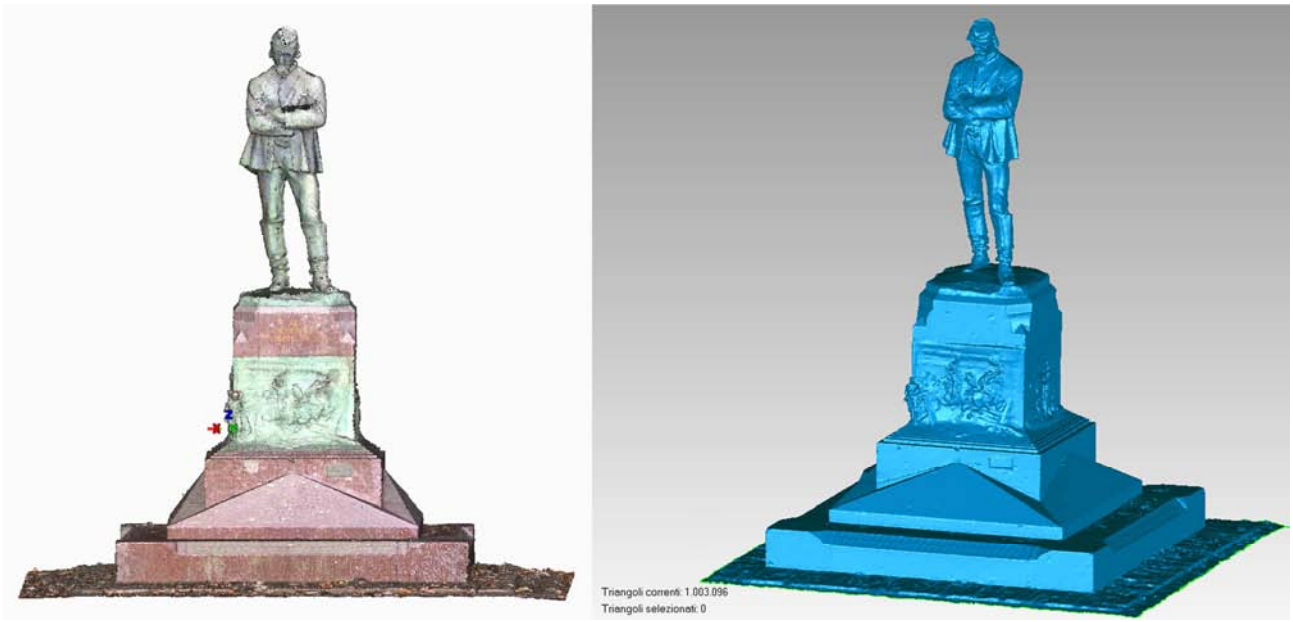

Fig. 2: On the left the point cloud registered in Leica Cyclone; on the right the reverse model of the statue.

The result achieved in this phase was a database of the monument to Giuseppe Sirtori complete in all its parts and easily interrogated in retrieving measurements. The technology of survey used has also permitted to acquire information of the reflectance of the material, favoring in this way the reading of different materials that make up the monument.
The next step was to export the point cloud acquired for the creation of a mesh model. The data of the single scans were then imported into the software Geomagic Studio, software that can handle large amounts of data and able to create models of triangular mesh surfaces through appropriate editing tools. Within this software the point clouds have been sorted and applied utility of noise reduction. The individual three-dimensional scans were then combined and edited to reduce redundancy of the points. Finally, the point cloud was transformed into surface mesh. The result thus obtained was processed with other analysis tools to determine and correct the imperfections such as intersection of polygons, holes and double surfaces. At the end of this process of conversion from point cloud to mesh surfaces the result was an accurate three-dimensional model of the monument to Giuseppe Sirtori.

3. Creation of the mobile application

This project aims to be an example of the potential that Augmented Reality (AR) can offer. Architecturally, AR systems include mechanisms to track information about user location and the position of real world objects; hardware and software to process information, and devices to show users the digital information integrated with the real environment [3].
The whole project was realized employing as programming software Unity 3D, platform that allows you to take advantage of a powerful graphics engine for the creation of mobile and stand alone applications. The software allows you to implement both three-dimensional models that programming languages for the creation and customization tools. The application developed in this project has been tested in two mobile devices: a tablet LG Nexus 7 and a smartphone LG Nexus 4.
First step to build the application was to import the 3D model created by the reverse modeling point cloud into the software dedicated to the creation of the mobile app. To optimize the display and management of the three-dimensional model was necessary to decimate the model created with Geomagic up to 65300 polygons. In Unity, single objects with more 65300 polygons will automatically be split into multiple meshes as necessary when imported. This automatic division of the object can however lead errors with complex three-dimensional models.



Fig. 3: On the left photo of the monument of Giuseppe Sirtori; on the right orthophotos of the front view.

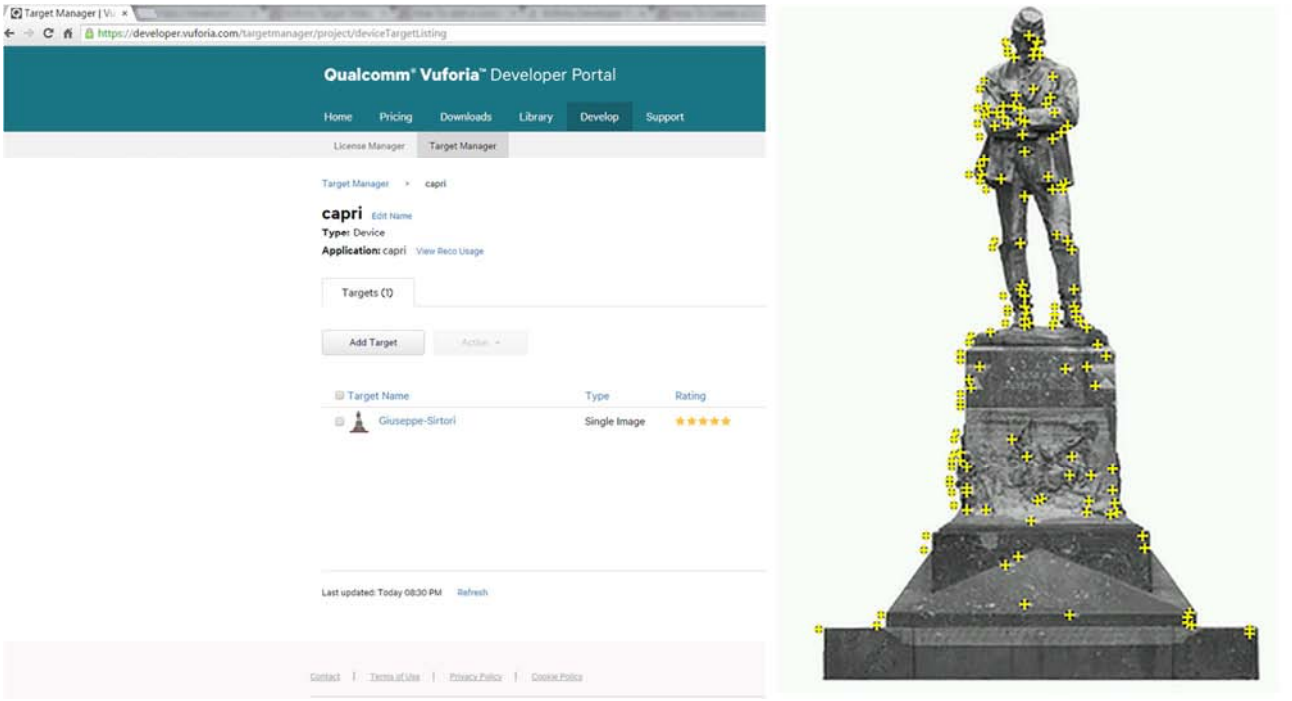

Fig. 4: On the left The Vuforia used Target Manager used to create and manage target databases online; Image showing the natural features that the Vuforia SDK uses to detect the image target.

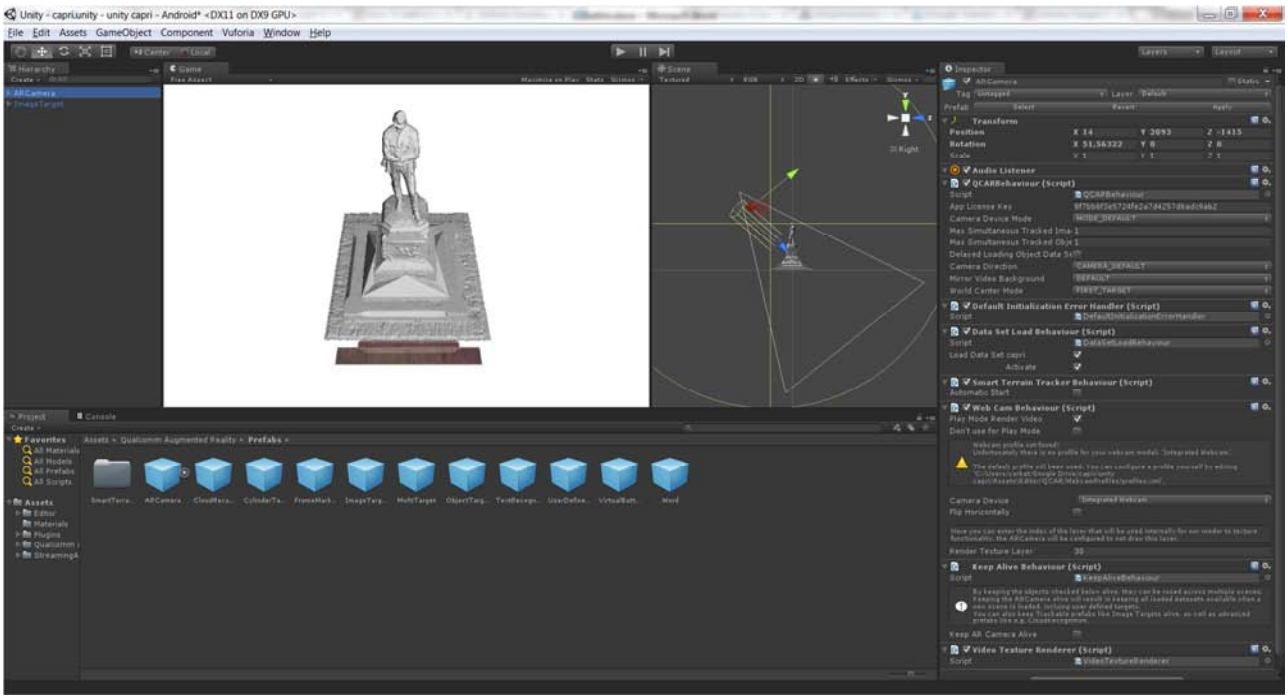

Fig. 5: Screenshot of Unity application. Creation of the scene with the insertion of the three-dimensional model together with the target for the reference

The optimization of the polygons must be done with a lot of accuracy and it has to guarantee that the number of polygons remains higher in the edge and in the outline of the model and lower in the planar part, where we can provide for the lack of detail in the polygon by the use of normal map [4].
Within Unity 3D was created a scene in which it was imported three-dimensional model divided into layers. The choice made to show some of the potential of the software was to divide the monument into parts that can show the different material used: the statue, the base and the four plates.

To implement the system AR was decided to use the plugin Vuforia produced by Qualcomm. This is an Augmented Reality Software Development Kit (SDK) for mobile devices that enables the creation of Augmented Reality applications. It uses Computer Vision technology to recognize and track planar images (Image Targets) and simple 3D objects, such as boxes, in real-time. This image registration capability enables developers to position and orient virtual objects, such as 3D models and other media, in relation to real world images when these are viewed through the camera of a mobile device. The virtual object then tracks the position and orientation of the image in real-time so that the viewer's perspective on the object corresponds with their perspective on the Image Target, so that it appears that the virtual object is a part of the real world scene.
In fact, Vuforia has a "visual" approach that provides access to additional information and to start their own augmented reality experience from the recognition of specific images. Targets created can be stored in a database to which it connects cloud service, in order to save space for local storage.
In this project we used a photographic image of the monument as a target on which detect and record the features necessary to attach the 3D model. This picture was sent to the Device Database Portal Vuforia, who tracked down and stored the features in a database. The DB was downloaded and packaged to be inserted within the project of Unity.
Last step for the creation of the app has been to create a few lines of code in C # to define the buttons that should be displayed on the screen of the device and some scripts to switch on and off layers created.
Finally, the project thus created was finalized producing an APK file to install and test the device Android.

4. Conclusion

The experiment performed in this project shows how to create simple applications of augmented reality. Visualizations that can make a strong contribution to the understanding of cultural heritage and disseminating also to a wide audience. Recent research shows that there is a strong interest in the creation of interactive museum systems that can involve the visitor in the exploration of the works of art.
Some research also shows how augmented reality can be a valuable aid to display and update data during the restoration work. Some studies and applications are able to implement 3D tracking, so that AR may then be used for three-dimensional objects, for example using the ARmedia 3D SDK application. This tracks three-dimensional objects in space. This feature associates coherent three-dimensional information to what is being seen in the camera viewfinder.

Bibliographical References

[1] AUKSTAKALNIS, Steve, BLATNER, David. *Silicon Mirage - The Art and Science of Virtual Reality*, CA, USA: Peachpit Press Berkeley, 1992. ISBN 0938151827

[2] DRASCIC, David, MILGRAM, Paul. Perceptual Issues in Augmented Reality. In AA.VV. *Proceedings of Stereoscopic Displays and Virtual Reality Systems III.* San Jose, California. Feb. 1996, p. 123-134.

[3] AZUMA, Ronald T. A Survey of Augmented Reality. Course Notes #9: Developing Advanced Virtual Reality Applications. Los Angeles: ACM SIGGRAPH, 1995 p. 20-1 to 20-38.

[4] KRISHNAMURTHY, Venkat., LEVOY Mark. *Fitting Smooth Surfaces to Dense Polygon Meshes*. *Proceedings of* SIGGRAPH'96. New Orleans, LA, USA: SIGGRAPH'96, 1996, p. 313-24.

[5] DI PAOLA, Francesco, INZERILLO, Laura.. Augmented reality. The case of Salinas Museum of Palermo. In GAMBARDELLA Carmine, *Proceedings* of Le Vie dei Mercanti. S.A.V.E. Heritage, La Scuola di Pitagora Editrice, Napoli, Italy, 2011, p. 1-7.

[6] BONACINI, Elisa, 2014. *La realtà aumentata e le app culturali in Italia: storie da un matrimonio in mobilità*, in: *Il Capitale Culturale. Studies on the Value of Cultural Heritage*, IX, EUM Edizioni Università di Macerata, Italy, p. 89-121.

[7] MOHAMMED-Amin, Rozhen Kamal. *Augmented reality: A narrative layer for historic sites*. MEDes (CMD), University of Calgary, 2010.

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Adjustments. Repairing and reinventing damaged landscapes

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Abstract
Starting from a design research on Sarno landscape, being leaded within the Department of Architecture and Design of Second University of Naples (1), and on the basis of an in-progress research on Italian landscapes, the paper proposes a reflection on reparation and reinvention of disaster-damaged landscapes.
In a moment when environmental changes are accelerated, in a Country where they deal with obstinacy in building and inhabiting vulnerable lands, environmental disasters are more frequent and their risks are greater. In Italy, where 40% of the territory is at high seismic risk and 10% is at high hydrological risk and there is a long list of recent disasters, where the investments for the safety of the territory are less than 1/10 of the necessity and the maximum effort is pointed at solving emergency and metabolizing both disasters and reconstructions, damaged landscapes require a new design care.
Sarno could be a significant experimental laboratory: hit by the flood of the 1998, it is the symbol of a disaster and the origin of a legal advancement in planning with risk; damaged but not abandoned, it represents the adaptive attitudes of everyday life; covered with buildings beyond its necessities, and without any plan, it expresses the conflicts and contradictions of present urbanization. While the Municipality of Sarno is providing itself with an urban plan and directing attention to its landscape, and while national and international design culture is facing the topic of disasters, a design laboratory can work on reparation and reinvention, turning the vulnerability of this landscape into a peculiarity.

Keywords: Landscape values, landscape risk, reparation, architectural urban and landscape design.

1. Damaged landscapes. Te many declensions of the risk
While the debate on landscape is more and more interlaced with that on risk and the project increasingly faces the issues of prevention and reparation, a design research on the territory of Sarno is an occasion for reflecting on some urgencies and emergencies of Italian landscapes and some questions they ask to architectural urban and landscape design.
Starting point is the complexity of a present definition of the risk for landscape, which keeps together the features of the territory and the way of inhabiting of its populations, according to the most recent definition of landscape itself [2] and to the subsequent attempts to update the conception of risk. In an up-to-date map of the risk for Italian landscapes [3] both climatic and environmental phenomena and human, economic, social and cultural ones contribute, as risk factors, to highlight the vulnerability of our landscapes and to require a renovated care for them. In a Country where half of the territory is subjected to high seismic risk and 10% of it is subjected to high hydrological risk, and the construction keeps on growing over fragile lands, the topic of risk is particularly urgent and deals on one side with the climatic change which affects all the world, and with is peculiarities in Italian places, on the other side with the urbanization phenomena which, through expansion and shrinkage, modify the balance between natural and built world.
In all these senses, Sarno is a mirror of Italian territory and a significant investigation sample for the many declensions of risk for Italian landscapes.
Hit by the flood of the 1998, Sarno embodies the Italian condition of hydrological risk, which is so common as to concern about the 80% of Italian towns, so strong as to be the cause of many of the Italian disasters of the last fifty years - Polesine, 1951; Vajont, 1963; Firenze, 1966; Agrigento, 1966; Val di Stava, 1985; Valtellina, 1987; Piemonte, 1994; Sarno, 1998; Messina, 2009; Spezzino and Lunigiana, Genova, Messina, 2011; Maremma Grossetana, 2012; Sardegna, 2013 [4] – and so weighty in the modification of Italian landscapes

to be object of engagement for architectural and urban culture. In a recent issue of the *Giornale dell'architettura* [5] a review of Italian hydrological disasters, and related reparation works, traces the portrait of a damaged landscape, with conflicting relations between nature and building, policies of reparation and prevention and policies of construction and expansion, everyday practices of gaining soil and cohabiting with risk. In Sarno the flood produced 137 victims and heavy damages to the houses, which were located on the vulnerable mountain and which, although damaged, have kept on being inhabited for a long time. If, beyond its vulnerability, a territory is at risk when it is covered by people and buildings, and if everywhere in Italy sprawl constructions, and urban centres as well, are exposed to floods and landslides, Sarno represents, under this point of view, a national condition. And national is the relevance that Sarno acquires with the flood, which attracts the attention of the whole Country, produces emergency actions of the Government and leads to a new national law for preventing hydrological risk [6], continuing the Italian habit of acting and legislating in emergency. As after the disaster of Sarno a law for hydrological arrangement plans was born, after the landslide of Agrigento a law against illegal housing came out [7], and after the earthquake of L'Aquila a law for anti-seismic building [8] was prepared. While these normative interventions confirm the acquired awareness that in order to reduce the risk what is to be reduced is building and population exposed to it, the precarious condition of Italian land demands reparation and reinforcement interventions as well. In addition to the advancing building on the ground, the advancing change in climate is a strong risk factor: a geography in motion [9] all over the world, with an expected 2°-4°C average increase of the temperature by the end of the Century, and increasingly irregular rain and flood, and a geography in motion in Italy, where the average increase of the temperature is almost double the global one, and where in 1 day before a disaster it rains almost half 1 year rain [10], require a new care of fragile lands [11]. Sarno deals with reparation and reinforcement of its mountain from 1998, evaluating the safety interventions already done and the opportunity of providing it with new ones. While the discussion on utility and waste of its big safety basins for collecting water flows [12] goes on, they are still to be absorbed by the landscape as a part of its life and design.

Compromised by water pollution, Sarno identifies environmental risk at its maximum degree. Being the most polluted river in Europe, Sarno river, which crosses urban, agricultural and industrial landscapes, represents, beyond the risk of flood, an emergency for the landscape. In a moment when, similarly to the land, the water increasingly acquires the value of a precious and limited resource, and the debate on water as a common good appears to be a laboratory for many other debates on common goods, the topic of pollution, like the one of quality and quantity of the building, expresses demands of both policies and design strategies. Concerning this topic, if on one side the European framework directive on the quality of the water [13], which institutes a framework of actions to be done and a list of goals to be reached, and the Italian monitoring of water conditions [14], which reveals Italy is far away from reaching that goals, demonstrate a new environmental sensibility, on the other side reclamation interventions, as well as consolidation ones, become a new issue for landscape design, which requires technical expertises – engineering, botanical, chemical –, usually separated from design expertises, and newly joint in new design perspectives.

Marked by a no-planned urbanization, Sarno represents urban growing as a risk for landscape. A risk that concerns the quality of the built environment, even independently from its relationship with the vulnerability of the land. Sarno, like a great part of Italian peripheral landscape, has grown up by following dynamics of expansion and, like a great part of Naples metropolitan area, has been combining those dynamics with the hidden ones of an obscure city, founded on the gap between inhabiting and building demands and on a speculative attitude which leads to an overmanned quantity of building and facilitates crimes and abuses. Although the building growing separately from the inhabiting demand isn't always illegal, in Sarno the topic of illegal building is the background of urban risk for landscape. The controversial story of the local urban plan, which was committed to a Milan-based architectural firm and a relevant figure of the architectural and urban debate [15], has carried beyond Sarno's boundary the illegal building of this town, bringing it to national fame. While the architect Stefano Boeri was engaging a contentious with the Municipality of Sarno, denouncing conditionings and coming to legal ways, the debate on Italian landscape, being focused on urban sprawl, was starting to investigate its effects and to consider illegal building a matter of study for architecture and urban design. In recent times, while on one side the acquired awareness of the excesses of recent building trends and their environmental risk effects starts to work as a resistance to a further growth, on the other side the emerging need for reparation of the illegal town becomes a laboratory for urban design, involving the exploration of its features and its dynamics [16]. The preparatory walks for Sarno's plan [17], with the partitioning of the territory in characterized zones, the dialogs with inhabitants and stakeholders and the involvement of intellectuals, exemplify this attitude to exploration which permeates these times and, although not actually leading to the plan, represent a precious base of knowledge of the place. Once Sarno's plan is realized by someone else, and once its administration has changed [18], the work still constitutes a patrimony of knowledge at disposable of urban design.

Connoted by a tendency to abandonment, Sarno identifies another risk for Italian landscape, consisting in desertion and disuse. As a counterpart of the population move to the coastal or plain urban sprawl, the inland landscape of Apennines experiments abandonment, and the sprawl town itself, built on the spur of the

enthusiasms for the 80's economical boom and development expectations, experiments retraction. Emptied villages and abandoned historical centres, as well as disused industrial and commercial sheds, never inhabited or never completed houses, represent the materials of a discarded landscape that urban culture begins to be aware of and design debate begins to afford [19]. While, in times of crisis, the abandoned inlands and the remains of urban sprawl are the objects of a new season of explorations and accounts [20], in Neapolitan territory discard-devoted landscapes express a congenital condition of waste, a waste effect quite independent from the crisis. In a city which grows up answering to building rather than to inhabiting demand, taking advantage of occasions and financings, tactical projects with no long-term vision build up a landscape of abandonment, depreciation, interruption and suspension. In Sarno the historical centre tends to be emptied by the young people's move, some factories get to be disused, agricultural activities tend to dissolve, houses, built on individualistic impulses, are partly abandoned, as fragments of a suspended city. In the suspension, a demand for re-design emerges.

2. Re-making landscapes. The many declensions of the reparation

Re-making landscape could mean to intervene in damaged landscapes starting from an up-to-date conception of landscape and from up-to-date tools for its re-construction. To act in reparations, but also to accept existing reparation devices, recognizing the resilience of damaged landscapes and their adaptive capability; to implement performances through the reparation, not only repairing what is broken, but also enriching its sense and use; to work on the relations in time and space, assuming precariousness as a condition, and so time as a material of design, and fragmentation as a status, and so space as the place for fragments' re-signification.

In all these senses, Sarno could be an useful experimentation laboratory where to verify the many declensions of re-making and repairing Italian landscapes, and to renew, in a design key, a debate on landscape which still seems to be fixed on the opposition between protection and transformation, urbanization and environment's defense.

Re-making landscape could mean, first of all, to re-think of its concept, interpreting it as human and inhabited landscape, away from the stereotype of landscape as a picture which, although may be overtaken by architectural and urban culture, and by some normative, like the European Convention [21], still seems to resist in landscape management and in common debate. If in Italy there is a management gap among landscape, environment and territory, which are committed to different authorities - the Ministry of Cultural goods and activity, the Ministry of Environment, the local Administrations -, as Salvatore Settis highlighted [22], resulting in conflicts and contradictions among the preservation of the landscape, the protection of the environment and the urban planning, it becomes a cultural gap between preservation and transformation in a debate which, after a season of enthusiasms for construction and expectations of development, has fall back, in times of crisis, in regrets for the consumed land [23]. To re-affirm the idea of landscape as human landscape, including ordinary landscape and contemporary vernacular landscape [24], combining landscape, environment and territory in a sole vision and adding other values - economical, social, cultural - to the visual/esthetical ones, so recognizing the fragmentation of Italian landscape [25], and the necessity to deal with it, could be the first step for filling the gap and thinking of re-making landscape in a contemporary way. Sarno is not the picture of the mountain, is not the disaster of the flood, is not the illegal city invading nature; it is all these things together, so that a project – of reparation and reinvention - should contemplate them all, considering their conflicts and contradictions as occasions for design. A project for Sarno landscape could, within the beauty of nature, consider the stabilization of the mountain and the reclaim of the river, as well as the qualification of the city in its different forms, as topics for design: inhabiting the mountain, the nature, the dense and the sprawl town are ingredients of an inhabited landscape which calls for new visions. In the most actual trends in landscape design - from landscape urbanism to the landscapes of dross [26] - these visions could find new roots.

Re-making landscape could mean to recognize the value of some in-progress transformations. To find in landscape design's culture the familiarity with practicing adjustments, dealing with accidents, putting relations into play, which can lead to recognize the value of tactical actions, within and beyond planning strategies. As landscape culture promotes the third landscape [27] as the place for marginalities and remains, where spontaneous species advance with more pervasiveness than cultivated ones, this concept, carried to a more extended field, gives value to the adapting capacities of the spontaneous interventions [28] of inhabiting practices of everyday life. Adjustments, tolerance towards mistakes and exceptions, adapting devices daily express latent design attitudes that re-making landscape could reveal. In Sarno, the cohabitation with disaster, the occupation of semi-destroyed buildings or residual empty rooms besides those full of mud, the increasing construction despite the decreasing demand, the mutation of safety basins into uncertain common spaces, the suspension of unfinished buildings are implicit projects, which build up the landscape by many individual ventures, and suspended projects, which are open to many completions. In a moment when tactical urbanism [29] gets fortune in urban studies, against the crisis of urbanism in its traditional form, when participation and involvement acquire a new necessity in front of a lack of money and means, when public art architecture and everyday life converge in changing places and re-inventing common

goods [30], while bottom-up actions, subverting orders from inside, and recycle projects, post-producing buildings and spaces, are on display [31], a design work on Sarno could recognize in the many energies and expressions of the resilience of this place germs of latent transformation waiting to be revealed.
Re-making landscape could mean to assume time as a design material and precariousness as a condition, dealing with hydrological risk but also with the alternation of expansion and retraction characterizing urbanization. To include the unfinished; to introduce progressive transformation, contemplating both emergency and quite conditions; to establish some fixed points leaving the rest to unpredictable evolution. While present urban culture more and more interprets project as a process in architecture, city and landscape, providing transformations which will be completed in time, introducing virus of change, working on high and low definition, accepting interruption, looking at temporary uses as urban catalysts [32], at cyclical uses as generator of variable space solutions, at open architecture and uncertain planning [33], in Sarno time concerns the cohabitation of extraordinary and ordinary life: the research for settlements on the fragile mountain which fit with both quiet and emergency situations; the supply of a first equipment for the under-used country which allow any future configuration; the work for a reclaim of the river which could be the starting point of a new water landscape design; the manipulation of unfinished architecture or the construction of architecture not necessarily to be finished in the uncertain sprawl town, the grafting of new activities and buildings in the urban centre to be revitalized, always waiting for events and concerning abandonment as a part of urban life. If recycling means to act on the life-cycle of something making corrections in order to save it from waste, recycling this precarious landscape could mean to act within its cycle both correcting and accepting waste [34].
Re-making landscape could mean to intervene on the damaged existing by introducing new relations. To act on fragmented landscape and residuals in order to give them a new sense, to work on up-grading through the reparation. While recent urban requalification programs search for mending – think of Renzo Piano's manifesto for Italian periphery [35] -, re-making landscape searches for re-invention. Actions may be parasite additions, subtractions, manipulations, may concern both building and open spaces, agricultural and urban sites, and any material of the damaged landscape – damaged by the flood, by urban growth, by human retraction, by pollution -. Aim is to use what already exists reinventing it through the new relations, as architecture has always done [36], and present times of crisis require to do. If landscape is the place of relationship for natural, architectural and urban spaces, and landscape culture is the place of relationship for different visions and expertises, making project with a landscape approach could mean to focus on relation. While in Sarno, the finally conquered urban plan is based on landscape in the form of park, the park itself – as from *Parc de La Villette* project [37] on - assumes many declensions: it is urban park, industrial park, inhabited park, agricultural park, infrastructure park, natural park, depending on places and conditions, and it can also be emergency park, temporary park, waste park, or assume many other connotations, depending on design concept and strategies. Moreover, landscape, as the place of relation among many expertises, keeps together engineering, botanical, architectural competences in a project that, starting from the reclaiming of a polluted water or terrain, or from the reinforcing of a mountain – as for Landscape urbanism's projects of *Fresh Kills* in New York, or *Paludi Pontine* in Italy [38] -, gets to a new landscape design. In the fragmented landscape, fragments of architecture are waiting for a new life: grafting, manipulations, demolitions and many other adjustment devices, intended not to recover but to reinvent them – as in the Italian tradition of *Grafting* projects [39] much more than in the international re-cycle style -, writing onto writings [40], reveal the elements of a latent city still to come.

Quotations and Bibliografical References

[1] Course of Architectural Design 2 prof. Fabrizia Ippolito in collaboration with Course of Architecture Representation prof. Alessandra Cirafici.

[2] The European Landscape Convention, Firenze, 2000.

[3] RICCI Mosè (editor), *Rischiopaesaggio*, Roma: Meltemi, 2003. The book presents the results of a research which was committed by the Central Institute for Restoration of Italian Ministry for Cultural Goods and Activities. The author was part of the research group

[4] IPPOLITO Fabrizia, Rumore di fondo, in MOLINARI Luca (editor), *Ailati. Atlante d'Italia in numeri*, Milano: Skira, 2010.

[5] *Il giornale dell'architettura,* L'Italia è pericolosa, n.113, 2013

[6] *Conversione in legge, con modificazioni, del decreto legge 11 giugno 1998, n. 180, recante misure urgenti per la prevenzione del rischio idrogeologico ed a favore delle zone colpite da disastri franosi nella regione Campania*, Law, 267/1998,

[7] *Modifiche ed integrazioni alla legge urbanistica 17 agosto 1942*, Law, 765/1967.

[8] *Conversione in legge, con modificazioni, del decreto-legge 28 aprile 2009, n. 39, recante interventi urgenti in favore delle popolazioni colpite dagli eventi sismici nella regione Abruzzo nel mese di aprile 2009 e ulteriori interventi urgenti di protezione civile,* Law, n. 77 /2009

[9] *Lotus*, Geography in motion, n. 155, 2014

[10] IPPOLITO Fabrizia, *Atlante d'Italia in numeri*. *Paesaggi frantumati*, Milano: Skira, on print

[11] NAVARRA Marco, Terre fragili, in *Dromos. Periodical Architectural Book*, 100 mt, n.1, 2010

[12] Government Deputy Commissioner was Pasquale Versace, full professor of hydraulic engineering at University of Calabria

[13] 2000/60/CE Directive, 23 October 2000.

[14] data referring to 2012, in LEGAMBIENTE*, AcQualeQualità?*, 2014

[15] Boeristudio was commissioned, after a public competition in 2002, to do the plan by a left wing administration. While the work was in progress a right wing administration, Amilcare Mancusi Major, succeeded. The work started in 2004. In 2007 the preliminary plan was delivered, in 2009 Boeristudio resigned from the commitment, with a public letter. See Stefano Boeri's letter in Wilfing architettura: http://wilfingarchitettura.blogspot.it

[16] Among the studies on illegal town, see ZANFI Federico, *Città latenti. Un progetto per l'Italia abusiva*, Milano: Mondadori, 2008.

[17] In 2005 Boeristudio organized 5 walks in Sarno. Episcopio; Lavorate; Masseria della corte and Foce; Masseria Pirocca, Serrazzeta and Acquarossa; Historical centre were the areas of the walks.

[18] In 2014 Sarno Administration, Amilcare Mancusi Major, approves the Town Plan. Afterwords, it changes to present Administration, Giuseppe Canfora Major.

[19] Among the researches on this topic, see *Re-Cycle Italy. Nuovi cicli di vita per architetture e infrastrutture della città e del paesaggio*, PRIN 2013-2016.

[20] On abandoned villages, see, among the accounts, TETI Vito, *Il senso dei luoghi. Memoria e storia dei paesi abbandonati*, Roma: Donzelli, 2004; ARMINIO Franco, *Vento forte tra Lacedonia e Candela*, Bari: Laterza, 2009; TARPINO Antonella, *Spaesati*, Torino: Einaudi, 2012. Among the projects, FELD 72, *Million Donkey Hotel*, Prata Sannita Inferiore, 2007.

[21] The European Landscape Convention, cit.

[22] SETTIS Salvatore, L'Italia si fa in tre: paesaggio, territorio e ambiente, in *Paesaggio, costituzione e cemento*, *La battaglia per l'ambiente contro il degrado civile*, Torino: Einaudi, 2010.

[23] ASOR ROSA Alberto, *La Repubblica*, 24 August 2006, against the urbanization in the small town of Monticchiello; RIZZO Sergio, STELLA Gian Antonio, *Vandali. Assalto alle bellezze d'Italia*, Milano: Rizzoli, 2011; SETTIS Salvatore, *Paesaggio, costituzione, cemento,* cit.

[24] See, among the others, JACKSON John Brinckerhoff, *Discovering the Vernacular Landscape*, New York: Yale University Press, 1984

25] IPPOLITO Fabrizia, *Atlante d'Italia in numeri,* cit.

[26] See, among the others, WALDHEIM Charles, *The Landscape Urbanism. Reader*. New York: Princeton Architectural. Press, 2006; BERGER Alan, *Drosscape: Wasting Land in Urban America*, New York: Princeton Architectural Press, 2007.

[27] CLÉMENT Gilles, *Manifesto del Terzo paesaggio*, Macerata: Quodlibet, 2005 (Original edition 2004)

[28] *Spontaneous interventions. Design Actions for the common good*, www.spontaneousinterventions.org, American Pavilion, Venezia: Biennale di Architettura, 2012

[29] IPPOLITO Fabrizia, *Tattiche,* Il melangolo, Genova, 2012; *Uneven Growth: Tactical Urbanisms for Expanding Megacities*, New York: MOMA, november 2014- may 2015

[30] Participation and public art find their roots in experiences and studies of the 70's. On participation, see DE CARLO Giancarlo, An Architecture of participation, in *Perspecta* n. 17, 1980, published in Italian by Quodlibet in 2013. On participation, art and landscape architecture, see HALPRIN Lawrence, *Changing Places: Exhibition San Francisco Museum of Modern Art, 3 July - 24 August 1986*, San Francisco: San Francisco Museum 1986. As for present debate on common goods in Italy, see, among the others, MATTEI Ugo, *Beni comuni. Un manifesto*, Roma- Bari: Laterza, 2011, and the experiences of occupation in Teatro Valle, Roma, and Asilo Filangieri, Napoli.

[31] On post-production, see BOURRIAUD Nicolas, *Postproduction. Come l'arte riprogramma il mondo*, Milano: Postmediabook, 2004 (Original edition 2001). Among the exhibitions, see BORASI Giovanna, ZARDINI Mirko (curators), *Action. What you can do with the city*, Montreal: CCA, 2008; CIORRA Pippo (curator), *Re-cycle. Strategie per l'architettura, la città e il pianeta*, exhibition, Roma: MAXXI 2011.

[32] *Urban catalysts. Strategies for temporary uses*, Fifth Framework program, 2001-2003. The author was senior researcher in the program.

[33] On open architecture and planning, see, among the others, RATTI Carlo, *Architettura open source. Verso una progettazione aperta*, Torino: Einaudi 2014, Among open architectures, see LACATON&VASSAL, *Palais de Tokyo*, Paris, 2010; on open planning, see *Lotus*, Unpredictabe City Planning, n. 107, 2000

[34] LYNCH Kevin, *Wasting Away. An Exploration of Waste: What It Is, How It Happens, Why We Fear It, How To Do It Well*, San Francisco: Sierra Club Books, 1990

[35] PIANO Renzo, Il rammendo delle periferie, *Il Sole 24 ore*, 23 gennaio 2014

[36] FERLENGA Alberto, *Le strade di Pikionis*, Siracusa: LetteraVentidue, 2014, and Ricicli e correzioni, in CIORRA, *Re-cycle*, cit

[37] *Parc de La Villette* competition, Paris: 1982. See the projects by Bernard Tschumi (winner) and Rem Koolhaas

[38] CORNER James and FIELD OPERATION, *Fresh Kills Park*, New York, 2001-2008; BERGER Alan, *P-Rex project*, Paludi Pontine, 2008

[39] ZUCCHI Cino (curator), *Grafting*, Italian Pavilion, Venezia: Biennale di Architettura, 2014

[40] GAMBARDELLA Cherubino, *Supernapoli,* Siracusa; LetteraVentidue, 2015, and *Supernapoli* exhibition (IPPOLITO Fabrizia curator), Milano: Triennale, 2015

HERITAGE and TECHNOLOGY
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The Recovery of Urban Post-War Landscape Middle-Class Housing in Naples

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Abstract
In the recent years, throughout Europe, there has been growing awareness of how the considerable residential housing heritage, built after World War II for the emerging urban middle-class, is the core issue of any strategy aiming at contemporary urban recovery. Major European cities are now starting to face the issue of a radical recovery and rethinking of this building heritage and research centers have the task of providing the necessary knowhow, skills and planning to deal with this new phase of urban renewal.
Middle-class buildings represent a time of extraordinary social architectural planning and design which is undergoing dramatic decay. They were constructed in large numbers, at great speed, and with a low monitoring of "modern materials". Extensive planning was possible thanks to property speculation logics and often with the support of Public Administration politics.
The paper will be focused, particularly, on Neapolitan post-War middle-class housing, one of the greatest and most invasive portions of residential housing in Neapolitan history. Moreover, some of the most interesting modern Neapolitan architects were involved in the planning and construction of residential building complexes which have never been systematically studied.
Today this housing heritage occupies a considerable portion of the city and yet its increasing deterioration comes along with important economical, social and urban consequences. The aims of the research is to rethink our post Second World War housing heritage, in order to preserve and recovery it.

Keywords: residential housing heritage, middle-class buildings, Naples, modernity

Preface
In recent years the extraordinary heritage of residential buildings that rapidly colonised the undulations and hills surrounding the centre of Naples has turned into an example of the problems of a city that needs to escape from the potentially harmful stasis of its fragile environmental and social equilibrium.
It is a tragic nemesis because the sparkling white rendered walls, mosaics and sparkling colours were true witness to an aggressive modernism, but now they are victims of increasingly dramatic wear, a physical and symbolic representation of middle class dwellings seeming to have lost touch with the reality of a rapidly changing metropolis.
The example of the *palazzina* (a small apartment block) or condominium became the solid image of the extremely fast densification of an urban territory which could not overcome the impact of a potent social pressure, that brought different wishes and requirements. And a generation of talented Neapolitan designers with a solid grounding in modernism developed infinite variance on the theme of urban middle-class living in a very complex physical and environmental scenario.
However today one of the most interesting and least studied developments of Italian architecture between the 30s and the 60s, could turn into an economic and cultural opportunity for Naples, by becoming a place of innovative technical experimentation.
The progressive dilapidation of the post-war buildings heritage due increasingly to the poor quality of the modern materials used, together with neglectful or entirely absent physical and environmental maintenance, have led to a no longer sustainable loss of value. The opportunity for private clients to initiate widespread

recovery and improvement via a concerted action plan could become an interesting economic driver for the city for businesses, for public institutions and the many professionals that would be involved.
Such a highly compromised and dense scenario could even present the possibility of replacement of buildings and additional structures which could on one side redesign the system of connection to the ground level and on the other side, lead to the reformulation of the traditional type of Italian middle-class dwelling of the 20th century.
To tackle this ever more current issue of restoration and recovery of contemporary buildings heritage with realism and, at the same time, to see this part of the city as a fresh urban laboratory, could be part of the innovative and visionary approach that Naples apparently needs [1].

1. Continuity or crisis?

From the second half of the 50s, for around 10 years, Italy lived through that particular time of history called *economic miracle* [3]. A number of factors, including the end of prohibition, energy self-sufficiency, low cost of wages, paved the way to a boom without precedent. Between 1958 and 1963 Italy became, from an almost entirely agricultural country, one of the most industrialised Western countries [2].
The urban and rural landscape, houses, lifestyles underwent a radical change during the *miracle*. Building, in particular, was a powerful driver for the Italian economy among the new free-market based neoliberal politics [4].
If economic development focused on buildings became a constant in Italy in the after war years up to the first half of the 50s, in the south, and in Naples in particular, it took on peculiar and permanent aspects in the local economy [5]. Infact, according to a largely shared interpretation, the 50s, which were almost entirely under the administration of Mayor Achille Lauro (1952-1958) [6], was the decade when the city was plundered, when building speculation inexorably compromised the urban landscape. This analysis is rarely opened up into broader enquiry, one with a longer timescale and therefore having historical continuity into what went before and after and often hiding the view of the national scenario.
However it is possible to grasp clear continuity of the building process in the town planning policies at the beginning of the century and those in the 50s and 60s. It was from the end of the 19th century that the use of building permissions was simplified, when the city allowed the expropriation of certain depressed areas, which were then rejuvenated via new urbanisation and via the finance of building companies which brought together local investors with capital from companies located in the north of Italy. The administration's permissiveness at the time of the so-called *Risanamento* was the direct precedent of the even more aggressive and ambiguous practices that would be applied in the years after the Second World War and that would become the policy initiated by Achille Lauro. This town planning deregulation lasted rather longer than the Lauro era, and brings us up to the beginning of the 70s, involving the Christian democracy party, government officials and centre-left politicians. In total, between 1951 and 1960 Naples issued 11.538 building licences, for a total of 1.989.144 m³ of covered surface area, without any obligation for primary urbanisation. While from 1960 to 1967, 6.230 building licences were issued only in the areas involved by the variants to the city master plan of 1939. During the same period plots were authorised for a total of 10.905.510 m³ without obligation for primary urbanisation. In total, from 1951 to 1967, 469.854 spaces in buildings were built, the equivalent of a large city like Palermo [7].

2. Private residential architecture

Building speculation and *Laurismo* were main drivers of the Neapolitan reconstruction up until the 70s. While for many Italian cities such as Rome, Turin and Milan, there are several studies that deal with public and private output with a layman's attitude, history and criticism have in many cases ignored Neapolitan architecture during this period or, when they have talked about it, they treat it as being the direct result of political malpractice. This has meant that the majority of private Neapolitan architecture of the post-war period has been considered without any historical interest.
It is precisely because of this academic status – recently enriched by a number of publications, particularly essays on certain architects working during that time [8] – that one feels the need to reconsider private Neapolitan architecture to try to place it within a debate on the discipline and in a broader context.
In the first place, let's consider the state/private mix, that too often was talked about as a dichotomy. First, as private building was favoured and was generally highly stimulated by state and local authorities, through finance and the unburdening it benefited from through a dense series of laws founded in the fascist tradition, when building, whether state or private, was considered a highly significant factor of the national economy and therefore to be incentivised as much as possible by administrations. The majority of the laws and public funds, including the Tupini law in 1949, facilitated private building, contributing to the enrichment of those who decided to invest in bricks and mortar during the boom years. It was broadly demonstrated then that even state building, including in particular the *Ina Casa* project started by Fanfani's law in 1949, contributed to feed the sprawl of cities, and the regeneration of peripheral land which facilitated private investment, and even unauthorised building. Furthermore the mechanism of the variants and the ever more frequent

deviations from the plans in urban transformations of all Italian cities at that time fall fully within this process.
Lastly, to make the border between state and private ever more mobile, there is the contribution of the unavoidable situation that many architects were designing at the same time both for state and private clients, by simultaneously building popular buildings and condominiums for the real estate companies.
The fact that the condominium was at the same time the most widespread form of dwelling in medium/large Italian cities and the most sought-after by a certain social group, but also the symbol of building speculation, is clearly worth analysis. Building production in the early part of the second half of the last century is in fact a reflection of the demand and wishes of entire groups of the population seeking well-being and modernity. This aspiration of the market has already been stated by cultural histories as having led to the production and consumption of goods at an ever more accelerated rate, influenced by the examples overseas [d'oltreoceano]. Less investigated however are the methods by which the new imaginaries driven by advertising and by the new marketing affected housing; how the home also became a consumer item included in the mechanism of competitiveness. In this sense, the *palazzina* and more generally the condominium took on a fundamental symbolic value by becoming a genuine object of desire for the emerging middle class in the 50s [9].

3. Neapolitan condominiums

While modern Neapolitan houses have been the subject of profound analysis [10], there is a notable absence of systematic study on post-war condominiums in Naples. The need to tackle this gap is ever more urgent given that this type of dwelling is emblematic of the constraints and conditions architecture fell into during the modernisation years. Condominiums could be held up as the motif of a lengthy historical process which exploded with the boom and that today, starting with the global economic crisis, has weakened.
While waiting to publish a detailed critical filing of private residential dwellings that stand out in terms of excellence in Naples during the 50s and the 60s [11], only some of them shall be mentioned here. They are listed or partially dealt with in local historiographies [12].
We could take as an example the building on Via Manzoni, whose plans were designed by Franz Di Salvo (1948) and brought to life by Vittorio Amicarelli (1952). Its in-line footprint, a matrix of pillars dividing five apartments per floor, is repeated to compose a sort of macro-structure of eight floors overlooking the bay, by exploiting the different levels given by the hillside Via Orazio traverses. The floors are repeated strictly identically all the way up the building, apart from the presence of an atrium level with pillars fulfil the function of a springing line and split the front into two parts, *giving the colonnade the intensity of a belvedere between two equivalent spaces and giving the building the mass of the two overlapping bodies drawn together by punctiform junctions* [13]. It happens that in this house, as in many other modern Neapolitan dwellings, *the typical features, normalised by the requirements of maximum surface area, describe an extremely dense layout where the natural aspect is unveiled to be as precious as an archaeological find* [14].
Vittorio Amicarelli resolves the design of the front of the building on Via Manzoni with abstract geometric patterns through the strong colour of the parapets and loggias (now faded), and dresses the pillars of the basement floor with blue mosaics to dematerialise the volumes and therefore not break up the view of the sea that opens up from this view-offering portico. As regards the colouring of the facades, an explicit reference to the Neapolitan Concrete Art Movement was noted by Giovanni Menna [15].
As for the *palazzinas* on Via Petrarca by Davide Pacanowsky (1953-54) the sinuous movement of the steep street, with which the plot aligns, typifies the composition. According to this rule the floors are divided between the various properties, with balconies facing the sea to highlight the parallel lines of the horizontal levels which virtually extend to infinity. The high-quality details play on the small variations of the open or closed balustrades, the planters, the closures, and the cut-outs of the loggias. Even the names ("azalea", "orchid") of the condominiums on Via Petrarca evoke a park, with vegetation that covers the long balconies facing out over the sea which, *projecting out around 3 metres, run along the entire principal facade and connect with the sides of the building. The planters hold geraniums and bougainvillea, the latter of which also cover a good part of the walls* [16]. The balconies are composed "as a chain", according to the definition of the author, obtained by staggering the volumes and shaping the spaces of the various floors [17] with variable sections, and the greenery-clad floors and balcony balustrades form an artificial level that focuses on the nature metaphor [18].
As a whole the design work of the condominium architects of those years was broadly focused on seeking some degree of autonomy over the overwhelming constraints of the speculators that imposed maximum exploitation of the plot. Some solutions adopted to articulate the volumes and the prospects transform rapidly into actual "formulas" which, whilst introduced by an architect in a certain building, are to be found in other condominiums in other cities [19]. A recurring theme is the "dual façade", intended as an autonomous element overlaying the structure: a theme that derives directly from the development to the extreme consequences of one of the founding ideas of rationalism, that is to say the system of the structural frame, which leads to non-bearing, light facades, acting merely as a cladding. The detachment between structure and volume is also obtained by rotating the masonry covering to the exterior or interior and varying the angles in order to create a zigzag effect, which transforms prospects into what could be described as "urban

theatre wings". A slight variation to the tendency towards a matrix of pillars could be Michele Capobianco's *palazzina* in Parco Comola-Ricci in Naples (1952-55) [20] where the frame exposure goes through its partial concealment. The lateral prospect of this building repeats the formula adopted by Luigi Moretti for "Il Girasole" in Rome (1947-50), where a series of windowed walls are arranged at right angles to the street to allude to a virtual opening to the exterior and at the same time guaranteeing as much light as possible to the trapezoid rooms. It cannot be excluded that the Neapolitan architect was inspired by his Roman colleague in developing this solution.
In many cases, the intent of conferring prestige on the building translates into extreme attention to the covering materials, also made possible by the loss of bearing input of the walls and therefore the progress made in the sphere of light facades. In Naples, where the tradition was strong and brick structures were seldom used, starting from the post-war years, completely coated, frame-structured buildings began to appear ever more frequently. To give a few examples, we have brick coated facades of the *palazzina* by Michele Capobianco on Piazzetta Santo Stefano (1956-58) of clear Scandinavian origin and the buildings that make up Parco Manzoni by Stefano Paciello and Giovanni Malatesta in Posillipo (1961-65), with their organic design, *that reminded of the residential houses that were popular in the United Kingdom in the 60s* [21].
Again to break the monotony of box-like volumes and to give buildings greater prestige, designers focussed on the design of details.
The collaboration with tradesmen and artists can be interpreted in this sense. They embellished the atriums and the facades of many of the most iconic condominiums of that time with majolica tiles and mosaics, pictures and reliefs. And in particular numerous entrance halls, the most prestigious of all condominium spaces, have artistic contributions: for example in the condominium by Carlo Cocchia on Via Palizzi (1957), where the lively blue ceramic flooring created by the historic majolica tiles factory of Vietri "Le tre felci", provides a joyful background for a dancing Punch with a mandolin, by L. Carà, or in the building by Davide Pacanowsky in Vomero where there is an actual fountain, which gives the building its popular name [22].

4. Codes

As a whole, the language of modern Neapolitan condominiums could be defined as non-orthodox rationalism which makes the city a peculiar laboratory of modernity: spurious modernity, full of compromise and nostalgia, non-committed.
A possible post-war Neapolitan Italian architectural style then emerges, based on the city's morphological and topological characteristics, for which the field of experimentation of condominiums in the 50s coincides in many cases with the natural context and with the landscape.
It could be proposed that the 50s Neapolitan architecture, as also happened in the rest of Italy, developed output according to a modern code which took for granted adherence to rationalist language in the majority of non-orthodox cases, but also, specific to Naples, a constant dialogue with the natural environment and an everlasting tension with the landscape also intended as the result of the anthropic component. This does not translate into integration, even less into blending in, but on the contrary, it translates into architecture with a strong impact, at times capable of imposing itself on the view and more generally, having a presence in spite of the potency of the natural scenery.
In a sense, modern style in Naples shows us another aspect of a language which for a long time has been seen as universal, uniform and international, but that instead is full of nuances and exceptions. It is, as has been noted [23], a modern way that seems to unite the international/regional dichotomy [24] with impertinence. As a matter of fact, this can be found in Italian architecture as a whole, in that Italian Style represents an ever particular and peripheral modernism compared to the rest of Europe and America. Therefore, rather than emphasizing an exhaustion or consumption of rationalism, it seems more appropriate, from our perspective, to start from the influences, relationships, interrelationships, when not from citations or even from plagiarism, that is to say from the many implementations of the model of modernism. A large part of Italian architecture produced in the years after the Second World War could be read under these categories. In this sense, as happens for many other aspects of the city, modern Neapolitan architecture represents a sort of sample from which one can read into many, often intensified, aspects of Italian culture. This is probably because in Naples the challenge of modernisation arrived late and slowly but in a perhaps more violent way than elsewhere, so much that it wasn't given time to experience the emancipation from the historical constraints of past styles: the city plunged immediately into a phase of frantic rebuilding during which, however, many important projects were carried out.



Fig.1: Michele Capobianco, Building in Parco Comola-Ricci, photomontage [Michele Capobianco Archive]

Notes:

[1] About middle-class architecture, see also: MOLINARI Luca, INGROSSO Chiara, *The 'Residential Park' as a New Model for the Emerging Middle-Class in Naples during the 1950s*, Peter Lang Press, now being printed.

[2] Part of this paper references the research: *Il condominio. La "città privata" negli anni del boom economico a Napoli*. Please refer to this essay, which is being printed, for further analysis.

[3] CRAINZ Guido, *Storia del miracolo italiano*, Rome: Donzelli, 2005.

[4] FERRACUTI Giovanni, MARCELLONI Maurizio, *La casa,* Turin*:* Einaudi, 1983. The figures convey the huge size of building production: houses built in Italy went from 148,000 in 1953 to 275,000 in 1958 and 450,000 in 1964. This publication, page 131. A 400% increase was accounted for in (state and private) investment in buildings between 1951 and 1964. *Ibid*. p. 46.

[5] ALLUM Percy, *Potere e società a Napoli nel dopoguerra*, Turin: Einaudi, 1975.

[6] GHIRELLI Antonio, *Achille Lauro*, Naples: Gaetano Macchiaroli, 1992.

[7] GEREMICCA Andrea, *Le mani sporche che soffocano la città in Dentro la città. Napoli angoscia e speranza*, Naples: Tascabili Guida editori, 1977, pp. 84-85. The reference is taken from the report attached to the city master plan of 1972, from which the author took all the data reported herein.

[8] These include: MENNA Giovanni, *Vittorio Amicarelli architetto 1907-1971* Naples: ESI, 2000; BERTOLI Barbara, *Giulio de Luca 1912-2004, opere e progetti*, Naples: Clean, 2013; BURRASCANO Marco, MONDELLO Marco, *Lo Studio Filo Speziale e il modernismo partenopeo. Palazzo Della Morte*, Naples: Clean, 2014.

[9] Among the first authors that referred to the phenomenon from this point of view, PORTOGHESI Paolo, *"*Tipi e simboli*"* in *Modern Building*, 1963, 82-83, p. 7.

[10] Of these, GAMBARDELLA Cherubino, *Case sul golfo. Abitare lungo la costa napoletana 1930-1945*, Naples: Electa Napoli, 1993.

[11] A reasoned analysis of Neapolitan condominiums, currently being printed and the outcome of many years of work started with the students of History of Architecture and Design, APIA, which I lead, at the Department of Architecture and Design "Luigi Vanvitelli" (SUN).

[12] These include: BELFIORE Pasquale, GRAVAGUOLO Benedetto, *Napoli architettura e urbanistica nel Novecento,* Laterza, Bari 1994, DE FUSCO Renato, *Napoli nel Novecento,* Naples: Electa Napoli, 1994.

[13] GAMBARDELLA Cherubino, *Ossature metropolitane. Posillipo nelle architetture di Franz di Salvo*, in Fusco Gaetano (carried out by), *cit.*, p. 43.

[14] *Ibid.*, p. 51.
[15] MENNA Giovanni, *cit.*, p. 96.
[16] PACANOWSKY Davide, "Tre palazzine panoramiche*"*, in *Edilizia Moderna*, 1955, 55, p. 39.
[17] *Ibid.*
[18] GAMBARDELLA Cherubino, *Posillipo moderna,* Naples: Clean 1999, p. 129.
[19] MUNTUONI Alessandra, *"*La palazzina romana degli anni Cinquanta" in *Metamorfosi*, 1991,15, Rome, p.4.
[20] D'AURIA Antonio, *Michele Capobianco*, Naples: Electa Napoli, 1993, pp. 126-127.
[21] DE FUSCO Renato, *cit.,* p. 160.
[232] SERRAGLIO Riccardo, *Continuità individuale e crisi locale: Davide Pacanowski nella Napoli degli anni cinquanta* in GIANNETTI Anna, MOLINARI Luca (carried out by), *Continuità e crisi. Ernesto Nathan Rogers e la cultura architettonica italiana del secondo dopoguerra*, Florence: Alinea, 2010, pp. 204-205.
[23] MANZO Elena, *Architetture del moderno a Napoli tra progetto e prassi. La casa di Stefania Filo Speziale*, in *Il moderno tra conservazione e trasformazione: dieci anni di Do.Co.Mo.Mo. Italia: bilanci e prospettive.* Proceedings of international conference, Trieste: Editreg, 2005.
[24] *Ibid.*, p. 51.

HERITAGE and TECHNOLOGY
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Guidelines for the Maintenance Plan of the Archaeological Heritage: the case-study of Villa di Poppea, Oplontis

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Abstract
In recent years, the issue of maintenance has left the technical and operational field and has assumed programming, strategic and organizational perspectives. Practices in design of Maintenance Plans just since a few decades have found new impulses, also due to laws which have introduced mandatory scheduling of maintenance activities even for Cultural Heritage.
The result of this trend is the overcoming of traditional categories of ordinary and extraordinary maintenance. Therefore, the maintenance is understood as a continuous process in time to ensure the conservation of the built environment.
This approach has not always found implementation through suitable tools with the variety and the complexity of Cultural Heritage.
In the case of the Archaeological Heritage, the loss of material, due to the decay, is dangerous because it decreases the witness value of the asset.
The Archaeological Heritage prevents the use of standardized tools to determine the frequency and the ways of inspections and interventions. Therefore, it is fundamental the critical rethinking of the strategies of maintenance and management under the system of intrinsic characteristics and values witnessed by ancient contexts. [1]
The paper develops a procedure for drawing up Maintenance Plans dedicated to Archaeological Heritage. This procedure, tested on case-study Villa di Poppea in Oplontis (Torre Annunziata - Naples), aims to predict maintenance actions, with different intensity and frequency, in order to control the effects of decay agents. In the case of Archaeological Heritage, the implementation of maintenance plans is strategic, in order to prevent the severe loss of the materials and to preserve the values of authenticity and identity of the site.

Keywords: Archaeological heritage, vulnerability, maintenance, preservation, enhancement.

1. Background
The topic of the research, developed within the *Urban Ecotourism for Cultural Heritage Enjoyment in Campania*, launched by BENECON Scarl [2], concerns the vulnerability of the Archaeological Heritage. The paper defines methods and tools for the planning of maintenance of Cultural Heritage with archaeological value. The aim is to ensure the best conditions for preservation and use of assets.
In the field of Archaeological Heritage, the main problems are related to both a maintenance approach pointed to repair activities - breakdown incurred - and to the increasing anthropogenic pressure [3].
Indeed, the Heritage at issue is affected by widespread degradation phenomena due to ineffective maintenance interventions, which are not able to act against the increasing effects of environmental aggressiveness.
The complexity and importance of the Archaeological Heritage, consisting of buildings in use, disused buildings and ruins, highlights that issues relating to the protection can not be separated from those connected to "full use". According to this principle, the intervention aimed to improve the enjoyment of the Archaeological Heritage were also considered [4].

In recent years, the scientific community became aware of the need to facilitate prediction and prevention of Cultural Heritage decay with planned inspections and preventive maintenance activities, rather than with emergency measures [5]. Nevertheless, these processes not always have been able to fully meet the multiple and complex needs of heritage spread over the territory.
As a "best practice" the model of conservation, maintenance and enhancement developed for the archaeological site of Herculaneum should be mentioned. The Herculaneum Conservation Project is based on the public-private partnership established since 2001 between the Packard Humanities Institute (PHI) - a non-profit organization under US law - and the Superintendence for Archaeological Heritage of Pompeii, Herculaneum and Stabiae. This experience is based on an innovative approach to cultural heritage property, as well as on the multidisciplinary nature of involved skills, on the widespread knowledge and on the computerization of procedures. The Project considers the scheduled maintenance as a key tool/service [6].
Indeed, the peculiarity of the Archaeological Heritage prevents the use of standardized tools for maintenance and requires a multidisciplinary approach, aimed to test and validate the applied tools through the integration of different skills [7].
In particular, the Italian laws make planning maintenance activities compulsory also in the field of Cultural Heritage, affecting the way of structuring Maintenance Plans. Maintenance - also with regard to interventions on Cultural Heritage - was introduced by Presidential Decree 554/99, which specifies that "maintenance consists of a series of specialized technical operations, periodically repeatable, aimed at maintaining the historical and artistic characters, material integrity and functionality of the building, in order to ensure its conservation" [8].
The most recent Presidential Decree 207/2010 [9], Regulation implementing Legislative Decree 163/06 [10], states that the qualifying content and the purpose of maintenance are defined in Section 29 of Legislative Decree 42/2004, as amended [11]. This article defines maintenance as “the set of activities and interventions aimed to control the conditions of the cultural object and to maintain the integrity, the functional efficiency and the identity of the asset and of its parts". This strengthens the mutual bond between maintenance and conservation. Nevertheless, the law does not provide really effective implementation tools.
In addition, it should be noted that the Presidential Decree 554/99 introduces the obligation to define the Maintenance Plan in planning phase also for the intervention on Cultural Heritage. The Legislative Decree 163/06 repeals Law 109/94, while confirming its provisions. It also establishes that in the design of interventions on Cultural Heritage, such obligation stands even in case of absence of detailed design [12].
The innovations arising from the analysis of the regulatory framework concern the overcoming of traditional categories of ordinary and extraordinary maintenance, as well as the concept of maintenance practices meant as the summation of independent interventions, separate and time-bound. In contrast emerges the concept of maintenance as a constant process, continuous in time, as a guarantee for the preservation of Cultural Heritage [13].
We must emphasize that the main principles of mandatory legislation on Public Works are primarily addressed to new construction and do provide adequate information to plan maintenance of Cultural Heritage.
It is important to highlight the great potential that the Maintenance Plan could take on, in relation to the specific characteristics of interventions on Cultural Heritage, which always require a deep knowledge [14].
The Plan - conceived in developmental key and properly integrated - might prove a very useful tool, not only to perform conservation activities, but also to collect information, as well as to report inspections and maintenance interventions progressively implemented and to monitoring the status of the Heritage [15].
The goal of the research is to develop Maintenance Plans dedicated to Archaeological Heritage, starting from cases which allow to activate maintenance strategies able to enhance the quality of the interventions and to ensure full enjoyment of Archaeological Heritage [16].

2. Methodology

The research assessed critical issues in drawing up of the technical documentation required for the Maintenance Plan. This tool, usually designed for building maintenance, should be overhauled to be effectively and efficiently applied to the Archaeological Heritage. In order to perceive this goal, the research outlined the following issues:
1. the codification of the Technical and Spatial Elements of archaeological asset, which requires a straightforward classification system to process information (by aggregating/ selecting/updating);
2. the identification data of archaeological asset, including both complete building and ruins;
3. the valuable elements, for which the goal of preservation is a priority;
4. the need to analyse each element or technical component to be maintained, as well as the nearby elements;
5. the critical joints, connecting new structures and archaeological finds.
In order to implement Maintenance Plans for archaeological asset, according to guidelines provided by UNI standards, the following documents have been improved:

- the Separation and Classification Plan of the Technological System, with an additional Class of Technology Units concerning wall and floor decorations;
- the Building's Identity card and the Environmental Unit cards;
- the Technical Element cards and the Diagnostic cards dedicated to the valuable elements and to critical joints (where the extent of degradation is more likely). For the latter cards the interactions with other Technical Elements of the system has been deeply analysed, in order to identify elements that are mutually involved in the implementation of maintenance.

In order to detect vulnerability of the technical elements, an operational procedure has been developed. Such procedure allows to schedule maintenance, according to diversified scheduling depending on intensity of damages and breakdown thresholds (Fig. 1). The vulnerability degree of each Technical Element refers to breakdown indicators [17].

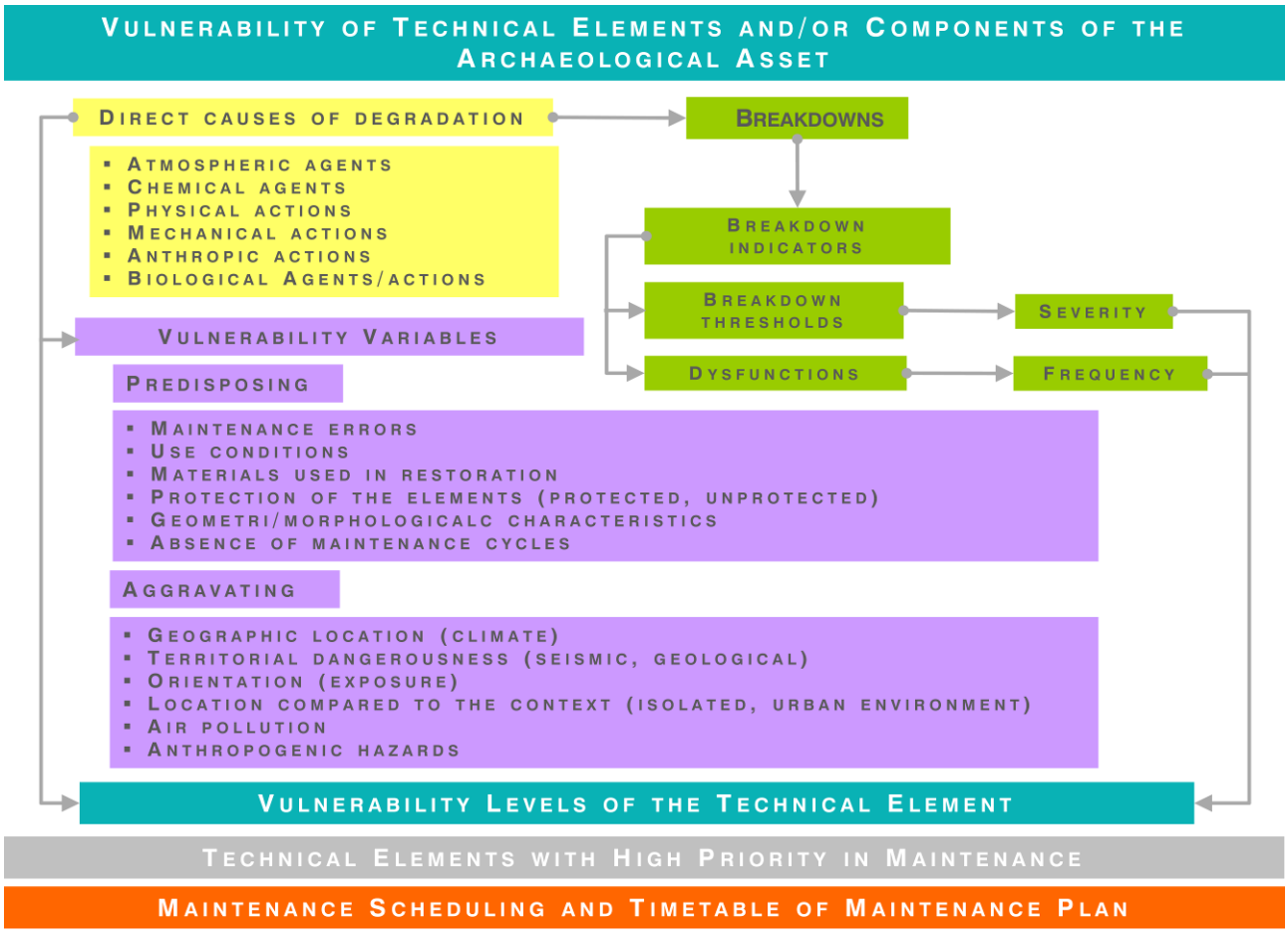

Fig. 1: Vulnerability Degrees in Maintenance of Technical Element.

The result of the research is to identify vulnerability levels of the technical elements, in order to optimize planning and calibration of maintenance.

Through this procedure, likewise vulnerable Classes of Technological Units and Technical Elements that requires high priority in maintenance are identified.

For each Technical Element, the procedure requires the following activities:

- analysis of degradation phenomena, aimed to identify the direct causes and the compromised performances;
- breakdown detection, aimed to identify critical conditions and breakdown indicators;
- causes which predispose and aggravate vulnerability, affecting efficiency;
- vulnerability degrees.

This process allows to identify high priorities in maintenance of Technical Elements, which requires urgent inspections and maintenance interventions.

The most vulnerable Technical Elements are included in an urgency list, following an order due to vulnerability degree. Such elements are analyzed through Vulnerability cards that integrate the Maintenance Manual required by UNI standards (Building's Identity cards; Technical Element cards; Diagnostic cards; Maintenance cards; Maintenance Scheduling; Timetable).

The Vulnerability cards report the prediction and identification of possible problems and breakdowns that could occur in the building system due to the impact of predisposing or aggravating causes, which can accelerate the normal breakdown processes. The information concerning vulnerability are used to upgrade Maintenance Scheduling and Timetable.
The goal is to identify both the evolution of the deterioration phenomena in timing and the "critical areas" that require carefully monitoring, in order to schedule inspections and to define effective and efficient maintenance solutions [18].
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3. Case study: Villa di Poppea in Oplontis (Torre Annunziata, Naples)

The methodology was tested on a case study, selected from representative examples of archaeological heritage: Villa di Poppea in Oplontis, located in the center of Torre Annunziata (Naples) (Fig. 2).



Fig. 2: Villa di Poppea in Oplontis (Torre Annunziata, Naples).

The Villa is the main archaeological find - the only one open to visitors - included in the Pompeian suburban area. It is a magnificent house built in the middle of the first century BC, enlarged in the Claudian age. At the time of the Vesuvius eruption the building was being restored. Attributed to Poppaea Sabina, second wife of Emperor Nero, has been included since 1997 in the UNESCO "World Heritage" list [19].
Despite the Villa is one of the best-preserved archaeological sites in Campania, it was not included in an enhancement program able to increase the number of visitors. In 2010 the site was visited by 32 thousand tourists; the total amount of income from tickets was only three thousand euro, due to many non-paying visitors. This income does not cover the high operating costs.
The Villa is not included in the main circuits of cultural tourism and requires the following enhancement interventions:
- restoration of frescoes and flooring;
- maintenance of restoration roofing, built about forty years ago;
- completion of the excavation of the wing of the Villa which is located under the road and reaches the near Fuse factory.
- construction of exhibition area for white marble sculptures, Roman copies of high quality of the Greek original version, which currently are stored in warehouses (Fig. 3).
The Superintendence of Naples and Pompeii planned a maintenance intervention for the roofing, requiring a grant of approximately one million euro.

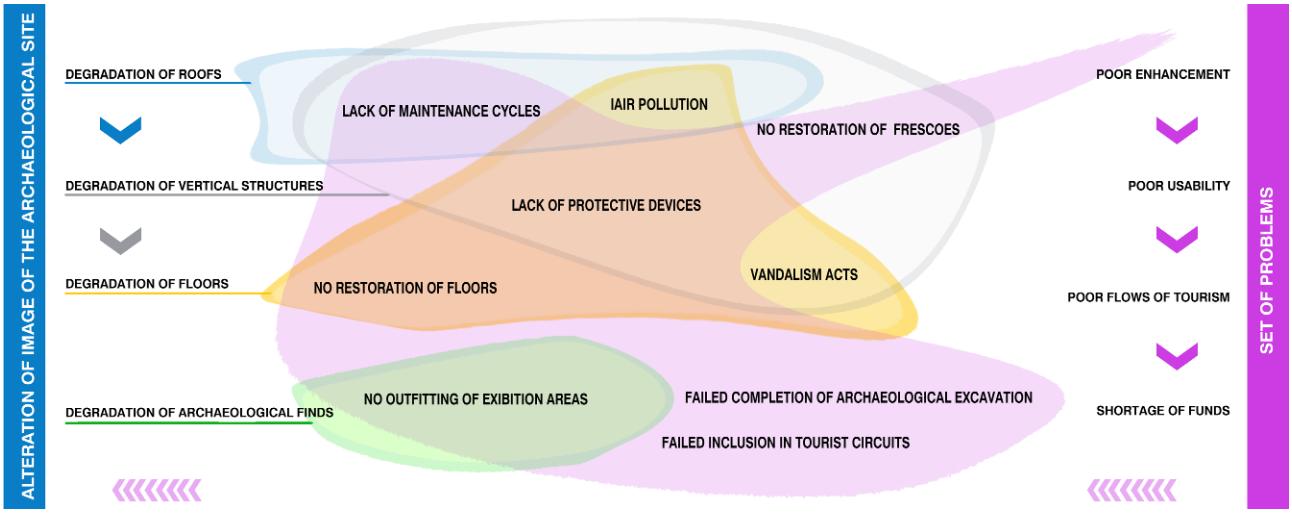


Fig. 3: Alteration of the image of the archaeological site.

Significant breakdowns affect the protective roofs - built to cover the Villa during the excavations and to guarantee the preservation of its frescoes - as well as affect the whole Pompeian protective roofs; in particular, the roofs do not adequately satisfy the requirements of protection from the elements, due to the poor durability of materials, together with to the absence of cyclic maintenance [20].
The roofs have anchor points clamped in the archaeological structures; this construction technique causes loss of material and do not guarantees the reversibility of restoration. In addition, breakdowns of the rainwater pipes cause water infiltration phenomena and water percolation on the archaeological walls.
The Maintenance Plan requires a first phase of knowledge, including the following activities: collection of data from public and private archives; the acquisition of maps, aerial photos and iconography; the selection and organisation of drawings (geometric survey); visual survey of the site.
This phase allowed to obtain the information for filling out the Building's Identity card of the Villa, according to the guidelines for the Real Estate ID card provided by UNI standard 10874:2000 [21]. The proposed Building's Identity card implements the UNI model with the following additional data: identification codes of asset, morphology (building completed or ruin), type of asset (archaeological complex, isolated asset, isolated asset included in archaeological complex), location (old town centre, urban area, extra-urban rural area, archaeological area, old town centre in archaeological area, urban area in archaeological area, extra-urban rural area in archaeological area) [22], exposure (fully excavated, partially excavated), height/depth (above the level of floor, under the level of floor, at the level of floor), accessibility degree (high, medium, low), seismic classification, presence of roofs (original, provisional or built during the restoration intervention), finds and excavations.
Due to complexity and distinctive features of the asset, the Building's Identity card also features Environmental Unit cards. For each room in the Villa, these cards provide information concerning characteristics, accessibility, original use, dimension, including description, drawings and photographs of the room, of the roof, of frescoes and flooring.
In the Classification Plan of the Technological System, alphanumeric codes identify Classes of Technological Unit, Technological Units, Classes of Technical Elements and Technical Element, in order to discretize the archaeological asset. In the Plan additional Classes of Technological Unit concerning decorative finishing (wall and floor) and critical joints have been introduced.
The Technical Elements to be maintained have been identified and recorded through a systematic survey and storage of data. The research analysed the protection roofs of the archaeological heritage, built during the restoration works. In particular, joints connecting protection roofs and archaeological walls have been analysed. The result of such analysis shows how the connection of different materials and the relationship of different constructions techniques often cause vulnerability conditions [23].
Other critical issues occur especially when the execution was not carried out in a workmanlike manner, or for the poor quality of the materials [24].
It should be also noticed that conservation of additions - built to protect the decorative elements – is indispensable to preserve the original elements and requires constant maintenance.
The Diagnostic card of protective roofs provides information about the degradation analysis, in terms of performance decay occurred, as well as the prediction and assessment of breakdown of the Technical Elements (Fig. 4).

DIAGNOSTIC CARD - TECHNICAL ELEMENT ROOF - ROOM 5

PRISTINE TECHNICAL ELEMENT	**TECHNICAL ELEMENTS REBUILT**

CLASSIFICATION OF THE ARCHAEOLOGICAL SITE: Oplontis Archaeological Site

CLASSIFICATION OF THE ARCHAEOLOGICAL ASSET: Poppea's Villa

LOCATION

ADDRESS: VIA DEI SEPOLCRI

STREET NUMBER: /	ZIP CODE: 80058
MUNICIPALITY: TORRE ANNUNZIATA (District Mascatelle)	PROVINCE: NAPOLI
REGION: CAMPANIA	COUNTRY: ITALIA

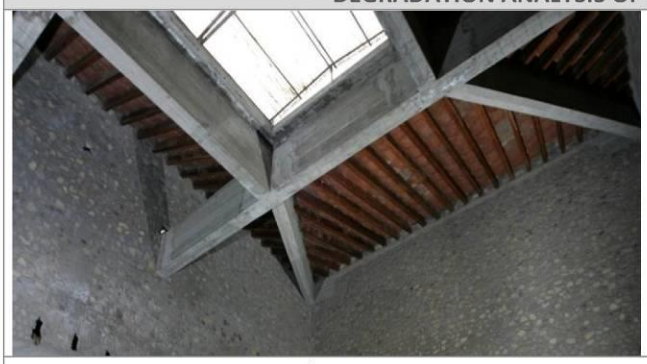
IDENTITY CARD OF THE TECHNICAL ELEMENT

Room id.	TECHNOLOGICAL CLASSIFICATION OF THE TECHNICAL ELEMENT								
	Class of Technological Units		Technological Units		Class of Technical Elements		Technical Element		
	Code	Classification	Code	Classification	Code	Classification	Code	Id.	Classification
ROOM 5	2	envelope	2.4.	overhead envelope	2.4.1.	discontinuous tilted roofing	2.4.1.1.	5	pitched roof

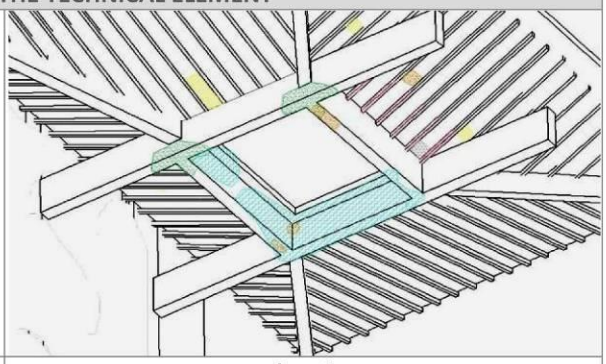
* information concerning the accessibility, drawings and description of the Technical Element are reported in the Technical Card of Functional Unit and in the Technical Card of Technical Element Room 5.

INFORMATION CONCERNING DEGRADATION OF TECHNICAL ELEMENTS AND DEVICES

DEGRADATION ANALYSIS OF THE TECHNICAL ELEMENT



picture



drawing

DESCRIPTION

Some secondary wood joists show superficial alterations and deformations due to physical and chemical agents. No significant reductions in the resistant section. Presence of damp spots and efflorescence on concrete beams, due to water from percolation. The bad sealing of the skylight and the presence of cracks on some brick slabs led to infiltration of rainwater that clearly damages the original flooring of the room 5.



DIAGNOSTIC SURVEY: None

PREVIOUS TREATMENTS: None

SIGNIFICANT ISSUES

Degradation phenomena surveyed		Location	Extent	Assessment method	Performance lapse in Room 5					
				Visual/Instr.	User safety	Protection from the elements	Usability	Aesthetics of surfaces	Maintainability	Easiness in cleaning
	Chromatic alteration due to fungus attack	Scattered on the wooden purlins of the secondary structure	sq.m. 4	V						
	Surface deposits	Scattered on the brick slabs	/	V						
	Efflorescence	Scattered on the main bearing concrete beams and on the brick slabs	sq.m. 5	V						
	Damp spots	Scattered on the main bearing concrete beams	sq.m. 3	V						
	Washing away	Scattered on the main bearing concrete beams	sq.m. 2	V						
	Cracking	Brick slabs	sq.m. 1	V						

RELATION TO OTHER TECHNICAL ELEMENTS OF THE SYSTEM



Code	Classification of the Technical Element	Type of joint	
		Verticale	Orizzontale
1.2.1.1.	Wall		

DEGRADATION CONCERNING THE RISK TECHNICAL DEVICES

Technical Devices		Inspection data			Assessment parameters		
Code	Classification	Severity	Breakdown Indicator	Breakdown	Intensity[1]		
					A	L	C
2.4.1.1.1	Main bearing concrete beams	HIGH	Percolations and water infiltration	Default of the weather protection			
2.4.1.1.2	Wooden purlins	MEDIUM	Drenching of wooden elements and loss of matter	Decrease in load resistance			
2.4.1.1.3	Brick slabs	HIGH	Infiltrazioni acqua	Breakage of brick slabs (default of the weather protection) and damages to the underlying flooring			

[1] The intensity, assessed according to the spread of the breakdown, lead to different maintenance activities, as follows:
A High - Breakdown threshold that requires a thorough diagnosis and a possible corrective intervention.
L Medium - Breakdown threshold that requires corrective intervention.
C Low - Breakdown threshold that may require a partial or total replacement (no value, if the replacement is not required).
n.s. Not significant parameter (the diagnosis / intervention does not depend on the extent of the breakdown or is not Indispensable).

Fig. 4: Diagnostic Card - Technical Element Roof - Room 5.

In the Diagnostic card, for each surveyed degradation, the following information is reported: drawings; location and extent of degradation; assessment methods; performance decays, concerning the Classes of Needs of Safety, Comfort, Usability, Management and Aesthetics.
The card reports the breakdowns surveyed on the building components and classifies such breakdowns referring to different criticality degrees (high, medium or low) depending on severity and frequency of damage. Intervention planning is performed in accordance with the content of the Diagnostic cards.

4. Results

The Maintenance Plan allows to perform planned interventions in time-varying cyclic patterns, depending on the emergency degree. In order to plan interventions, maintenance vulnerability degrees have to be established according to the archaeological value of the elements to be maintained.
The planning of a maintenance program for archaeological heritage requires to improve the reliability of predictions by vulnerability monitoring of the assets. Such monitoring provides information on degradation evolution, referring to vulnerability variables, which can speed up the decay process. In this case, it is necessary to limit the risk to repair when breakdown incurred, taking into account the value of the assets.
Joints between preexistences and new elements (bearing external wall/roof and bearing external wall/floor) are "hot spots", due to the onset of disease and performance decrease. In these cases, the Maintenance Plan should include shorter deadlines for monitoring and diagnostic activities. The Maintenance Plan considers the coexistence of buildings of ancient and modern elements or contemporary designed to protect and improve the use of archaeological asset. Therefore, the breakdown may be resulting from a crisis involving both the pristine Technical Elements and rebuilt Technical Elements.

Bibliographical References

[1] THIEL, Tomasz. *Decision aiding related to maintenance of buildings: technical, economic and environmental aspects.* International Journal of Environment and Pollution, vol. 34, no. 2/3/4, p. 158-170, 2008.

[2] Research Project *Urban Ecotourism for Cultural Heritage Enjoyment in Campania*, launched by BENECON Scarl, POR Campania FSE 2007/2013, O.O. 2.1 and 2.2. funds. *Data processing for Heritage real estate enhancement and for implementation of certified Maintenance plans*. (Scientific Head: Prof. Arch. Carmine Gambardella).

[3] DELLA TORRE, Stefano. *La Conservazione programmata del Patrimonio storico architettonico*. *Linee guida per il Piano di manutenzione e Consuntivo scientifico.* Milano: Edizioni Angelo Guerini e Associati SpA., 2003. ISBN: 8883353595.

[4] CECCHI, Roberto. *Roma Archeologica. Interventi per la tutela e la fruizione del patrimonio archeologico.* Terzo Rapporto. Milano: Electa, 2011. ISBN: 8837087381

[5] MOLINARI, Claudio. *La manutenzione programmata*. In: Manuale di progettazione edilizia, Progetto tecnico e qualità, parte terza - La qualità nel tempo. Milano: Hoepli, 1994, vol. 3°, p. 297-365. ISBN 8820319802.

[6] LAINO, Annunziata. *La partnership pubblico-privato per la conservazione, la manutenzione e la valorizzazione di Ercolano*. Facility Management Italia FMI, Rivista scientifica trimestrale dei servizi integrati per i patrimoni immobiliari pubblici. Anno 6, no. 25, p. 28-34, ottobre 2014. ISSN 19735340.

[7] CECCHI, Roberto and GASPAROLI, Paolo. *Preventive and Planned Maintenance of Protected Buildings*. Firenze: Alinea editrice s.r.l., 2012. ISBN 8860556899.

[8] D.P.R. 554/99, *Regolamento di attuazione della Legge Quadro in Materia di Lavori Pubblici L.109/94*.

[9] D.P.R. 207/2010, *Regolamento di esecuzione ed attuazione del D.L.163/06*.

[10] D.L.163/06, *Codice dei contratti pubblici relativi a lavori, servizi e forniture in attuazione delle direttive 2004/17/CE e 2004/18/CE*.

[11] D.L. 42/2004 e s.m.i., *Codice dei beni culturali e del paesaggio*.

[12] CECCHI, Roberto and GASPAROLI, Paolo. *La manutenzione Programmata dei Beni Culturali edificati, Procedimenti scientifici per lo sviluppo di Piani e Programmi di Manutenzione. Caso studio su architetture di interesse archeologico a Roma e Pompei.* Firenze: Alinea editrice s.r.l., 2011. ISBN 9788860556684

[13] CECCHI, Roberto and GASPAROLI, Paolo. *Prevenzione e Manutenzione per i Beni Culturali edificati, Procedimenti scientifici per lo sviluppo delle attività Ispettive. Il Caso Studio delle Aree Archeologiche di Roma e Ostia Antica.* Firenze: Alinea editrice s.r.l., 2010. ISBN 9788860555762

[14] CATERINA Gabriella and FIORE Vittorio. *Il Piano di Manutenzione informatizzato. Metodologie e criteri per la gestione informatizzata del Piano di Manutenzione*. Napoli: Liguori Editore, 2002.

[15] PINTO, Maria Rita, FABBRICATTI, Katia and VISCARDI, Cristiana. *Il processo di certificazione per la redazione del manuale di manutenzione: il sistema dei mulini di Ottati*. In Fiore V. (Eds). Atti del convegno nazionale La cultura della manutenzione nel progetto edilizio e urbano. Siracusa, 24-25 Maggio 2007. Palermo: LetteraVentidue, 2007, p. 382-387. ISBN 9788860556912.

[16] PINTO, Maria Rita and DE MEDICI, Stefania. Controllo della qualità nelle procedure di manutenzione del Patrimonio pubblico. In FIORE, Vittorio and DE JOANNA, Paola (eds.). *Atti del Convegno internazionale Urban Maintenance as Strategy for Sustainable Development.* Napoli: Liguori Editore, 2002. ISBN 8820735172.

[17] LANDOLFO, Raffaele, LOSASSO, Mario and PINTO, Maria Rita (eds.). *Innovazione e sostenibilità negli interventi di riqualificazione edilizia. Best practice per il retrofit e la manutenzione*. Firenze: Alinea editrice s.r.l., 2012. ISBN 9788860556714.

[18] DI GIULIO, Roberto (ed.). *Manuale di Manutenzione edilizia. Valutazione del degrado e programmazione della manutenzione.* 3ª ed., Rimini: Maggioli S.p.a. editore, 2007. ISBN 8838739374.

[19] GUZZO, Pier Giovanni and FERGOLA, Lorenzo. *Oplontis, La villa di Poppea*. Milano: 24 Ore Cultura, Gruppo 24 ORE, 2000. ISBN 8871792432.

[20] MENDES SILVA, J.A.R. and FALORCA, Jorge. *A model plan for buildings maintenance with application in the performance analysis of a composite facade cover*. Construction and Building Materials, no 23, p. 3248-3257, 2009.

[21] Norma UNI 10874:2000, *Manutenzione dei patrimoni immobiliari. Criteri di stesura dei Manuali d'uso e di Manutenzione.*

[22] *Norme Tecniche di compilazione scheda anagrafico-identificativa*. Carta del Rischio del Patrimonio Culturale. Ministero per i Beni e le Attività Culturali. Istituto Superiore per la Conservazione ed il Restauro. <http://www.cartadelrischio.it/manuali/anagrafica_identificativa/norme_anagrafica.pdf>.

[23] MUSSO, Stefano Francesco (ed.). *Recupero e restauro degli edifici storici. Guida pratica al rilievo e alla diagnostica*. 3ª ed., Roma: EPC LIBRI, 2010. ISBN 9788863102253.

[24] BOAGA, Giorgio (ed.). *L'involucro architettonico. Progetto, degrado e recupero della qualità edilizia.* Milano: *Masson S.p.A. editoriale Esa*, 1994.

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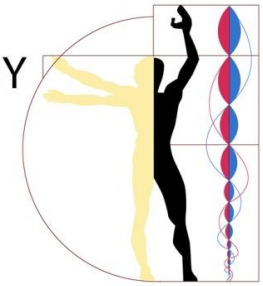

The Influence of Colouring on Style Expression of Industrial Architecture

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Abstract
The aim of the paper is to present the phenomenon of colouring in architecture of production facilities since the mid-19th century to the twenties of the 20th century, on the example of iron industry objects in central Slovakia. The colouring is an important part of architecture, environment and the overall Genius loci, which is considerd as an attribute of cultural diversity. Our research deals with the materials of various objects of ironwork sites.
We have observed, compared and evaluated this issue in four locations. Despite the fact that there are lot of information about the history of ironworks, there are no relevant studies about their colouring. Initially the influence of "official" architecture, its means of expression and colouring to industrial architecture was shown. The colouring of this architecture is much more moderate and is based on the functioning of used material. In the later period the impact of functionalism and the maximal dosility of industrial constructions was manifested. In the contribution the individual development stages focused on colour - typological classification will be presented.

Keywords: metallurgy, industrial architecture, colors, industrial heritage

1. Introduction
The study deals with the colour of production buildings of four selected historic ironworks in Slovakia. This project is an attempt to actively project and enrich the knowledge of architecture from the perspective of other specialists. Historiographical research of architecture and its characteristics in these areas are complementary supplemented by monitoring the proportion of colour to the overall architectural expression.
During the past centuries, iron production has contributed towards economic and social development of the whole population and contemporary government services in Slovakia. Although the history of this industry in Slovakia is relatively well explored and published, in fact it is unknown the architecture dealing with iron works.
Although the topic of industrial heritage has been currently popular since the 1970s, current professional literature does not focus on the identification and documentation of architecture in these works. Lack of experience with the recovery of industrial heritage "prevents" verification of existing methodologies and specifying its legislative recognition.
Descriptions, restoration and history of Slovak industrial architecture have all had the following assigned to them: several dissertations [1-3], a number of thematic editions of journals (e.g. Project 2/2014, 4-5 / 2010, Eurostav 10/2013), exhibitions (Industrial day 1-3, Building of Slovakia, Water and Town- brown fields) and workshops (Workshop for graduation in Zilina). There is no professional publication describing the architectural and urban characteristics of ironwork resorts in Slovakia.
Ironwork is described in enough professional literature, in terms of describing the history and development of the technology used within the production process, secondary in these publications, the accompanying socio-economic aspects are described. A most extensive work, regarding the deliverance

of a comprehensive picture of the development of ironwork in the area of today's Czech and Slovak Republic, is a three-volume publication called History of ironwork in Czechoslovakia [4-6]. This publication was developed under the guidance of the Technical and Economic Research Institute of metallurgical industry. More than 200 working papers were developed for this work, which initiated a variety of other publications dealing with the history of metallurgy. For example, there is a highly beneficial publication of Šarudyová [7]. Among other authors whose works complement the imagination of the development of metallurgy and individual plants include J. Alberta, P. Hapák and Á. Paulíny. One specific area of the current state of knowledge is monument protection. During 2008-2010, the Monuments Office of the Slovak Republic was responsible for obtaining information by mapping these monuments.
Industrial buildings of ironwork sites are carriers of many cultural and historical values, several of these buildings have the potential for a new use with regard to preserving architectural qualities in the process of monument restoration. The current state of threatened historic industrial buildings, including ironwork sites in Slovakia, is due to the end of their production. This leads to disturbing questions about the prospects for possible maintenance and use of this segment of Slovak industrial heritage. A necessary condition for a positive resolution of these issues is thorough knowledge and a comprehensive evaluation of its cultural and socio-economic potential, which is necessary via the use of research. The paper therefore focuses on one of the most important architectural aspect- colour in the context of architectural expression. The project is the result of the cooperation of two authors and is based on two separate ongoing researches processed in the framework of dissertations.
This issue is not yet systematically processed in monitored areas of architectural work. The results of the present project will help to shape the vision of architectural production sites examined in terms of colour.
Colour is one of the key components of our perception of the outside world. Colourful composition following the stylistic elements have a major impact on the character of the environment and such they are fundamentally implicated in co-design of the emotional level of perception. "Basically, any solution via colour is also a contemporary interpretation giving witness to not only the historical appearance of the property and the extent of one's knowledge, but also of a contemporary view of specific people living in particular circumstances of a particular environment, the level of their technical knowledge, finding and choice of materials (pigments and binders) used in paint." [8] Since the 19th century, i.e. from the beginning of preservation of historical sites the importance of colour in architecture is monitored as it is considered as an important element of preserving the authenticity of the work. Despite the importance of colouring research, number of research is relatively small in Slovakia, while colouring of architecture in the project is far more systematically explored.
Initially architecture of production facilities bears characters and colour of "official" architecture. Later was created their own industrial style as well as the inherent colour of industrial objects differing from the colour of "official" architecture. This is reflected in innovative disposition and material solutions. In our research, we verified the assertion in four selected ironwork areas where we monitored, compared and evaluated manufacturing objects with the "official" architecture of residential and administrative buildings.

2. Methodology

A description of the development of colour and its changing role in the architectural embodiment will complete the picture of the development of industrial architecture in the period of research. Data collection for tracked objects of ironwork production sites from selected sites were conducted by excerption of relevant literature sources, archive research (private archive of Ironworks Podbrezova a.s., The State Central Mining Archive in Banska Stiavnica, and Horehronie Museum in Brezno) and a field survey. Obtained and processed data were the basis for the identification of colour and its role in the architecture rendering of production facilities. Subsequently they were compared, and the result is a proposal of making Coloured - typological breakdown for each stage of evolution in regards to architecture.

2.1 Selection of monitored sites

Four historic ironworks resorts in Slovakia have been selected for research: the ironworks in Hronec, in Podbrezova- Piesok, Banska Stiavnica and Vlachovo. The historic ironworks in Vlachovo and Banska Stiavnica were private enterprises and now in their area are historically protected manufacturing objects. These resorts were mainly supplying the local market. Ironwork resorts in Podbrezova-Piesok and Hronec were owned by the state and their significance was nationwide. During the period were the most important hardware businesses within the former Kingdom of Hungary. [7] Private ironworks resorts in Vlachovo and Banska Stiavnica were built outside the contiguous buildings nearby settlements and a diverse typological group of objects formed areas. The historic ironworks resorts in Podbezova- Piesok and Hronec, which were state owned, were built with compact buildings built alongside existing resorts. The described range of monitored sites responds to the complexity of development, accompanied by alterations.



Fig. 1: Foundry from 1858, Hronec



Fig. 2: Worker's houses from the 19th century, Hronec



Fig. 3: Worker's houses from the 19th century, Hronec

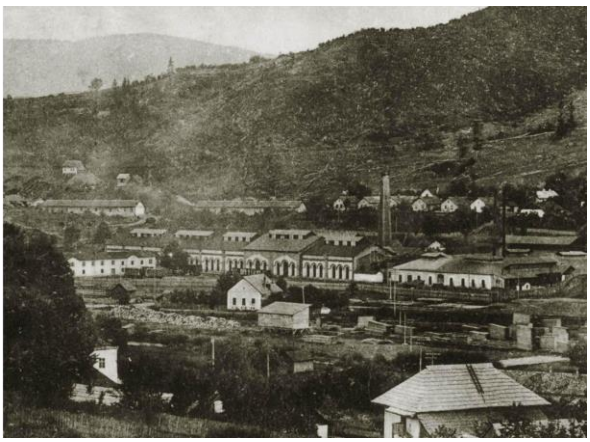

Fig. 4: The ironworks in Hronec, photo from 1926 (source: Horehronie Museum in Brezno)

3. Description of architectural- historical development of monitored iron sites and the evaluation of colour

3.1 Ironworks in Hronec

The iron-making complex of Hronec was the most outstanding, largest, and most modern manufacturer of its kind while ranking among the most important producers of iron in the Hungarian Kingdom. [7] The Complex Hronec consisted of several ironwork sites in the Slovak Horehronie region, in central Slovakia.
Construction of the monitored ironwork site in Hronec was launched in 1858. In Hronec it was already the third production site. The previous two during that time did not meet the new conditions of production and were gradually adapted to the capacity of housing and amenities of the village. As the first objects was built a massive longitudinal foundry with a stylish facade. In addition to the old foundry there were carpentry and a mechanical workshop and storage space. Next to the foundry hall was built a large brick enamel building with a central courtyard. Behind the foundry hall were (built in 1863-64) two modern blast furnaces of a Scottish type, with the engine next to the boiler. In the 60s and 70s of the 19th century, the government-issued ironworks in Hronec was considered to have the best-equipped blast furnace plant in Slovakia. [9]

3.1.1 Evaluation

Facades of iron foundry halls have representative character thanks to architecturally interesting details. Complicated elaborated facade elements such as profiled cornices, pilaster strips and arched forms above the window ledge are accented plastically, materially and by colour. Large neo-Romanesque windows, grouped by three forms a regular, symmetrical division of facade with a gradation on the facade of the highest, middle production hall. Colouring of object facade, is mainly based on the colour and the material used - bricks and plaster with natural colours, given by colouration of filler. Window frames are close by colour to the colour of the bricks. Roofs with fanlights, serving to illumination of high spaces were made of metal and had a dark grey colour. To the original foundry were later built constructions on the north and west facades.



Fig. 5: The production building of the former Henrich's from about 1907, Piesok



Fig. 6: Worker's houses from the 19th century, shop Podbrezova

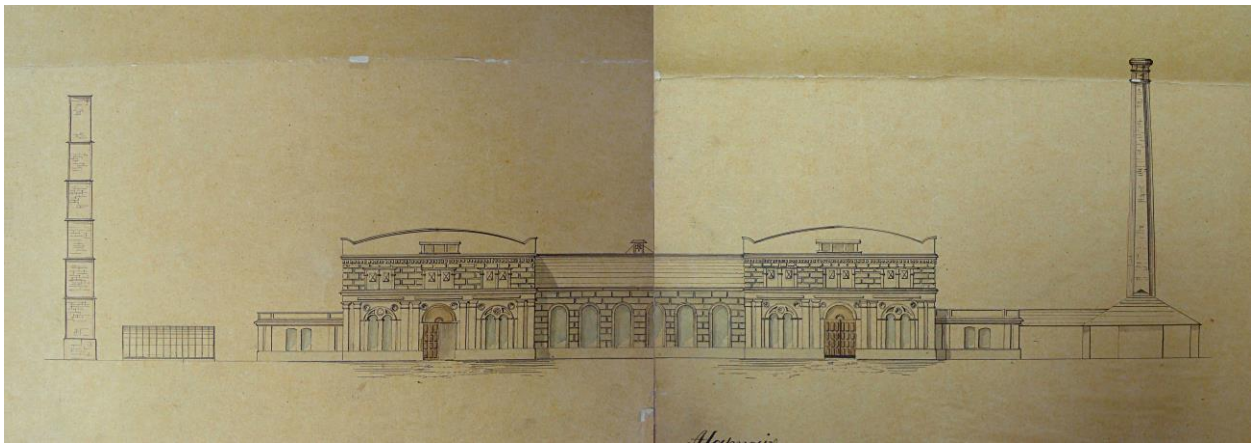

Fig. 7: The factory building of Ironwork Podbrezová, photo of original plan- south elevation, about 1850 (source: private archive of Žleziarne Podbrezová, a.s.)

The architectural style of houses / apartment buildings is simple and practical. Colour of plaster was also given by material, i.e. the plaster coloured by local filler. A significant element of the facade is created by single architraves, cornice and skirting, which was highlighted by plasticity and colour - the coat was painted by few shades darker natural colour.
The representative facade of ironworks with precisely elaborated details of ornaments from bricks reflects the importance and glory of this production complex. In terms of colour they used only colour of materials and by creative composition they made visually appealing and artistically valuable work. The significant colour accent was the brick of production halls. The colour significantly differentiated them from their surroundings. Residential buildings were the second-rate, which is also reflected in their moderate decorativeness and colour.

3.2 Ironworks in Piesok- Podbrezová

The origin and development of the ironwork complex in Podbrezova and Piesok is directly related to the development of the Hronec complex. The ironworks in Podbrezova were established in 1840 and today consist of two industrial sites: industrial area of Podbrezova, now called Zeleziarne Podbrezova old plant and the plant in Piesok, now called Zeleziarne Podbrezova new plant. In the period between 1840 and 1920, Podbrezova underwent a significant development, while the importance of the factory was growing. The industrial area of the ironworks was extended and modernized by technological changes and expansions of production. In 1851 the first construction of production building was completed in Podbrezova. [10] This building was not sufficient for iron production because the space requirements caused by the technological development were gradually increased. Significant redevelopments were carried out around 1880, 1907, and 1918. In 1880 were on both sides of the oldest manufacturing buildings built new large area buildings. In 1907, the oldest production building was demolished and in its place was built new production buildings, which since 1918 completely replaced the constructions from the 1880's.



Fig. 8: Factory administrative building from about 1870, Banska Stiavnica



Fig. 9: The production building from about 1870, Banska Stiavnica

Development of Podbrezova ironworks continued by establishment of a new factory in Piesok, called the Henrich's shop around 1907. The Henrich's shop consists of four main production buildings, several smaller secondary buildings and a water tower. The buildings have open space disposition and thus are flexible and respect the need of changing technological conditions. These buildings are well preserved and still used today.

3.2.1 Evaluation

The very first building of this industrial site in Podbrezova was designed in historical style with strong emblematic aspect of architecture. The facade was decorated with boscage and cornices and divided by double pilasters, in the bay were neo-Romanesque windows. In the middle, there was the arcade facade. During archive research was found a coloured picture of the first production object in Podbrezova. Protruding decorative elements are white and the colour of rectangles is pale grey. Later built halls, which replaced the first production building, have a minimum fineness.

The colouring of production facilities, which does not exist any more, are partially documented by coloured historic photographs. The colour of the roof was dark grey, material was steel. Ochre plasters and wood filler structures, latter metal, represented colour of facades. From photographs of that time is evident that colour of production enterprise fits to colouring of surrounded buildings. Till today only administrative objects were preserved from the original ironwork complex.

The architectural design of former Henrich's shop is the abstraction of neo-Romanesque style. The facades are decorated with abstract motives of lisens and round arched friezes composed of bricks. The buildings of Henrich's shop are still preserved today with almost no change in architecture. The colour of this site corresponds with the surface material - red brick. Today the bricks are painted by "red" paint, which nearly corresponds to the colour of the original bricks. Today's coat has a protective function against weathering of bricks, which has already been appeared in some parts of the facade. Unlike the part of the production site in Podbrezova, the colour of this part of the factory was significantly different from the surrounding of family houses and civil objects. They were probably plastered by pale ocher colours. The closer identification of these objects colouring was not identified by current research.

3.3 Ironworks in Banska Stiavnica

The Old Smeltery is located in Banska Stiavnica, the oldest mining town in Slovakia. The building is an important historic sight of the whole history of the mining region. It also represents an important part of industrial heritage in a European context.

Smeltery was probably built by wealthy miner Brenner before 1580. After the fire and subsequent restoration in 1761 it was taken over to the administration in mining Eraro. In 1872 the Ministry of Finance in Budapest ordered reconstruction, which included modernization and enlargement. Reconstructed smeltery was very important for the whole region of former Hungary (Hungary meaning as a sovereign empire Austria- Hungary until 1918). Operational and social buildings were built next to the smeltery. The production facility was suspended after a fire in 1971 and has since decayed. [11]

The building of smeltery is now registered as a National Historic Landmark and is listed in the Central List of Monuments Fund of Slovak republic under No. 2731/0. The object in addition to significant scientific and technical merit also features distinctive architecture and valuable details. The subjects of monument protection are plaster and paint layers of interior and exterior plastic facades and historic wooden window panels.

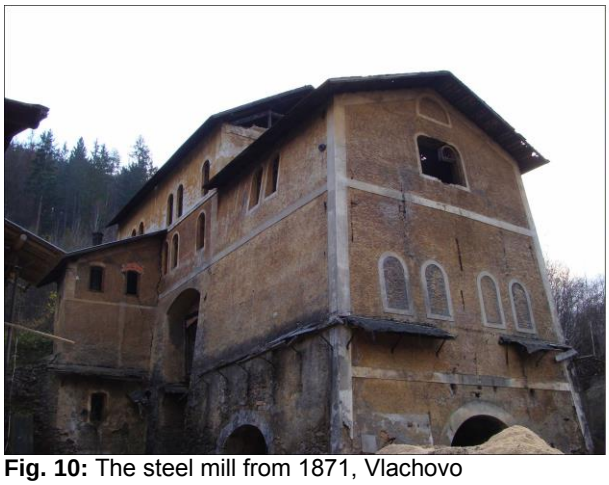

Fig. 10: The steel mill from 1871, Vlachovo



Fig. 11: The ironworks in Vlachovo, photo from 1980 [7]

3.3.1 Evaluation

The main manufacturing facility of this industrial area (the Old Smelter), which is under investigation, has not undergone significant rebuilding since 1872. The proportions of the building as well as the design correspond to the most modern technical requirements of that period, taking into account the needs of production. The mass of the building and its interiors have “superhuman scale.” The robustness of the object tried to soften the moderate structuring of facade by cordon, vertical decorative elements and raster of windows which size is about the same as the size of the window openings of administrative buildings nearby area. The facade had the similar architectural features as non-productive adjacent objects. Colour of facades, observed by field research, was under the layers of newer paint of production and administration building similar- natural shades of ocher. The Colour of administrative building had a deeper shade. We assume that also in this case the colour determined more representative character. However, it does not occur only in the colour of the object but also in the more decorative architectural style of administrative building by cornices, shams, allusive selvage rectangles, quoins and pediments.

3.4 Ironworks in Vlachovo

This iron complex, called the Steel mill Karol was built northeast of the village Vlachovo near the resources of iron ore mines in 1843. In 1870 the complex was reconstructed and a new blast furnace of pillar design was built. The ironwork factory mainly produced pig iron and sold it for processing at the local hammer mills. [12] Karol`s smelting plant was owned by the Andrassy family, who were a local noble family. Since 1900 its was owned by the Rimavsko-muransko-salgotarianska company. After the state owned Hronec complex, it became one of the most important ironwork company in the area of Hungary during the late 19th century. [7] Production of iron was finally stopped here in 1907.

3.4.1 Evaluation

Buildings in the northern part of this iron work complex were removed and today there is only the trio of buildings in the southern part of the site. Those buildings from its construction in 1870, has not undergone any significant construction and today's colour can therefore be regarded as authentic. Despite the fact that among them is a protected monument- blast furnace, the buildings are in a very bad technical condition. Production and administrative buildings were in the area of direct contact and the architectural design has common architectonic features. On the basis of archival and field research can be stated that the colour of production facilities is not different from the colour of buildings so called “official” architecture as the architectural design of both typologies is very similar. The ocher colour is complemented by white accents of corners and architraves.

4. Results

The monitored ironworks in the time period from the mid-19th century till the twentieths of 20th century have developed as associated with reconstructions and modifications, as well as expanding in terms of at once and compactly built parts of the site. The building development reflects the evolution of architectural design changes and the related changes in the colour of these objects. The research of monitored sites confirms the gradual emergence of own architectonic morphology of production facilities, which is associated with own colour scheme different from surrounding “official” architecture. When examining the monitored sites we identified several different factors acting on the architectural design and colour of production facilities. These are: ownership (private (company, noble family), state), financial strength of

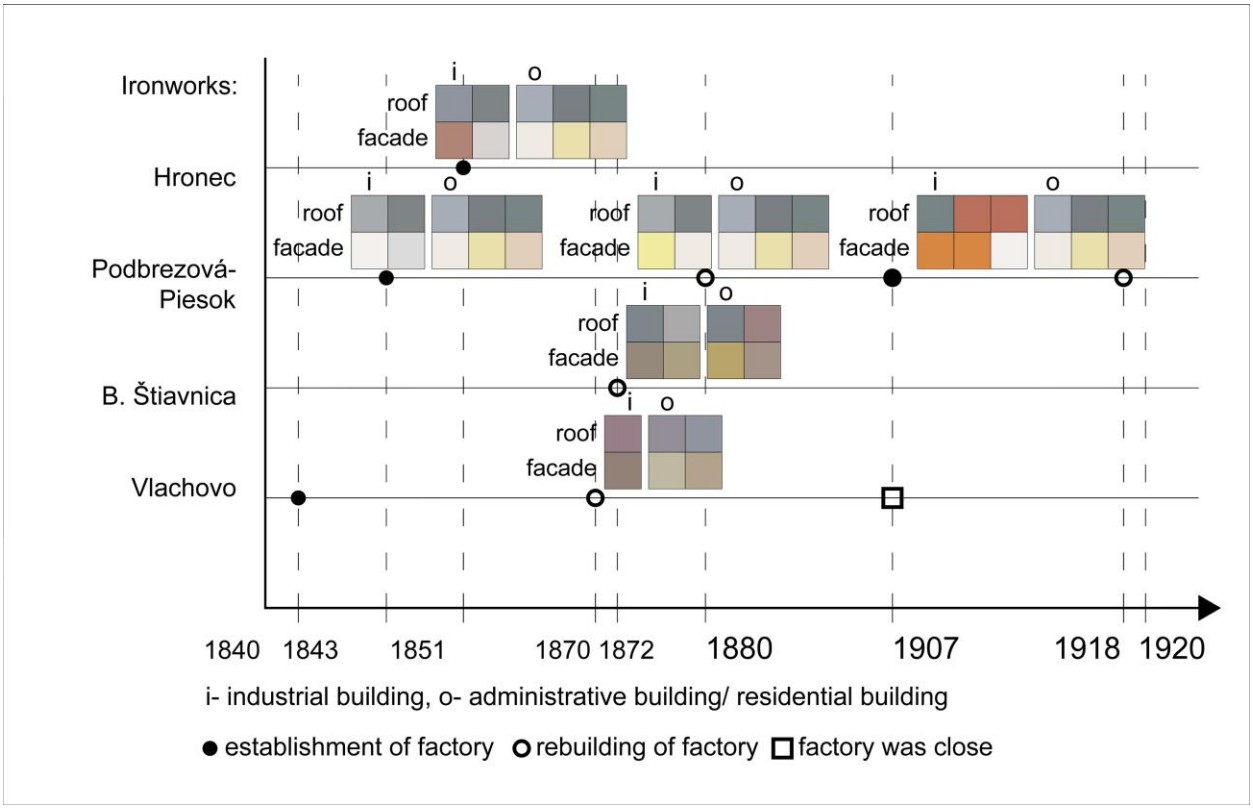

Fig. 12: Scheme of color and typological classification of the selected ironworks

owner, the scale of production, trade links of factories, date of establishment and degree of technological progress of iron production.

The output of the work is the creation of colour- typological classification (Fig. 12). Colour-typological classification describes the colour of production sites and subsequent (nearby) “official” architecture in the range of monitored time horizon. It includes the identified colour of monitored objects as well as probable / estimated colour of now defunct production objects detected on the basis of archival research. Such elaborated results of the research are illustrative tool presenting the development of one monitored architectural aspect -the colouring. The created colour- typological scheme demonstrates and suggests changes of architectural design of production structures in the monitored period. Monitored areas, however, represent only a fraction of the total number of historic ironworks in Slovakia. During the 19th century many of these sites had the whole Hungarian importance and therefore it should be interesting to verify the examined issues in the whole Hungarian scale.

5. Conclusion

The study was aimed to the phenomenon of colour and its changing role in the architectural embodiment of manufacturing facilities of selected ironworks in Slovakia. The colour of production facilities was compared with the colour of surrounding area. In the introduction the following assumption was given: at the beginning the architecture of production facilities had feature and colour of “official” architecture. Later own industrial style was created and with it also the own colour of industrial objects differing from the colour of “official” architecture. The conducted research suggests its accuracy but due to the small amount of monitored objects the further research is needed for its confirmation. The article briefly describes the construction and historical development of selected sites of historic ironwork with regard to changes in the architectural features. The result of the study is the colour- typological classification describing the development phases of architecture of monitored constructions.

Bibliographical References.

[1] AMBRUŠOVÁ, Petra: *Innovative technologies in monument preservation and reconstruction of industrial buildings. New use of former textile mills.* Bratislava: STU, 2013. Dissertation thesis.

[2] ŠIMONČIČOVÁ, Katarína: *Architectural heritage of power plant buildings in Slovakia.* Bratislava: STU, 2014. Dissertation thesis.

[3] BARTOŠOVÁ, Nina: *Premises of the Dynamite Nobel factory in Bratislava*. Bratislava: STU, 2012. Dissertation thesis.

[4] PLEINER, Radomír et al. *Dějiny hutnictví železa v Československu 1, Od nejstarších dob do průmyslové revoluce.* Praha: Academia, 1984.

[5] PLEINER, Radomír et al.: *Dějiny hutnictví železa v Československu 2, Od průmyslové revoluce do konce 2. světové války.* Praha: Academia, 1986.

[6] DOSTÁL, Vladimír: *Dějiny hutnictví železa v Československu 3, Od znárodnení k současnosti (1945-1980).* Praha: Academia, 1988.

[7] ŠARUDYOVÁ, Mária: *Topografia železiarní na Slovensku v 19. storočí.* Košice: Východoslovenské vydavateľstvo, 1989. ISBN 80-85174-33-2, 220 p.

[8] MACEK, P.: *Barevnost fasád, Průzkum, dokumentace, vyhodnocení a obnova exteriéru historických staveb.* Praha: Národný pamiatkový ústav, 2009. ISBN 978-80-87104-48-4, p. 16

[9] WEISS, Ján - FILLOVÁ, Ľubica: *Zlieváreň s areálom.* In: Mapovanie industriálnych pamiatok na Slovensku v rokoch 2008-2010. Bratislava: Pamiatkový úrad Slovenskej republiky, 2010.

[10] BELLÁKOVÁ, Eva: *The development of industry as a condition for the development of urban planning and architecture on the example of an industrial site in Podbrezova.* In: NEDVĚD, Martin - PEŘINKOVÁ, Martina: *Advanced Engineering Forum, Architecture in Perspective VI.* Pfaffikon: 2014. vol. 12, ISBN 978-3-03835-323-2, p. 30-34

[11] ĎURIŠOVÁ, Ľubica - KRÁĽOVÁ, Eva: Medený hámor v Banskéj Bystrici. In: KRÁĽOVÁ, Eva (ed.): *Stopy priemyselného dedičstva.* Bratislava: Nakladateľstvo STU, 2010. ISBN 978-80-227-3308-3, p. 180-187

[12] SCHMIEDL, Juraj (ed.): *Dejiny hutníctva na Slovensku.* Košice : Zväz hutníctva, ťažobného priemyslu a geológie Slovenska, 2006. ISBN 80-968621-7-0, 399 p.

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The role of non invasive diagnosis for preventive archaeology in the frame of projects of industrial and energetic plants.

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Abstract
The law about preventive archeology is effectively an innovation and a fundamental progress in the context of archeology and Italian Cultural heritage, in the direction of a more successful action for the protection of cultural heritage that can better balance the demands of protection with infrastructure development and construction. In the frame of this action, in Molise, a survey was conducted in order to preserve Cultural Heritage which could be subject to destructive works such as the installation of facilities for the production of alternative energy. The use of geophysics, in this case, has become essential for the a-prior knowledge of what is still buried into the subsoil. The diagnostic measures were performed in order to have a screening of the subsoil, to give a vital aid to surface surveys, made by archeologists, in the identification of specific points in which to perform direct excavation. Archaeological investigations have provided important data in many sites and their overlapping with geophysical results can be considered a confirmation of the validity of the proposed methodology in detecting the targets location underground and of its resolving power.

Keywords: electrical resistivity tomografy (ERT); Ground Penetrating Radar (GPR); Cultural Heritage protection; preventive archaeology;

Introduction
The Molise territorial frame work is composed by rich and varied landscapes, naturalistic environment and historical background are both visible aspects of this thousands-years old region. In many cases, it is difficult to obtain detailed information about the hidden resources in the ground, the deficiency of time and the lack of financial means prevent large-scale archeological interventions. Areas of interest are rarely unearthed so our awareness about buried artifacts, their width and distribution, remains very limited.
However it is possible to plan detailed strategies for a future excavation trough geophysical studies and modern technologies on acquisition and processing data, they are especially useful to detect three-dimensional elements of structures underground hidden in a rapid and accurate way. This is a great advantage in terms of preservation and enhancement of the Cultural Heritage, since all the necessary elements to minimize impact in archeological areas are provided.
Non- invasiveness is geophysical methodologies main feature, in fact they succeed in illustrating buried artifact and structures through measurement from the surface, they do not put structures to pinpoint in danger because they do not involve a mechanical and intensive work. They minimize drillings and dugouts which are expensive and invasive. Measuring from the surface means describing in physical terms: electrical density and resistance, magnetism and so on. It is possible to identify the presence of archeological structures from the profile of the measurements and especially from geophysical “anomalies” and in the most

fortunate case it is possible to evaluate directions and profiles and approach to their three-dimensional spatial distribution.
With the Legislative Decree 63/2005 regulating the sector before preventive archeology and the Ministerial Decree 60/2009 then , the Government has set up the filter of the Archaeological Superintendence for all preliminary projects of infrastructure and public works in general .

In practice it explains how archeological verification must be first initiated by the Superintendence after the delivery of the preliminary project by the contracting authority , which must contain all the results of both geological and archaeological surveys.
Check will be in two phases, the first one involving core drilling implementation, geophysical and geochemical prospects, archeological essays that allow to have a clear geo-archeological description of the interested area.
The second phase, the integrative one, provides for the execution of surveys and excavations.
The result of such surveys will produce as direct consequence an opinion on planning stages in a reasoned way, putting at the base a deep knowledge of the context in question. All this will allow to the implementation stage having already defined, the various requirements relating to the activities to be followed to safeguard the discoveries and the preservation, as well as the protection of the most important sites.
In the Molise region all this has a particular importance thanks to the advent of new means of energy production in the field of wind power and photovoltaic. From these works on the areas designed to house the plants, there was the need to draw up large scale plans in those territories not yet investigated in a preventive measure.

Intervention methods and choice of investigation methods

Planning geophysical survey means a preventive study of the issued area, considering parameters such as the geological, economic, logistic, and physical ones. The use of geophysics can be planned to search for elements and structural issues which can differ for parameters that provide response during the investigation. Referring to research surveys of structures in the subsoil, they can express very different identification parameters, e.g. graves or building foundations. Taking care into accounting various parameters listed above you can choose the method of investigation that best suits the type of objects that you must investigate.
A magnetic survey is used for the detection of changes in conductivity or resistance, it is based on the physical principle of electromagnetic induction. This principle consists of inducing current flows in the subsoil without the use of electrodes.
This method can be used in optimal conditions when the ground under investigation presents fairly uniform, fine materials and with a moderate magnetic susceptibility; you may have a negative feedback in the investigation when this method is used in a sandy soil, with surface irregularities, and with the presence of volcanic materials in the nearby or a shallow rocky bottom.
It presents very short production times, but this advantage is offset by a poor tomographic resolution, that’s why it is used in large areas aimed to give a general description of the archeological area.
The geo-electric method, instead, although having much longer acquisition times, is more efficient because of its versatility to the changes in the ground conditions, it allows the individuation of structures even at considerable depths. The physical parameter used is resistivity: it is experimentally determined by sending an electric impulse in the ground using two energizing electrodes, this action is aimed to generate streams which follow a physical trajectory, in fact they start from the positive electrode and go to close on the negative electrode, establishing their behavior as a function of electric anomalies in the ground. These anomalies affect the electric potential distribution. The surface potential measurements are made by a voltmeter connected to a second pair of electrodes, called receivers, they are aimed to define such variations. Each energize, therefore, allows to measure the potential difference between two arbitrarily chosen points. The use of this method means that the presence of moisture in the first meters of the subsoil makes the soil good conductors of electricity, compact stone structures like walls, furnaces, buried structures, instead behave as poor conductors and as insulating too. Hidden structure, therefore, can be simply identified through a physical parameter indicating this behavior: electric resistivity. Survey activities can be set up if physical parameters in the area of interest allow it, as the incorporation of various methodologies, to better highlight the structures in the subsoil.

It can be planned using both the analyzed methods, providing a first scan with an electromagnetic method areas that may present structures can be identified, in a second stage, after identifying most “at risk” areas, it is possible to plan a geo- electric survey which give a more detailed feedback on the hidden structures.

Conclusion

Geo-physical surveys were led on most of the sites proposed as possible wind farms and photovoltaic parks, the incorporation of geophysics to archeological investigations was crucial for the promptness in the discovery of archeological sites still buried. The specific choice of feasibility research, therefore, has led to use the most appropriate methodological association.
In some cases have made it possible to apply multiple investigation methods, resulting, after the comparison of acquired data a better view of the subsoil.
In the cases studied by me two methodologies have been used: geo-electric and electromagnetic.
Surveys concerned almost exclusively fields assigned to cultivation. Before initiating subsoil scanning, a general survey to identify the areas with the highest concentration of archeological material was conducted, in order to have a direct feedback to the post processing data. After the individuation of the area, a perimeter was identified in order to plan the research.
Tomographic images returned by them have always provided a positive feedback to the identification of areas of archeological interest, which after the excavations unearthed several sites already identified by the geophysical survey. The contribution of such investigations on the cultural heritage and landscape of Molise are uncountable, they allowed the identification of unknown archeological sites and connected to archeological researches led on the sites identified by scanning the subsoil, besides they resulted in a better knowledge of the buried regional cultural heritage, as well as the interruption of landscape and cultural defacement of this small region by speculators



fig. 1 Sequenze di indagini geofisiche (in alto: metodi elettromagnetici, a destra utilizzo del Profiler, a sinistra Georadar; in basso: metodi geoelettrici, a destra A3000, a sinistra ADD-01).

Bibliographical References:

AITKEN M.J. (1974). *Physics and archaeology, 2nd edition. Oxford: Claredon Press, 286*.

BERNABINI M., BRIZZOLARI E., MONNA D., PADULA G., PIRO S. and VERSINO L. (1985). Individuazione di cavità sepolte mediante prospezione geoelettrica. Esempio di applicazione: ricerca di tombe nella necropoli di Colle del Forno nei pressi di Montelibretti (Roma). *Bollettino del Servizio Geologico d'Italia, **CIII**, 67-79.*

CARABELLI, E. (1967). Ricerca sperimentale dei dispositivi più adatti alla prospezione elettrica di cavità sotterranee. In *Prospezioni Archeologiche, **2**, 9-21.*

CAMMARANO, F., MAURIELLO, P., PATELLA, D. & VESINO, L. (1996). Integrazione di prospezioni geoelettriche e georadar ad alta risoluzione. Individuazione di strutture archeologiche a piccola profondità. *1st International Congress on Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin, vol. I, Catania – Siracusa 27 novembre 2 dicembre 1995.*

CAMMARANO, F., MAURIELLO, P., PATELLA, D. and PIRO, S. (1997). Integrated geophysical methods for archaeological prospecting. In *Volcanism and archaeology in Mediterranean sea, 7-34.*

CONYERS, L., GOODMAN, D. (1997). Ground-Penetrating Radar: An Introduction for Archaeologists. *AltaMira, Walnut Cred*.

LAPENNA V., MASTRANTUONO M., PATELLA D. and DI BELLO G., 1992. Magnetic and geoelectric prospecting in the archaeological area of Selinunte (Sicily, Italy). In *Bollettino di Geofisica Teorica ed Applicata, **XXXIV**, 133-143.*

ORLANDO L., PIRO S. and VESINO L., 1987. Location of subsurface geoelectric anomalies for archaeological work: a comparison between experimental arrays and interpretation using numerical methods. In *Geoexploration, **24**, 227-237.*

PATELLA D., 1978. Application of geoelectric dipolar techniques to the study of an underground natural cavity of archaeological interest. In *Bollettino di Geofisica Teorica ed Applicata, **XXI**, 23-34.*

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SUSTAINABLE DEVELOPMENT OF HOSPITAL STRUCTURES

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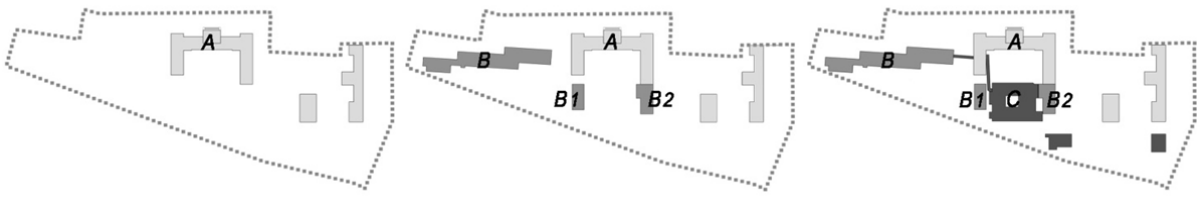
Abstract
Hospital structures are considered as a single body that should not stop working. Since hospitals are profoundly different from other types of buildings, they have special needs for "human energy" and "environmental sources energy". They have a physical and psychological impact on both patients, and health providers. At the same time they affect the environment, with which the structure interacts. Since hospital structures take care of the human health, they have to take care of the environment, too. So, an improved design of hospital structures is important for a better environment and for a better future.
In this article, the issues mentioned above are analyzed in the Regional Hospital of Korça city, Albania. The energetic consumption is shown up after spatial and environmental analysis. Finding ways to reduce costs on human and environmental sources, in order to improve health care quality, is our architectural aim.
Proposing a functional and managerial reorganization, finding alternative energetic sources, selecting proper materials etc., may be the right solutions to the issues mentioned in this article. Going towards a sustainable architecture, furthermore, is given the way in which the quality of life is improved with less negative environmental impacts possible.

Keywords: Healthcare Architecture, Reorganization, Sustainability, Technology

1. The context
The hospital system in Albania has its origins in the '30s of the 20th century, and began its consolidation immediately after Second World War, in the early years of the communist era. Buildings with other previous functions were adapted to hospitals and new ones were built for this purpose. Almost all hospitals have changed over the years, from beds capacity to buildings and city area. This is what happened with the object of this study; the general regional hospital "Teni Konomi" of Korça city, the center of the south-eastern region of Albania, and 170 km far from Tirana, the capital city.
Built in the early 30s, the main building (Block A, Fig.1) of the Hospital Complex is the older one. It was originally a military school, and it became a military hospital immediately after the Italian invasion in 1939. Since 1946, the two-storey building, along with several other newly-built one-storey buildings, turned into a civilian hospital. In early 70s, about 40 years later, the multi-storey building next to the main building (Block B, Fig.1), and two smaller two-storey buildings were built. They look like two wings of the main building, but they are not connected with it. In 1991, political changes in Albania brought to many other changes in economic, social changes, etc., which was reflected in the hospital system, too.



1930 - 1970 **1970 - 2000** **2000 - sot**

Fig. 1: Construction progress in time.

In time, existing structures and technologies become obsolete, and insufficient. That's why requalification of buildings is required. Most of regional hospitals in Albania, part of Public Health System, have been the subject of full or partial requalification, conducted with one or several stages of implementation. This is what happened with the object of our study, too. In the early 2000s, the majority of the existing buildings such as the Department of Pediatrics (part of Block B, Fig.1) and the main building (Block A, Fig.1), which identifies the Hospital Complex, were reconstructed. The structure was expanded with a new emergency care building, too (Block C, Fig.1) The reorganization of the structure met the requirements for more space and new standards, according to funding requirements of the building site.
Nowadays the Regional General Hospital "Teni Konomi", serves a population of 220.000 people [1], and it is responsible for the running of three hospital buildings; the main Hospital Complex, which includes most hospital services, the Department of Pulmonology, and the Department of Obstetrics and Gynecology, situated in the city, far away from the main complex. The completely separated Department of Obstetrics and Gynecology from the main complex is a unique characteristic of the hospital facilities not only in Korça, but throughout Albania.
The main hospital complex has six health care departments, divided in three different buildings. This is why the hospital is considered a Pavilion Type. In Europe Pavilion Type Hospitals are being replaced with compact constructions, like Monoblock−Type, Tower−Type or Slab−Type construction.

2. Functional organizational analysis of existing structure, and routes in the building.

Functional organizational issues in health services of the city are mostly related with the large distances between buildings of the hospital. For instance, the Department of Neonatology is 1 km far away from the Department of Pediatrics, which is situated in the Hospital Complex.
Medical staff, patients and visitors should take these main routes to go from a health department to another in the Hospital Complex:

- **Entries in the territory of the hospital are mixed for vehicles and pedestrians. A dedicated entrance for ambulances in case of emergency is missing.** The main entrance to Emergency Department is used for patients in critical condition, transported on stretchers, and also for non-recovered patients, medical staff and visitors.
- **There are many entrances to the building, where movement of all users (doctors, patients, visitors) and transport of supplies are mixed.** Being a Pavilion-Type (Fig.2), the hospital has the health services entrances and 8 other mixed entrances, too. This makes it very difficult to have the situation under control, and the corridors are crowded all day long. Sterile and infected equipments are transported in these corridors, too. So, contamination and spread of infectious diseases is a permanent threat for patients, physicians and visitors.
- **A waiting room and an information desk is missing.** The same entry hall is available for assessing the health condition of all internal and external patients; from patients transported on stretchers, to others with milder symptoms. The entry hall is used as a waiting room and a corridor, too. Orientation of walking and waiting user groups is missing in all this space, which causes confusion and delay. But the most important thing is that all users, without exception, whether patients, employees or visitors (including children), are exposed to infectious threats (Fig.3)
- **There are many difficulties in transporting patients on stretchers and wheelchairs.**

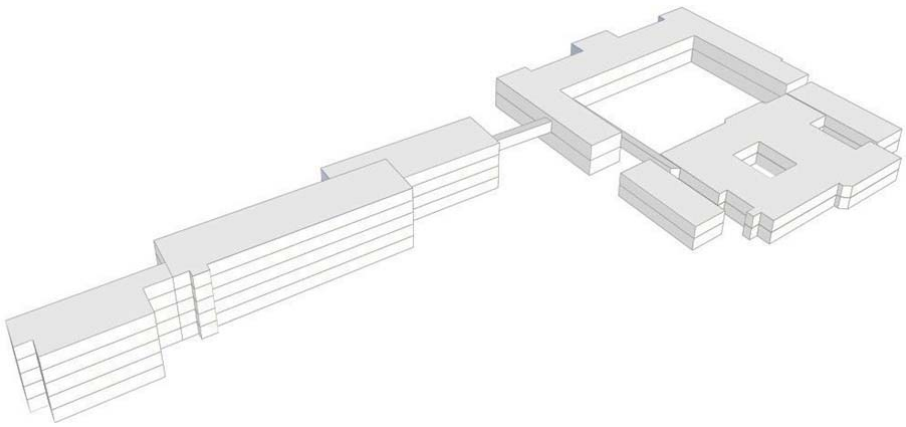


Fig.2 Three-dimensional presentation of the structure. Pavilion-Type

- **Departments of Radiology, Pediatrics and Otolaryngology, have not an internal connection. There are difficulties in communicating between departments and between other health services.** To go from one department to another, people should go outside, in sunny, rainy or snowy weather, to take the short way. Everybody should follow the same route; medical staff, visitors, and patients, including those transported on wheelchairs or stretchers. There is a route to go from one to another department without going out of the building, but it is a very long way, which includes the use of ramps, stairs, elevators and long corridors.
  For instance: If a child recovered to the Department of Pediatrics, needs a radiological examination, he should be transported through the shortest route out of the Pediatrics' building to the Department of Radiology, which is in another building. It is estimated that a patient should take up to 150 meters horizontal route, and a 4-storey vertical route (elevator) dedicated to the Department of Pediatrics.
  The second and longer route for the little patient is the route inside the building. He should go 3 floors down using an elevator from the hospitalization room, to the Department of Otorhinolaryngology, where the connecting bridge with the main building of the complex begins. This route brings the patient to the surgery ward, where an elevator dedicated to emergencies takes the patient 1 floor down, to the Department of Radiology. So, the child should be transported 200 meters in horizontal plane, of which 45 meters ramps (metal construction bridges), built to connect separate buildings and departments with each other. He must also take two elevators, to go down 4 floors in vertical plane.
  All these mixed routes mentioned above cause movement confusion between users inside the building, especially in the Emergency Department and registration area.

It should be emphasized that, besides a companion, the patient is also accompanied by a medical staff member, who spends time and energy. A nurse should take the sample of the patient from hospitalization rooms of Pediatrics to the laboratory, and bring the result of the analysis back to Pediatrics through a 380 meters long route. This is a long distance to walk several times a day. Overwhelming at work and physical fatigue of medical staff brings a negative impact, both at individual level and management level.
Some negative consequences at the individual level are;

- Negative behavior towards patients,
- Nervousness and lack of patience,
- Lack of concentration in taking decisions for the patient (studies have revealed that 70% of nurses rue their decisions),
- Lack of job satisfaction,
- Deterioration in personal health and low quality of their life,
- Increased staff absence.

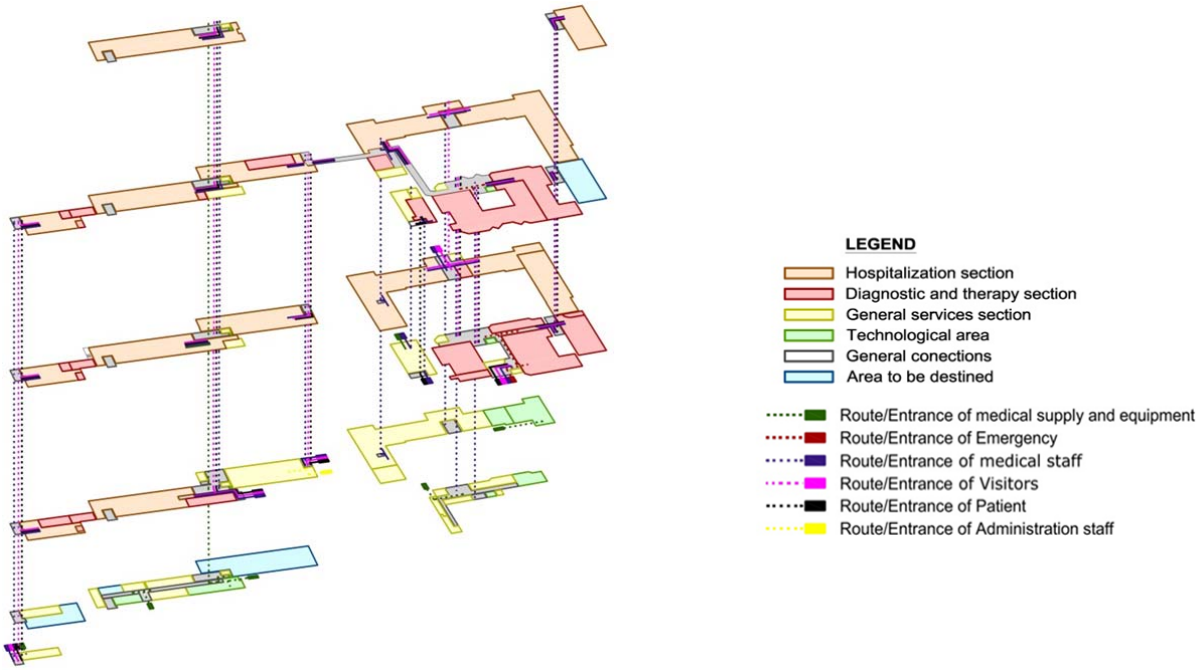


Fig.3. Graphical representation of routes all over the complex

A study of University of Pennsylvania of Nursing, USA, has revealed that every extra patient added to a nurse's workload increases the risk of death within a month of surgery by 7%, according to data from 420,000 patients, in 300 European hospitals of nine countries. A 10% increase in the proportion of nurses was associated with 7% lower surgical death rates.
The result: Tired nurse – patient at risk.
Long distance between health departments may also put the patient's life on risk. For example, a patient in critical life condition theoretically should take a 19.5 meters straight line route to go from the emergency entrance to the elevator, in order to enter the operating room. But health practitioners take practically a 35 meters route transporting the patient on stretcher. Including three mandatory corners, it takes double time to arrive to the elevator, compared with the straight line route from the emergency entrance to the elevator. A straighter line route means a less time wasted, and therefore less fatigue for medical staff and more possibilities to save lives.
The blood bank is only 5 meters away to operating room in straight line route. But if only 1 more blood bag is urgently needed in the operating room, one has to walk down the stairs, get out of the building, take a 22 meters route in sun, rain or snow, and go back to the operating room to bring the blood bag. There is no other route. So it turns out that distances are not only tiresome, but also "dangerous".
Korça hospital is relatively small and has a lower capacity compared to European hospitals, but – cutting the distances – it can be more efficient.
It is difficult for the medical staff to be physically and psychologically recovered by the overwhelming work, because recreation areas are missing. These personal-level effects have their impact on organizational working plan. The decrease of working performance of medical staff brings insufficient and poor quality health services for the patient. But can these problems be solved?
Can the architect help?
Yes, of course!

3. Analysis of the technology used in existing buildings

Hospital technological system consists of:

- Construction technology;
- Plants;
- Equipment of all kind.

The work of the architect is associated with the first two technologies.
The main corpus constructive system (Block A) – construction of the 30s – is realized with massive retaining walls, according to the distribution scheme; Lighted hallway with rooms on one side. The surrounding walls are made of 50X38cm bricks, plastered from the outside, without thermal insulation. With project changes in time, thinner walls, with bricks and gypsum are realized. *Heating System;* With hot water radiator. *Finishes;* Plain-plastered and painted walls and ceilings. Floor c*overing;* With simple ceramic tiles. *Fixtures;* Aluminum, single glazed, replaced in 2000.
Constructive system of Block B - built in the 70s – is realized with beam-column retaining system, according to the distribution scheme; hallway with rooms on both sides. The facade has a perimeter wall of 25 cm bricks, without thermal insulation. *Heating System;* With hot water radiator. *Finishes;* Plain-plastered and painted walls and ceilings. *Floor covering;* With simple ceramic tiles. *Fixtures;* Aluminum, single glazed.
Constructive system of Block C of Emergency – construction of the 2000s – is realized in reinforced concrete with beam-column system. *Heating System;* With water radiator. *Finishes;* Plain-plastered and painted walls and ceilings. *Hanging ceilings;* Plastered tiles fixed to a metal skeleton, which is fixed directly in the slab. Floor c*overing;* With simple ceramic tiles. *Fixtures;* Aluminum, single glazed.
The existing system of hospital plants consists in a furnace for the three Areas, which carries water heating by burning oil. The heating system with radiators in hospital environments ensures no air change. In a year the hospital consumes an average of 202,300 liters of fuel, the equivalent of about 232,000 euros just for heating costs in cold period of the year.
Kitchen services, laundry and all other services are provided by electricity. The structure is connected to the national grid of electricity supply. In a year, the hospital spends an average of 136,000 euros for the consumption of approximately 1,092,107 KW power. The laundry spends about 36,000 euros, the kitchen about 12,000 euros and other hospital services spend over 80,000 euros (according to the office of finance of hospital administration) for power supply. [2]
Hospital environment is not connected with a circulation, treatment and air conditioning system. Freshness in hot period of the year is not available, except for the operating rooms, which are newly built, according to today's standards. They are connected with a system dedicated to air treatment.
Construction techniques and thermal plants do not have any close connection with each other. Interventions and transformations do not affect each-other. Therefore, it is possible to easily modify or replace power plants.

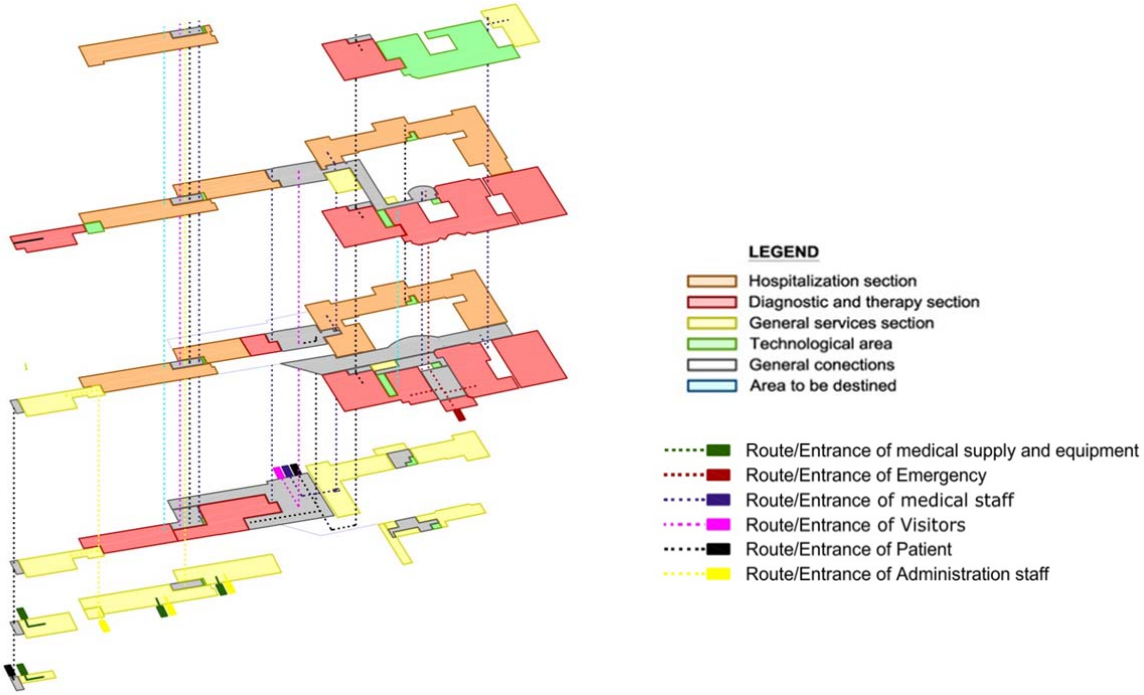


Fig.4 Graphical representation of the structure reorganization

4. Reorganization of existing hospital structure

4.1 Preliminary analysis / project idea (Fig.4)

We conducted a series of analyzes about reorganization of the entire hospital structure;

- Hospital data analysis (morbidity),
- Analysis of occupancy rate, in percentage for each department,
- Analysis of demand and supply for hospital services,
- Analysis of existing surfaces of departments,
- Analysis of horizontal and vertical connections (for people, materials, plants).

The data obtained from these analyzes were confronted with the Italian standard design of hospitals and a project-idea was developed for the reorganization of the entire structure. The degree of intervention in the structure is shown graphically in Figure 4.

General interventions performed are:

- Creating entry hall and waiting room spaces with all necessary services, where movement flows take place,
- Relocation of units to meet their vicinity requirements,
- Adding the Departments of Oncology, Dialysis and Service Day (Day Hospital),
- Adding the technical plan for the air treatment for Diagnostic Area,
- Incorporating Department of Obstetrics-Gynecology and Department of Pneumatology in the complex.

4.2 Achievements of structural changes in the context of the movement in structure

With the suggested interventions, the conditions of hospital are improved, approaching European standards criteria. Routes of different users are well-defined and there's no intersection between them. Distances are shortened to about 40%.

- *Visitors route: Entry from hospital square, where all services are available. There is also the escalator in between, to reach the hospitalization rooms.*
- *Inpatients route: From hospitalization rooms, take the elevator of emergencies, to arrive to Diagnostic Area. This route does not interfere with the outpatients.*
- *Outpatients route: Entry from hospital square, which is directly connected to the reception hall for clinics.*
- *Emergency route: Movement of emergency is crucial and it must be done in the shortest way. After the warm hospital square, there is; Radiology left, Clinics right, or an elevator to the operating rooms in the opposite.*

- *Medical staff and personnel route: Entry from hospital square, towards the changing rooms or workplace.*

4.3 Proposals for mechanized transport infrastructure [3]

Today innovation in the transportation system of people and supplies has reduced the burdens of the past. Computerization replaces supplies transportation with data transportation.
Improved pneumatic transportation is used for emergency or programmed transportation of samples from departments to laboratory of analysis, accompanied with the transport of computerized data. Pneumatic transportation of small containers is suitable for existing buildings. Its installation and system of computerization of data would reduce the physical movements of medical staff towards laboratories and vice versa.
For the transport of materials, systems are differentiated, according to the size of the container and transport emergency.
For transporting heavy materials 300-400 kg, containers with wheels can be replaced with a more flexible robot transportation system, controlled by a magnetic system from the floor. Robot carts, departing from supply center, move to the floor of the area in a 2m x 2m minimum space, to reach the destination via a special elevator. Later transportation is realized manually.
Thanks to the warranty provided by airtight containers, the separation of routes for sterile and contaminated supplies and materials is not necessary.

4.4 Technological proposals and energy-plants/building function [3]

We are having such a significant impact in our environment that the balance between humanity and nature is getting destroyed, and that affects our health, too. This arise the needs for sustainable hospitals, which must meet the requirements of patients with less effects in nature as possible, in order to maintain the balance between built structure and natural environment. The use of intelligent technologies would meet the needs of the hospital for less energy consumption, and for less discharges of pollutants, without damaging our health and nature.

The hospital cures people's health. That's the same thing to do with the health of nature.

Hospital is a facility that consumes too much energy. The study "The rational use of energy in Italian hospitals" calculated the energy consumption in a hospital with 300 beds in the north of Italy. It is revealed that an average of 3.4 tons of oil per bed is consumed in one year; 2.6 tons for heating and 0.8 tons for electricity. Reducing energy consumption and maintenance costs of a hospital is a priority. Savings is related to the building site or orientation of the hospital. For an existing hospital, structure and plants improvement will result in the reduction of energy consumption.
Energy consumption reducing should focus on the following strategies:

- Realization of thermal insulation in exterior walls, and control of thermal bridges, especially in winter (in Korça winters are long, with minimum temperatures below zero degrees Celsius and snowfalls). Areas B and C of buildings should be insulating from outside, and thermal inertness in relatively massive walls of Area A could play the role of insulation,
- Thermal inertness in relatively massive walls of Area A could play the role of insulation during the summer, too (in Korça, summer is short, with fresh nights and dry air),
- Photovoltaic panels can provide a good percentage of electricity,
- Whenever necessary, the automatic or controlled opening of glass panes could realize passive cooling the hospital square,
- Type "screen" or "Brise-Soleil" heat-reducer constructions would be necessary in the southern facade of the Area B, to protect hospitalization rooms from sun's rays.

Cogeneration systems, refrigerating groups and air treatment machinery could substitute the existing furnace. They could provide heating, cooling, air conditioning, and hot water throughout the hospital. Air conditioning is a necessity, especially in hospitalization rooms, intensive care therapy, operating and diagnostic rooms with their instruments. This should be done according to environmental requirements of each area. Otherwise, the possibility of natural cooling has to be considered. Air treatment equipment should be placed as close as possible to the environment where it will be used. The capture of clean air and air extraction can be performed using the cover of the building.

4.5 Exterior coating technology and finishing proposals [3]

Like in any other building, the hospital contemporary architecture, design of facades, their technical solution and choice of finishes are of particular importance. This is because of the role they play in creating a cozy and pleasant internal and external environment. In atriums and corridors, this is possible with different colors and variation of glass panes. More and more continued structural type facades are applied today, fitted with

advanced systems that realize thermal insulation, preventing condensation in cold period of the year and overheating in hot period. The type of glass could be selective to solar spectrum or glass panes could be associated with internal Brise-Soleil heat-reducers of metal or wood. This technology is proposed to cover the facade and the hospital square.
In existing facades of Areas B and C, the ventilated facade system is fitted. The materials of the new facade coating could be ceramic or natural stone tiles, because it gives the feeling of being at home. In cases where the facade must be adapted to plants, its coating can be accomplished with prefabricated concrete slabs reinforced with fiber, which forms can be produced upon request. It would be highlighted the combination of two materials with contrasting colors.
Facades and windows in hospitalization departments are a very specific hospital design theme. Their solution should meet the requirements of lighting, obscuring, natural ventilation and external environmental perception of the patient in bed. Windows often occupy the entire height of the floor, so there should be equipment and mechanisms that realize different types of openings, and heat reducers that shelter from sun's rays.

5. Conclusions

5.1 Effects of reorganization

Concentration and completion of all medical and hospital services in a single structure brings;

- Shortening of costs and maintenance costs,
- Better management of hospital care,
- Provision of types of hospital services according to regional hospital standard.

Distribution and right relationship between departments brings;

- Shortening distance and ease the work of all,
- Elimination of crossed ways of different users in corridors, stairs and elevators.

Fulfillment of hospital square brings;

- Availability of a single entry for many user-groups and best control,
- Provision of all non-hospital services for all,
- Greater similarity with the European model of hospitals.

Reconstruction of the building and improvement of image, equipment, finishes, colors, lighting, bring;

- Thermal, visual and acoustic comfort for all,
- Better quality of indoor air,
- Better physical and psychological condition for everyone, especially for patients,
- The hospital does not remain a healing place, but turns into a healing environment.

5.1 Effects of proposed technologies:

- Improved quality of indoor air,
- Save up to 50% of non-renewable energy sources,
- Reduce up to 50% discharges of pollutants in external environment.

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Bibliography and References

Edited by TERRANOVA Ferdinando. Edilizia per la sanità.. Torino: UTET, 2005. *Vol 4.* ISBN 88-02-06288-9.
[1] Data from INSTAT, population census 2011.
[2] Data from finance office. Hospital Administration.
[3] Maria Chiara TORRICELLI. Tecnologie dell'edilizia ospedaliera. Edited by TERRANOVA Ferdinando. Edilizia per la sanità.. Torino: UTET, 2005. *Vol 4.* P. 118-129.

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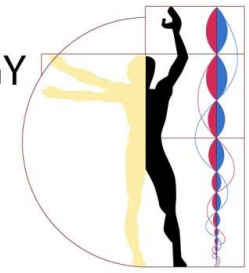

World heritage and technology, the different understanding

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Abstract

Technology evolves rapidly and prevails in modern world. The way it is used makes us rethink about the global understanding. As new mechanical methods flourish and automatism is in our everyday life, there is a dilemma whether it is used in a proper way or not. In architecture, parametric design absolutely changes the way of design and the relationship between the architect and the environment. The creativity of designer is now becoming limited and controlled by computers. Unemployment rises and the future of the planet is supervised by computers. Participation in urban actions collapse and a new understanding dominates. People care about their present but are not interested any more about their durability, their past and their future. Therefore, our heritage is in great danger. Organizations, like UNESCO, are defending this threat, incapable however to solve the entire problem. They set strict limitations, in order to preserve our past, as habitants are not any more capable to recognise the value of their roots. Reconstructions, of Monuments, margins of modern and ancient world are issues that need special coordination. Architects and engineers are responsible for the direction they give to this process. Moreover, they have to realise the meaning of the divine world, composed by participated residents. This is the understanding they should revile from the past, to preserve the heritage and render it to the next generation.

Architects and engineers, are responsible for the next steps of the worlds. Technology is the element and the operator is responsible for its use. Hence, the operator has to respect again the urban and natural environment he lives and rethink about his eternal life in the world. It's the architect's and the engineer's duty, to direct the operators to rethink about their understanding.

Keywords: global understanding, parametric design, UNESCO, reconstruction, divine world

Section

The writing aims to define what heritage and technology is, analyze their basic structure, compare them and, finally, combine these technical terms to create a balanced modern city. The significance of a city is great, as city is a mirror that people use to create a picture of themselves. Even if we demolish a city, its marks always exist, recording its past and its history which we should respect and develop.

City signs are seen in many writings through descriptions. Except from city planning information, through descriptions we discover the cities feeling in everyday life, its characteristics, functionality and the affection to the residents. Invisible cities of literature writings, is now virtual reality of video games and drugs. This virtual reality expresses peoples' need to escape from everyday life and resign. It reveals a need for recognize which is not provided in modern cities. Many people are incapable to find their identity, their belonging in modern city.

The most lifelike reconstruction of history is our cultural heritage. In order to understand the way technology affects our heritage, it is vitally important to clarify the exact meaning of technology and monuments network, heritage.

On the one hand, technology results from the set of theoretical scientific knowledge in order to create methods necessary for people to succeed their aims and cover their needs. Consequently, technology is part of our culture and defines our evolution. Technology itself has no will, is discovered and used by humans, who have will and are responsible for what they produce and how they use it.

On the other hand, monument is something that perpetuates the memory. It is the respresentive data that imprint the historic evolution of the city. These imprint composed by the historical buildings, the way they were connected, streets, parks and squares and by their function on that time. However, nowadays there is no functional connection with the modern urban environment. On the contrary, many times fences secure distance of the monument from the modern life.

Monuments are not separated but create a network of monuments that expressed the past of the city. They include the fourth dimension of time. The direct relationship of monuments network and urban environment is vital, to recognize the historical continuity of the city and to be taught by the either wrong or right past techniques.

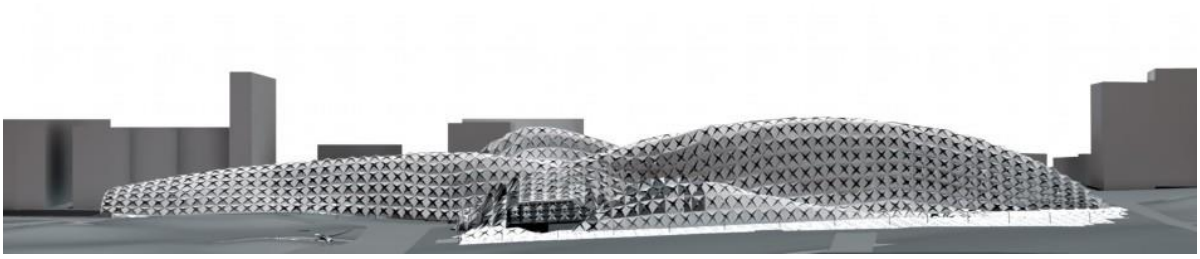
Therefore, technology needed to focus in reconstruction of these buildings and networks as much as possible, to adapt them in modern city. On that way, monuments remain "alive pieces" of the city. At these cases, the new function of each building has to be based on ethical values.

Our heritage shall benefit from technological evolution, in the faculties of computer science and communication. This is able by digitizing libraries and files and by developing computer applications. Moreover, it able by digitizing monument networks, using laser scanners or different techniques, and giving access to cultural heritages. The digitising goes one step beyond, by creating virtual historical environments according to the data of the monuments we have found. Then, the view has an entire impression of the city life in historic times. Technology has even digitised ancient music, to understand what their songs were like. The way people played music in ancient times is part of our immaterial world heritage.

On the contrary, technology can be problematic if used in a different ay. In architecture a new problem is created by parametric design and 3d printers. Outlining, parametric design is new way of computer design through algorithmic equations that connect constructions' pieces. Practically, mathematic equations are created between the elements, including parameters, composing different constructions according the numbers you give to them. These equations are not arbitrary and take into account environment's characteristics and bioclimatic parameters, all translated in mathematic equations.

Despite mathematics is translation of environments harmony, these compounded constructions collapse. Parametric design, sets an impersonal relationship between designer and

environment they intervene, and the creativity is missing. Simultaneously, these constructions can fast and easily be multiplied by giving different numbers in the parameters. Then, technology aims to quick, easy and cheap mass constructions, without personality. Therefore, parametric designs' purpose is mass building constructions, where personal characteristics of the citizens and the signature of the designer on each of his plans, are superseded



1. Paremetric design course in Madrid

In heritage, the building personality is more obvious and is the reason why these buildings turned into monuments, as years passed. In traditional buildings there is a clear character, depending on the place the construction is built, the habits, customs and needs of the residents. The intention of constructions was to be closer to human scale. As buildings adapted in larger scale, compounded united cities, with clear character, that reflects citizen's needs.

Technology and globalization, affect on materials and technics used in construction. At these cases, importance should be given to the natural and urban environment. Otherwise, the structure seems strange and does not fit in the space. On the contrary, traditional buildings are based exclusively in local materials, for easiness reasons. This is not only practical but also logical as each material is created by nature for a place in order to undercover more efficiently its needs. Otherwise, bamboo trees would grow in Scandinavia and desert would be full of trees. Functionality and comfort of space, is undoubtedly profited by new technologies and imported materials. Heritage, reminds us to rethink the balance needed between technology and environment.

Complex is coexistence of heritage and technology on larger scale. In world heritage centers the comparison becomes more obvious. UNESCO world heritage centers preserve unalterable historical, traditional characteristics. Modern designers, interfering on such spaces, are able to work in three different directions, preservation, adaptation and comparison. Preservation refers to conservation and small scale interferes, otherwise results tend to be misplaced imitations. Adaptation is successful by using high technology in construction and taking into account the existing historical space, its qualities and functions. In adaptation, the traditional character of space, remains and prevails, next to a modern construction, in order to success balance between old and new. In comparison, a high technology construction prevails over primitive historical buildings, expressing that modern city should be based in development. Then, high technology is used as futuristic tool, burning the past for a better future. This belief is arrogant, as tradition is responsible for the whole technologies evolution. Therefore, designers that do not respect historical places, vainly try to disavow their roots.

It is vital to respect and learn from our root in order to evolve. This main idea is internationally reminded by the UNESCO organization. The extensive report of UNESCO organization, following, is going to direct the relationship of modern and older culture and reveal their various differences.

UNESCO, the educative, scientific and cultural organization of UNO, is a specialized national organisation established in 16 of November in 1945. UNESCO ’s purpose is to protect the global natural and cultural heritage, in order to prevent its destruction by upcoming raised threats.

The importance of the organization is to remind us the value of our heritage and the need to protect and shelter it. The cultural criteria, for a space to be in UNESCO ’s catalogue, are numbered, to clarify the perception and the direction of the organization. It is vital for each monument to be in UNESCO’s catalogue, that it satisfies at least one of these criteria.

Cultural criteria

1. present a masterpiece of human creative ingenuity
2. Display of an important evolution of human value in terms of architecture, technology, urban planning and environmental design.
3. Form the only or at least a great value of witness, of a cultural tradition of an alive or disappeared heritage.
4. Constitute a great example of architecture or technological building type, building network or landscape, that represents an important or some important events of human history.
5. Form a significant example of traditional settlement, function of earth or sea, that is characteristic of a culture, especially if it vulnerable because of the consequences of non-upset changes.
6. The space has to be directly and clearly connected with facts and alive traditions, ideas and beliefs, art or literary work with universal significance.

Additionally, in order to consider a monument or a location as a distinguished worldwide value space, it has to be stable, original and provide a system that secures and protects it. The cultural heritage is authentic if it is regarded that the cultural values are fulfilled and expressed through characteristics such as form, materials, function, techniques and tradition, location, language, sense and other exterior and interior factors.

Stability is necessary condition to register UNESCO’ s catalogue and refers to having

a. all the facts that express a great universal value
b. a cultural heritage with sufficient size so that all the information and processes are recognized, in order to attribute a monument its importance.
c. Difficulties dealing the negative consequences of modern evolution or indifference.

In Greece, the old town of Corfu island is in UNESCO for over seven years. This would be a beneficial example to analyse, as it would specify the direction, the purpose and the limitations of UNESCO in practice.



2. the old town of Corfu

The old town of Corfu, in Ionio sea, is since 2007, in UNESCO's catalogue of world cultural heritage, according to criterion [4] The integration includes the institution of an integrated protection zone important for

- control of lands use, so that incompatible function would not be permitted
- supervision of reconstructed volumes so that the optical view to the monument are not obscured
- Supervision of the buildings form, so that the special character of each architectural period, is not disturbed

The old town of Corfu, was exclusively used in the past as a fortress port. Therefore, it provides us great example of military architecture.

The protection of the old town of Corfu includes the forbidding of demolitions, the control of insertions at the exterior of the buildings, to protect the buildings shell and the supervision of the insertions of public spaces.

Moreover, the municipality of Corfu is responsible for the protection of the historical center, by discouraging the abandonment of the old multi- storey buildings, forbidding additional volumes at existing buildings and avoiding dangers that alter their shape.

Another problem that is recognized in Corfu old town is the margin between modern and historical buildings.

In modern Corfu town there was no try to imitate historical building, or impose modern architecture to traditional. The value of the historical buildings is not degraded, but there is an obvious difference in quality compered to modern buildings. Corfu's modern architecture is mainly based in convenient standard constructions by concrete, without any beautician quality and remarkable materials. These buildings do not carry and durability in time and could easily be demolished without any great loss. They are not care about the quality but for a quick and cheap result, that technology can provide according to the operators will. The contrast is obvious next to the historical buildings of the old town, many of which dominate for more than 200 hundred years, with identity and durability, characteristics that collapse in modern architecture.

Hence, it is becoming clear that an international organization is established to preserve spaces, which fulfill basic principles. There is great question if there is such a need of an international organization to recognise a space a protected and institute strict limitations to preserve him. The question can be also formulated as, who is UNESCO trying to protect our world cultural and physical heritage from?

Apparently technology is responsible. However, practically it is the way humans use technology in relationship with their heritage. The way we use technology is problematic not technology itself and due to different factors. Firstly, there is a lack of education, to essentially recognize past's value, for a city to evolve. The monuments network defines not only the historical limits of the form but also the relationship with the natural environment, providing on that way different knowledge. The recognition of these principles is based in proper education that analyzes the structure, content and the meaning of the monuments and is a basis for the modern city to evolve.

For instance, in the old town of Corfu, high buildings with narrow balconies are situated in the densely populated city. High buildings, the dense populated city with narrow streets, and the small, narrow balconies result from the fort architecture technique according to which the building has been constructed. However, narrow balconies same while, declare that in the island it was raining frequently. Nowadays, Corfu is no longer a fortress island. Nevertheless, still in Corfu it rains very often and it would still be more functional if the balconies were still designed to be narrow.

Another factor why modern people do not respect their heritage is that the human perception is different than in the past. In modern life, there is an indifference of global issues and there is emphasis is given to private life. The sense of human durability in space is not evaluated correctly and prevail the belief of expendability of people and things. Therefore, people do not care anymore about their roots. These feelings are reinforced by the lack of social responsibility, which comes from the inadequate participation of modern people in every collective process. These various collective processes may be the configuration of a park in their area, or the participation to the local residence committee.

Advanced constructions are focused in quick and cheap results. This direction is understandable as global population has risen rapidly and covering people's needs is much more difficult. Concurrently, disposable buildings interface to the consuming phenomenon, where products are used

as a way to cover every different need. The quality of the dwelling is, however, downgraded as the durance of use is limited. Modern man constantly evolves and his need change quickly like the constructions.

On the contrary, traditional dwellings focus in quality instead of quantity. Emphasize is given to durability of the building and great importance to each person separately to constitute operational residents and active members of the city. Tradition is everywhere to remind us that dwelling is something stable for a man, his identity, which is evolved according to his needs, but does not lose its authenticity. Durability in space usage provides a safer absorption and intervention in the city, essential for its development.

The greatest danger of technology is 3d printing, meaning machines produced to construct without any hand work needed, in short time. This breakthrough provided quick multiplied results, with no man work need. These machines are monitored by introductions of the programmers and apply plans based in algorithmic equations, as these of parametric design. This revolution, in automatism and robotics is according to recent researches going to raise unemployment to 45% globally.

Tradition reminds us, each person's value and special characteristics', which are beneficial for the city. The existing city, where computers and robots prevail, does not allow peoples and spaces identity to be seen and flourish. Tempore and mass results of technology are inadequate, as they rely on the fact that a city forms a man.

Figuration of collective spaces and rebound of human parameter in new constructions is inevitable. Relationships of modern people and their difficulty to respond to their everyday responsibilities, expresses that there is no intimacy and adaptation to the outrageous cities. Big cities could break up, so that there would be greater control and corresponding in cities and citizen's needs. Technology has forgotten that people create a city and does not let them express enough themselves, either because people are lost in huge cities size, or because the feel incapable to deal with the high technology robots which have taken their jobs. Always, man was trying to create a robot which could work instead of him. Essentially robots replace humans' brain, but how do they succeed it working instead of people, as we have only discovered a small part of our human brain?

Technological innovations should be influenced by tradition, where constructional process was more related to the user of the building. The down to up idea, in order to create a city, using technology, manages to overcome problems and factors that consuming, automatism and robots cannot. On that idea, the distance between man and environment is closer and he is not afraid of the chaotic city. Instead of trying to turn people into god, we shall try make god a bit more human. Somehow, tradition has the same meaning for technology, reminding us, our deepest needs.

However, the difference is not between tradition and technology, past and presence, but a difference between modern and older understanding.

Technology is not practically responsible. Humans are responsible for the way they use it. The problem that exists in modern technology utilization is the different ethics of its operators. This comparison to heritage lies to the idea of durability and eternity in space. These principles have been disturbed, because of naderism and consequently its disposable fast and economical buildings that ensure only present adequacy. Hence there is general problem about the heritage we are going to deliver to the next generations and how we recognize and evaluate the world heritage that is now given to us. Without respect in space durability and in intervention in space, ideas that collapse in modern mentality, it is impossible to respect pre-existing space. Modern understanding focuses only in

presence. This is the main difference with the past. Our culture teaches us practically issues of the functionality and the flourishing of the city, educate us simultaneously the behaviour and the understanding our culture was based on, to evolve.

In modern life, the perception of the relationship between man and space and the interaction with the urban environment has changed. Modern people emphasize in private life and do not participate in the configuration of their public life.

In the past, people were counting on space durability, meaning the eternity of the building something that give a character of divine and respectful volume in space. The dominated view of a volume was able by a collective process to construct the building. Participation in construction of such buildings, made an illusion or gave an feeling to the people that took part, they could let their imprint and on that way that they live for ever. These imprints is our world heritage.

In the past the dwellings were used and connected by religious beliefs that pushed people to go out an participate in common actions. The appearance of concrete and the way it was used gave a new direction. Firstly, the new material was though as new way to connect earth with the divine world. In practice, however, it was directed to construct buildings with no divined continuity but limited durability.

Nowadays, the dwelling is a divine space that protects people from the hostile and endless exterior world. There is no need for typical behaviour and respect in a world that forbids collective actions and the sense of divine, superior and respectful beliefs

According to these facts, the direction we have to provide as engineers is based in ethical human values, focusing in a community which is going to unite the humanity and avoid the speed and the greed of the modern perception, to destroy much of the creative work, like in parametric design.

Architects' responsibility is to encourage the collective memory of our community and to proceed in architectural insertions that stimulate the imagination and combine it with participation of the residents.

Bibliography:

[1] Article| Changes in managing world heritage: dynamics and limits of new technologies | Paris Calamaras, Aristidis Vaggelatos

[2] Book p130-150| Monuments and the city | Manolis Zivas, professor in National Technical University of Athens, architecture faculty

[3] Book p100-150| Architecture ethics and technology | Pelletier/ perez- Gomez

[4] PHD | Architectural design in conditions of advanced technourgia | Dimitris Manios

[5] Article | Heritage and technology, Technology is part of a communities culture and is responsible for its evolution | Theodoros Lianos, professor in economic university, in cultural economy faculty| published in 18/06/2000

[6] Book p1-40| Management plan of Corfu old town, description and meaning of the proposed monument for UNESCO's catalogue | Mairi Mitropia, Leonidas Stanellos | 2007

[7] Web: el.wikipedia.org/wiki/technology

HERITAGE and TECHNOLOGY
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Utility and necessity in architecture: design, construction and transformation of alpine buildings

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Abstract
Alpine buildings are an integral part of the landscape system where natural and built elements must be as one to guarantee the safety and protection of both place and people.
The perfect and necessary symbiosis derives from a close relationship between the built elements and the natural design of the orographic and physical environment, making all formal and/or stylistic themes ephemeral and evanescent.
Alpine architecture thus incorporates values ascribable to the characteristics of the place and the search for adaptation to the site has always been the principal generator of any construction.
The alpine architectural system (seasonal alpine farmsteads and huts, hermitages on mountain passes) is made up of structures useful and necessary for the economy, for shelter, for defence and to stabilise the land.
In this context, we felt it would be interesting to study the system of alpine structures in the Valle di Fiemme, an area where from economic necessity subsistence agriculture has always existed side-by-side with forestry and livestock farming, leading to the development and construction of infrastructure even on slopes unfavourable for their steepness and exposure to the sun.
These structures are today partly abandoned and one often wonders if and how they should be restored, if they should remain a shelter for the alpine wanderer or if they should be transformed (functionally and thus economically), adopting architectural models knowingly indifferent to the physical landscape.

Keywords: alpine architecture, sustainability architecture, tourism, conservation and valoritation

1. The disappearance of high-altitude seasonal-housing structures
In the upper reaches of the Alpine system, the driving forces at work have always been utility and necessity. In the summer the valley's inhabitants were obliged to climb up to the vegetation line in search of new resources to supplement their poor incomes in the form of hunting, animal husbandry, forestry, mining etc. The regularity of such high-altitude activities enabled the valley dwellers to exercise a constant control over the territory. They carried out on-going land management measures to avoid devastating natural phenomena such as floods, fires, avalanches, and landslides and constructed buildings for their summer livelihoods that had to minimise the adversities represented by the climate, insolation, cleavage and the lack of water.
Furthermore, working in Alpine territories required special expertise. Operations had to be an integral part of the landscape system and the natural and built elements had to fuse together to ensure the safety and protection of both habitat and men.
This perfect and necessary symbiosis was the outcome of a seamless interrelationship between built elements and the orographic and physical environment's natural layout, which rendered any kinds of formal and/or stylistic themes ephemeral and evanescent. High-altitude architectonics whether applied in fields, means of transit or buildings had to accommodate the habitat's features, and thus the main concern was to adapt the construction site to the environment.
The principles of adaptation and the use of locally available resources (materials and technology), underlay all the work carried out at high altitudes on forests, fields, footpaths, roads, dairy farms, cabins, retreats, and

defensive structures for mountain passes, and all such work was necessary and useful for the territory's economic development, shelter, defence and stabilisation.
This is the viewpoint from which the system of high-altitude structures of the Fiemme Valley has been investigated. As subsistence agriculture here always had to turn to forestry and animal husbandry, the result was that even the most unfavourable mountain slopes in terms of gradient, geology and insolation were anthropised and infrastructured.
Partly abandoned buildings often raise the question of whether they should remain as shelters for Alpine excursionists or be transformed (functionally and hence affordably) by adopting architectural models that take account of the physical landscape or simply ignore it.

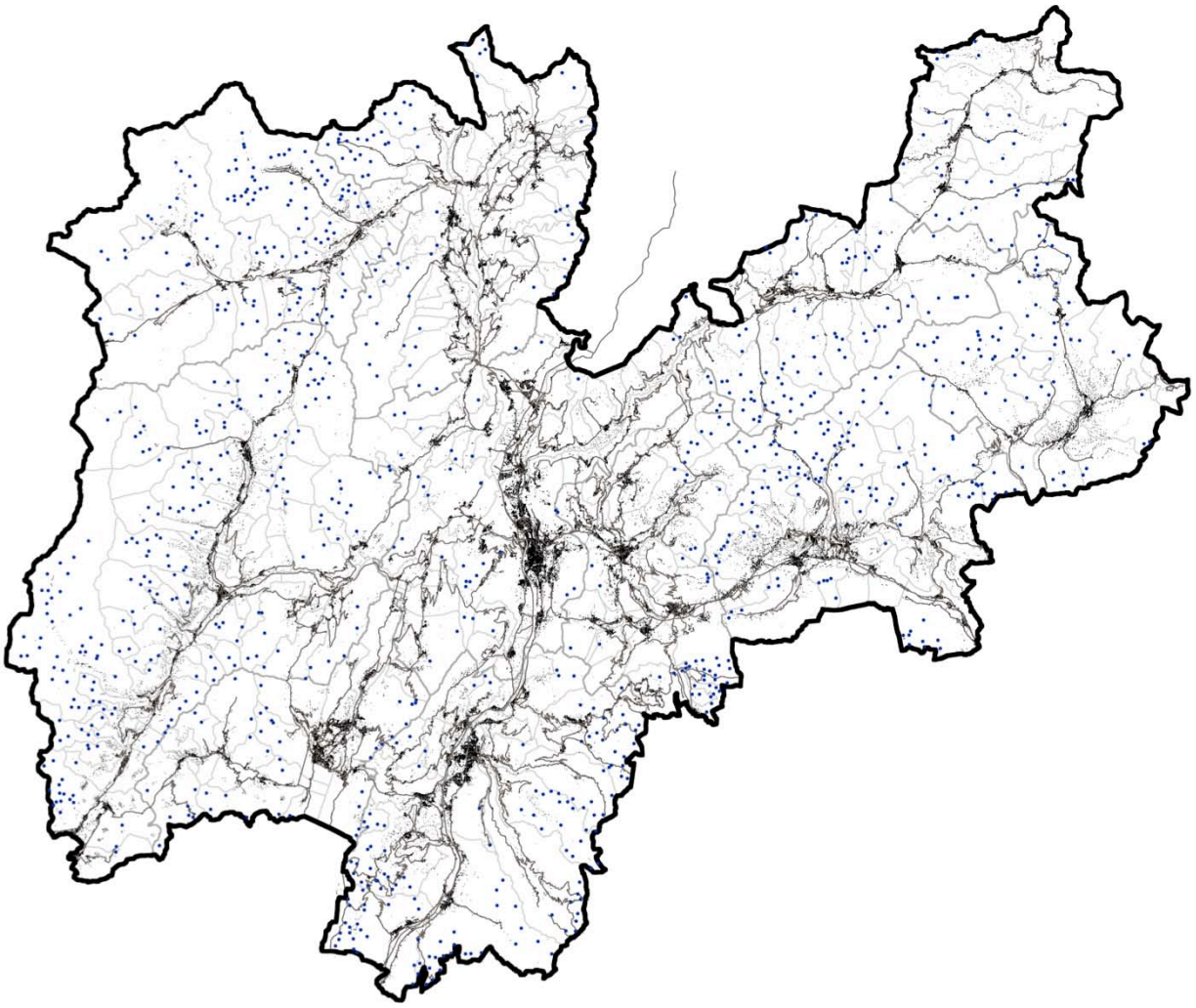

Fig. 1: La diffusione delle strutture temporanee in Trentino.

2. Seasonal-housing constructions

The Valle Fiemme Valley is an open Dolomite valley that together with the Fassa and Cembra valleys constitutes the catchment area for the Avisio waterway, a left tributary of the river Adige. To the west, the valley connects up to the valley floor (valle dell'Adige), to the north to the province of Alto Adige and to the east to the Veneto region.
Settlements in this territory go back to the times of the Raeti. Thus, it is not surprising that autonomy and the self-government of its own resources, as well as being distinctive features of the Fiemme community, produced an organisation based on equalitarian principles that survive to our own times and have shaped unique landscapes and architectures. As such works have recognised for their outstanding qualities for many years, this has also led to the institution of protected areas and natural parks (to the east the Paneveggio Pale di San Martino Park and to the west the Monte Corno Park)
Small constructions exist on the slopes of the Fiemme Valley, above the crop-field level, with very similar layouts, forms and technology. Partly used as stables and haylofts and partly for sheltering herdsmen, they are functional for the valley's vertically organised economic activities.

These constructions, dairy farms, haylofts (*tabia*) and cabins (*baite)*, still today maintain the same characteristic layouts, forms, distributive spaces and construction properties as the architecture used for permanent occupation in the valley.
Aside from the eleven settlements of almost 20,000 inhabitants (which triple in size in the winter and summer seasons), in a territory of just under 500 sq. km, many of these mountainsides buildings no longer serve their original purpose.
Above the level represented by crop-fields, it became necessary to build small cabins or brick and wood buildings for temporary shelter or to house mowers at the height of the harvest season. The small constructions could also be used to shelter herdsmen. The cabins or *baite* (3x5 m) had a masonry foundation with rocks taken from the fields and a superstructure of wooden beams interlocking at the corners.

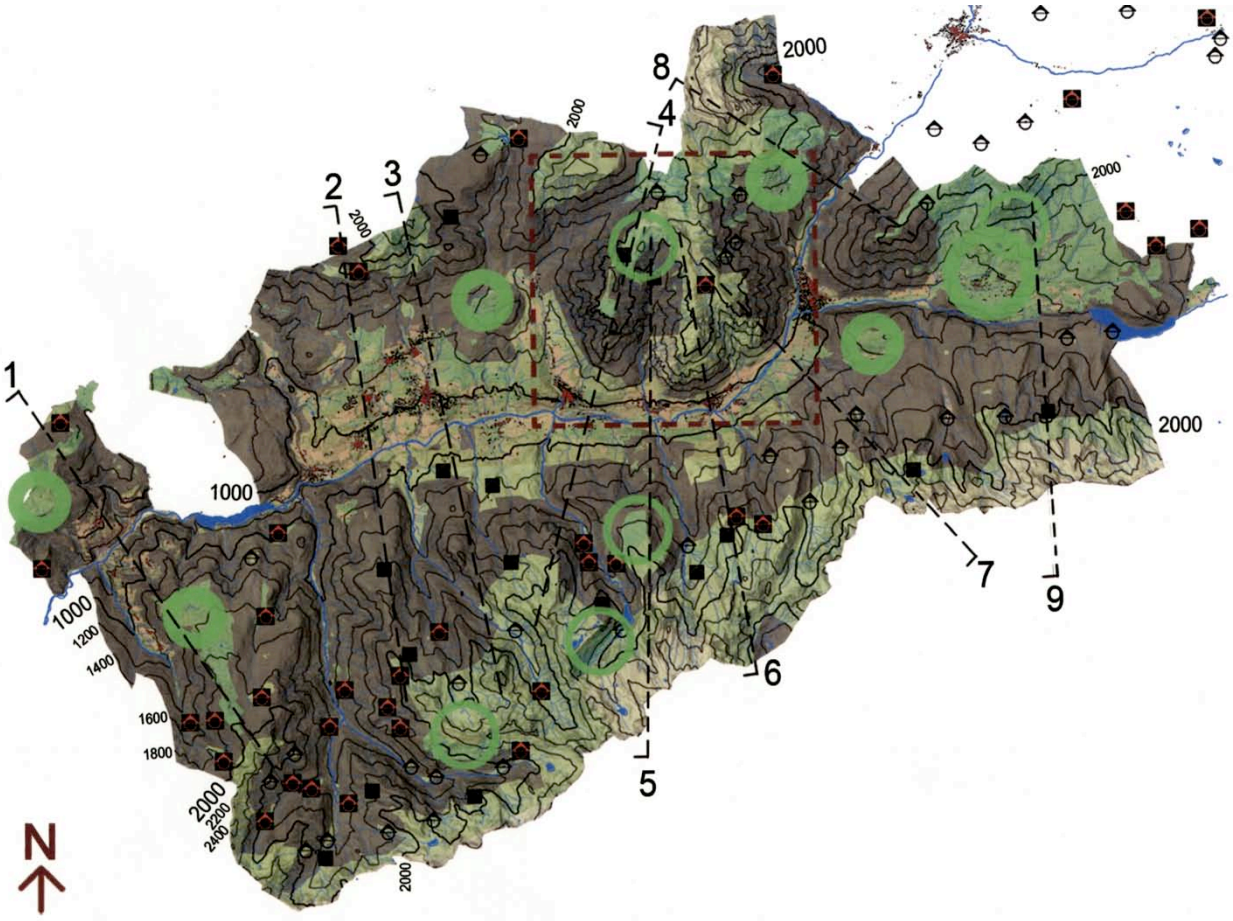

Fig. 2: La diffusione delle strutture temporanee in valle di Fiemme.

In the middle of the forests, usually at an intermediate height between the valley floor and the Alps, *tabià* were built, full-purpose haylofts which, occasionally, also served to keep equipment, and accommodate labourers during haymaking. The *tabià* (10x10 m) and the *caselli* (to house equipment) were multi-purpose buildings and built in the same manner as cabins, with a base made from rocks and a wooden superstructure. The basement served as a stable for a few animals while the loft was used to store hay.
At higher altitudes, dairy farms were found. These were more complex productive units where dairy products were processed. The dairy farms should be seen as the final result of the optimisation of a subsistence economy based on agriculture and animal husbandry. The increase in livestock numbers to top up earnings led to the transfer of these activities to ever-higher altitudes (between 1800 and 2100 m) in the zone between the timber line and rocks, where the vegetation thins out but where cows, sheep and goats could graze. On the contrary, the forage for winter fodder was produced at lower altitudes.
Although quite recent, high-altitude anthropization promoted building specialisation. Simple enclosures to keep livestock were replaced by buildings such as stables and larger animal shelters. Cabins or *baite*, with sizes similar to those at lower levels, were initially used to shelter herdsmen or for milk processing. After the increase in livestock numbers at high altitudes, single-purpose buildings were constructed for the production and storage of dairy products.

In all buildings on these valley slopes, archetypical features can be noticed that functioned as a base model, and which by horizontal and vertical duplication produced three types of construction.
The module adopted represented an optimised spacing in relation to anthropometric needs and a construction technology based on local sourced materials. All the buildings in the valley are thus multiples of the rectangular (5x4 m) module (a sesquiquadrate ratio - 5:4).



Fig. 3: Le strutture temporanee.

The valley's seasonal-housing buildings, being based upon regulatory schemes comprised of elementary forms such as the square, defined the principal lines of the layouts and elevations. This compositional technique gave the constructions an idea of perfection, achieving a universal harmony in terms of the "unification of multiplicity, inter-mixed and reconciled with dissonance", in other words a perfect equilibrium between opposing principles.
The sesquiquadrate ratio was able to solve technological problems as it enabled locally sourced materials and self-building construction techniques, especially the "Blockbau" type, to be used. Wood construction techniques exploited endogenous species comprising elements of between 4 and 7 m in length, cut from trunks of less than 10 m in height, and with 10-12 years of life.
It has been noticed as regards the *baite* that the sesquiquadrate ratio was redimensioned (4.5x3 m) to produce, as in buildings on the valley floor, “sub-cells", which were generally deployed as secondary rooms such as storerooms, warehouses and lumber-rooms.
The *tabià*, insofar as an evolution of the *baite*, have the same arrangements, and by analysing the layouts and elevations it can be inferred that vertical and subsequent horizontal doubling produced the volume needed for storing hay. From the analysis carried out on these types, it can also be deduced that they have undergone the same evolutionary-growth process as the residential buildings on the valley floor. A similar modular scheme can be found in the *caselli* (buildings to house equipment) as an evolution of the *baita* and *tabià*. Stables had a composite modularity: the sesquiquadrate ratio was paired with the ratio of the space intended for each cow. The width (1.05 m), determined the length of the whole building, calculated according to summer grazing capacity. The length of the standing (1.60 m + manger), in its turn, determined the depth of the overall building (6-6.5 m) (the standings were arranged in two rows and were generally served by two corridors). These dimensions were found in all structures in the valley, from *baite* to *tabià* and in all dairy farm buildings.
In the same manner as for all spontaneous self-build architecture, layout modularity determined the sides and the sesquiquadrate ratio and, therefore, the distinctive dimensions of the facades and the window and door openings. The elementary construction, the *baita*, generally had a single aperture (1.4x0.8 m) used for both lighting and access. A single opening, in the centre of the wall, afforded the maximum exploitation of the space available and did not compromise the box action of such two-storey structures. The opening was mainly made in the front exposed to the sun, thus facing toward the valley, which coincided with the smallest width (baito Le Bese), less frequently in sidewalls but never in the wall facing the mountain, where snow might block the entrance. As the dimensions grew towards the 5x4 m sesquiquadrate model, the height of

the entrances increased in subsequent *baite* buildings, while construction technology evolved to replace Blockbau with uprights and planks that made it possible to increase the size of the openings (Pizzancae, casellino della malga Sacina), without altering the building's structural equilibrium. In *baite* in Val Sassoi, Armentagiola and La Bassa, in addition to the entrance in the valley-facing front, some additional and smaller apertures were made. However, increasing their number also meant introducing wooden closing fixtures.
In the *tabià* the doors were generally situated on the longer sides while the short wall in front of the valley usually had just one opening. The dimensions remained constant: the entrance was about 1.5 m wide and 2 m high and the window 0.80 x 0.66 m (tabià Val Boneta).
In addition, as concerns the volumes of the diary-farm complex, aperture arrangements followed the same pattern, with the stable alone having two doors with a width of over 1.20 m (the stable of malga Sacina for example was 1.4 m wide and 1.7 m high). This double access to the stable produced a "protected" route between the *baita* and the infrastructures for livestock services (drinking trough and dung pit) which was mainly used at day.

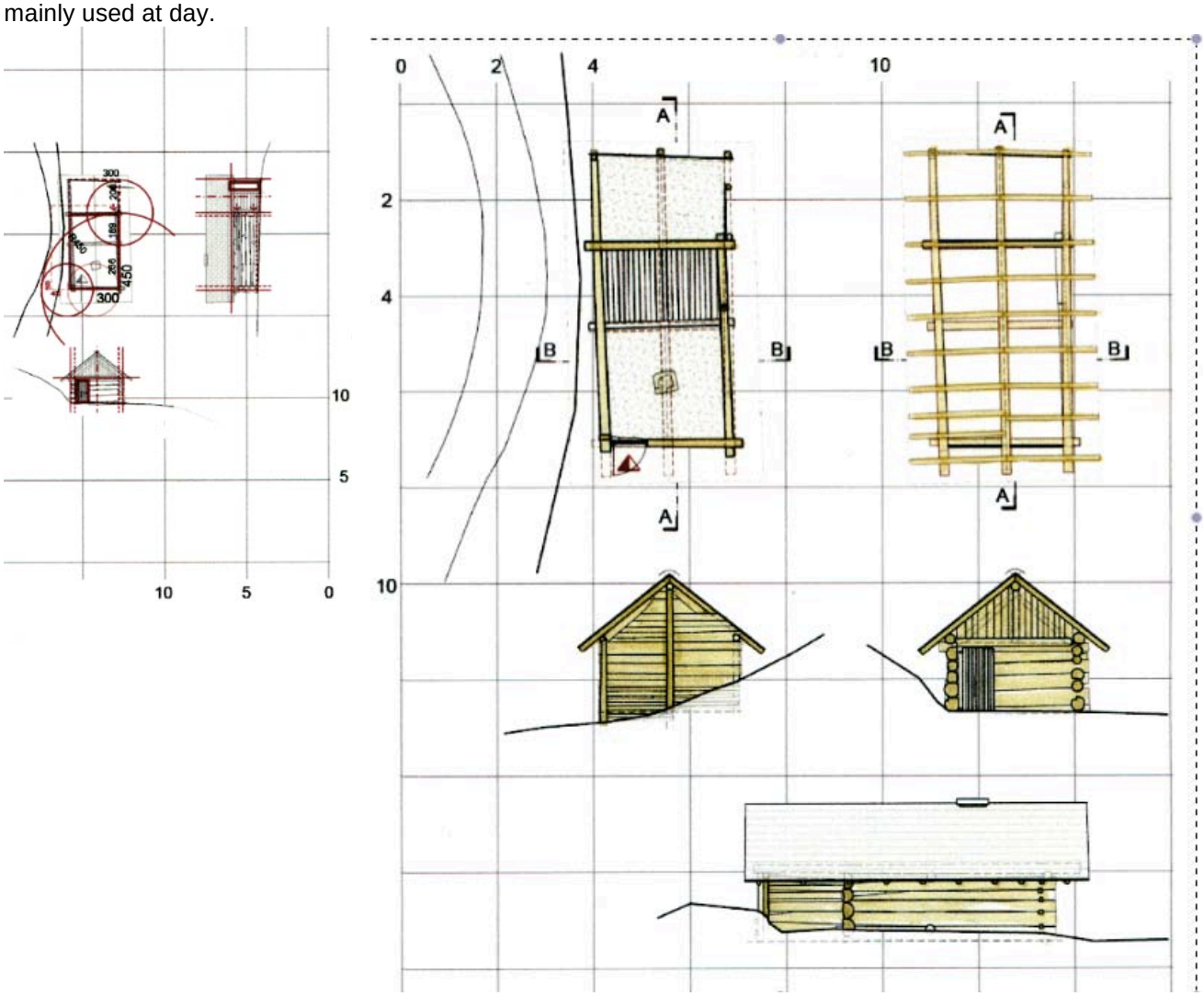

Fig. 4: The baito Le Bese.

The cheese storage room was also characterised by a few small apertures whose positioning depended on narrow and linear paths to adjacent buildings.
All mountainside buildings lacked apertures on the side towards the mountain, which usually faced north, because such openings risked being blocked by snow, and whose presence in shaded areas lingered on during the summer.
The other constant element of the valley buildings refers to pitched roofs, all with the same size and angle, whose primary function was to create storage space. Throughout the Alpine mountain range, roof morphology depended on the load-bearing structure, the materials used for roofing and climatic conditions. As elementary trusses were used in these buildings, a central space was left completely unencumbered. The wooden elements were placed at angles of between 20° and 30° which made the architectonics homogeneous and, thanks to the use of shingles, produced good waterproofing.

The evolution of the valley's seasonal-housing constructions produced progressive specialisation in terms of rooms. The initial single-cell module used by the *baite* (with the concurrence of several functions in the one room: living, hay storage and milk processing) underwent gradual refinement with the division of the small volume into two separate spaces. The sector given over to beds, *prìc'*, ran for the whole depth of the building and was between 1.8 and 2 m wide. The rest of the floor space was occupied by a central fire, *föghèra*, and a spartan table. These arrangements underwent subsequent improvement. Sleeping and cooking continued to be performed in the same area but the fire was initially replaced by a brick stove, *mussa*, and later by one in iron, *fornèl*, equipped with a chimney flue. Further specialisation led to the compete separation of these two functions by the introduction of an internal partition (Val Sassoi, Armentagiola, La Bassa and Pizzancae).

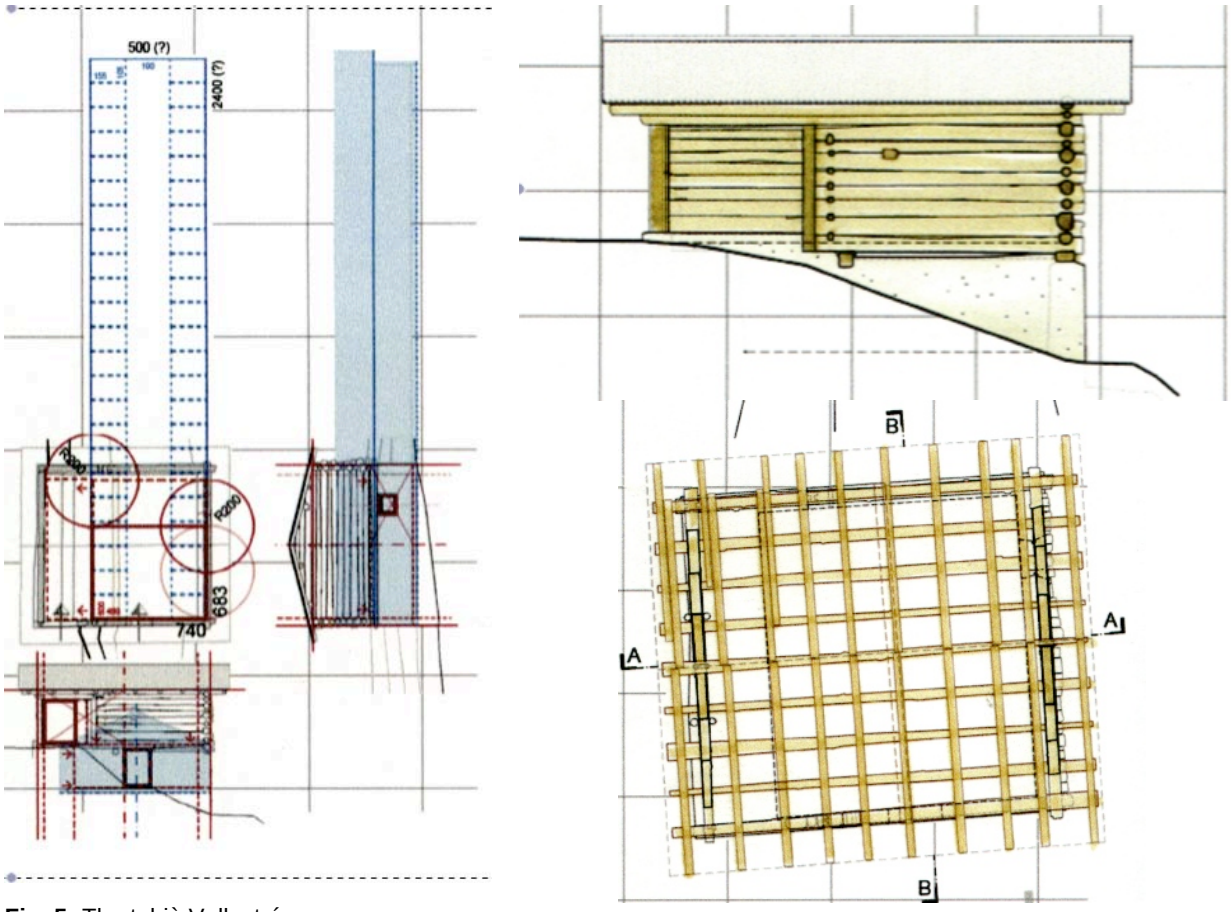

Fig. 5: The tabià Vallestré.

From the start, the *tabià* was conceived as a functionally specialised building. Each level had a specific function: the ground floor accessed from an opening on the side facing the valley contained livestock; the first floor, accessed by an opening on the side facing the mountain was for persons and/or hay. The two floors were only connected from outside and unlike the permanent buildings on the valley floor loft hatches were never introduced.

Originally there was no partitioning on either floor (Vardabè, Bellamonte and Malgola), but over time both floors were subdivided into smaller spaces.

In order to divide the space for livestock from living quarters, wooden and plaster partitions (*scorzoni*) were built, but they usually did not reach the ceiling. The first floor was divided into a number of rooms: kitchen, one or more bedrooms and storerooms separated by a corridor that ran parallel with the roof ridge.

In conclusion, the dairy farm being a specialised structure had single-function spaces. The productive layout determined the subdivision of the stable into a number of premises for keeping livestock, milk processing and ageing. In older complexes, these spaces were contained in two distinct buildings while more recently they were situated under the same roof. The area earmarked for livestock was divided by low dividers (less than 1 m high) and generally ¾ of the stable area was used to keep cows, while sheep and goats were kept in remaining area.

The premises for processing the milk would not have any connection to the stable and were only accessible from outside. The stove, *föghèra*, occupied a central position against the wall facing north. More modern buildings also had premises for ageing cheeses, a kitchen and a bedroom.

The seasonal-housing structures of the Fiemme Valley with their elementary layout have a high level of specialisation, which, over time achieved full functional optimisation.



Fig. 5: The baito Le Bese.

3. Seasonal-housing constructions in the present day and in the future

The Fiemme Valley comprises natural and cultural landscapes of outstanding importance where the various types of building constructed were the outcome of adaptation, over time, to climatic and geographic conditions. These buildings, especially those between the timber-line and the vegetation boundary are partly abandoned and questions are often raised as to whether and how they should be refurbished: if they should remain a shelter for Alpine excursionists or transformed (functionally and cost-effectively) by adopting architectural modes that either take due account of the physical landscape or remain indifferent to it.

This cultural heritage is very important and can become a tool for social and economic regeneration. The need to "occupy" the zones lying between the timber-line and the vegetation boundary and implement "active custodial" measures, are in line, first and foremost, with the modern concept of balanced and sustainable development furthered by regional, national and European policies.

The mountain requires structural policies that should be implemented within an integrated development framework, and through programmes and plans able to bond various local entities together.

In the Fiemme Valley where very important tourist sectors coexist with small industrial areas, and marginal territories, the regeneration of seasonal-housing building structures can take place by implementing restoration policies for such typical structures that are functional for the environment's rehabilitation. However, it has also emerged that it is no longer appropriate to operate in these ambits in a sectorial manner.

In order to restore seasonal-housing Alpine structures, we must give more prominence to the systemic nature of the framework in which they exist by making infrastructures fit for purpose, restoring buildings with new and different functions and attempting to introduce new activities. For example, cultivations could be increased and made more differential by bring back those crops that are no longer cultivated such as spelt, flax, hemp, rye, etc.

It is more evident, therefore, that it is necessary to promote multi-disciplinary studies if we are to make appropriate policies for conserving, leveraging and innovating this mountain heritage.



Fig. 5: The malga Sacina.

Bibliographical References

[1] GATTI M. P., CACCIAGUERRA G., The networking of alpine pastures for the development of sustainable tourism, in AA.VV. *The Sustainable City IX Urban Regeneration and Sustainability*, Ashurst, Southampton: WIT Press, 2014, p. 233-245, ISBN: 978-1-78466-023-9.

[2] GATTI M. P., Conoscere e conservare per la valorizzare: la messa in rete delle strutture d'alta quota, in AA. VV. *Apsat 7. Conoscenza e valorizzazione dei paesaggi trentini*, Mantova: Sap, 2013, p. 169-177, ISBN: 978-88-87115-79-6.

[3] GATTI M. P., CACCIAGUERRA G., D'AMBROS G. B., Le strutture temporanee del Cornon: un insieme culturale ed economico, in AA.VV., *Apsat 8. Le scritte dei pastori: Etnoarcheologia della pastorizia in val di Fiemme,* Mantova: Sap, 2013, p. 175-210, ISBN: 978-88-87115-76-5.

[4] GATTI M. P., CACCIAGUERRA G., Paesaggi di altura tra istanze di valorizzazione e di tutela della intrinseca sostenibilità, in AA.VV., *Apsat 7. Conoscenza e valorizzazione dei paesaggi trentini*, Mantova: Sap, 2013, p. 45-60, ISBN: 978-88-87115-79-6.

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USE OF TLS TECHNOLOGY FOR THE FEM-BASED STRUCTURAL ANALYSIS OF THE ANATOMY THEATRE

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Abstract
The demand for high-definition surveys within cultural heritage-related projects represents one of the main factors which promoted in the last decade a wide use of laser scanning technology. By measuring millions of points within relatively short time periods, terrestrial laser scanners (TLS) allows to derive complete and very detailed 3D models of real objects from acquired point clouds. A wide variety of objects, ranging from small pieces of pottery to statues, from buildings to whole archaeological sites, have been scanned and modeled for various purposes like preservation, reconstruction, study, and museum exhibitions. In order to evaluate the effectiveness of the use of TLS technology for the stability control of very ancient structures, a survey test was carried out on the Anatomy Theatre of the University of Padua. The main goal of this work is to verify the stability over the time of this kind of structure, given the inherent organic decay of the wooden parts. The Theatre has been fully measured with a Leica HDS 3000 laser scanner in order to derive a complete 3D model suited for Finite EleMent (FEM) analysis. In this paper we present the results obtained from this test and highlight issues and difficulties related to the survey of an unusual geometry such as the one provided by the Anatomy Theatre of the University of Padua.

Key words: stability control, terrestrial laser scanning, 3D modeling

1. INTRODUCTION
The use of high-definition surveying laser scanning for cultural heritage-related projects is one of the "sweet spots" for this technology. Given its capability of measuring millions of points within relatively short time periods, complete and detailed 3D model of objects could be efficiently and easily created from acquired point clouds. These features drew in last decade the interest of surveyors, engineers, architects and archaeologists towards the laser scanning technique as an invaluable surveying mean for 3D modeling of sites and artifacts of cultural heritage. A wide variety of objects ranging from small pieces of pottery to statues, from buildings to whole archaeological sites, have been scanned and modeled for various purposes like preservation, reconstruction, study, and museum exhibitions.
Among various applications, the use of TLS technology for the stability control, through FEM analysis, of very ancient structures with historical significance is still a research field not much investigated. In order to get more insights on this topic, we performed a TLS survey of the Anatomy Theatre, one of the oldest, most important and best-known historical "medical" buildings. Built in 1594, the Theatre was the first permanent structure of its kind and substituted for the temporary theatres which were set up when necessary. The main goal of this work is to verify the stability over the time of this kind of structure, given the inherent organic decay of the wooden parts. The Theatre has been therefore fully measured with a terrestrial laser scanner in order to derive a complete 3D model suited for the FEM analysis. As by-product, a video of the Theatre was also generated for multimedia presentations.
Just from the beginning, this work seemed to be quite challenging for the application of a TLS for two main reasons: the complexity of the structure's geometry to be surveyed and the need to develop a specific laser data reduction method. Indeed finite element softwares commonly employed require a very

limited amount of input data compared with typical laser scanner point clouds, which have therefore to be properly reduced, without loosing too much the information about the object's geometry.
The paper is structured as follows. Section 2 provides a short description of the Anatomy Theatre while section 3 deals with the description of the procedure we adopted to produce a 3D model suited for subsequent finite element analysis. Then in section 4 we present the results of the FEM analysis and in section 5 we draw the conclusions.

2. THE ANATOMY THEATRE

The Anatomy Theatre is certainly one of the oldest, most important and best-known historical "medical" buildings. Built in 1594, the Theatre was the first permanent structure of its kind and substituted for the temporary theatres which were set up when necessary. Inspired to the forms of Colosseum and the arena of Verona, using classical antiquity as a model, it intended to hold spectators of anatomy lectures disposed in concentric tiers. The particular shape of the structure resembles an inverted cone set inside a cylinder, both with an elliptical cross-section, and organised in tiers were spectators stand (figure 1).
The structure is comprised of larch beams positioned in "spokes". Curtain panelling is fixed vertically between the beams and air vents are placed in the panelling. The interior of the cone is subdivided in six levels or tiers, which permit a passage of about 35-40 cm (figure 2). The tiers are supported by overhanging corbels and are finished with a parapet of about one meter height consisting of shaped and carved walnut elements on which the handrail rests.
Access to the various levels is by stairs in stone and wood on the outside of the cone (figure 3). In the middle of the floor of the first balcony the structure shows a hole, whose longest axis corresponds to the dissection table which by means of an appropriate mechanism was raised and lowered to the floor underneath, where attendants could easily place the preparations without the need to come upstairs where the demonstrations took place (figure 4). Although the Theatre was in use for almost three centuries it is still well preserved and, apart from a few 18th century modifications, in its original state.
The dimensions of the Theatre, built inside a trapezoid-shaped room, turn out to be rigorous multiplications of the unit length of the time, the "Paduan foot", which corresponds to about 36 cm. According to such unit, the room measures 24 by 28 feet with an estimated height in the center of about 12 m. The internal minimum width of tiers is one foot, the width of some accesses is 2 feet with a height of 5, the minimum width between the walls and balustrade at the top level is 3 feet on the East and West sides, while it is 2 feet on the North and South ones (figure 5a).

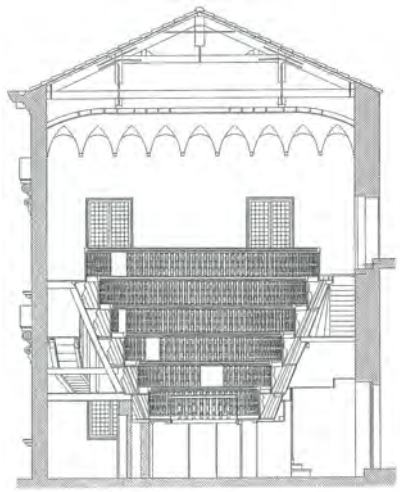


Fig. 1: Cross-section of the Anatomy Theatre.

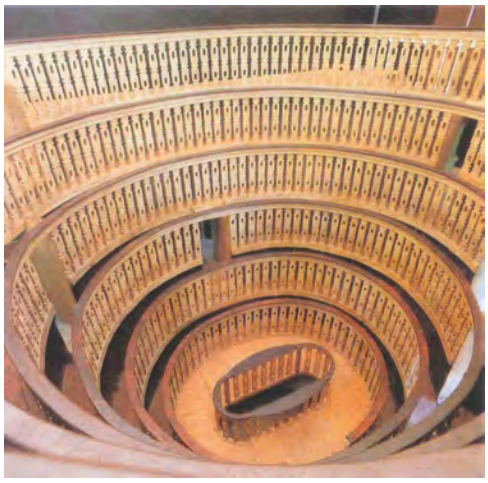


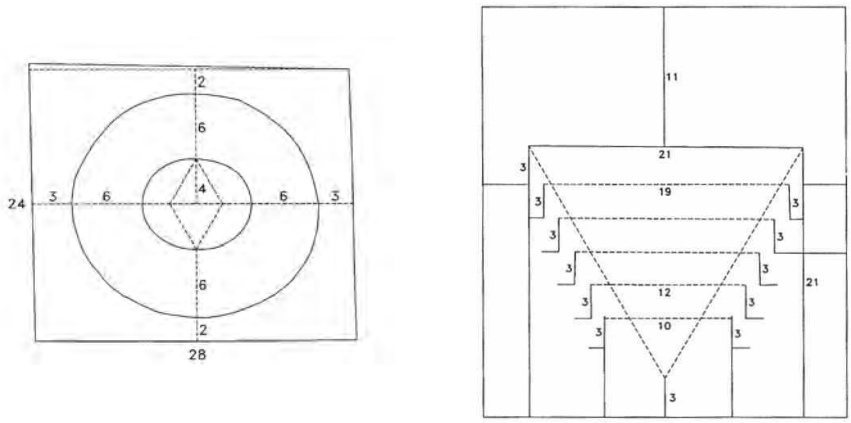
Fig. 2: Top view of the structure.



Fig. 3: Entrance to the top-most level.



Fig. 4: View of the Theatre from the aperture for the dissection table.



(a) **(b)**

Fig. 5: Composition scheme in Paduan feet of the plan (a) and longitudinal section (b).

The most interesting element is the first tier, which shows an elliptical shape with a major axis of 10 feet and whose focuses seem to form an equilateral triangle with respect to the minor axis. The sequence of the upper ellipses does not have coincident focuses going up each level, rather they get closer creating a more centralised form (figure 5b).
Optimal use of the Theatre was favoured by its unique form, a reversed “funnel”, whose functionality was accentuated by reserving the artificial light just for the “scene”, thus emphasizing the type of spectacle which was part of the scientific activity of anatomic operations.

3. DATA ACQUISITION AND MODELING

All the datasets employed for both the 3D modeling and for the stability check of the Theatre were collected with the Leica HDS 3000 laser scanner [1]. This scanning system allows for a larger field of view (360° H x 270° V), ensuring in the same time a low beam divergence and a good measuring accuracy (both $\leq$ 6 mm @ 50 m). The data acquisition and processing steps were performed both with Leica

Cyclone software [2]. The whole structure was surveyed with a point spacing of 1 cm for the wooden elements and 2 mm for black and white non-retroreflective targets (figure 6). The latters were used as artificial matching points in order to avoid possible mistaken during scan registration, given the high symmetry of the structure. Altogether 7 scans were collected resulting in a total amount of 25.850.000 points. Two work days were required to complete this initial stage, most of the time was spent for moving the laser scanner between planned station positions: the narrow space between the tiers (40 cm) made this operation very difficult.

3.1. DATA PROCESSING

Acquired point clouds were then registered each other in order to produce the 3D model of the Theatre. Even this operation was carried out in Cyclone software, adopting the well known two-steps procedure consisting in a pairwise scan alignment followed by a global registration, based on the Iterative Closest Point (ICP) algorithm [3, 4, 5]. The pairwise scan alignment was performed by manual selection of the center of the black & white targets, which could be easily identified by colouring the scans with the intensity data. As shown in figure 7, the average Root Mean Square error (RMSe) of the global alignment was around 7 mm: this is a quite good result considering that the Leica HDS 3000 is claimed for a single point measurement accuracy of 6 mm. The resulting aligned model is shown in figures 8 and 9.

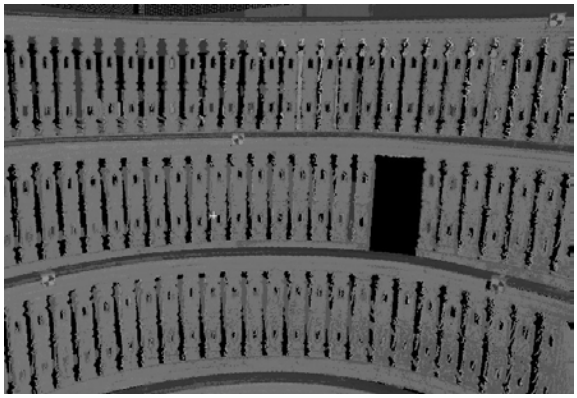


Fig. 6: Close-up view of the B&W targets.

ScanWorld	ScanWorld	Status	Weight	Error Vector
Scw_01	Scw_06	On	1.0000	aligned [0.007 m]
Scw_01	Scw_02	On	1.0000	aligned [0.008 m]
Scw_01	Scw_03	On	1.0000	aligned [0.008 m]
Scw_01	Scw_04	On	1.0000	aligned [0.007 m]
Scw_02	Scw_05	On	1.0000	aligned [0.005 m]
Scw_02	Scw_07	On	1.0000	aligned [0.005 m]
Scw_02	Scw_03	On	1.0000	aligned [0.005 m]
Scw_03	Scw_05	On	1.0000	aligned [0.005 m]
Scw_04	Scw_03	On	1.0000	aligned [0.009 m]
Scw_05	Scw_01	On	1.0000	aligned [0.011 m]
Scw_05	Scw_04	On	1.0000	aligned [0.007 m]
Scw_05	Scw_06	On	1.0000	aligned [0.010 m]
Scw_06	Scw_04	On	1.0000	aligned [0.007 m]
Scw_07	Scw_03	On	1.0000	aligned [0.005 m]
Scw_07	Scw_04	On	1.0000	aligned [0.007 m]

Fig. 7: Results of scan alignment.



Fig. 8: Side view of the aligned model.

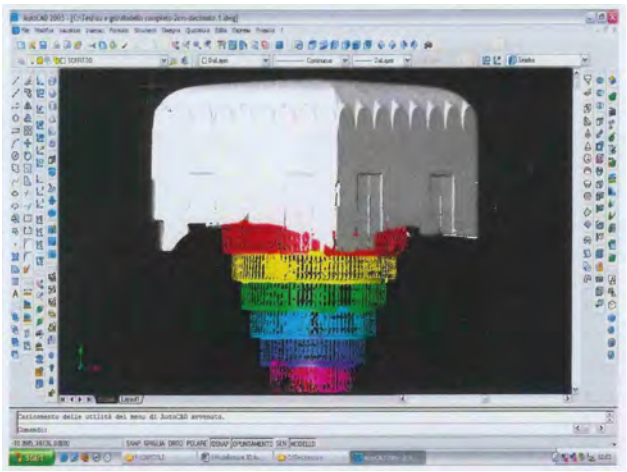


Fig. 9: Segmentation of the meshed model.

3.2. 3D MODEL TEXTURING AND SIMPLIFICATION

After registration, the resulting point cloud was properly decimated in order to be used for FEM analysis. Indeed, softwares available on the market for this kind of application are not optimized to manage the large amount of points typically acquired with TLS devices. Therefore, data reduction becomes a necessary processing step. Several trials were performed prior to find the best subsampling values combination, i.e. 5 cm for the ceiling and 2 cm for the tiers. Such approach was found to be a good compromise between level of detail and computational complexity. Then, the resulting 3D model was furtherly segmented in its componing parts, the ceiling and the 6 tiers, which were separately triangulated with the same step as used for the subsampling (figure 9). This way, the meshed model could be more easily imported in Autocad for further editing. In this environment the various components of the structure were properly modeled according to a procedure applied in a previous work [6]. Basically, a few representative objects of the balustrades, the handrails and other minor elements were selected and profiles were extracted from the corresponding laser points. Such profiles were then used to reconstruct the corresponding original 3D geometry: for each object the resulting replica was substitued in place of the laser points. An example of the profile extraction procedure is shown in figures 10 and 11. As final step, the mesh edited in Autocad [7] was imported in 3D Studio Max [8] for the texturing and for the generation of a multimedia video (figure 12). The rendering of the scenes was done with the Raytracing technique. A perspective view of the textured 3D model is shown in figure 13.

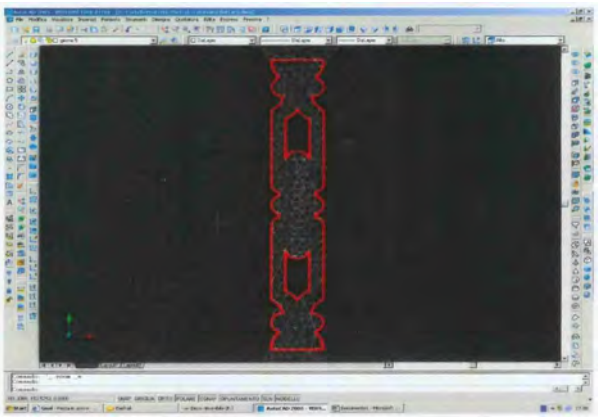


Fig. 10: Profile extraction of an element of the balustrades.

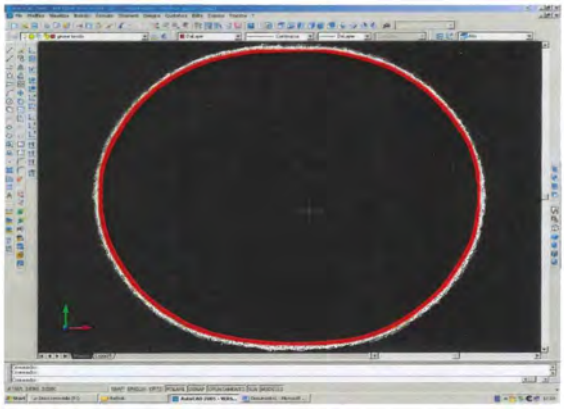


Fig. 11: Extraction of the profile of a whole handrail.

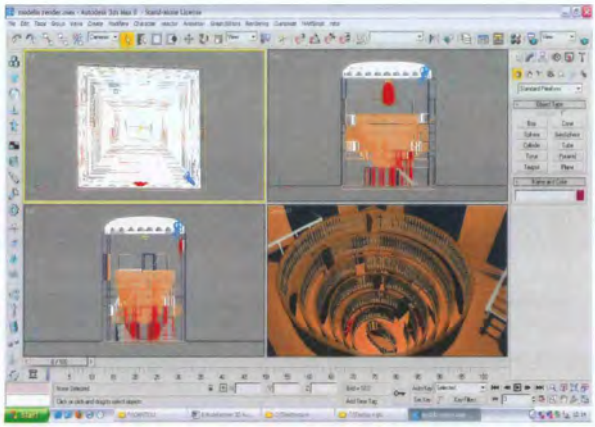


Fig.12: Model texturing and rendering in 3D Studio Max.

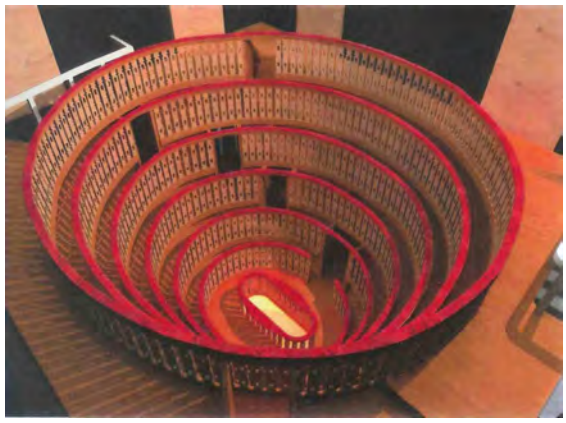


Fig. 13: A perspective view of the rendered 3D model.

4. FINITE ELEMENT MODEL ANALYSIS

The structural analysis of a historical building can help in defining the eventual state of danger and in forecasting the future behavior of the structure. In structural analysis, FEM is used widely. This approach essentially involves modeling the structure by dividing the body in small elements (triangular shapes) with definite mathematic models. These finite elements are joined with the nodes, which are corners of elements. In FEM analysis, the object under investigation is considered as a one dimensional structure composed by linear elements, two-dimensional elements, or three-dimensional elements as solid, depending on the problem of structure body being investigated. Analysis by FEM depends on stress evaluation of the nodes. The more elements are used, the better approximation can be obtained. However, this relationship makes the problem more complex and increases the processing time. For appropriate and rational analysis, the definition of the mechanical properties of the material and the implementation of constitutive laws for decayed materials is needed. However, the analysis of historical constructions is a complex task due to the building material, which is not homogeneous isotropic and linear elastic.

As mentioned in previous section 3, in order to reduce the number elements to be processed in the FEM analysis, and therefore the global computational load, the TLS point cloud of the Anatomy Theatre was properly decimated with a subsampling step of 5 cm. After triangulation, we obtained a meshed model composed of around 117000 triangles. Such mesh was then imported in dxf format in Straus software [9], to perform the structural analysis. In this environment, all the triangle surfaces (plates) we assigned the same physical-mechanical properties: continuous and homogenous walnut structure with a 3-cm thickness. The structure has been considered fixed to the pavement located under the first level and to the sourrounding walls. These constraints have been simulated by removing all the degrees of freedom (DOFs) of the nodes (triangle vertices) placed both at the bottom of the model and on the floor of its highest level, as shown in Figure 15 (purple points). A force of 400 kg/m^2 was then applied to each plate of the 3D model along the Z axis, in vertical direction, in order to simulate the effect of a compact mass of people distributed within the six levels of the structure. It can be demonstrated that the effects of such modeled load are mainly focused on the floor of each Theatre's level, while they are negligble on other parts of the wooden structure.

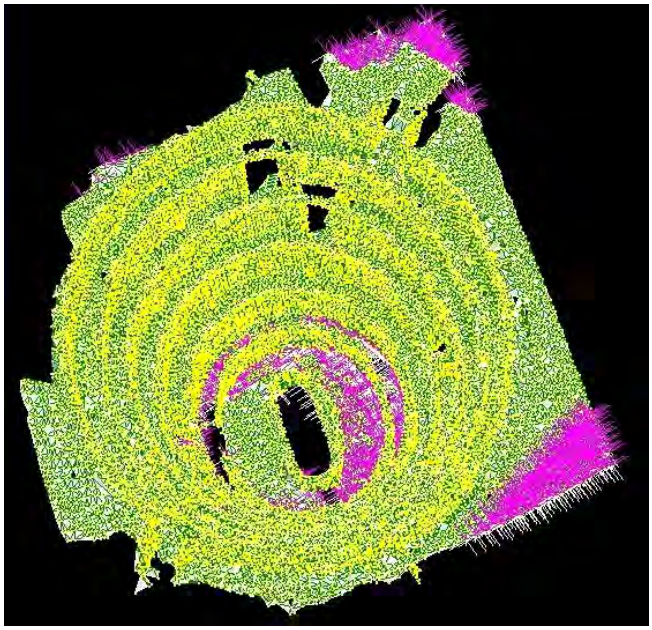


Fig. 11: Assignment of the DOFs, constrained nodes are colored in purple.

According to Italian regulations and to the assigned load, two different kinds of analysis were carried out:
1. Static analysis, from which charts for stress plate for plate moments have been derived. This analysis was performed in Strauss taking into account the weight of the structure and that of the mass of people.
2. Dynamic analysis, in which the combined effect of following three factors have been considered: weight of the structure, weight of a compact mass of people and a simulated earthquake of 3rd level (corresponding to a middle risk of earthquake).
The results of the static analysis are shown in figures 12 and 13, while as far as the dynamic analysis is concerned, Straus software provides results in terms of videos, therefore they are not presented here.

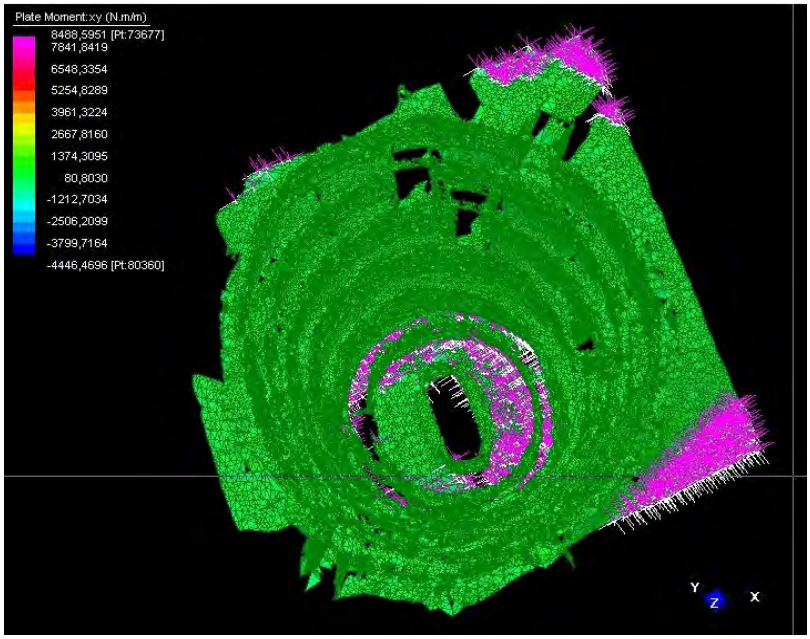


Fig. 12: Results of the linear static analysis. Top view of the moments applied to the wooden structure.

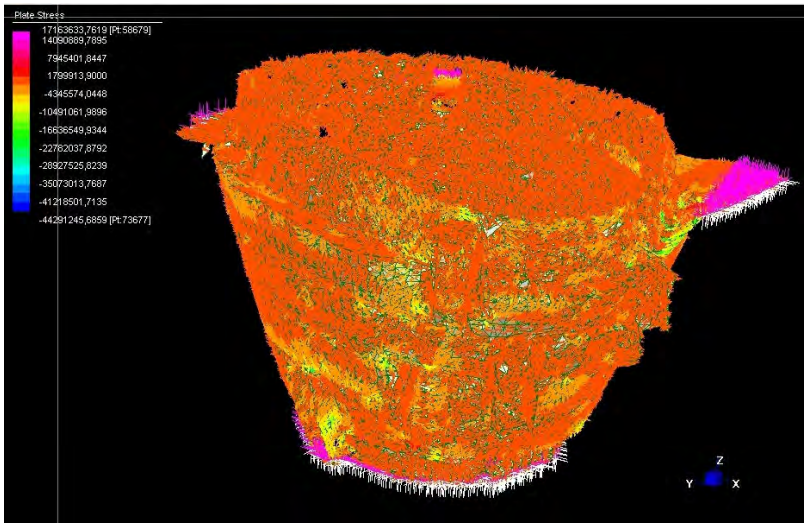


Fig. 13: Results of the linear static analysis. Side view of the stresses applied to the structure's model.

4. CONCLUSIONS

In this paper we have presented an example of twofold employment of TLS technology applied on the same object. Namely, a Leica HDS 3000 terrestrial laser scanner was used to survey a complex historical structure, the Anatomy Theatre in Padua, both to generate a full 3D model for multimedia presentations and to produce a dataset suited for FEM-based structural analysis. Given the particular geometry (circular shape) of the structure and the presence of repetitive patterns due to the balaustres, specific black and white targets had to be used in order to correctly re-assemble the laser scans during the registration step. Though very old, the wooden material composing the structure of the Anatomy Theatre did not show any issue to the measurements of the TLS laser signal. Results achieved from the FEM-based structural analysis have demonstrated that terrestrial laser scanner technolgy can be profitable used to simulate and assess the stability conditions of ancient historical structures over the time. However the huge amount of data tipically acquired by TLS devices need to be properly decimated in the processing stage in order to be employed in FEM softwares. Unfortunately, the level of subsampling must be determined time by time and object by object, as the best compromise between level of detail of the resulting model and the computational load required for the FEM analysis.

REFERENCES

[1] Leica Geosystems. The HDS 3000 technical specifications. URL: http://www.leica geosystems.com.

[2] Leica Geosystems.

[3] Besl P. J., McKay N. D. (1992). A method for registration of 3-D shapes. *IEEE Transactions on Pattern Analisys and Machine Intelligence*, 4(2): 239–256.

[4] Bergevin R., Soucy M., Gagnon H. and Laurendeau D. (1996). Towards a general multi-view registration technique. *IEEE Transactions on Pattern Analisys and Machine Intelligence* 18(5):540–547.

[5] Chen Y., Medioni G, 1992. Object modelling by registration of multiple range images. *Image and Vision Computing*, 10(3):145–155.

[6] Guarnieri A., Remondino F., Vettore A., 2006. Digital photogrammetry and TLS data fusion applied to Cultural Heritage 3D modeling. In *Proc. of ISPRS Comm. V Symposium "Image Engineering and Vision Metrology",* Dresden, Germany.

[7] AutoCAD, http://www.autodesk.com/products/autocad/overview

[8] 3ds MAX, http://www.autodesk.com/products/3ds-max/overview

[9] STRAUS, http://www.hsh.info

HERITAGE and TECHNOLOGY
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A planning & design approach for the rehabilitation of historic centres in Iraq.

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Abstract
This paper deals with the proposal of a methodology for the Iraqi historical centres. Of course the paper assumes that the current war will end one day and outlines a project totally related to the heritage preservation in times of ideological and armed conflict. The paper starts by describing how in Iraq the revitalisation of historic centres is developing in a frame of great uncertainty, marked by a controversial notion of identity and by strong market-oriented operations. The paper argues that in a city under reconstruction like Baghdad principles and methods adopted in Western world are often of limited value when adopted in countries of late modernisation. Consequently, the proposed strategy is based on the implementation of two integrated operating modes. The first is centred on the definition of a technical and regulatory planning, oriented to organize the multiple operations to carry out in the ordinary urban fabric. The second deals with the design of five central places providing the spatial and functional focuses of Adhamiya neighborhood. As such, the proposed strategy rests on the design of a 'planning process' and the design of five 'urban projects' mainly addressed to developers. These two levels, although developing at different speed, are intended to help each other facilitating the meeting of public and private interests.

Keywords: Rehabilitation, Historic centres, Planning tools, Urban projects, Baghdad.

1. Introduction
The requalification of the great sites of worship in Iraq, now moving its first steps, has a significant strategic value because of its huge driver impact toward the other urban policies, be they for preservation or innovation.
In this regard, the lessons that can be taken from the best experiences on preservation and rehabilitation of historic centres, based on principles and methods put forward by scholars and professionals mainly operating in the Western world, are very helpful, but often of limited value when adopted in other parts of the world "where large parts of the economy have transitioned from the pre- to post-industrial in a few short years, such that notions of heritage have emerged, disappeared and re-stabilised in rapid and unexpected ways" (Winter, 2014, p. 565).
On the other hand, if we address the international charters, we find many conceptual and technical tools (ANCSA, 1960; ICOMOS, 1964, 1975, 1998, 2003, 2011) but also large unsolved questions. Between an updated outline of the various key concepts that underlie the text of the Venice Charter (Petzet, 2004) and a recent critical reading of it, championing for a more open interpretation (Hardy, 2008), lies a world of incertitude, especially when operating in times of armed conflict, as in Iraq.
Searching for a way to overpass this incertitude, this paper deals with the presentation of a methodology for the rehabilitation of a historic neighborhood and its application for a specific project in Baghdad. This approach is conceived in order to respond to the peculiar conditions and demands connoting the Iraqi old city centres. In particular, the project is developed with regard to the requalification of both a site of worship, the area of the Abu Hanifa mosque, and the surrounding neighborhood of Adhamiya - launched in 2010 by the Amanat (City Hall) of Baghdad with the 'Regional /International competition to revive and develop the area of Adhamyia'.

To properly explain the adopted methodology it is better not to specially focus on the design of the buildings neither on planning issues, though significant, but rather on the methodological and analytical framework, so

making more understandable the consistency among the two sides of the chosen approach (planning and design) and their expected practicality in the given context.
In fact, the condition of a city under reconstruction, like Baghdad, poses problems whose complexity and exceptionality requires exceptional solutions, accurately related to the strong operational limits consequent to this condition, today worsened compared to the past. Just think that the proposals and the critical approaches on the historic city, developed from the 1980s to the 1990s, while facing difficult conditions at all levels, showed an operating environment far more evolved than the current one[i]. Not to mention the careful *Conservation study for the Rusafa area* elaborated under the direction of Stefano Bianca, al last buried in the administration drawers (Bianca *et al*., 1984). Aware of this situation, the project here presented[ii] takes into account some valuable experiences in terms of methodology, analysis and design, and tries to suggest appropriate solutions to come through the current remarkable difficulties.
As such, this project has been developed thinking also to a specific method of intervention for the historic parts of cities subjected to speed and heavy processes of urban reconstruction (Cinà, 2005). To this end two planning/design strategies have been put in place, encompassing both the conceptual and technical aspects:

- The consolidation of an inclusive identity (containing physical, functional and cultural aspects);
- The implementation of two modes of intervention, operating by regulatory tools and great projects.

2. The question of identity in times of ideological and armed conflict

Historically, cities identity is inherently all-embracing and the urbs, its physical counterface, gathers its multiple materials as the tangible evidence of a layering of identities. However, today in city transformation the identities are worldwide subjected in harmful processes of selection (Nagel, 2002), if not museumfication (Viqar, 2004; Saidi, 2012; Wang, 2012), reinvention (Mahgoub, 2007; Khechen, 2007) or almost ex novo production (Su, 2011).

The concept of heritage today widely acknowledged dates back to the *Convention concerning the protection of the world cultural and natural heritage* (Unesco, 1972), that includes among others the notion of the French 'patrimoine' and the Italian 'beni culturali'. Between this Convention and the *Operational Guidelines for the Implementation of the World Heritage Convention,* updates many times, principles and methods of conservation policies have reached an increasing shared definition at the international scale, specially pertaining an inclusive vision of heritage. However, their influence on practices of urban transformation remains alarmingly weak, mainly due to the persistence of different positions in terms of heritage, identity, preservation (Berque, 2007). In fact, a full awareness of the multiplicity of cultural identity emerges as a key factor in defining the necessary technical and cultural responses to the rehabilitation of the historic city (Cinà, 2010; Hastaoglou Martinidis, 2011; Abu Al Haija, 2012). The effect of a different notion of heritage provides a very clear example: the more you restrict the recognition of different cultural values, the less you feel the need to save them, so depriving their richness and diversity. Still, by their nature different identities are often in competition and frequently one affirms itself at the expense of another. We know that their coexistence can lead to results of great development and civilization, as in past Ottoman Istanbul (Mazower, 2004), but their opposition can lead to a social and cultural decline. Consequently, any planning and design practice in the historic city has a great responsibility to this regard.

Completely different is the situation when it concerns the reconstruction of cities traumatized by war or natural disasters. In the aftermath of these events the policies for the rehabilitation of historic sites are strongly related to the restatement of the greatest expressions of cultural identities. This restatement can be variously influenced: for instance by violence, mediatisation or discursive control over heritage questions (Hammami, 2012; Giblin, 2014). In the case of Iraq the several competitions and projects undertaken for the rehabilitation of the main sites of worship, together with the political discourse connected to them, can be intended as a significant attempt in this direction[iii]. Unfortunately, the approach following the inclusive vision of heritage above mentioned referring to international achievements has not been assumed as a leading one.

In fact, through the competitions and major projects two approaches to the problem are arising. One is trying to carry out an exit strategy from the present cultural isolation; differently, the other operates according to a merely real estate reconstruction strategy. In this situation, also characterized by a lack of debate, research and consolidated experiences, competitions are a major event at the political level, showing the limits and dangers of the ongoing operations, as they are handled by a government still not equipped to lead them to completion.
It should be considered that these projects are developed in a context where the few proposal granted by some political support have been heavily characterized by delirious real estate developments not making a difference between historical and modern city. One of these proposals comes from the project "Baghdad Renaissance", a gulf-styled huge intervention on a large area (900 ha) along both sides of Tigris riverfront

(4.5 km). Although not approved, the project shows the risks that loom over a city where the political class does not seem opposed to the idea of building a Dubai-like waterfront.

Besides, an increasing number of proposals for the rehabilitation of historic centers, driven by the recovery of the great shrines, it introduces a change full of potentiality. In this field, the rehabilitation projects for Al Kadhimiya district in Baghdad and Najaf's core city, both around a Shia shrine, are two eloquent examples. In both cases, the goal to consolidate the religious complex as a cultural and functional focus, and to revive the surrounding neighborhood, are stressed. Also, the updating of urban facilities and a strong push to the tourism development are foreseen. The resulting cityscape is a jump in a dreamed city where the connections with the historic city as well as with the present socio-economic condition are very few[iv].

On the other hand, the project for the rehabilitation of Mutanabi street and the development of Al Rasheed street and the Tigris river area, result more attentive to the character of the urban landscape and the recovery of the historical values. The former has been completed and also rewarded by a strong consensus, the latter is still under assessment. Although quite different in terms of goals, scale and conception, they seek for a way to conciliate the real estate interests and the conservation at least of the images of history[v]. However, it has to be stressed that the problems like the relationship between authenticity and innovation, building typology and plot partition, are simply bypassed. Still remains a dichotomy between the historic buildings to be restored and the urban fabric of historical interest that is meant to be renewed completely, often in a "post -neo- Moorish" style performing uninhibited formal inventions. Furthermore, many local professionals, considered the present condition, think that this approach fosters an acceptable – although unconservative - compromise.

A different reflection deserves the "Renewal Project of Old Mosul" (2009), consisting in a master plan for the entire ancient city with some more in-depth projects. This time no big demolitions are foreseen and it emerges the attempt to start a planning and design process step by step. But even in this case, as in those above mentioned, the prohibitive operating conditions have led to a stalemate.

From this bleak overview of small progresses and great confusion it arises an anxiety of innovation that clears as a bulldozer any attempt to deepen the true nature of a conservation plan. In this climate, plans and projects requiring a more or less intense process of social interaction are meant as a hindrance to a mode of action that prefers the developments decided in a blind ministerial bureau and handed over to foreign companies. The knowledge of the context of action through rigorous analysis, the conditions of economic feasibility, the listening of residents, all of these issues remain largely unexplored. At the end, also in Iraq the trend follows the examples of a conservation strategy where the heritage is tailored as a commodity internal to a tourist and commercial package. Of course, such a result comes from one hand from the globalization of real estate markets and from the other from the limits of local conditions. Among the latter the ideological conceptualisation of the heritage meaning and values is the most serious.

In fact, in Iraq the problem of the protection of cultural heritage is affected by the fragility of the political system, the backwardness of the technical apparatus, the weakness of the legal framework, the shortage of civil and associative structures and the submission to the market. By this situation it emerges a controversial consciousness of the cultural identity bringing to a not inclusive heritage conceptualisation. Actually, the cultural identity backing the plans and projects that we are arguing is the result of a construction not adequately elaborated and layered in the time, and above all not sufficiently shared by national community. This is a problem coming from far away and common to the countries that suffered a 'modernisation without modernity' (Jellal, 2005). In this condition the system of the cultural matrixes is still subjected to a progressive selection that reduces it into a narrow nucleus of values, more capable to avoid further cultural lacerations. In such a regressive process many aspects of the Iraqi cultural world have gradually loose ground and relevance. Just think the religious buildings not belonging to the Islamic faith, although on the civil field the situation does not diverge much (Fales, 2004; Fethi, 2005).

In this context, the "Regional/international competition to revive and develop the area of Adhamiya" (2010) introduces a breath of fresh air. In listing its goals the announcement introduces expressions never used so far, as follows: to get the best emphasis on the social and spatial integration between Al Kadhimyia (Shia) and Al Adhamyia (Sunni) communities; to emphasize the integration between the two areas building a bridge

to connect them across the river, so that an united national feeling could be reflected in spaces including gardens and leisure spaces on both the Tigris river fronts; to achieve the best architectural solution for the urban cityscape of the four districts of Al Adhamyia.

Accordingly, the project here presented is highly oriented to the consolidation of the *cultural diversity* still present in Adhamiya, avoiding interventions that would dismantle the weak links still relating the existing city and its old remains. As a consequence the project doesn't provide high buildings around the Abu Hanifa Shrine, neither proposes huge new complexes breaking the existing medium density of modern urban fabric. On the contrary, the historical values of the whole neighborhood are highlighted by stressing the different identities they are bringing, from the ancient fabric near the shrine to the many facets of the modern one, from the first British works in neo-Moorish style to the regional modernist houses of Iraqi architects (Warren and Fethi, 1983; Marefat, 2007; Pieri, 2008; Al Sultani, 2010). It is in this inclusive vision, by combining the architecture and the Tigris Corniche, the low rising urban fabric and the 100 buildings and places of historical interest, then translating it into specific measures of intervention that the project assumes an innovative value, worthy of subsequent dissemination.

3. The implementation of a dual system of intervention, between planning and design

The operational strategy of the project is based on the implementation of two operating modes, integrated and parallel, running on two different speeds. The first one is based on the definition of a technical, administrative and regulatory system, addressed to lead and manage the multiple operations and interventions to put in effect on the ordinary urban fabric. Linked to it there is a set of analysis which leads to a set of choices in terms of urban planning: among these choices there is the identification of five central places. The second operating mode is based on the design of these five central places, defined in their physical and formal components, providing the spatial and functional focuses of the Adhamiya urban system. Consequently, a double range of measures is forecast: one for the areas of conservation (in the old town) and soft transformation (in the modern town), the other for the five special urban places, intended as gates of innovation. In this case the preservation of some urban values is associated with a significant transformation of their formal and functional components.
It follows the construction of a set of interventions that is in part linkable to the 'design of a process' and in part linkable to the 'design of five central places' (each one provided by some flag-buildings). Ultimately, the project aims at integrating in a united logic of development different places, actors, institutions and policies (see Table 1).
It is evident that the management of the operations for the design and the implementation of the central places, even if demanding large investments, is less difficult than that concerning the rehabilitation of the ordinary city. In fact, it affects problems more concentrate in terms of time and space and also it implies the mastering of a simpler set of social, economic and political issues. On the contrary, the rehabilitation of ordinary city requires a long term policy mastering a larger set of variables in order to implement the public works (for historic buildings restoration, urban maintenance, infrastructures, public spaces,…) and the 'plot-by-plot' developments carried on by the private building activity .

Table 1 - A dual system of places and tools

CENTRAL PLACES	*ORDINARY CITY*
Urban Projects acting as spatial and functional corner stones	Schemes, Regulations, Guidelines, Pilot Projects acting mainly as regulatory and planning tools
Selected upgrading	General upgrading
International and national entrepreneurship	National and local entrepreneurship
Centralised administration (Ministries, Governorate of Baghdad …)	Decentralized administration (Amanat of Baghdad, Adhamiyia Authority…)
Centralized decision-making model	Participated decision-making model (local institutions, inhabitants, developers and stakeholders)
Implementation in a defined time	Continuous implementation (short, medium and long term)
Developments acting on selected areas, at medium and large scale	Interventions acting on the whole neighborhood, at medium and small scale
Landmarks	Ordinary landscape

We are aware that at present the political, technical and administrative bodies are not able to implement this process. Nevertheless, we believe that the simultaneous launch of the two policies above outlined, by both

regulatory tools and projects, is a compulsory gateway to start a true process of development. Such a strategy could release enormous energies because it would offer the opportunity to pass gradually from an emergency approach to a proper planning process, channelling these energies into an integrated development of the different urban components, without condemn the 'minor' residential fabric to abandonment.
Once established the methodological frame the project is developed following five goals, corresponding to five urban networks:
- Preserving identity and historical values;
- Rationalizing mobility and main connections;
- Providing a riverfront park system;
- Developing a system of cultural facilities;
- Organizing uses and functions.

It is noteworthy to point out that this dual approach was also adopted, albeit in different form, in the *Conservation Study for the Rusafa area* above mentioned. In declaring this cultural debt the present project wants to recall the lessons of that work, which should have been the starting point for an integrated approach to the historic city, but remained unimplemented and then ignored both in academic training and in research.

4. The issue of the preservation of historical values

Starting from the slant of historical values, a first problem to solve has been the definition of a procedure to identify the perimeter of the historic centre. In fact, the project was worked out in total absence of scientific references and without a proper technical survey of the site (for security reasons no permission was given). In this conditions the study of maps (1917, 1929, 1944, 1951-56, 1958), some of them possessing a true historical value (until 1917 the urban fabric was almost untouched by modernisation), has been fundamental for the definition of real historical borders of ancient Adhamiya, thanks also to some prudent photo surveys on the ground. As a result, the evolution of the whole neighborhood in its different stages of growth has been retraced, showing the mosaic of the two major components: the triangular historic area, which urban fabric contains mainly 'Transitional (intiqâlî) courtyard houses', and the Modern urban fabric, this latter containing in some parts prevalent 'Semi-detached regional eclectic houses' and in other parts prevalent 'Detached and semi-detached modernist houses'. To operate the reading of the urban texture a morpho-typological analysis, though in embryonic form, has been developed looking at the lesson of Italian approach (Caniggia, 1997; Maretto, 1999; Cataldi *et al*., 2002; Marzot, 2005; Gauthier, 2006).

Hence the project followed two paths:
a - the drafting of a 'Methodological scheme for a *Plan of rehabilitation and development*' (PRAD);
b - the sketching of two 'Demo-projects' showing how some interventions can be designed and build-up in a first phase, following the principle of learning by doing.

3.1 A methodological scheme for a 'Plan of rehabilitation and development'

The draft of a methodological scheme for a PRAD responds to the need to design a broad framework for all the operations and operators entering the process of city transformation. Such a framework, characterised in terms of administrative, technical and managerial aspects, is intended to put every large-scale intervention from the very beginning within a consistent strategy of transformation.
It this sense, the project gives a set of tools to put in place a long-term urban policy, avoiding that only big urban projects, often resulting in ghettos for tertiary and luxury functions, could take advantage by the energies set off with the urban rehabilitation policies, abandoning to their fate the poorer urban components.
The methodological scheme defines a set of both conceptual and technical steps, showing the different matters to work out in order to implement the planning process in its main different phases. To this effect, the main methodological references taken into consideration are traceable in two fields: in some valuable plan linkable to the 'Italian school' of historic centres preservation, as developed from the early 1960s to 1980s (Astengo, 1958; De Carlo, 1966; Cervellati, 1973; Scannavini, 1973; Cervellati and Scannavini, 1973; Comune di Palermo, 1984; Comune di Palermo, 1990; Cervellati and Floris, 2004; Maccaglia, 2009) and in some valuable rehabilitation processes carried on in Islamic cities (Spiekermann and Gangler, 2003; Busquets, 2006; ADER-Fez, 1999; Radoine, 2008).

The matters considered are included in the following six sections:
- principles and general measures of intervention;
- analytical framework;
- measures of intervention for uses and functions:
- measures for the mobility system;
- measures of intervention for open spaces;

- types of intervention for urban fabric.

What follows shows a synthesis with a few comments on the contents of these sections.

3.1.1 PRAD – Principles and general measures of intervention

In this part the principles and the general measures of intervention are also conceived in term of goals to be achieved. They range from ”Preserving traditional typologies, technologies and materials as true expression of architectural heritage” to ”Saving the average height of Adhamiya buildings, to preserve its outstanding landscape and avoid more densification of activities and traffic”. Of course, a more complete elaboration of this section should clarify more in depth the involved meanings, well distinguishing among principles, goals to be achieved and measures of intervention.

3.1.2 PRAD – Analytical framework

The current state of functional and physical degradation of old Adhamiya demands much more than a simple maintenance or a renovation with a façadist approach. In order to detect the proper answers to the required interventions a deep multiple analysis of the functional and physical context needs to be done. To this purpose, following a procedure diffusely experienced, the study of some major aspects of the urban structure is proposed. These aspects are identified among the most relevant in terms of formal and functional value:

- *morphological asset;*
- *typology of buildings;*
- *static condition of buildings;*
- *health standards;*
- *functional systems;*
- *mobility system;*
- *public facilities;*
- *open spaces*.

As such, the project is mainly referred to a standard set of analytical categories matured in a wide range of theoretical assumptions, plans and projects, already experienced in the Italian context. Perhaps, it is incomplete and not well matching some peculiar characters of the site, nevertheless it seems able to give a valid frame to the work of analysis. Even in this case the project aims at just address a more detailed framework to be provided during the implementation phases.

Yet, the major problem doesn’t rest on the completeness of the list but rather in the capacity of local technical board to support such a complex system of surveys. We know that at present this capacity doesn’t exist. So, how to proceed? By this impasse we begin to see the necessity to *invent* some solutions responding to the local difficult conditions, possibly some *shortcut* able to achieve even partial results without betraying the horizon of a scientific approach. In any case, the way to do it has to be found according to the present conditions.

3.1.3 PRAD – Measures for a balanced upgrading of uses and functions

In this section the main lines for a balanced distribution of activities, functions and uses within the neighborhood are provided. They are directed to ensure the complete insertion of all opportunities of upgrading and development of the historic city. To this end a set of basic principles are suggested, ranging from the “Preservation of residential function”, tending to ensure the permanence of the actual residents in a future more socially mixed housing, to the “Enhancing the existing craftsmanship”.

Besides, some ‘admitted functions’ are pointed out, excluding those that are supposed to contrast with the values of the historic city and increase the risk of gentrification (Abaza, 2011, Abu Al Haija, 2012). New functions are also provided, from those related to the Kulliye extension and facilities, to the others spread out in the old urban fabric (as the Centre for maintenance of heritage artefacts, the Museum of Adhamiya etc.).

3.1.4 PRAD - Measures for the mobility system

The proposal concerning the mobility system is articulated on three levels: the principles to be followed, the main proposals and some special measures to enhance the soft mobility.

The first ones are focused on the preservation of the present street network, potentially efficient, and on the upgrading of the mobility system, also enhancing the public transport. In this sense the opening of a metro line is the most relevant innovation. The second level establishes a functional hierarchy among principal and secondary axes, and short connections. The third level provide a set of measures limiting the vehicular accesses, from the creation of a “Zone 30” in the old centre to the implementation of a multiple mobility (ferry boat stations, tourist port, bus and metro stations, car-parks areas etc.).

3.1.5 PRAD - Measures of intervention for open spaces

The measures for the open spaces are conceived in terms of principles to be followed and main proposals. In fact, the development of the opportunities offered by the existing set of open spaces, usable as public facilities, is a primary step to improve the urban quality. More, the improvement of open spaces is a fundamental condition to trigger the private interventions. To this end the proposed interventions range from the ”upgrading of panoramic river walks” to the “creation of public green squares” and the “maintenance of public and private gardens”.

3.1.6 PRAD - Types of intervention for urban fabric

The relevant amount of works to be carried out on the urban fabric needs a clear definition of the different forms of intervention. Such an outcome is a fundamental one because it can result in a common technical syllabus in which skills, professional competences, knowledge and regulations find a proper reference. Thanks to this framework it becomes possible to avoid that different operators, acting in different times and positions, give contrasting names to a same concept, confusing among meanings, problems and solutions. To this effect a selected list of 'types of intervention on urban fabric', corresponding to the different conditions of buildings and fabric, is provided as follows:

1. Restoration
2. Conservation
3. Renewal
4. Protection of typical features
5. Functional rehabilitation
6. Maintenance / ordinary and extraordinary
7. Reconstruction
8. Volumetric completion
9. Removal of disturbing activities
10. Functional reuse
11. Demolition - Demolition with agreement
13. Protection of pedestrian road

Such a list should not be considered neither a vague set of indicators nor a rigid list of types of intervention. In reverse, it must be considered as a concrete technical field, to be worked out by the public technical bodies, giving to each item a proper definition explaining the modes and the fields of its use. More, it can be partially changed. The result should be performed as a regulatory platform, containing the *official* definition of all types of intervention, suitable to address planners and designers in a known and shared technical framework.

3.2 Two Demo-projects *for an operational first phase*

Besides the PRAD above synthesized, two *Demo-projects* are sketched in order to show how two relevant interventions can be designed since the first phase: the *National Museum of palm trees* and the *Revitalisation of the Adhamiya Corniche.* They can be implemented following the principle of learning by doing, because they don't need the prior implementation of the PRAD and, furthermore, they can help to draft it. In some way they act in between the scales of planning and design.

3.2.1 The National Museum of palm trees

We all know that the palm tree is an expression of the Iraqi national identity from the era of Mesopotamian Antiquity to the Islamic and modern times. More, it has always been part of the landscape around the Abu Hanifa Shrine of Adhamiya. Hence the idea to devote the empty area around the Shrine to a wide traditional palms garden. Such a solution also aims at answer an important demand stressed in the competition announcement: to seek for solutions favouring the dialogue between the Sunnis and Shiites communities, respectively located in the districts of Adhamiya and Kadhimiya.

According to this goal the project sketches some spatial solutions able to show the mains results to achieve, as follows: a) the preservation of a visual link between both river Togris banks, b) the reduction of the impact of the cutting of Al Imam Al Adham str. by saving a pedestrian continuity near the Mosque and close to the river bank, c) the provision of both a huge shaded area and a permeable pavement to improve the bioclimatic conditions, d) the creation of a scientific collection of most relevant species of Iraqi date palm, e) the set up of a didactic section of the Museum in a restored building near the Abu Hanifa Square.

3.2.2 The revitalisation of the Adhamiya Corniche

The Adhamiya Corniche is the most relevant open space of the neighborhood. More, to save the Corniche means saving the most precious local landscape, bringing back the city-river symbiosis. Hence the project provides some proposals and measures of intervention thinking to a slow infrastructure able to heal the energies of the city along the riverfront.

The proposals range from "keeping the actual average height" to "providing a homogeneous design for the system of open areas", also in order to give new impulse to the tourist and commercial activities. To this end new skyscrapers along the Tigris are firmly rejected.

The various measures of intervention range from the "reshaping of façades" to the "reconstruction of ruined traditional building" and from the "removing of contrasting element and materials" (glass wall, red reservoirs, etc), to the "demolishing of buildings not legally built". According to these measures the project sketches some spatial solutions able to show the mains results to achieve.

3.3 The creation of a "Board for the rehabilitation of Adhamiya Historic Centre"

The implementation of both the PRAD and the Demo-projects implies a deep commitment of the local technical staff, at present not equipped with the needed skills. Then, the project suggests the creation of a dedicated local "Board for Adhamiya Historic Centre", possessing a trained and specialized staff, so that the

implementation of the project could be supported by local officials and advisers in all the administrative and technical proceedings.
Many and important tasks could be immediately assigned to this Board, beginning from the implementation of PRAD. Equally important has to be considered the setting of at least two Operational Guidelines, for private and for public interventions as well as an 'Operational plan for the Adhamiya Corniche revitalisation'. At a different level would be also important the launch of a 'Tender for public co-funding of private initiatives'. It is evident that both the Board and the connected tasks call into question a strong political commitment, at present seriously lacking.

3.4 Conservation of both monuments and current urban fabric in the modern city
Adhamiya enjoys a balanced urban structure with a consistent and modern morphological pattern (1930 - 1970) requiring an overall revitalisation not disrupting the existing fabric
As a consequence also in its modern fabric the project provides a light conservation strategy, though limited to some special buildings and conditions. In this regard, the project lists the following set of mains interventions to be put in place:

- Restoration of 3 remarkable modern monuments (University Al il-Bayt, Royal Mausoleum, Sports Club -Nadi al-Adhamiya);
- Measures of respectful improvement of 100 Buildings and places of historical interest, listed by the Municipality;
- Moderate conservation of the existing townscape, linked to its three main characters: the rational morphological pattern, the moderate and quite uniform height, the types of plot exploitation (one of them is the sequence of villas provided by green courtyards).

Add to this the need of a set of "Guidelines for upgrading modern Adhamiya districts" is pointed out, as a necessary tool to technically address all the private conservative interventions of maintenance and upgrading.
In this case it is clear that the issue it is not just to operate a prudent renewal, within a framework of technical guidelines (Marconi, 1987), but to implement a planning process supported by a clear conservative approach. In that sense, to follow such a commitment would be in some ways revolutionary: because it would lead to recognize even in the modern city a distinctive identity value; it would follow the foundational principle of the urban maintenance and the prudent urban renewal (IBA, 1987; GTZ, 2003; Herle, 2003); it would preserve not only the monuments but also the modern medium-density texture of Adhamiya still miraculously intact.

5. Innovation and development in the modern city: the creation of five *Central Places*

Parallel to the policy of preservation, the project provides solutions for an overall development worked out by means of a deep urban innovation. To this end, according to the present potentialities, the creation of five Central Places is proposed as a strategy of integrated development, able to connect problems and solutions affecting different functional field, first of all the mobility and the functional networks.
The Central Places give multifaceted opportunities for upgrading the existing civic spaces and invent the new ones, by the mean of big projects acting as landmark.
They work as true by-passes, playing at both the spatial and functional level. At the spatial level, being distributed within the central area and along the border of the neighborhood, they connect its different parts ordering their physical relations. At the functional level, they provide new tertiary functions at the scale of neighborhood itself and in relation to the whole city and its outstanding role as capital.
Concerning the architectural design, the new buildings are conceived in order to meet with the regional and local characters and to perform innovative solutions not subjecting to global paradigms or post-moorish shortcuts.

4.1 The area of Abu Hanifa mosque square
This area is conceived as a central place to be restored and developed following the issues of identity. The requests of the competition for a new organisation of the area are resolved with the design of a continuous architectural system giving a formal/functional solution at different levels: defining a border along the rotten and undefined fronts of the square, separating the pedestrian and vehicular mobility, giving a double consistent function to the square: as a *piazza* and a garden. It results in an urban scene characterised by the plain monumentality of the built-front, not competing with the Mosque height; and by a green shaded square providing a sense of unity in the big empty space. The built system is based on some basic elements:
- a three storeys set of buildings running all around the square and maintaining the size and the scale proper to a *piazza*;
- a classical architectural partition, marked by continuous porticoes/terraces, here and there interrupted by some modern/ vernacular elements recalling the traditional *shanashil*;
- a wall apparatus in brick, reminding the architectural tradition of Iraq;

- a strip of panoramic terraces interrupted by semi-transparent volumes, to give shadow and to be used all day along;
- the 'gates' on the building frontline, leading to the surrounding urban fabric.
The counterpoint between classical order and traditional references is consistent with the requirements of bioclimatic function and results inter alia in a double facade with crossed ventilation.

4.2 The area of the crossing Nu'man street / Al Iman al Adham street
This area is conceived as a central place for urban services, exploiting its pivotal location, in the middle of the neighbourhood and Al Iman al Adham str. It is a focus of formal and functional innovation, mainly providing tertiary and commercial uses. The architectural apparatus is marked by the fluent movement of volumes, with brick facades breaking the flat uniformity of the existing straight built fronts. Here the new metro station becomes the major gateway to reach the core of Adhamyia and Al Bait University campus.

4.3 The Antar square area
This area is conceived as a central place for business and tertiary activities, located at the east border of the neighbourhood, so directly connected to the city centre. Thanks to this position, and to the fluxes passing through, the place is suited to become the nerve centre of the infrastructural network. As such, in order to gather and distribute all the city fluxes, Antar square is the most built and crossed central place.
The architectural asset is characterised by a round double set of buildings around the square (from 4 to 12 floors) hosting tertiary functions. The collection of the most rising building in this peripheral location produces the bigger urban landmark in the south-western neighborhoods.
The infrastructural asset is characterised by a ground level mainly devoted to vehicular circulation and a lowered square with multiple functions, settled according to the example of Tahir square in Baghdad. The square connects the double set of tertiary buildings and gives pedestrian access to the different part of the area as well as to the metro line.

4.4 The campus of Al il-Bayt University
This area is conceived as a central place for High Education. Here the central axe of the plan designed for the campus of Al il-Bait University (J.M. Wilson arch.,1924) during the English Mandate, is reinforced as a cultural Mall. The project acts at different levels: making denser the built front; adding new volumes for education and cultural leisure; upgrading the range of high educational functions; increasing the green areas while reinforcing the perspective of the Royal Mausoleum (J. Cooper arch., 1936). By this upgrading and extension the University is meant to achieve a primary role in the high education system of the capital.

4.5 The park on the riverfront of Al-Harra
This area is conceived as a central place for cultural functions, creating a district of public interest at local, national and international level. The location on the Tigris riverfront is suitable to host very high civic functions, playing the question of identity in positive counterpoint with the religious character of the Shrine pole and consolidating the Adhamiya cultural prestige.
The project sketches a spatial solution for a set of low buildings showing the aim to oppose the towers mushrooming along the riverfront, unfortunately ubiquitous in all recent great projects of urban renovation in Baghdad. The main new functions provided are the following: a Museum of National History of Iraq; a Library for 500.000 volumes (requested by the call); a Multipurpose Hall, hosting spaces for music, poetry, conferences, theatre, etc.; buildings for tourist facilities, respecting the riverfront's peaceful landscape. Lastly, a green park, especially equipped for athletics and sports facilities, a river promenade linking the Adhamiya Corniche to the south bank, equipped with other public amenities, and a ferry boat station.
In fact, this area is proposed as a pivotal one in the perspective of the construction of an urban/natural park along the riverfront on both banks, connecting the areas not yet urbanised.

6. Conclusion
The project tries to face the requests set by the competition announcement through a holistic approach oriented to an overall upgrading answering the need of order and urban quality of Adhamiya.. By this approach the following set of main goals comes out: valorizing all the historical values of Adhamiya; update and enlarge the network of urban functions (culture, , high education, tourism, commerce, leisure etc.); providing new central places; enhancing the landscape resources ;
To meet this scenario the project forwards a method based on two operating modes, expected to run in parallel and connect a broad set of interests, skills and energies at many levels. These two modes acts through a) a planning process providing a regulatory system for the interventions, mainly elaborated and managed by a public board; b) a set of large projects, mainly addressed to private developers. These two levels meant to interact and help each other, facilitating the implementation of public and private operations on separate and interacting fields. In short, a plan-project process is set up, promoting a development across all social and physical components of the neighborhood.

Such a process remains still difficult to implement. To overcome this difficulty it can be addressed by single parts, distinguishing those invariable from the variable ones. The former concern the strategy of intervention, in terms of method and goals, as the adoption of a planning process based on both regulatory instruments and projects. The latter concern the timing and the modes of possible solutions, especially at the scale of architecture. For example, the five central places can be significantly modified, after a deeper check on the operational conditions.
As a matter of fact, it is necessary to provide ample flexibility both to the modes of governance and the formal solutions. Thus, there are no fixed priorities. It is possible to start from any regulatory instruments or central places, providing that in each case an acceptable participatory process would be assured, supplied with proper technical tools, public and private participating actors, mix of final users.
To be honest, it is hard to imagine at present to which extent this process could be managed. Many of the key issues in point (identity and heritage, public management of planning tools, participation, slow mobility, urban landscape) may assume an operational value only after a strong political commitment. In many ways such a commitment today is absent.
More, considering the turbulent and in some way threatening process of reconstruction now underway in Baghdad, many of the key issues above mentioned appear to be revolutionary. It is so in the case of the identity, a concept that melts like snow in the sun face to the interreligious conflicts. Just consider how much this conflicts are fateful not only to the heritage related to religious minorities, but also to the very ground of Islamic culture, contested between Sunnis and Shia. Not to mention the modern architecture, today suffering a lack of recognition at all levels, the opposite of how it has been considered in the 1950s (Haytam, 2007).
Nevertheless, it is possible to detect some significant signs of change at various levels. New social figures and conditions are emerging and we must be prepared to offer them something better than the braised dishes of Dubai-like developments. The proposed solutions, establishing a strategy open to the intervention of a wide range of private and public operators, are looking just at this emerging civil society.
All in all, the project affirms the idea that it is possible to put in coherence a strategy of both participative rehabilitation and development, not limited only to hard interventions, but able to flow back through the ‘city of all’.

Bibliographical References

Abaza, M. Critical Commentary. Cairo’s Downtown Imagined: Dubaisation or Nostalgia? *Urban Studies*, 48 (6), May, (2011): 1075–1087.

Abu Al Haija, A. H. Jordan: Guidelines for Urban and Architectural Heritage Conservation: Umm Qais Case Study. *International Journal of Architectural Heritage: Conservation, Analysis, and Restoration*, 6:1 (2012): 62–85.

ADER-Fez. *Case study: Fez, Morocco. Rehabilitation of the Fez Medina*. Graduate School of Design, Harvard University, The World Bank, 1999.

Al Sultani, K. *The role of modern architecture as an element of Baghdad city center identity*, PRICC Conference, Amanat of Baghdad, March 22–25, (paper), 2010.

ANCSA, Italian National Association of Historical and Artistic Centers. *Charter of Gubbio.* Final declaration after the National Conference for the protection and the restoration of historical centres. Gubbio (Italy), 17-19 Sept. 1960.

Astengo, G. Piano regolatore di Assisi (Master plan f Assisi), *Urbanistica* n. 24–25 (1958).

Berque, A. Transmitting the past to the future: an ontological consideration on tradition and modernity. In: *Historical architecture heritage Preservation and sustainable development*, International symposium, Tianjin University, 10-12 Nov. 2007.

Bianca, S. Designing compatibility between new projects and the local urban tradition. In: *Continuity and Change: Design Strategies for Large-Scale Urban Development*, M. Bentley Sevcenko (ed.), Cambridge, Massachusetts: The Aga Khan Program for Islamic Architecture, pp. 21–34, 1984.

Bianca, S., Yamada, S., Fethi, I., Lombardi, G. and JPC consultants. *Study of conservation and development of Historical Centre of Baghdad City*. Synthesis Report, sept., Amanat Al Assima, Baghdad, 1984.

Busquets, J. ed. *Aleppo: Rehabilitation of the Old City*. Cambridge: Harvard University Press, 2006.

Caniggia, G. *Ragionamenti di tipologia. Operatività della tipologia processuale in architettura (*Reasoning about typology. Operativeness of typological processing in architecture). G. L. Maffei ed. Firenze: Alinea, 1997.

Cataldi, G. *et al*. Saverio Muratori and the Italian school of planning typology. *Urban Morphology*, 6, 1 (2002): 3–14.

Cervellati, P.L. Bologna, introduzione all'intervento pubblico nel centro storico (Bologna, introduction to public intervention in the historic center). In: *L'intervento pubblico nei centri storici*, *Edilizia Popolare*, monographic issue 110, Rome, 1973.

Cervellati, P. and Floris, P., eds. *Piano particolareggiato per il recupero del centro Storico* (Detailed plan for the historic center recovery), Comune di Senigallia, 2004.

Chadirji, R. and Carlfried, M. The Bab al-Sheikh Project, Baghdad. In: *Continuity and Change: Design Strategies for Large-Scale Urban Development*, M. Bentley Sevcenko (ed.), Cambridge, Massachusetts: The Aga Khan Program for Islamic Architecture, pp. 56–69, 1984.

Cinà, G. Baghdad and the risks of an unsuitable reconstruction. In: *Urban Design in Change, Change in Urban Design*, XV International Urban Design and Implementations Symposium, Proceedings, Mimar Sinan GSU, Istanbul, pp. 181–191, 2005.

Cinà, G. Rebuilding identity between reconstruction and preservation: the case of Iraqi cities. In: 54th IFHP World Congress, *Building Communities for the Cities of the Future*, Puerto Alegre, web proceedings, 2010.

Comune di Palermo. Il Piano Programma del centro storico di Palermo (The Plan Program of the historic center of Palermo). *Progettare* n. 1, monographic issue, Palermo, 1984.

Comune di Palermo Piano particolareggiato esecutivo del centro storico. Relazione generale, 1989 (Detailed plan of the historic center. General Report, 1989). Assessorato all'Urbanistica e centro storico, *Parametro* a. XX, n. 178 (1990): 16–63.

De Carlo, G. *Urbino. La storia di una città e il piano della sua evoluzione urbanistica* (Urbino. The story of a city and the plan of its urban evolution). Milano: Marsilio Editori, 1966.

Fales, F. M. *Saccheggio in Mesopotamia* (Pillage in Mesopotamia). Udine: Forum, 2004.

Fethi, I. Iraq. State of Ecology and Built Heritage after Four Decades of Adversity. In *Heritage at Risk*, ICOMOS World Report, pp. 111–124, 2004/2005.

Gauthier, P. Mapping urban morphology: a classification scheme for interpreting contributions to the study of urban form. *Urban Morphology,* 10, 1 (2006): 41–50. ISSN 1027-4278.

Giblin G. D. Post-conflict heritage: symbolic healing and cultural renewal. *International Journal of Heritage Studies*, 2014 Vol. 20, No. 5 (2014): 500–518. DOI:10.1080/13527258.2013.772912

GTZ - Deutsche Gesellschaft Für Technische Zusammenarbeit. *Design handbook. Outlining planning statutes for the redesign of Sibiu's historic old town*. Joint romanian-german project Restoration of the historic centre of Sibiu/Hermannstadt, Sibiu, June 2003.

Hardy, M. ed. *The Venice Charter Revisited: Modernism, Conservation and Tradition in the 21st Century*. Cambridge Scholars Publishing, 2008.

Hastaoglou Martinidis, V. Urban aesthetics and national identity: the refashioning of Eastern Mediterranean cities between 1900 and 1940. *Planning Perspectives*, 26:2 (2011): 153–182.

Haytam B. Cultivating the nation space: modernism and nation building in Iraq, 1950-1963. *Taarii Newsletter, The American Academic Research Institute in Iraq*, n. 2.2 (2007): 9–11.

Herrle P. *Sustainable urban conservation in Yangzhou, China*, Habitat Unit, Ergebnisse des Feldaufenthalts, Berlin, 2003.

IBA. *Step by step: careful urban renewal in Kreuzberg.* Berlin: Internationale Bauausstellung Berlin, ed. Jochen Mindak, 1987.

ICOMOS. *Venice Charter*. The 2nd International Congress of Architects and Technicians of Historic Monuments, Venice, 1964.

ICOMOS. *European Charter of the Architectural Heritage*. Amsterdam, 1975.

ICOMOS. *The Burra Charter for the conservation of places of cultural significance.* Burra, South Australia, 1998.

ICOMOS. *Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage*. Victoria Falls, Zimbabwe, 2003.

ICOMOS. *Principles for the Safeguarding and Management of Historic Cities, Towns and Urban Areas*. The Valletta, Malta, 2011.

Abdelkafi, J. Patrimoine culturel et identités de la meditérranée contemporaine. In: Institut de Recherches pour le Développement, Programme ISMARMED, *Séminaire International sur la gestion de l'heritage meditérranéen partagé*, Alexandrie, 29-31 mars 2005.

Khechen, M. Beyond the Spectacle: Al-Saha Village, Beirut. *Traditional Dwellings and Settlements Review*, Vol. XIX, No. 1 (2007): 7–21

Hammami F. Conservation under occupation: conflictual powers and cultural heritage meanings. *Planning Theory & Practice,* Vol. 13, No. 2 (2012): 233–256.

Maccaglia, F. Redonner forme et vie au centre historique de Palerme (Sicile). Retour sur une expérience de développement territorial et de requalification urbaine (1993-2001). *Urban History Review/Revue d'histoire urbaine*, Vol. 37, No. 2 (2009): 40–52.

Mahgoub, Y. Hyper identity: the case of Kuwaiti architecture. *Archnet-IJAR, International Journal of Architectural Research,* Vol. 1, Issue 1, March (2007): 70–85.

Marconi, P. *Manuale del recupero dei centri storici* (Handbook for the historic centres preservation). F. Giovanetti ed., Palermo: Flaccovio publisher, 1987.

Marefat, M. 1950s Baghdad-Modern and International. *TAARI Newsletter*, issue 2:2 (2007): 1–7.

Maretto, M. *The historical centre of Chioggia: a critical and working analysi*s, in *Transformation of Urban Form: from interpretations to methodologies in practise*. ISUF International Conference (Firenze, july 23-26, 1999). Firenze: Alinea, 1999.

Marzot, N. The Italian approach: premises, developments and future perspectives. The importance of building type in urban design strategy. *Urban Design*, 93 (2005): 30–31.

Mazower, M. *Salonica, City of Ghosts: Christians, Muslims and Jews, 1430-1950*. London: HarperCollins, 2004.

Nagel, C. Reconstructing space, re-creating memory: sectarian politics and urban development in post-war Beirut. *Political Geography*, Volume 21, Issue 5, June (2002): 717–725.

Parapetti, R. and Ibrahîm Kajiha, M. Traditional Houses in Al-Kraîmât quarter. *Mesopotamia,* XXXIV-XXXV, Università di Torino. Florence: Le Lettere, 2000.

Petzet, M. Principles of preservation. An introduction to the International Charter for Conservation and Restoration 40 years after the Venice Charter. In: ICOMOS, *International Charters for Conservation and restoration*, 2nd edition, Monuments and sites I, pp. 7–29, München, 2004.

Pieri, C. *Baghdad Arts Deco, Achitectural Brickwork 1920-1950*. Cairo: The American University, Cairo Press, 2010.

Radoine, H. Urban Conservation of Fez-Medina: A Post-Impact Appraisal. *Global urban development,* Vol. 4, Issue 1, August (2008).

Raouf, L.A.N. Housing and social segregation in Iraq. *International Journal of Urban and Regional Research*, Volume 9, Issue 3 (1985): 368–382.

Saidi, H. Capital cities as open-air museums: a look at Québec City and Tunis. *Current Issues in Tourism*, Special Issue: Global change and tourism in national capitals, Volume 15 (2012): 75–88.

Scannavini, R. Bologna, il piano per il centro storico (Bologna, the plan for the historic center). In: *L'intervento pubblico nei centri storici*, , *Edilizia Popolare*, monographic issue 110, Roma, 1973.

Spiekermann, M. and Gangler, A. Urban Heritage Preservation and Tourism Development in the Old City of Aleppo, *Trialog* 79 (2003): 16–21.

Su X. Heritage production and urban locational policy in Lijiang, China. *International Journal of Urban and Regional Research*, Vol. 35.6 (2011): 1118–32.

UNESCO. *Convention concerning the protection of the world cultural and natural heritage*, Paris, 1972.

Viqar, S. A Commentary on Recent Heritage Conservation Efforts in the Emirate of Dubai. *Journal of Research in Architecture & Planning,* Volume 3 (online journal), NED University of Engineering & Technology, 2004.

Wang, S.Y. From a living city to a World Heritage City: authorised heritage conservation and development and its impact on the local community. *International Development Planning Review*, 34, 1 (2012): 1–17.

Warren, J. and Fethi, I. *Traditional Houses of Baghdad.* Horsham: Coach Publishing House, 1983.

Warren, J. and Worskett, R. Conservation and Redevelopment of the Kadhimiyeh Area in Baghdad. In: *Adaptive Reuse*: *Integrating Traditional Areas into the Modern Urban Fabric*, M. Bentley Sevcenko (ed.). Cambridge, Massachusetts: MIT Laboratory of Architecture and Planning, pp. 32–46, 1983.

Winter T. Heritage studies and the privileging of theory. *International Journal of Heritage Studies*, 20:5 (2014): 556–572, DOI: 10.1080/13527258.2013.798671.

[i] In this period a more evolved social milieu, exploiting the contribution of foreign professionals, was active at cultural, academic and professional levels, both in urban planning discourse and in technical achievements. Thanks to it, along with the great themes of modernisation, some first attempts to rethink the traditional city were carried on (Warren and Worskett, 1983; Bianca, 1984; Chadirji and Carlfried, 1984; Parapetti and Ibrahîm, 2000) as well as some critical readings on the theme of housing (Raouf, 1985).

[ii] Project team: Giuseppe Cinà (responsible), Maryam Alsaigh, Luca Barello, Davide Ferrero, Nahla Jajo, Mauro Sudano. Consultant for historical aspects: Caecilia Pieri .

[iii] Relevant projects have recently involved the historical centres of Samarra, Najaf, Mosul, Kerbela and Baghdad. The most important have been presented at the *International Conference Preservation and Rehabilitation of Iraqi City Centers,* promoted by the Mayoralty of Baghdad in collaboration with University of Baghdad, College of Engineering, Iraqi Cultural Support Association, General Directorate of Physical Planning, Ministry of Municipalities & Public Works, General Directorate of Antiquities and Heritage, in Baghdad, March 21-27, 2010.

[iv] The “Al Kadhimiya Shrine's Integrated Conservation and Development Scheme” (2009) is an international competition whose goals are to renew and develop the area of the Shiite Al Kazimiyah shrine, the most important of the capital. The project provides the redefinition of the formal and functional set-up of the area surrounding the mosque for a radius of about 500 m, including religious schools, services for the sanctuary, public spaces, tourism and cultural facilities, improved accessibility. The urban scheme proposes a new urban set-up coming from the demolition of all the buildings within the area surrounding the shrine, so clearing a vast housing traditional fabric and the Souk Astrabadi here included. The “Najaf city redevelopment project” (Dewan Architects & Engineers, 2009) is a destructive project as well, but at a larger scale than that of Al Kadhimyia. It proposes to solve the existing problems according to the most simplistic development strategy: to isolate the shrine from the residential fabric and rebuild the whole area around it: of course, in traditional style.

[v] The “Mutanabi street rehabilitation project” (2007) concerns the street of Bagdadi booksellers, once the heart of the literary and intellectual Baghdad. Affected by heavy bombing of 2007, it was brought back into operation after a radical intervention of reconstruction and a few restoration which reconfigured the image and spirit of the place. Despite the redundant decorations of the new buildings the project became in some way a model to imitate, and a shortcut for a recovery approach. The “Al Rasheed street - Tigris river area development” (Consulting Group, 2009) covers an area of 18 ha and is a worth attempt to give a careful solution to the remaking of the historical district aligned on Al Rasheed street. The proposed renewal aims to reverse the decay of the area today, in terms of activities, public services and infrastructures, by adopting a strategy of allocation of new functions and new urban central places. Sure, it is an uncritical solution, following the speedy method adopted for Mutanabi street.

HERITAGE and TECHNOLOGY
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Survey of Architecture
Complex models for analysis, valorisation, restoration

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Abstract:
Meaning moves from the architectural form, but varies due to the effect of modifications on the architectural form, of its existence in a real context, and of social solicitation, which view it as protagonist; it is a function of valuations that have gained credit in time and of those that emerge due to the different analyses that are conducted. Both graphic analysis (selection/emphasis of signs; functional, distributive and compositional schemes) as well as instrumental analysis (new acquisition instruments, restitution software, archival documents), that tend to create a *dialogue* with the work that is the subject of the study in order to make its value emerge.
In architectural analysis, only the language of representation – acquisition and return *software* –appear to us to be able to build a dialogue and to 'take' surveys and works as interlocutors: through it, it is possible to conduct repeated tests, select cognitive contributions and verify the correctness of the solutions, but above all it is possible to realize an area of action in which every author can enter their own research ability and selection of architectural significance.

Keywords: architectural survey, representation as a language, graphical complexity.

1 Architectural analysis

It is striking to note how, in 1969, the "Encyclopaedic Dictionary of Architecture and Urban Planning" neglecting every other cognitive option, at the entry for survey it bears the definition of an operation that is "*topographical with the aim of identifying the dimensions and the form of an object by means of the reciprocal determination of a sufficient number of points*" [1].
There is no doubt that the acquisition of measurements is an integral part of any surveying action, but within its ways of intervening, in the formulation of analyses that it can promote, and above all in graphic renderings, there are not only issues of measurements. By means of the instruments, which are normally used, and the language of representation, surveying is able to 'reinvent' the architectural form, to discover it as a source of knowledge and principle of unity. Yet it is not only this; investigations and drawings allowed by surveying, allow for the realisation, perhaps, of the most comprehensive way to evaluate a work and discover its order: they determine the most useful operative and study *environment* to operate in with the aim of architectural knowledge; not only the environment of the actual construction built, but the one of aims and of cultural options (for knowledge, valorisation and restoration, etc.) necessary in order to formulate conjectures and to implement a research practice that is properly dedicated to both ancient and modern architecture. It is for the definition of a similar environment that it becomes possible to efficiently use different instruments, methods and competences, and transform architecture into a "heterogeneous" group, that is correctly analysable (analysable precisely because it has been rendered analytically heterogeneous); it is survey operability that succeeds in *provoking* the meaning – we use provoke in the sense of *calling out*, because only elements involved in its action have the possibility of assuming value while others are reduced to the background or to elements without determined architectural elements – of the components of a work of urban fabric. This is the origin of how each new survey operation can register architectural structures as significant that had previously been under evaluated, or which the survey, due to the occurrence of new

interests (new controls, new studies, etc.) can enforce contents and knowledge that had hitherto not even been considered
Meaning moves from the architectural form, but varies due to the effect of modifications on the architectural form, of its existence in a real context, and of social solicitation, which view it as protagonist; it is a function of valuations that have gained credit in time and of those that emerge due to the different analyses that are conducted. Both graphic analysis (selection/emphasis of signs; functional, distributive and compositional schemes) as well as instrumental analysis (new acquisition instruments, restitution software, archival documents), that tend to create a *dialogue* with the work that is the subject of the study in order to make its value emerge. "*We usually say 'conduct' a dialogue* - writes H. G. Gadamer - *but as a dialogue is authentic, much less his way of unfolding depends on the willingness of both the interlocutors (…).Indeed, in general, it is more correct to say that in a dialogue has been 'taken"* [2].
In architectural analysis, only the language of representation – acquisition and return *software* –appear to us to be able to build a dialogue and to 'take' surveys and works as interlocutors: through it, it is possible to conduct repeated tests, select cognitive contributions and verify the correctness of the solutions, but above all it is possible to realize an area of action in which every author can enter their own research ability and selection of architectural significance.
Each time, graphics provide a " version " - a series of versions – of the work created , that can define problems and direct attention; a version that not only serves to reproduce its appearance, but the set of relations (form, function and technology etc.) that support it and that the detector is able to capture and highlight. Yet again, a version that, as much as it is defined and exhaustive, it, however, includes reductions and evaluations of components and for this it can almost be assimilated to a "technique" to bring forth meaning.
In other words, detection occurs on the architecture ensuring the references between the parties (between the architectural materials, between form and technology, and between the building and the urban context), the geometric correspondences and the perceptive relations; detection intervenes ensuring bibliographic and archival data, in short ensuring that a set of situations - due to the effect of detecting and representing - become progressively important, whether they are not given immediately or if they do not appear with evidence (in this sense architecture can be seen as a sort of "accumulator" of meanings from which each time can highlight those no longer needed).
Exaggerating slightly, it could also be said that architecture would not exist, at least how we believe it, in knowledge, without the transactions that surveys are able to predict. It is due to the survey's efficiency that problems are clarified and special investigations planned, arriving at the need to specify the necessity of compositional solutions and promote the "clarifying" of the contents that, normally, are held by any architectural shape.
The ways to restitute never follow a rigidly fixed path, one in which once the starting data is set then the result is produced with certainty; there are no established procedures, but rather situations to understand and experience figuratively, situations where even incidental aspects may play a role. An image repeated by varying methods of representation - *scalar relations*, or *graphic mediation techniques* - can produce different meanings, at times unexpected, for selections/emphases of the graphic signs that the same methods inevitably include. The transition from one scheme to a complete image or from analogue graphic mediation techniques to symbolic techniques involves the verification of each component. It is also necessary to verify the solicitation of the compositional potential it contains. Moving from brief drawings to detailed drawings, and vice versa, is equivalent to triggering different logical procedures (set/detail, concrete/abstract, discrete/continuous, etc.), with a wide range of individual interpretative reactions.
In these terms, the survey is presented as a 'formidable' discipline, perhaps the most versatile that we have, which is able to work with others to analyze the constructed reality and react to its complexity.
Surveying, from operations that are "suitable" to detect the shape and size of an object or a system that is useful in performing well-defined experiences of measurement, allows for the maturing of an authentic attitude of thought on architecture, capable of both considering it as a whole - through the evaluation of the determinants that identify it- and that of electing some aspects as significant and only paying attention to these.
Since it is not possible to postulate any "truth" of the work, it is necessary to imagine architectural knowledge as a process more of successive reformulations – in some senses a "horizontal" procedure, of complementary interpretations – than readings that each time cancel the previous readings.
The concept of dialogue mentioned above ultimately returns definitively, which moves from the considerations that can be derived from the real object, considerations that assume the value of a query on the work and of a real and proper strategy for the analysis and interpretation of architecture.
It may seem a paradox, but the project, which in executive drafting guides the creation of architecture, does not automatically set up a path for its knowledge; this is formalized later due to the analytic attitude and interpretations that it is able to activate. It is formalised "transfiguring" the architecture, that is, transforming it into a set of graphic competing and directed towards a goal. It formalises working on architecture and the

urban context that identifies it with reliefs and graphic restitutions - measurements, instrumental analysis and graphical analysis – that are progressively more effective and determined.
By broadening traditional opportunities for the acquisition of information, new instruments (3D *scanner*, digital photogrammetry, modeling *software* …), can favour analytical exhibitive modalities that had been unthinkable until a few years ago: not only investigations and restitutions on geometrical, morphological and constructive aspects of a building (or of an urban space), but *3D models* capable of facilitating a series of extended simulations (reconstructions, virtual visits, reconstruction of deteriorated parts…) and consequent in-depth analysis of meaning [3]. Even if 3D models do not resolve all surveying problems, they are certainly useful to have the necessary references in the laboratory, to subrogate, for operative aims, the reality of the work. In addition to the quantity/quality of measurements (restitution of texture, of chromatic values, etc.), digital 3D models and *software* for surveys, also allow the avoiding of equipment imprecisions and formal mistakes, but above all they allow for the setting of the practice of reading and of analyses that are impossible in reality.
As it is emerging, surveying can be specified as a discipline necessary for interpretation. It can both indicate and impose rules for transactions that are normally conducted; rules that are applicable to act on the architectural form and evaluate it. For the survey attitudes, it is possible to define analysis directions and guide the surveyors' sensitivity and awareness to both the compositional structure of a work (opening/closing, compactness, permeability and transparency, etc.) rather than on technical construction (materials, landslides, degradation, color, etc.). Furthermore, it is possible to produce qualitative leaps in architectural or urban analysis (discovery of masonry structures, substructures, environments, redetermination of the construction partition) and specify, if one has the strength to identify them, unprecedented situations of awareness. Moreover, it is possible to render the relations and connections between parties certain, classifying arrangements and comparing them with other similar ones, evaluating in a perceptive sense (chromatic, formal, etc.) typical solutions and variations etc.
The accessibility and, so to say, the analytical permeability allow to consider the digital modelling as a circumstance with the aim of elaborating conditions that are useful for passing from the reality of architectural form to their virtual expression, conditions that, transforming reality into a codification of points, allow for it to be reedited in the laboratory – without losing formal coherency, devices, colour, continuity (or lack of continuity) of the structures of the survey, becoming part of the study process.
Therefore, 3D modeling, as a novelty for the acquisition of measurements and forms, but above all a novelty for discussing architectural realities and dislocate it, both for interpretative and operative aims.
It is not a claim that it is a discipline (and mode of analysis) sufficient in order to provide answers for each type of problem, but one which is capable of dialoguing with others and of producing figurative options characterising architectural research.
If surveys are not conducted only to reproduce an existing work – to have an image that resembles it – it is because not even an "isomorphical" representation would manage to fully give that which reality holds. A similar representation, that we can imagine as equal to the built work, with the same wealth of details and an identical urban collocation, would be entirely useless as it would not produce any possibility of further attention compared to real observation nor any increase of knowledge.
On this theme, Georges Simenon, in inspector Maigret's investigations, makes us note how even the "truth" does not always appear to be true: "*Try to tell someone a story, any story. If you don't embellish it a little, it will appear to be unlikely, invented. Instead, with a little adjustment, it will appear truer than it is not*" [4].
On Simenon's reflections, we observe that in surveys graphic restitutions congruent with the real devices, capable of returning its form to it (technology, spaces) but also its own "convincing version" that can take into account the context in which the form is to be found and of the relations that, over time, have consolidated. A version that can render the organisation of elements, their role and, above all, their intensity, with the emotional value that they produce.

1.2 Valorisation and restoration

The coincidence of monument/document [5], the recognition of ancient buildings as a source of information, as an "authentic" text to be read and interpreted, perhaps manage to identify the most delicate concept – the most important and also the most ambiguous – of the entire restoration action, that moves both to define and conserve the preeminent values of the architecture and of the materials that form it to make the it available for critical readings successive to restoration works.
Thus each restorer considers works from the past as a document to be valorised, but also as proof of events that occurred, available for interpretation and critical comparison: ancient works as *documents* to be interpreted and valorised and, at the same time, as *monuments* to be conserved in order that they can produce, in time, further effects of knowledge (interpretative, operative, etc.).
In other words, architectural works contain an "open" documentary within, one on which the restoration project intervenes in order to highlight the determining characteristics – at least those that appear as more necessary and urgent in order to safeguard traces of the past.

In relation to the first aspect, it can be said that the ancient building "*presents itself as a "page of history": an event, or rather a set of events that "self-narrate"* (…)*. The object of the restorer, for this precise aspect of his disciplinary interests, is the recovery of possible units and expressive homogeneity of the critical-documentary content attributed to the monument*" [6]. It is a recovery that, notwithstanding the attentions and legacy of knowledge (historical, philological, technical-constructive, etc.) modifies the state of the work and this needs to be taken into account in each new initiative, be it interpretative or operative. The action of restoration, therefore, though moving to clarify and consolidate the historiographical and architectural contents of the works, almost despite the caution and coherence with which they intervene, formalizes a *new* work, or, at least, a new *documentary structure* of the work, corresponding to the cultural instances of the period in which intervention occurs and is that of the academic-restorer who works on it.
With regards to the second aspect, that relating to the traces of the past, the restoration project intervenes to conserve and protect the data and information that are layered over time. "*The task that the restorer assumes is not, in this case, that of transferring to the monument the results of interpretative work, of giving it the role of corresponding to one's own critical hypotheses […], but that of protecting the total integrity of the data, perpetuating availability to exegetic openings*" [7]. In other words, the restorer's task if that of operating so that signs of the past are conserved and so that the work lends itself to readings of the historical, architectural and documentary values it contains.
In both cases, the presence of a digital model (the possibility of manipulating information, archives, management) becomes an extraordinary possibility to perpetuate memory of the past and to know (analyze and interpret) the "subject" to be restored, both by means of images or graphics that are easy to manage and which, through complex drawings, are capable of rendering the determinants, the qualities and architectural complexity of the works.
The possibilities of 3D modeling and of treatment of the acquired data increase the participative and productive opportunities of the surveyor and, consequently, those opportunities for the reading and interpretation of the work under exam. The virtual presence of architecture and the executive opportunities of *software* thus become a sort of "active factors" for the elaboration of research strategies and products previously unknown; active factors that offer the surveyor both perceptive opportunities of the copy as well as the operative opportunities of the prototype.

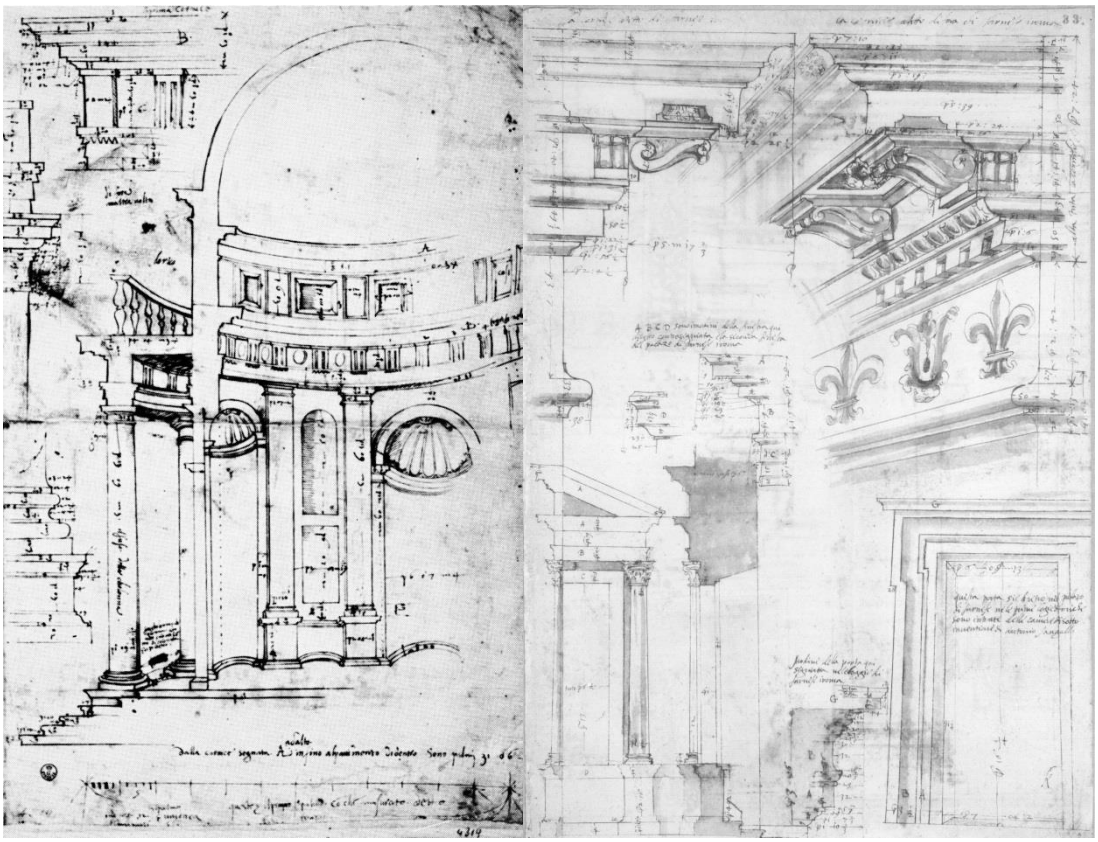

Fig.1: Aristotile da Sangallo, survey of the S. Pietro in Montorio tempietto; complex graphic device that is not only for describing the work in question, but to examine it and get to know it, above all in the design contents it contains.
Fig.2: Giovanni Antonio Dosio, survey of the palazzo Farnese in Roma, 1560-65; reading of architectural particulars in orthogonal projections and in axonometry, quoted and with written notes.

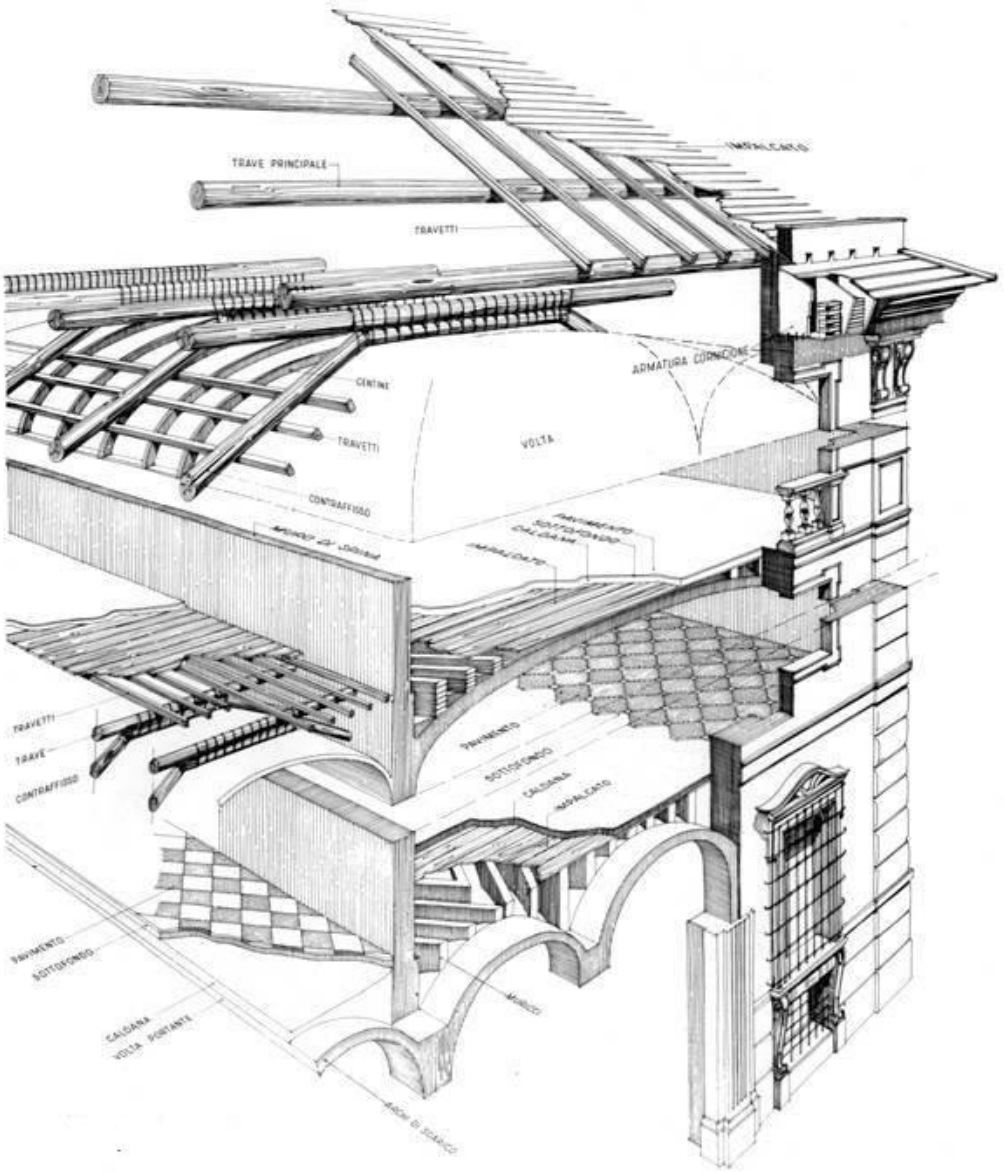

Fig.3: L. Vagnetti, *Genova, Strada Nuova*, 1970; complex graphic device of most widespread constructive solutions.

On the aforementioned theme of the complexity of restitutions, it is necessary to remember that with the authors representations, whether they are surveyors or designers, they "react" to the reality of things and that the contents of the images do not only exist in the type of simulation they present, but also in relations that they are capable of highlighting and in the relations that, at different research moments, they manage two establish with the architectural attitude they represent. In other words, it is an issue of figurative quality and of efficiency of the graphic appliances rather than the quantity of points (lines, pixels, etc.). Furthermore, it is not an issue of primogeniture methods, graphic techniques or scalar relation (Figs. 1-3).
The graphic "complexity" and, in a derivative form, the "pertinence" with the situations to be analysed can be seen as the outcome of a double operation: namely that of *partialization* of themes, with a consequent specialization of images on determining aspects, and that of the *complementarity* of the depictions, that produce a progressive group of figures, corresponding both to the maturation level of problems and to the convincement of the authors (surveyors or designers) in the different moments of the investigation.
Let us repeat that restitutions provide an occasion to interpret architecture for the opportunities existing to graphically reformulate the attitudes of a work, stating the generative principles that formalize the volumes and the connections between parties, but above all analyzing the real arrangements through figuratively complex "equipment" (created for the co-presence of more graphics, of axonometries/prospects pertinent to the spatial and constructive characters of the architecture), capable of rendering the articulation of a work and its compositional identity (formal, constructive and spatial). Perhaps, it is this type of device, as well as technical drawings, which enhancement and restoration experts should require of the surveying discipline,

even though today the wealth of experience and graphic restitutions - that until the middle of the last century characterized our discipline in the formulation of drawings with the objective of knowledge of works, drawings in which the formativity of graphic language is revealed as decisive - seems to be worth less and affect only marginally the *Survey of Architecture*.
Particularly in teaching, it seems useful to point out that in the new ways of surveying and of returning attention to similarity - to the creation of automatic digital expressions and the procedures used to obtain them – it risks becoming the only data to be shown, to the detriment of all the rest. With the progressive abandonment of any formal experimentation conducted by means of representation, both the holistic value – dependent on the interrelations between graphics, images and models, etc. - and the formative value of the same representation tend to disappear. Furthermore, the necessity of putting together different drawings for the same architecture to make them react together for meaning; the possibility of dialoguing with past works, to obtain answers that are pertinent to the compositional rules that determine them, also has a tendency to disappear. However, above all, in the creation of plausible constructs or in those of “automatic” derivation, which are ever more common, the formality of the language made available by digital modeling to think and act in 3D creates a tendency not to produce effects that are architecturally significant.
The risk lies in directing attention towards the development of technical and operational problems, regarding the "construction" of digital models, neglecting or considering less, all those that are of strictly architectural relevance. The effectively transforms the qualitative problem of architectural analysis and interpretation into a quantity of data to be collected and ‘processed’ to produce drawings, that are far removed from any judgment on the form and logical assumptions that identify it (Figs. 4-5).



Fig.4: *R. Sarubbo,* created during the Architectural Survey Course, UNICAL, A.A. 2010/’11; as well as the drawing of the set, the graphics foresee the decomposition of the architectural constituents of the work, investigations on the technology/form relation, perceptive evaluations, etc.

Fig.5: *L. Covello,* created during the *Architectural Survey* Course, UNICAL, A.A. 2010/’11; the complexity of the table bears witness, not only to metrical accuracy of of the attained graphic appraisal; but it “formulates” analytical progression while it is the reason of order in the knowledge of the components presented by the work.

Bibliographical References

[1] PORTOGHESI, Paolo (ed), *Dizionario Enciclopedico di Architettura e Urbanistica*, Roma Istituto Editoriale Romano 1969, vol. V, p. 171.

[2] GADAMER, Hans-Georg, *Verità e Metodo*, Bergamo Bompiani, 1977, pag. 441.

[3] For further detail see cfr. GUIDI, Gabriele, RUSSO, Michele, BERALDIN, Jean-Angelo, *Acquisizione 3D e modellazione poligonale*, Milano McGraw-Hill 2010; GAIANI, Marco (ed), "La rappresentazione riconfigurata - Un viaggio lungo il processo di produzione del progetto", Milano Poli.Design 2006; MIGLIARI, Riccardo (ed), "Disegno come modello", Roma Edizioni Kappa 2004; GARLAND, Michael, *Multiresolution Modeling: Survey & Future Opportunities*, Eurographics, 1999; GARLAND, Michael and HECKBERT, Paul, *Surface simplification using quadric error metrics*, Proceedings of Siggraph 97, 1997; KRISHNAMURTHY, Venkat and LEVOY, Marc, *Fitting Smooth Surfaces to Dense Polygon meshes*, Siggraph, 1996; KRISHNAMURTHY, Venkat and LEVOY, Marc, *Fitting Smooth Surfaces to Dense Polygon Meshes*, Siggraph New York 1996.

[4] SIMENON, Georges, *Le Memorie di Maigret*, Adelphi 2002 Milano, p. 34.

[5] LE GOFF, Jacques, *Documento/monumento*, Torino Enciclopedia Einaudi 1978, pp. 38-48.

[6] TORSELLO, Benito-Paolo, *Le geometrie dell'architettura*, in "Ricerche di Storia dell'Arte" 1986/27, p. 24.

[7] TORSELLO, Benito-Paolo, *Le geometrie dell'architettura*, *ivi*, p. 24.

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The Industrial Building Heritage : first steps for the Damages Evaluation of Innocenti-Maserati Structural Plant

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Abstract

The problems concerning the requalification of dismissed and, since many years, abandoned industrial plants and sites require different approaches and competencies.
The authors have been involved in many different cases bounded to the industrial activities which have been developed during the early first half of the last century around Milano city, some of them have been firstly dismissed at the beginning of 80's years.
In many cases, problems concerning the land pollution, and the prior related costs of the land drainage have stopped the different necessary approaches regarding the assessment on the actual conservation and damage evaluation of existing abandoned buildings. Among these , works for land drainage and reclamation are planned, some in progress; in particular the "Innocenti-Maserati firm" is one of a major remaining industrial complex in the suburban district of Milano, with its 4 industrial hangars, completed dismissed and emptied out, and showing the steel bearing structures in their impressive shape of large dimension (figure 1).
The paper focuses on the evaluation of the actual mechanical and physical properties of the structural elements, no less the modelling about one of the dismissed buildings; in particular the building under investigation is the oldest of the four. The paper illustrates a brief history of the Innocenti Milan Industrial Compound, the description of the structures, the on-site investigation and Laboratory tests for the evaluation of the overall distribution and degree of corrosion attack in steel structural elements.

Keywords: Requalification, Heritage, steel corrosion, BIM.



Fig. 1: The Innocenti Maserati Industrial steel Building, know like "The Cristal Palace", an interior view.

1. Brief History and description of the Innocenti-Maserati dismissed plants

As brief recalled in the summary, Milano and its suburb, present ever the same big problem, and opportunity, on how reuse some big industrial dismissed areas and their buildings, like the Milano S. Giulia masterplan, previusly “Montedison” firm, as well as the “Falk SpA” area, and many other. The common problem of each of these areas is the brownfield site and the related great costs of its reclamation for fundamentals priority of any design and intervention. The area of Innocenti-Maserati factory has been one of the first reused brownfield site.

The building under investigation, illustrated in Fig. 1, was devoted, in the past, to produce the famous “Lambretta” motorcycle and, more recently, to produce the Innocenti-Maserati cars. The area, owned by AEDES s.p.a., is devoted to social and commercial use, municipal rules requiring the preservation of the steel skeleton.

The history in brief: Ferdinando Innocenti was born in Pescia, Toscana, in 1881, in 1920, he studied the application of steel pipes and it’s innovative use in different fields. In 1933, he started the production and the distribution of steel pipes and connections of the well known Innocenti Scaffoldings System (originated by a system of the British Scaffolding Company). The Milano-Lambrate industrial area started its development in this year.

The “Fratelli Innocenti Società Anonima per Applicazioni Tubolari in Acciaio”, became one of the most important Italian manufacturing reality. The production ranges from civil to industrial buildings, from cars to weapons components.

In 1944, part of Milano-Lambrate industrial buildings were destroyed by bombing. Nevertheless, at the end of the 2° worldwar, in 1948, the buildings were recovered and the production of most popular Lambretta started with a production of 250 units per day. Later on, the Mini Minor, in concession to the Britannic bmc, and a Spider, designed by Bertone, were there constructed. In the seventies the importance of Innocenti production declined and the factory in Milano-Lambrate has been sold to the British Leyland, later to Maserati [7, 8].

In the nineties the factory in Milano-Lambrate was dismissed, and the area became one of the largest urban void in Milan.

The oldest of four industrial buildings covers an area of 75x310m: it is divided in three aisles, 25m wide, and with elevation at the top of about 19.50m.

The structure in elevation consists in:

- principal portals, disposed on three aisles, with distance among them of about 10m (Portals "A") (see Figure 2,b), and secondary portals, equally outdistanced among them every 10m, which have not central columns (Portals "B"), (see Figure 2, c).

The columns result, therefore, to alternate every 10m, while the coverage portals every 5m.

The steel columns are composed by UPN profiles, jointed by welding to steel plates.

There are three different kind of columns:

- Lateral single columns;
- Lateral double columns;
- Central triple columns;

The central columns, (see Figure 2,a), are made of two external columns, that carry the bridge crane beams. These columns raise up to about 7.5m. The central column continues upward, by connecting itself with the polygonal five sides arch truss, that terminates, on the top, with the lantern.

The bridge crane beam is shaped as a double "T" section, which measures 100x51cm. It is made of four UPN sections connected to plates by means of nails (see Figure 3,b).

The polygonal arch truss is composed by three parts, jointed by bolts (see Figure 3,a).

The foundations of the columns are made of isolated reinforced concrete plinths, with underlying reinforced concrete foundations of about 2-3m of depth.



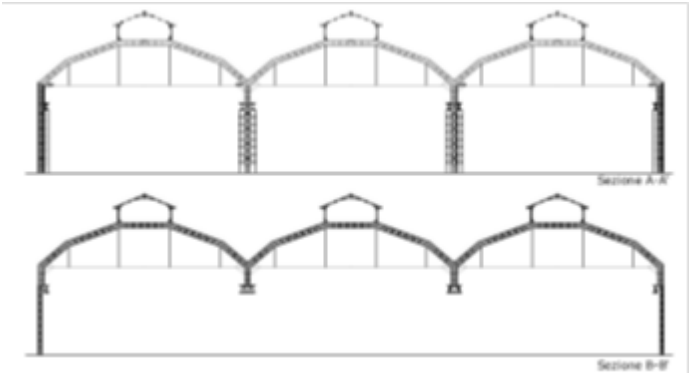

Fig. 2,a,b,c: In figure a) you see the typical central column, on figure b) and c) the two typologies of portals.



Fig.3a,b,c: Three kinds of connection and degradation which mostly depend on the exposition.

2. Degradation assessment of steel principal structures

The investigations to evaluate the degradation of the structural elements [2] are subdivided into two phases:

- phase 1: limited number of tests for the evaluation of the physical, chemical and mechanical properties of the most damaged and most undamaged structural elements in order to identify a possible range of the mechanical properties [1, 5, 6];
- phase 2: extensive non destructive investigations for the verification of the integrity of all the structural elements with substitution and integration of the obsolete ones.

The plan of investigations has been preceded by an historical investigation [2], followed by a visual inspection that has allowed to hypothesize the necessary steps to be taken in the subsequent operations.

2.1 Evaluation of the distribution and degree of corrosion's attack in steel structural elements.

The characterization of level of corrosion was performed by Department of Chemical, Material and Chemical Engineering "Giulio Natta" of Politecnico di Milano [1].
The evaluation of the diffusion of corrosion has been done according to [1, 4].
The degradation has been established according to the following ranking:

- R1: when the rust is distributed on 0,05% of the surface;
- R2: when the rust is distributed on 0,5% of the surface;
- R3: when the rust is distributed on 1% of the surface;
- R4: when the rust is distributed on 8% of the surface;
- R5: when the rust s distributed on 40-50% of the surface;

The extension of the attack has been classified in base to the percentage of area interested by corrosion of the structural element:

- A: < 5% of the total surface;
- B: 5-10% of the total surface;
- C: 10-40% of the total surface;
- D: > 40% of the total surface;

The degree of propagation of the corrosion doesn't result constant in all elements.
For example in the columns it results that:

- the degradation type R5, present for the 20.4% of the columns, is located mainly in the North zone and only in some single cases in the rest of the building;
- the degradation type R4, present for the 33.7% of the columns, is located mainly in the East zone;
- the degrade type R3 is present for 45% of the columns.

The degradation for the elements that constitute the beam bridge crane, is verified in function of the exposition:
for the connection and the upper wing,

- the R5 degradation type, present for the1.1% of the totality of the beams;
- the R4 degradation type, present for the 15.1% of the totality of the beams, is verified in the West South zone of the shed;
- the R3 degradation type, present for the 83.9% of the totality of the beams;

for the lower wing:

- the the R5 degradation type, present for the19.9% of the totality of the beams;

- the R4 degradation type, present for the 50.5% of the totality of the beams;
- the R3 degradation type, present for the 29.6% of the totality of the beams.

The chemical and metallographic analyses have been done at DCMIC laboratories [1] while the mechanical tests at LPM of DIS, Politecnico of Milan [2].
The chemical and metallographic analyses (see Figure 4, 5, 6), underline that the steel plates, and the UPN sections, have the same type of microstructure containing small quantity of carbon 0.02-0.04%, and are primarily constituted by ferrite-cementite's particles with inclusions.
The nails, element of connection between the profiles of the bridge crane (see Figure 5), have a thinner microstructure than the plates, and it is constituted by a ferrite-perlite microstructure, and it contains more elevated quantity of carbon than the plates (0.06% in mass).
As regards the bolts, which connect the beam with the column, they have a ferrite-perlite microstructure; the welding fillets are in good state of maintenance, with modest corrosive attacks.
Considering the corrosion attacks, it has been verified that the degree of damage is not the same for all structural components.
For example, the metallographic analyses (by electronic microscope) have shown that the reduction of thicknesses in the columns is:

- for the degree R3, in which the products of the corrosion occupy a fraction reduced of the surface and partial separations of the protective painting and reduction of the thicknesses for the plates is less than 100 μm and for the welding to 100-200 μm;
- for the degree R4, where the products of the corrosion occupy a great fraction of the surface, with great separations of the coverings, the reduction of the thicknesses of the plates is of the order of 160μm (see Figure 9);
- for the degree R5, the corrosion show a surface covered for a fraction which reduce the thickness that go from 100 μm to 3 mm.

The mechanical tests, developed in DIS laboratories, (Department of Structural Engineering laboratories), allowed the characterization of the steels, of the plates and bolts.

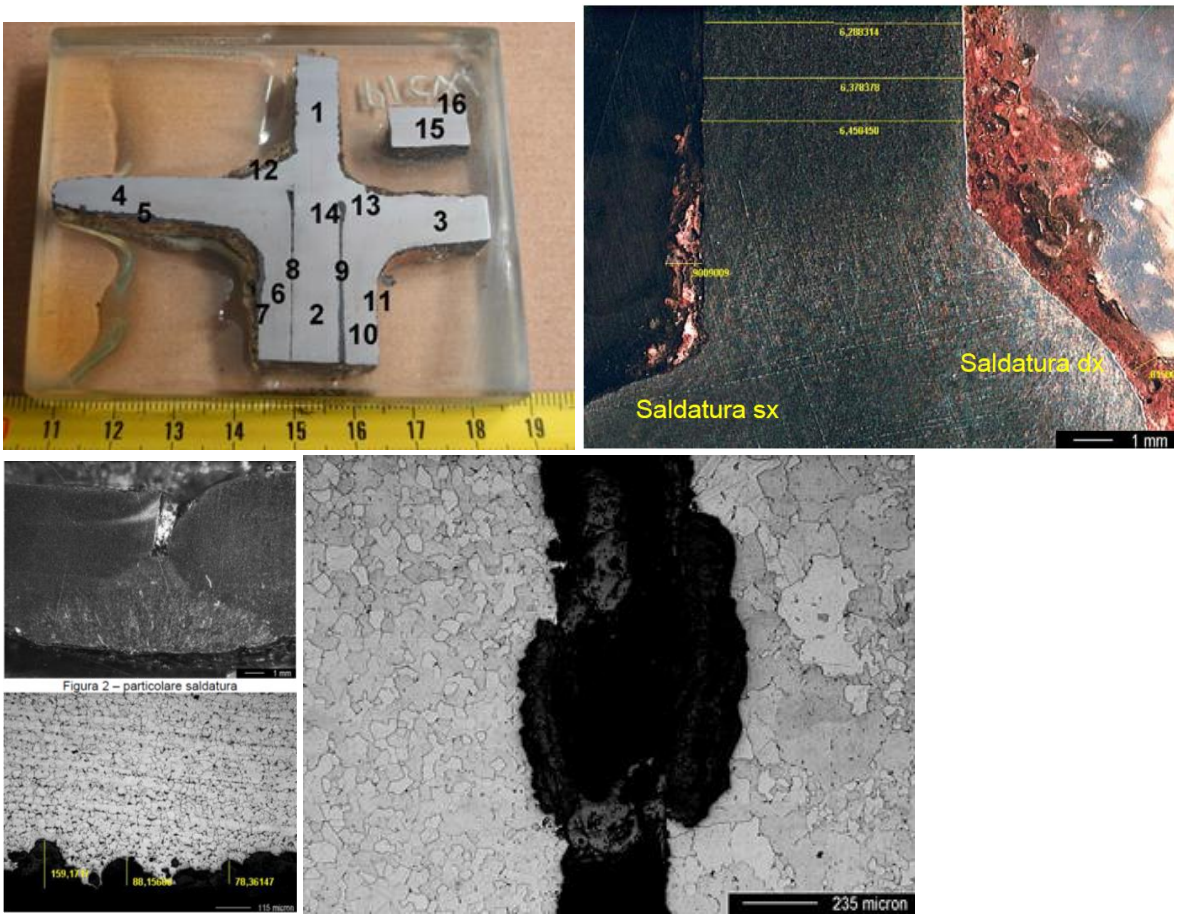

Fig.4a,b,c,d: the micro investigations about weldings, in a) the sample, in b) residual thickness, in c) particular of welding and penetration of corrosion, in d) void inclusions and cracks.

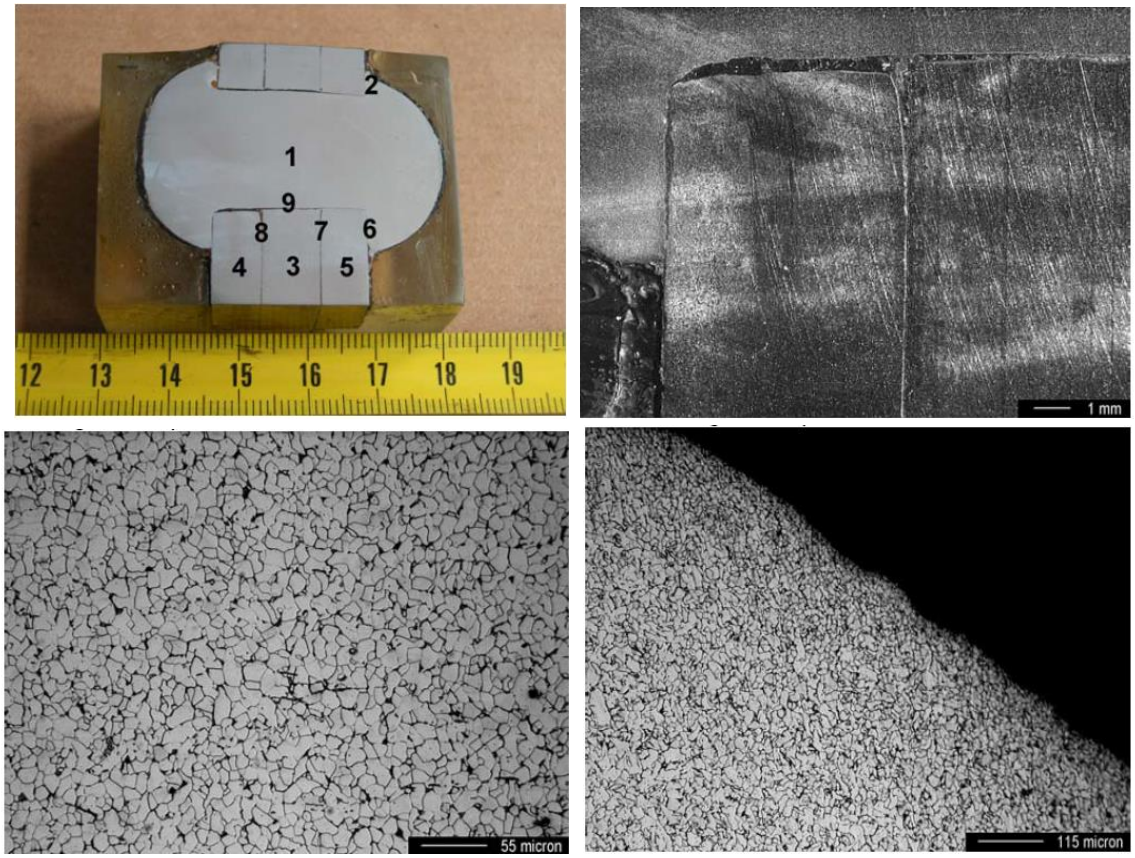

Fig.5a,b,c,d: the micro investigations about nails, in a) the sample, in b) the interface between nails and plates, in c) and in d) evaluation of percentage of carbon.

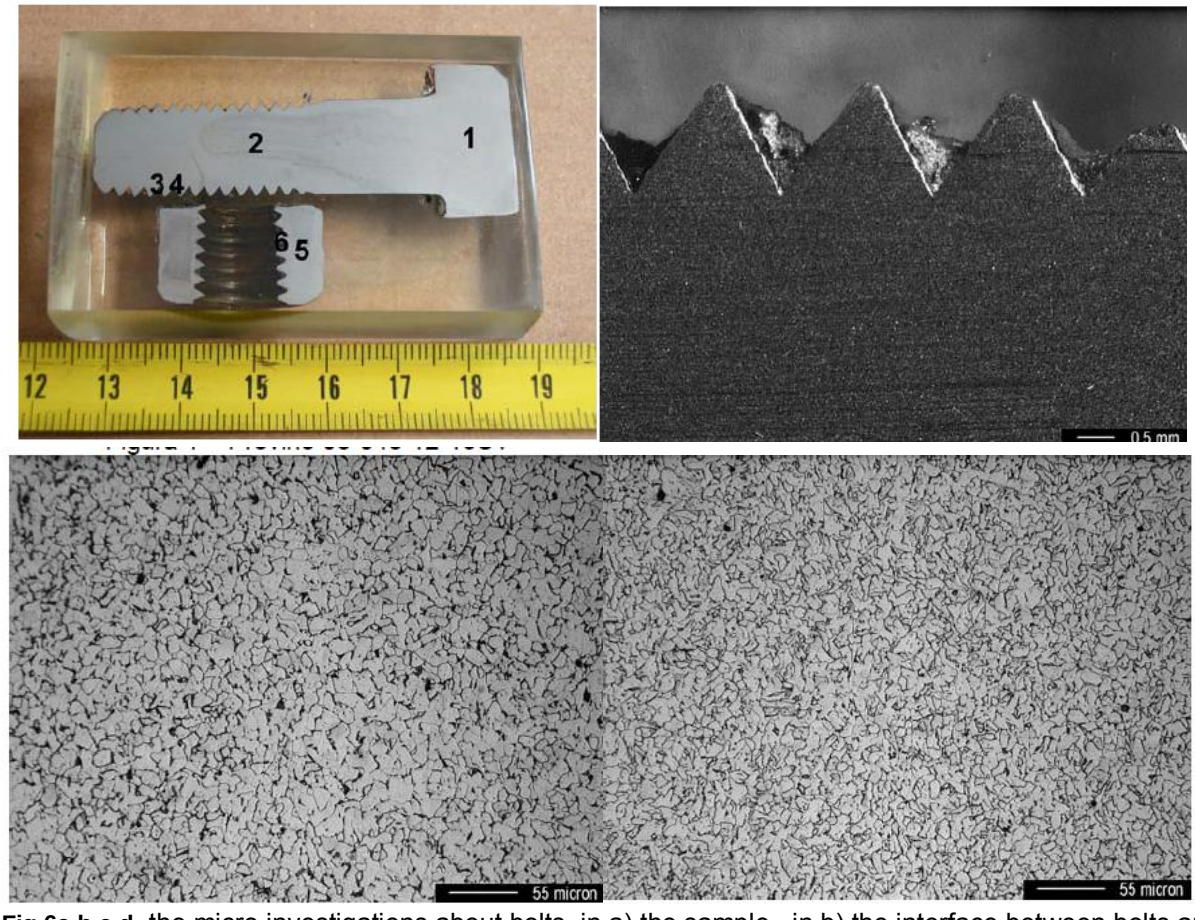

Fig.6a,b,c,d: the micro investigations about bolts, in a) the sample, in b) the interface between bolts and screw, in c) and in d) evaluation of percentage of carbon.

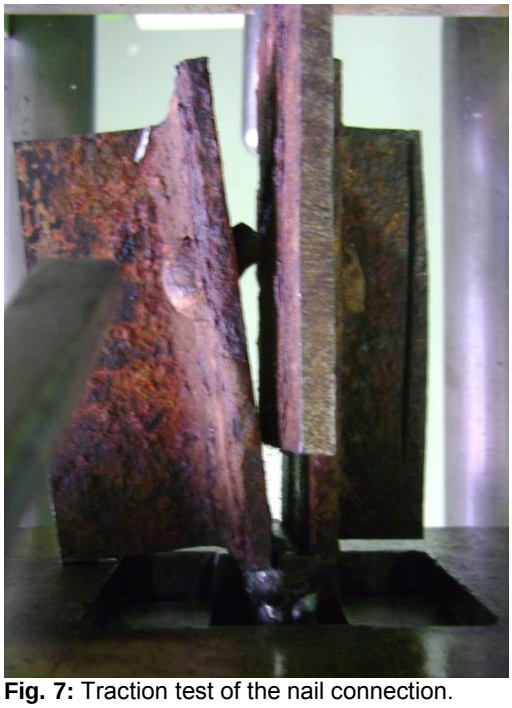

Fig. 7: Traction test of the nail connection.

The tests have been reported with the degree of corrosion to verify the possible reduction of mechanical propriety of the steel due to the corrosive phenomena.
The tensile and the resiliency test, practiced to steel sample have been done in according to UNI 10025-1; the tests seems to confirm the hypotheses of degrade established by the chemical analyses, according to which the degrade has interested only the reduction of the thicknesses of the plates but not the morphology and the mechanical performances of the steels.
The bolts and the screws have been tested according to UNI EN ISO 898 [9].
The connection by nails and welding have been made simulating the actions to which are stressed.
The nail's connection in the particular case, result stressed by a strength orthogonally to the axis of the nail.
The shear action on the same time can induce:

- the shear breakup of the nail;
- the breakup of the plate, for tensile action.

3. Geometric relief and definition of the state of conservation of the foundation structures

The problems of the discontinuous structures of foundation, plinths and piles, have been:

- definition of the geometry, particularly of the piles;
- material characterization and degradation.

The measures have been practiced in correspondence to three typologies of plinth, tied up to the different characteristics of the structures in elevation.
All the piles are surmounted by the plinth of foundation: it has been therefore employed the "echo metric method" sending and receiving the signals of the propagation of the mechanics impulses along the length of the pile (see Figure 8).
The measures have been performed according to ASTM D 5882. 00 and NF P 94-160 -2.
The length (L) of the investigated element is given by the simple relationship:

$$L=V_m \Delta t/2$$

in which:
V_m = is the medium speed of propagation of the mechanical impulse in concrete,
t = time between the emission and the receipt of the signal, reflected by the end of the pile.
The evaluations of the length of the element are done attributing two values limit to the speed of propagation of the elastic wave commonly assumed for concretes of this type: 3700 - 3900 m/sec.
Being the piles overhung by the foundations of the structures in elevation, the emission and receipt of the signals has been achieved by the opening of a special niche created in the concrete on the top of pile (see figure 8, d).

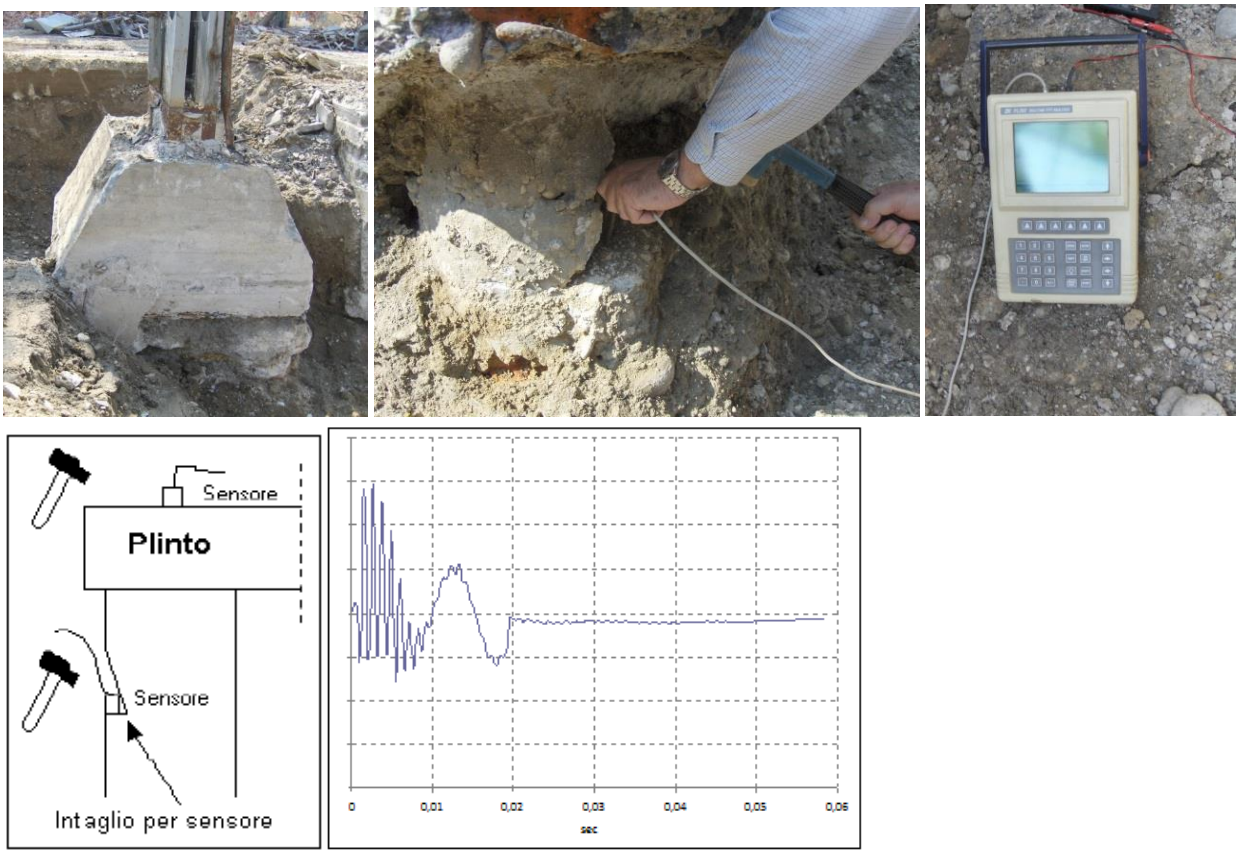

Fig. 8, a, b, c, d, e. : in a) the plinth and the piles below, in b) and c) the instruments, in d) the functional schemes and in e), the graphs of the echo metric signals.

The graphs that represent the echo metric signals are of good quality and legibility; this allows to formulate the following conclusive observations:

- The lengths of the piles deduced by the echo metric's measures can be considered real;
- The light anomalies found along the stem of the piles can be considered negligible.

Possible interruption or interferences on the piles may be due to this use of the echo metric method.

4. Structural and Architectonical modelling

The geometrical reliefs and the material characteristics finally are used to create the models to evaluate the structural safety, lines guides for the restoration, not less the architectural model and the energy model too [11].

The building was modelled using BIM (Building Information Modelling) concept. In this way the information applied in the models are the same.

To evaluate the safety of the structures, and suggest the better choices for restoration of the building a complex model analysis was created. We remember that in 1930 years was very unusual evaluate the structural functionality for dynamic actions like wind and earthquake. The structural model is created using the geometric information and the residual thickness of steels structures, and the residual steel characteristics.

5. Conclusions

The paper illustrates the preliminary tests for the material characterization and also on some principal elements of the structures to be conserved. The BIM Model together with the structural modelling analysis give us the information necessary to create the Guide Lines for correct rehabilitation design of the structure [3], not less it's ready for evaluations of the feasibility of the architectural choices the future use of the building.

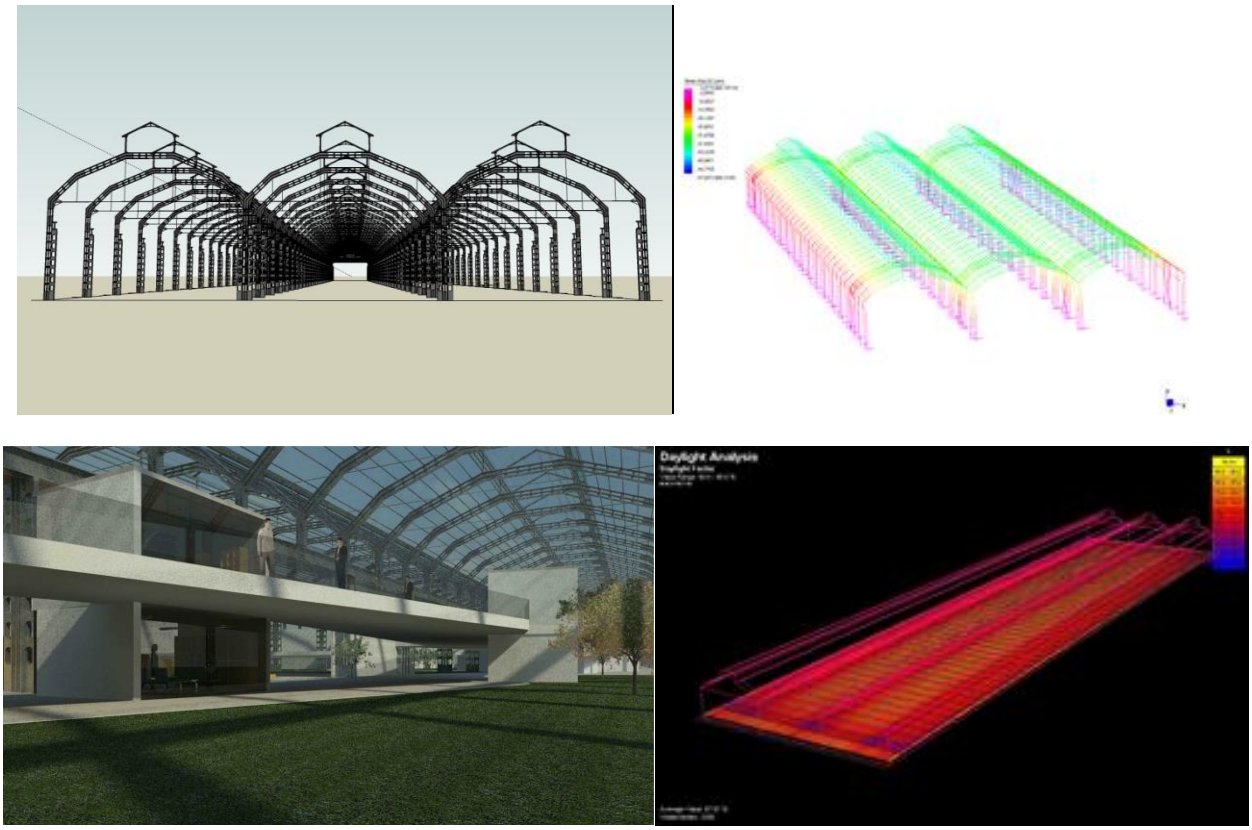

Fig.9, a, b, c, d. : in a) the BIM model, in b) the structural analysis and in, in c) the BIM model used to create a render about a possible reuse of the building, in d) natural lighting analysis, in energetic model.

Bibliographical References

[1] BERTOLINI LUCA, BOLZONI FABIO, Relazione tecnica: Diagnosi dello stato di conservazione delle strutture metalliche dello stabilimento ex Innocenti in via Rubattino a Milano, 2008. Milano.

[2] Consorzio CIS-E, Rilievi, prove ed indagini sulla struttura di un edificio industriale nel complesso edificatorio ex Innocenti a Rubattino Est a Milano. 2008, Milano.

[3] Consorzio CIS-E, Linee Guida per il ripristino delle strutture in acciaio di un edificio industriale nel complesso edificatorio ex Innocenti a Rubattino Est a Milano. 2008, Milano.

[4] ISO 4628 -3 Paints and varnishes - Evaluation of degradation of coatings -Designation of quantity and size of defects, and of intensity of uniform changes in appearance.

[5] PEDEFERRI Pietro, Corrosione e protezione dei materiali metallici, Polipress, Milano, 2007.

[6] PEDEFERRI Pietro, BERTOLINI Luca, La durabilità del calcestruzzo armato, McGraw-Hill, Milano, 2000.

[7] TESSERA V., 1995. Innocenti Lambretta, Nada, Milano.

[8] Uffici Tecnici della Innocenti Servizio Pubbliche Relazioni della Innocenti, 1966. Innocenti: Stabilimenti di Milano, STILO società Tipografica Lombarda s.p.a., Milano.

[9] UNI EN ISO 898 Mechanical properties of fasteners made of carbon steel and alloy steel - Bolts, screws and studs.

[10] UNI EN 10025-1:2005 Prodotti laminati a caldo di acciai per impieghi strutturali.

[11] ZICHI A., ANAFI A., MAISTRELLO M., BUZZETTI M., DEL PERO C., TAGLIABUE L. ECOWEEK WORKSHOP THEME – CISE, Scuola Master F.lli Pesenti – Politecnico di Milano, 2011, Milano.

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In-situ tests, analytical and numerical studies for the assessment capacity of a historic building in l'Aquila

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Abstract
The paper summarizes some of the studies carried out on the stone masonry structures of the building "palazzo Paone" to assess the damages caused by the earthquake of April 6th 2009, in the historical center of L'Aquila and to suggest rehabilitation materials and techniques. The extended report about the work done is available on [1]. After a brief description of the building, the in situ diagonal compression test on the building masonry wall is described, in order to quantify the enhancement of masonry wall mechanical properties by injection. Subsequently, a modified Coulomb failure criterion, fitted for that specific masonry, is referred to and the suitable mechanical parameters have been adopted for the numerical seismic analyses of a finite element model of the building. The input numerical values have been deduced by comparing the results of the performed flat jack in situ tests.
The performed analyses have shown a comparable picture of seismic damage on the structure, as those observed on site. From the analyses results, useful suggestions are proposed in order to evaluate the techniques to be adopted to improve the seismic capacity of the building.
The analysis results, in term of stress field, are evaluated following the mandatory Italian design code and even proposing an appropriate comparison with the Coulomb failure criterion, in the case of masonry.

Keywords: Stone masonry, rehabilitation, compression test, seismic analysis

1. Brief description of the building and frame of damages
The building called "Palazzo Paone" was damaged by the earthquake of 2009 and it has been one of the first buildings structurally rehabilitated with respect to seismic loading. It was not damaged likely to impair its stability and all its structural elements, even if damaged, have kept their carrying capacity. The damage is mainly present on the ground floor and first floor, either for the vaults, arches and walls. The bearing walls of the building are predominantly made of stone bricks. The type of stone masonry reflects the typical local construction system: two coupled layers made of calcareous stone blocks with rounded edges of medium size (about 20 cm) with a large, poor, inner core. The thickness of covering plaster is of about 10 cm on each side, as shown in Fig. 1.
The following Fig. 2 schematically shows the plans of the building and some results of the damage relief work done. Inclined cracks and cross lesions are visible on the external facades: some examples of such damages are shown in Fig. 3, 4 and 5.

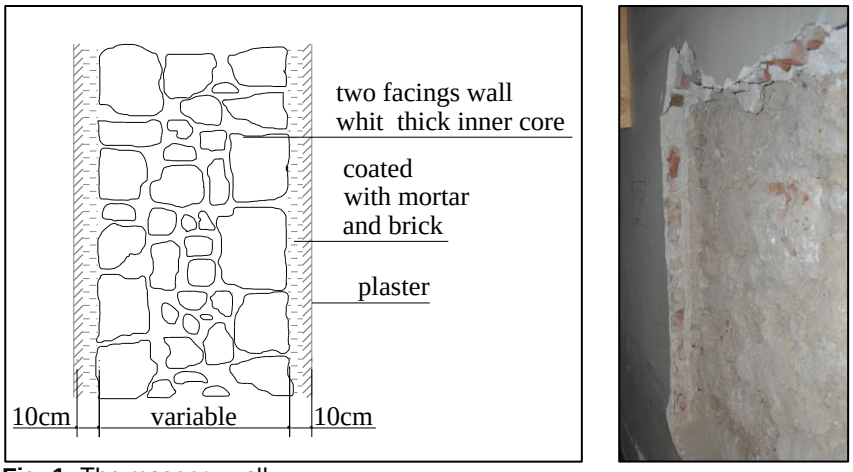

Fig. 1: The masonry wall.



Fig. 2: Plans of the different levels of the building.

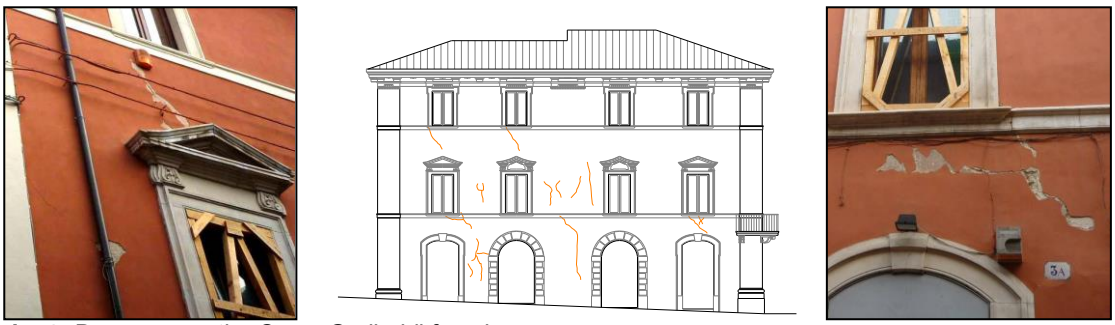

Fig. 3: Damages on the Corso Garibaldi facade.



Fig. 4: Damages on the Via Filetto facade.

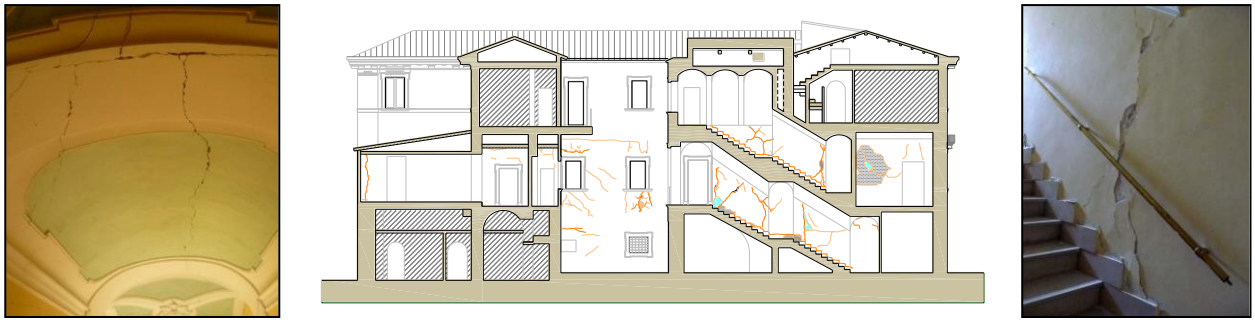

Fig. 5: Damages inside the building.

2. New in-situ diagonal compression tests under displacement control

Experimental techniques capable to evaluate the mechanical characteristics of the in-situ masonry structures have been performed. These in-situ techniques had been able to give a precise answer to the demand of reliable knowledge of the material mechanical properties [2]. The authors of the paper have been asked to get mechanical properties, of that masonry, to be used in the structural model for seismic analysis and, as a consequence, for the rehabilitation project, concerning both new materials and techniques.
A campaign of single and double flat jack tests have been performed, showing the average results summarized in the following Fig. 6.

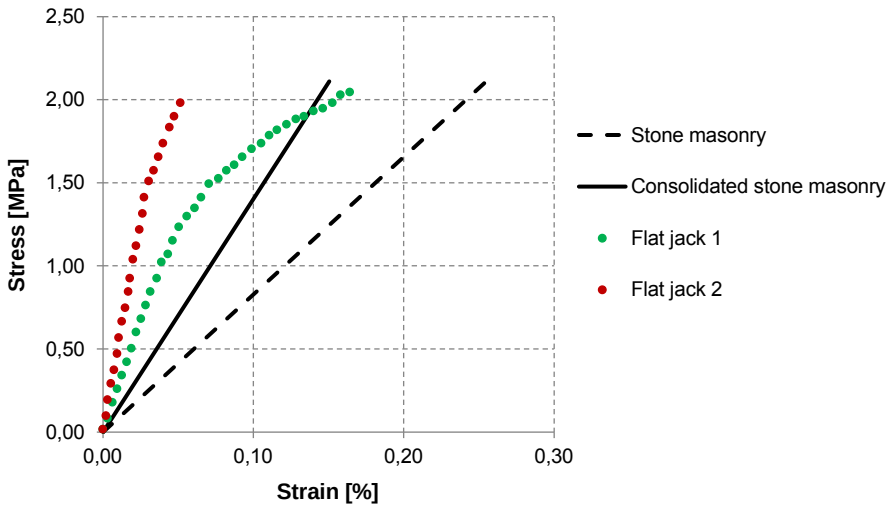

Fig. 6: Flat jack test results.

The second and perhaps more significant test, either from the point of view of the innovative procedure and of the given results, is the so-called “diagonal test under displacement control”, performed on two wall specimens of the building.
The diagonal tension test is one, if not the only, possibility in order to evaluate tensile and shear resistance of an existing masonry wall. This test has been standardized at international level [3, 4] and

utilized/developed in several applications, like in [5-12]. Modern non-linear analysis, particularly for seismic loadings, requires the experimental evaluation of the post-peak degradation curve in order to adopt reliable analytical models. No in-situ diagonal compression tests have been done before under “displacement control” (at least to the authors’ knowledge) but, vice-versa, the complete experimental program in L’Aquila has been executed under “load control”. Moreover, historical masonry walls at L’Aquila exhibit two external layers (approximately 10 cm of thickness) which are connected by a central part that is less predictable as far as presence of mortar and size and type of aggregates. Therefore, it is most likely to expect a non-homogeneous behavior of the entire cross section of the wall, i.e. it has to be expected that the two external layers move with a certain independence one from the other. The equipment has been studied in order to control, independently, the two jack forces, which act on each masonry external layer.
The testing equipment designed and prepared at the Politecnico di Milano Testing Laboratory is described in detail in [13]. That equipment was then adopted in order to perform the in-situ diagonal compression test on two specimens of Palazzo Paone. Here, the in-situ test is recalled as fundamental test giving results useful in the reconstruction and rehabilitation technique. The construction company, belonging to the Paterlini Group from Brescia, has selected and adopted a specific grout to be injected into the masonry walls in order to improve their mechanical characteristics. The aim of the test program was therefore to evaluate mechanical characteristics of the historical masonry walls, before and after the injection of that specific mortar product.
Experimental equipment is composed of:

- 1 piston pump (Fig. 7) with oil circuit at a pressure of 220 bar. The pump is able to feed two separate oil circuits; each circuit is made of one pipe for the oil that flows from the pump to the jack and a second pipe from the jack to the pump. Two servo valves are placed on each circuit: one on the line that goes from the pump to the jack and a second one on the line from the jack to the pump. Servo valves are of analogical type such to control both pressure and flow rate;
- 2 jacks able to apply both tension or compression force; the piston has a central screwed hole which allows to screw in series a load cell, with a spherical joint for avoiding the creation of inclined undesired force, and a steel bar. The 2 jacks (Fig. 8), positioned at both sides of the masonry wall, are placed on a steel loading shoe, which transmit the compression load from the two jacks to the masonry specimen;
- two steel loading shoes (Fig. 8) positioned, as usual for this type of test, at two opposites corners of the masonry specimen;
- two steel bars (Fig. 8) which are connected, at one end, to the jack and, at the other, to the opposite steel cap;
- two displacement transducers (Fig. 8) placed on each side of the specimen along the two diagonals;
- 1 PC (Fig. 7) for the data acquisition.

Being the rehabilitation project of the building based on the enhanced mechanical properties of its masonry, the following experimental results, briefly resumed in the graph of Fig. 9, have been extremely useful.

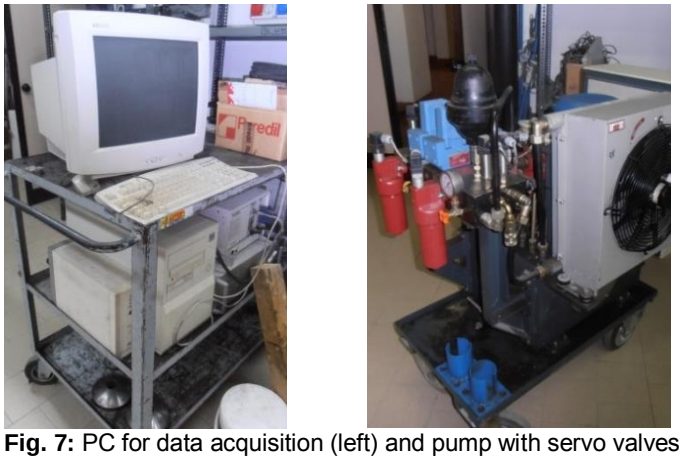

Fig. 7: PC for data acquisition (left) and pump with servo valves (right).



Fig. 8: The injected masonry specimen before (left) and during the test (right).

The following Table 1 gives the results of specimen A (the two sides of the wall are identified with number 1 and 2), not reinforced by mortar injection, and specimen B which has been reinforced with injected mortar. Figure 9 gives diagrams of diagonal single jack load versus corresponding head piston displacement. It is worth to remark: (i) Figure 9 shows that the 2 jacks forces on the external layers are almost equal in the reinforced injected specimen, while the opposite for the original specimen; (ii) injected specimen presents a strength and a ductility which is between 3 and 4 times the values registered for the original specimen. Figure 10 shows the cracks pattern at maximum load along the diagonal of the injected specimen.

Table 1: Single jack diagonal peak load and corresponding displacement.

Specimen	Max diagonal load (kN)	Diagonal displacement of the jack piston head at the peak load (mm)
A1	34,43	22,12
A2	23,45	21,76
B1	80,36	38,71
B2	76,04	38,87

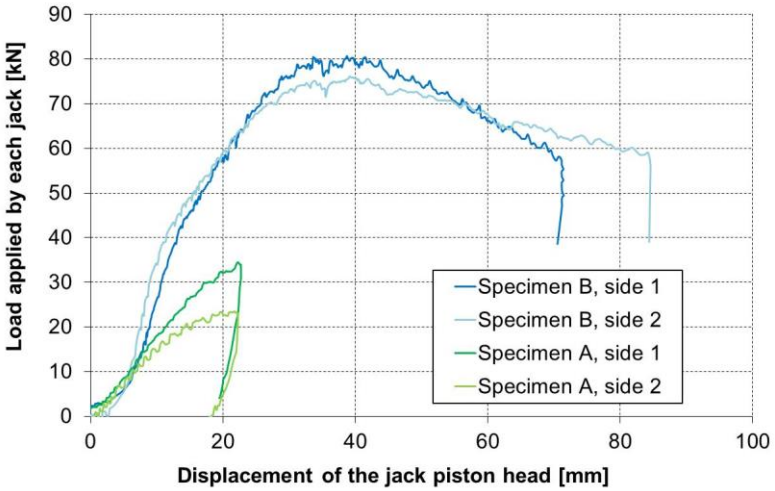

Fig. 9: Single jack diagonal force versus corresponding displacement.

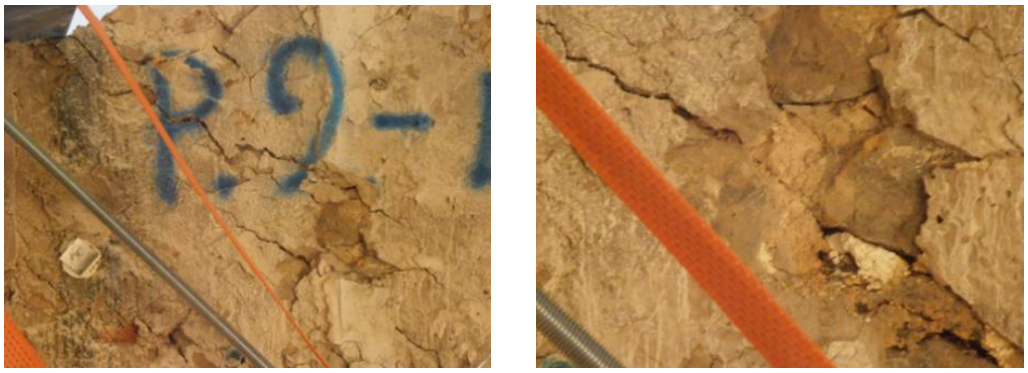

Fig. 10: Cracks at peak load of the injected specimen.

3. Finite element numerical analyses

The study of the seismic behavior of the building was carried out by linear dynamic analysis based on the vibration mode shapes. The results can be considered valid only for small oscillation amplitudes and without any sources of non-linearity, as in the case of spread damage. To determine the effects of the earthquake on the building, for each mode of vibration, the response spectrum prescribed by the Italian design code has been used, taking into account the local seismic hazard.

The peak ground acceleration values are 0.301g for the horizontal earthquake, and 0.180g for the vertical earthquake (Fig. 11). The design spectra are defined by assuming a behavior factor q = 2.25 for the horizontal direction and q = 1.5 for the vertical one.

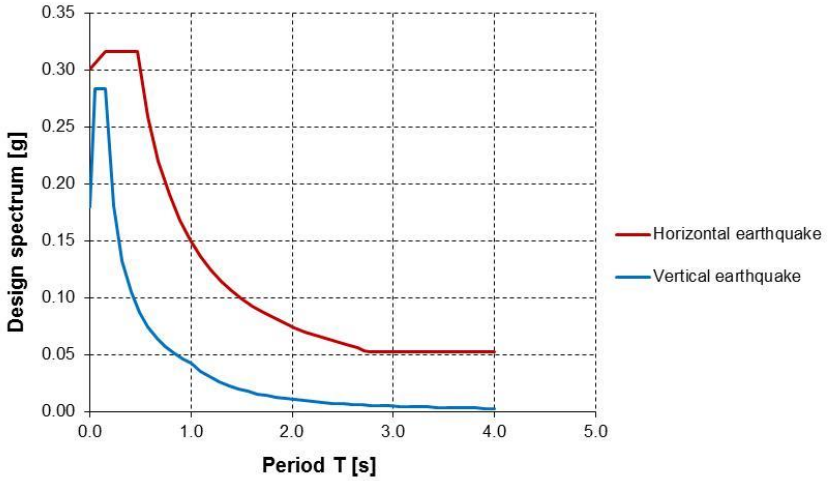

Fig. 11: Design response spectra.

The three-dimensional geometry of two finite element models have been created: the first model corresponds to the original state of the building, while in the second model the changes prescribed in the restructuring project were included. Two-dimensional finite elements (plate) were used to model the walls, vaults and floors, with a regular mesh made of a mix of three and four nodes elements, with approximately 50 cm side length. One-dimensional beam elements were used to model reinforced concrete beams and columns. A detailed description of the chosen mechanical parameters is given in [1], as well as the dissertation on the “adequacy of parameters”, by comparing the stress results of some points of the structure, represented in the Mohr-Coulomb plane, and comments on the results. In the following Fig. 12, the overall behavior of the modal analysis for the first and second model is graphically shown.

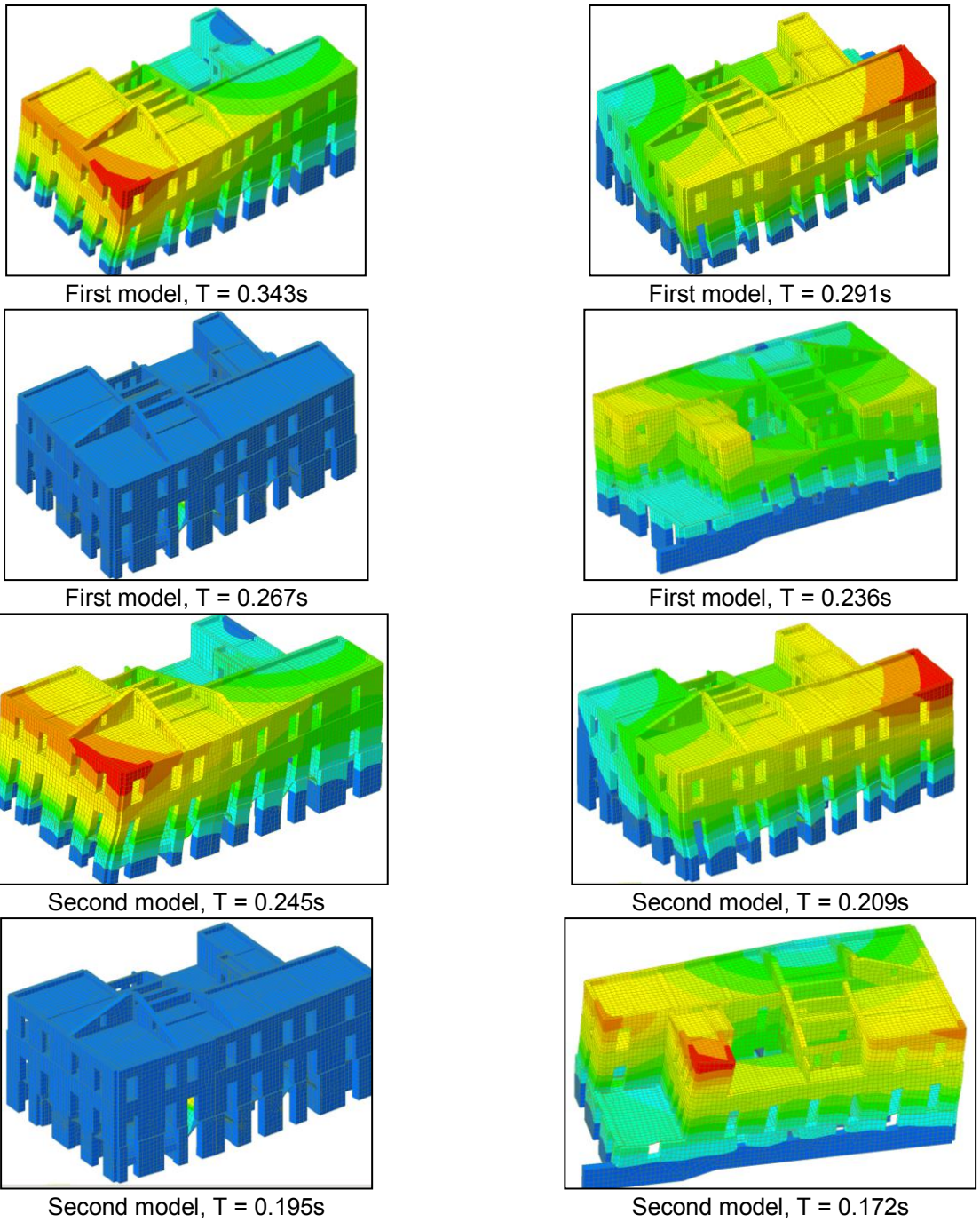

Fig. 12: Vibration mode shapes.

4. Conclusions

The global analysis carried out using the finite element method with a response spectrum linear modal analysis has provided a good correspondence between the numerical model and on-site structure behavior observations, in terms of damage sustained by the building. The measures provided for the restructuring project did not alter the overall behavior of the building, except in the provision of a greater stiffness given by improving the materials characteristics and the presence of rigid planes.

It was used the failure criterion of Coulomb to conduct seismic checks on stone masonry of the building. The parameters of internal friction and tensile strength were determined in an analytical way.

With regard to the high degree of satisfaction of seismic verifications achieved for both the first and second model and with regard to the considerations made on the criticality of the tensile strength, observations are concerning the failure criterion of Coulomb that may lead to a non-conservative control of tensile stress conditions. For this reason, it may be interesting to truncate the Coulomb criterion by excluding checks characterized by a too high tensile stress [1]. On the other hand, to reach this target, it could be appropriate

to increase the experiments intended to determine the friction coefficient and cohesion of the masonry (rather than the tensile strength) by means of diagonal compression tests.

Bibliographical References

[1] FRANCHI, Alberto. Relazione di prova in situ del 04 ottobre 2012. Milan: Consorzio CIS-E, 2012.

[2] DM 14/01/2008. *Norme Tecniche per le Costruzioni*. Rome, 2008.

[3] ASTM E 519. *Standard Test Method for Diagonal Tension (Shear) in Masonry Assemblages*. 2010.

[4] UNI EN 1052-3: *Methods of test for masonry - Part 3: Determination of initial shear strength*. 2007.

[5] BRIGNOLA, Anna, FRUMENTO, Sara, LAGOMARSINO, Sergio, PODESTÀ, Stefano. Identification of shear parameters of masonry panels through the in situ diagonal compression test. *Int. Journal of Architectural Heritage,* 2009, vol. 3, p. 52-73.

[6] CHIOSTRINI, Sandro, GALANO, Luciano, VIGNOLI, Andrea. On the determination of strength of ancient masonry walls via experimental tests. *Proceedings of 12th WCEE*, Auckland, New Zealand, 2000.

[7] CORRADI, Marco, TEDESCHI, Cristina, BINDA, Luigia, BORRI, Antonio. Experimental evaluation of shear and compression strength of masonry wall before and after reinforcement: Deep repointing. *Construction and Building Material*, 2008, vol. 22, p. 463-472.

[8] CALDERINI, Chiara, CATTARI, Serena, LAGOMARSINO, Sergio. The use of the diagonal compression test to identify the shear mechanical parameters of masonry. *Construction and Building Material*, 2010, vol. 24, p. 677-685.

[9] CHIOSTRINI, Sandro, GALANO, Luciano, VIGNOLI, Andrea. In situ shear and compression tests in ancient stone masonry walls of Tuscany. *Journal of Testing and Evaluation*, 2003, vol. 31, n. 4, p. 289-303.

[10] CORRADI, Marco, BORRI, Antonio, VIGNOLI, Andrea. Experimental study on the determination of strength of masonry walls. *Construction and Building Material*, 2003, vol. 17, p. 325-337.

[11] BORRI, Antonio, CASTORI Giulio, CORRADI, Marco, SPERANZINI, Emanuela. Shear behaviour of unreinforced and reinforced masonry panels subjected to in situ diagonal compression tests. *Construction and Building Material*, 2011, vol. 25, p. 4403-4414.

[12] GALLO CURCIO, Antonino. Comportamento a taglio delle murature. In: *Sul consolidamento degli edifici storici*. Rome: EPC LIBRI, 2007, p. 119-137.

[13] CRESPI, Pietro, FRANCHI, Alberto, GREGORI, Amedeo, RONCA, Paola. An in situ diagonal compression test with displacement control of the two wall sides. Proceedings of 9th International Masonry Conference, Guimaraes, Portugal, 2014.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE

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The Trezzo sull'Adda's Castle: restoration and reuse of the Cultural Heritage for a sustainable future use

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Abstract

The themes of recovery, restoration and safeguarding of the artistic, architectural and landscape heritage of our country, since several years have been addressed in different areas like technical research, legislation, manufacturing techniques, and is debated in national and international context. Despite the very important contributions from these areas, the missing ring in the chain, often, is the vision of the economic management of the future reuse of the buildings and of the environmental sustainability. The costs of these operations are so challenging that only a clear prediction of the "future economic capacity" of the restored object it can encourage the restoration. Here we show an emblematic case history, where studies and works, are planned for the restoration of the entire area of the Visconti Castle in Trezzo sull'Adda. The topic is that the "start-up" of the process has been developed both in parallel with cultural aspects and social-economic studies on the entire area where the town of Trezzo, for historical and geographical reasons, has a prominent position. The results of these documented studies and the undoubtedly propositional attitudes of the Municipal leaders have pushed this administration to undertake and finalize the restoration of the castle, with the purpose to create facilities for the entire area social re-use by the population and to stimulate, a sustainable development.

Keywords: Heritage, sustainable development, restoration.



Fig. 1,a,b: The Trezzo sull'Adda Castle is in a strategic area. In fig.a) the investigated areas, in fig. b) the view of the castle.

1. The Trezzo sull'Adda Castle a strategic area: geographical location and history

We are all witnesses that there are many realities, where a concerted planning, using LCA, LCC and LCM simulations giving direct and indirect costs and profits and social and economic consequences, are crucial for decision-making of restoration strategies to be used.

Studies and works for the restoration of the entire area of the Visconti Castle in Trezzo d'Adda, some of them are still in progress, are emblematic in this sense. The motivations has been in parallel studies and complementary results among the cultural landscape and the socio-economic view of the entire area.

We mention the studies described and documented in [1], [2] and [5] commissioned by the municipal administration of Trezzo, for the civil reuse of the castle area which his in between to the historic center of the town and the riviera of the Adda river. Trezzo town in located in the east side of Milan, and, for historical and geographical reasons, the town occupies a prominent position.

The documented results of these studies, lead this administration to undertake and finalize the restoration of the Castle, maintaining a very clear vision and constraints of restoration of the whole area, with the aims to facilitate the use for recreational-cultural scope and leisure of the population of the whole district, which may encourage, as it is also briefly highlighted in the conclusions of this communication, the sustainable social development.

The Trezzo's castle is located in a central and strategic site in the Central-East of Lombardy: specifically, the Visconti's Castle is one of the cornerstones of the extraordinary cultural heritage of Lombardy; It is itself a monument and at the same times is the center of the networks for the accessibility, cultural, geographical, ecological, historical and economic settlement of the territorial district of the valley of the Adda river. One of the fundamental importance was during the centuries, the synergy between the castle, the old town of Trezzo and the Adda's and Navigli's Lombardi river system.

The valuable manufacturing of these values in the area is still strong: they are, for example, the Leonardo da Vinci's engineering works, the hydraulic barriers system of the canals, the hydroelectric power plants and the village of Crespi d'Adda, the diversified historical urban centers, the great landscape that goes from Milan to Lecco, Lodi, Bergamo, and the all economies today in activity.

The Visconti's Castle and the areas that surround it, owned by the City of Trezzo, in the last decades where excluded from any productive use and became usefulness. As often happens, the degradation has become increasingly evident and invasive. In order to restore functionality for the entire area, a system of planned studies and interventions was undertaken at the end of the 2000's: the restoration of the tower was completed, and contemporary was commissioned to Politecnico di Milano a diagnostic tests to evaluate the safety of the surrounding walls and to evaluate the presence of voids in the underground castle park.

In Figure 1 highlights the strategic geographical area of the Castle, built on the top of the promontory between two bends of the river, in continuity with the historic center of Trezzo, dislocation undoubtedly favorable for a functional restoration program. In Figure 2 the historical transformations of the castle are pictorially represented, from the original Visconti castle, the ruins of the same at the end of '800, to the situation of degradation, covered by the infesting vegetation, as it appeared at the beginning of the investigations conducted by the group of writers and with some students of the Master School F.lli Pesenti [3], [4], thesis of which this article is a brief summary.

About the original Visconti's Castle and the ancient arch bridge on Adda river there are few archival documents, which essentially dates back to the end of '800 [5], [6]; the actuals walls are in Lombard's sandstone know like "ceppo d'Adda"; part of them are bordering the flat part of the garden, and was built in nineteenth century. The garden and the walls enclosed the ruins of the overhang and underground rooms dug the rocks, partly accessible, showing great lesions of various nature, certainly also due by the water seeping into the shaped vaulted roofing.

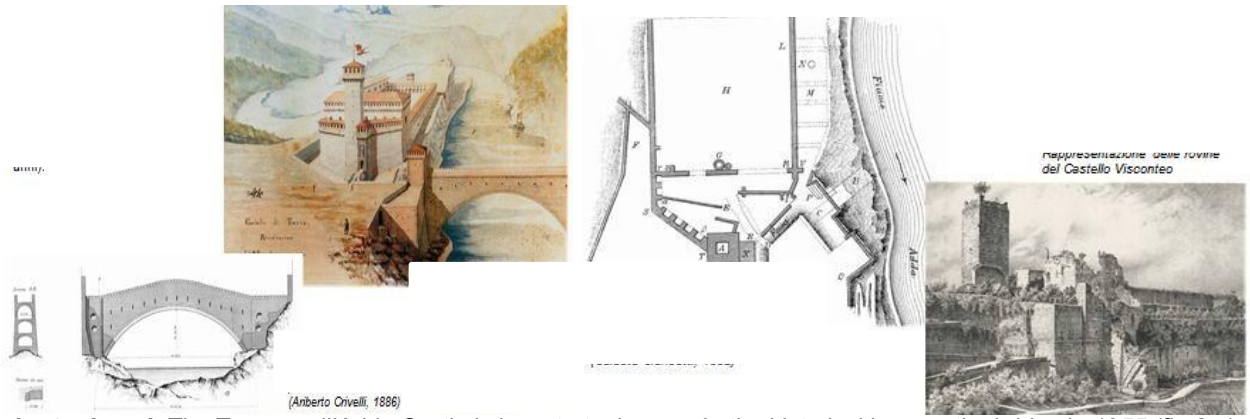

Fig. 2,a,b, c,d: The Trezzo sull'Adda Castle is in a strategic area. In the historical images the bridge in 1355 (fig.2,a) and the castle in the years 1377(fig.2,b,c,d), in 1882 (fig.2,c,d).

Erosion and leaching caused by rainwater have created in the times discontinuities and damage of the supporting structure of the entire complex. The two areas most affected by such damage, are the garden and the road “via the Porto”, with clear shallow depressions of the garden which causes out of plumb of retaining walls and injuries along the street, degrading to the river, so that since a long time the street have been closed to pedestrian and vehicle traffic.
The investigations and the restoration are just been addressed primarily to these two areas.
The erosion caused by the rainwater is macroscopically denounced by some subsidence and visible cracks, partially shown in Figure 3. The design for the intervention on the walls and new drainage system of the water has required the wide spread knowledge of the precise composition of the soil and a mapping and extent of the damage of the surface and the immediate underground soil, as described below.

2. Diagnostic survey for priorities actions

In this first phase, the owner asked to Consorzio CISE to evaluate damages and voids on the park, on the hypogean rooms and the exterior fortifications walls. All diagnosis was proceeded by a geometric and material relief, not less, the photo straightening of all the walls.
The diagnosis and relief in briefly consist on:

- geometrical, material, degradation and crack relief;
- georadar and geoeletric diagnosis for the park and the perimeter walls;
- geometrical, material, degradation and crack relief of the hypogean rooms.

2.1 Diagnostic survey for priorities actions on the perimeter walls and the park.

Specific and innovative techniques for the application of geophysical and geoelectric, as will be described below, required for their application and reliable reading of the results, thorough cleaning from weeds, with subsequent relief and straightening photo of the entire surface of the perimeter walls, as shown in Figure 4. This preliminary survey, conducted by a specialized team for exploration in the vertical rock/wall, has allowed us to identify promptly the different compositions of the walls and the typologies and real extension of the visible damages and give back the real relief with straightening photo techniques (see in Figure 4).
The state of conservation with several discontinuities in material’s walls required further investigation to verify the damages and consistency of the thickness of the walls; a campaign of georadar surveys on all over the walls was performed. Only with this second phase of the investigation, it was possible to get information about the real and prevalent damage, even in depth, material decay, and the static safety of the walls. In Figures 4 and 5 the steps of georadar survey and the returning results are shown, showing even the portions of the walls with cavities. According to the overall picture of the damages detected, the priorities actions for



Fig. 3 a,b,c,d,e,f,g,h,i,l: the areas investigated and the different typologies walls and deterioration. Fig. a,b,c the parapets and the ramps vegetation and water polluction decrease the safety of the street; Fig. d,e,f cracks on the walls; Fig.3, g,h,i, l and the tower overlooking the River.

structural reinforcing and operating drainage system through the wall in “via Castello” are shown (fig. 5). In particular the static reinforcement of the wall was achieved by injections and and reconstruction techniques, as well as the creation / restoration of drainage holes, as shown in Figure 5.
As for the castle walls, also for the park the use of non-destructive techniques, able to get the information about the stratification of the ground below, have been used by means of geoeletric and georadar technique, the geometrical extension and distribution of which are shown in Fig. 5a. For this extended area in the garden, the intention of the municipality administration, is to control the safety of the area open to the public, also for cultural exhibitions and entertainment. The geophysics techniques, used in conjunction as briefly described before and in [5] extensively , have been able to render the composition of the soil and to find small medium underground cavities (Figure 5). This is possible only using non-invasive techniques, based on the transmission of waves, with complementary capabilities.



Fig. 4 a,b,c,d,e,f,g,h,i,: in Fig.4,a the areas investigated with georadar technologies; in Fig. 4 b,c,d,e,f,g, the phases of georadar investigations and the results with the existence of voids and deep measures, in red Z=60 cm, in blue Z=70cm, in fuchsia, Z=80cm, in yellow Z=100cm.

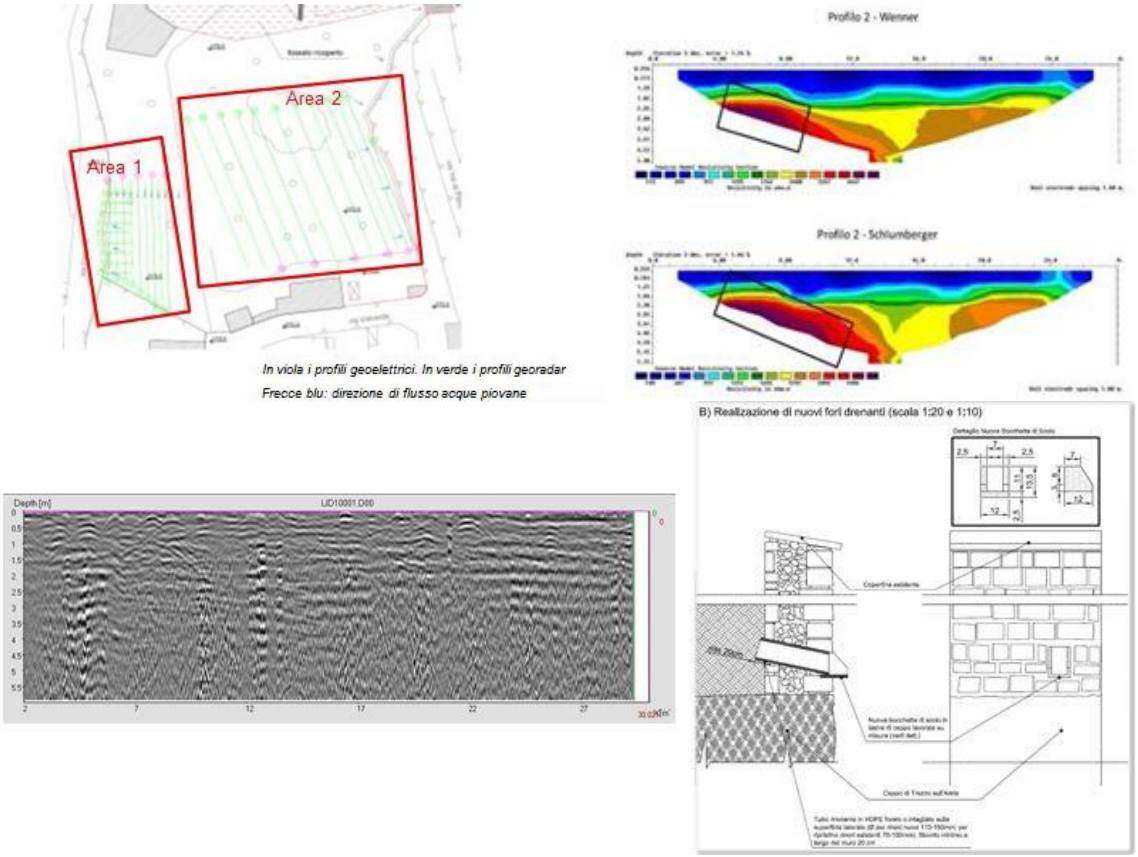

Fig. 5,a,b,c,d: Geolectric investigations, in Fig.5a) The areas, in Fig.5b),c) the results on the section, in Fig.5d) a typical solution for the management of the water.

Detailed description of geophysical techniques implemented in the present case is shown in [5], in conjunction with the schedule for the interpretation of the results. Here, briefly, please note that "low resistivity" (blue) corresponds to the presence of solid ground, and on the other hand "high resistivity" (Reds) corresponds land with the presence of cavities, and a regular transmission of electromagnetic waves (for depth of 1.5 / 2 meters) corresponds lithographic regular arrangement on the whole area.

2.2 Diagnostic survey for priorities actions on the hypogeus rooms.

A big part of the building is distributed under the park where there are hypogeus rooms as graphically shown in fig. 7.

The diagnosis consist on geometrical, material and cracks relief.

The geometrical relief is under disposed to the representation of materials and degradations, not less the photo straightening of all the walls. As shown in fig 6 the geometrical, the cracks and degradation relief, help us to create the guide line for restoration ad for the structural analysis.

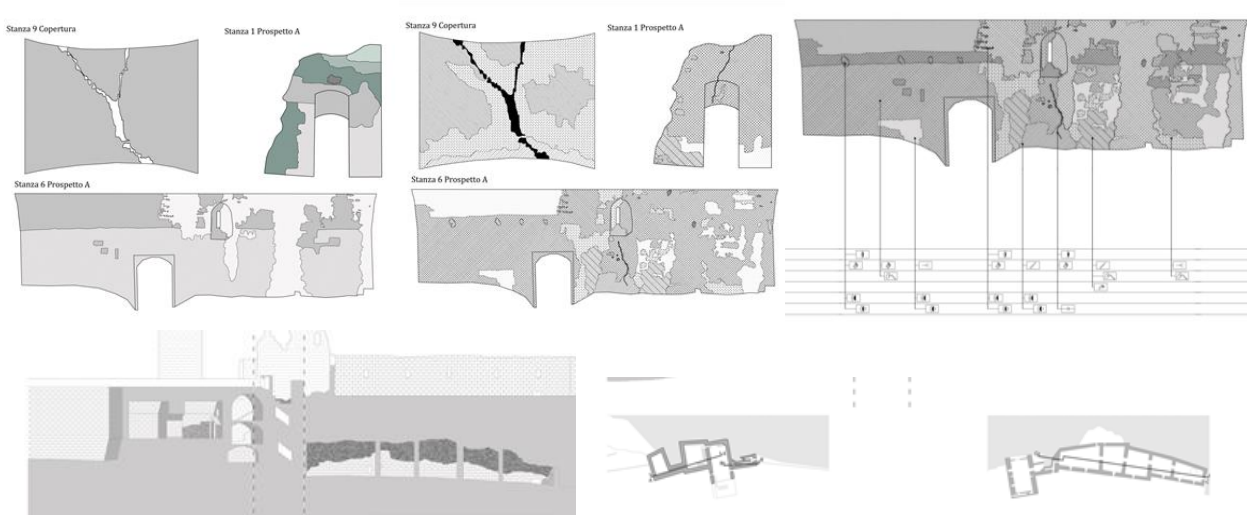

Fig. 6a,b,c,d: Relief of cracks (a) , material construction (b), schemes for restoration (c) and 3D modelling (d).

3. Suggestion for the design of a new sustainable reuse of the Trezzo sull'Adda Castle

The Trezzo sull'Adda Castle strategic area will be a new landmark which can became a strategic site where insert new functions to reactivate synergies of the east side of the Lombardia region, where however the population of a number of towns are continuously increasing. The reuse Castel operation may have an influence area of about 20 km, it is already provided by the bicycle paths, which connect Milan to Lecco lake and other cities around Adda's river.

The study here presented include many suggestion to install temporary service buildings where insert retail, toilets without interference with the historical buildings (figure 7, 8).

The geometrical relief may be modelled using BIM software, a parametric software which can be used to evaluate structural capacity, material characteristics not less to create simulation with inserting new buildings. This models help designer team and superintendent authority to control and evaluate the reuse of historical buildings.

The work presented here provides further developments, summarized in the following two addresses:

- definition of guidelines and operational techniques for innovative approaches for diagnosis and restoration in services for the safety of cultural heritage; in particular the experience in the Castle, viewed as the application lab using innovative techniques for surveying and monitoring, with the aid of BIM software, allows us to create a virtual reconstruction of the site (the state of the fact, the state of implementation of the past documented) and the mapping of the degradation. The same model will be useful in the drafting of the guidelines and methodology of the restoration of the monument, the programming of assistance, the management of the activity construction, thanks to the BIM application;
- definition of the system of historic networks, accessibility, cultural, geographical, environmental and economic information that characterizes the "territorial cultural district" in which the Castle of Trezzo help to reconstruct the macro cultural networks urban and territorial.

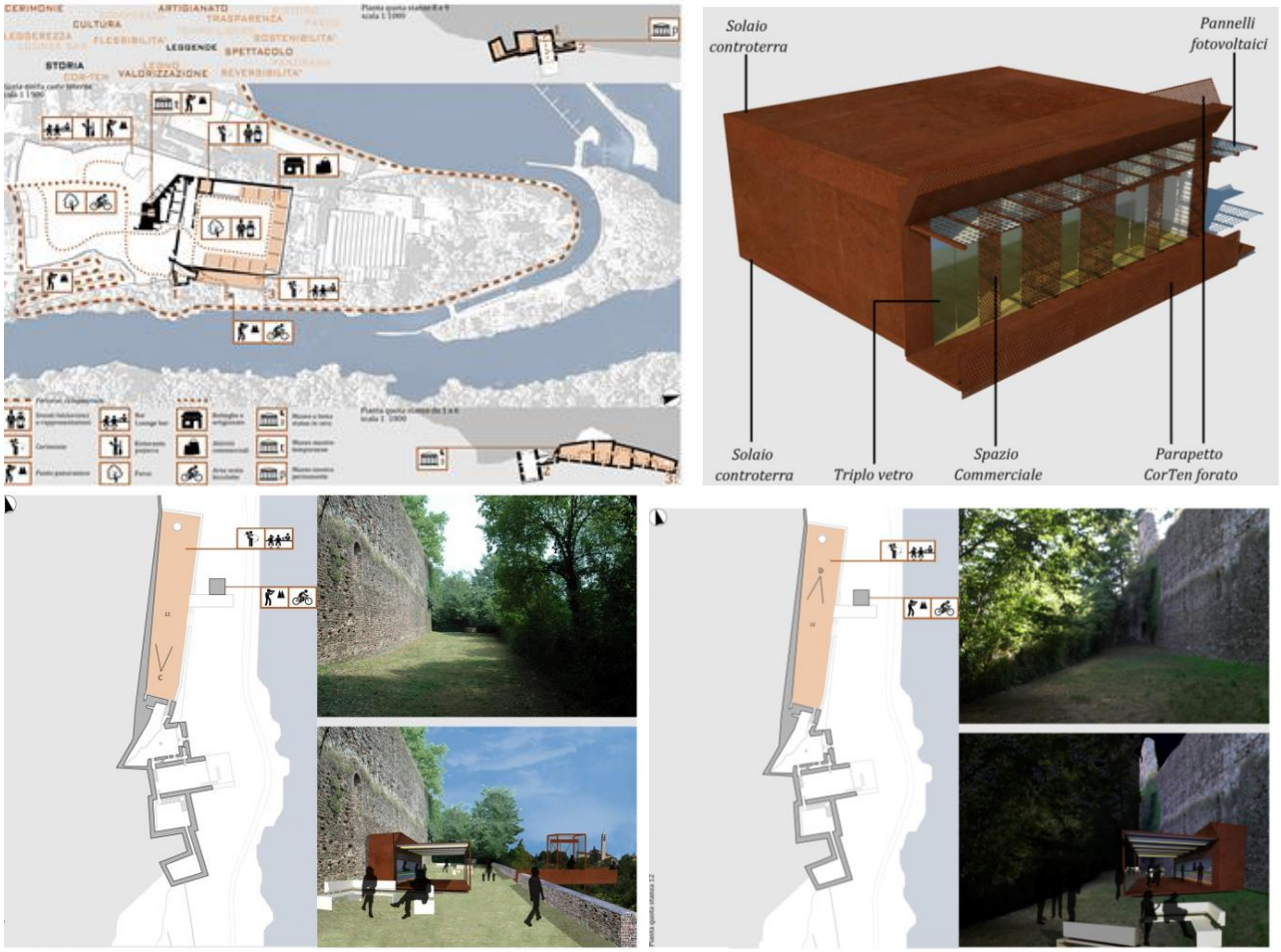

Fig. 7a,b,c,d: Represented design reuse of the Trezzo sull'Adda Castle and its strategic area. The examples of buildings and services which don't create interference with the historical building.



Fig. 8: Represented design reuse of the Trezzo sull'Adda Castle and its strategic area. The examples of buildings and services which don't create interference with the historical building.

3. Conclusions

The "Case History and Study" of the Visconti Castle of Trezzo, here briefly exposed at different stages, from the decision-making approaches, with particular attention to socio-economic development, diagnostic investigations and early operative interventions, wants to emphasize the integrated methodology for management, conservation and dissemination of cultural heritage of monuments and landscape. It is an example to use for different and for larger scales.

The Visconti's Castle of Trezzo is a primary joint nets which qualify the territorial use of the High Adda, which is a territorial district oriented to culture and landscape of excellence with a system of local landmarks, historic buildings, landscapes networks, intermodal connection networks, river and pedestrian networks, both along the canals and along the Adda's river.

The basic result of the research is as follows: the qualitative restoration of this territorial district and its cultural vocations is the preferred methodology for understanding the history and the actual vitality of the territory. These ideas may lead to a future capable of preserving its historical matrix, but also capable of the area developing, in terms of human settlements and economic activities, according with its vocations. At the same time, it will make a verification of accessibility in order to propose potential new mobility by river, bicycle roads and public transport (MM2 metro extension until Trezzo) [2].

Bibliographical References

[1] LEDDA, F., Studio di fattibilità per il prolungamento di servizio pubblico di trasporto Gessate-Trezzo sull'Adda. Milan: Master thesis, Master School F.lli Pesenti, Politecnico di Milano, 2012.

[2] MORINI, G., RONCA, Paola. Prolungamento di linea metropolitana leggera da Gassate a Trezzo. Milan: CISE - Studio TAU report, 2012.

[3] GRACCIONE, S., MANCA, S. Il Castello di Trezzo sull'Adda: restauro e ipotesi di riuso. Milan: Master thesis, Master School F.lli Pesenti, Politecnico di Milano, 2012.

[4] ANZANI, A. Interventi di consolidamento della cinta muraria esterno del Castello di Trezzo sull'Adda. Milan: Master thesis, Master School F.lli Pesenti, Politecnico di Milano, 2012.

[5] LUALDI, M. Indagini geofisiche per l'area del Castello Visconteo di Trezzo sull'Adda. Milan: CISE Consortium report, 2012.

[6] BELTRAMI, L. Il castello di Trezzo : disegni e documenti inediti, Milan: Allegretti, 1910.

[7] MEDOLAGO G., MACARIO F.; Relazione storico, archivistico, stratigrafica sul Castello di Trezzo sull'Adda, 2007.

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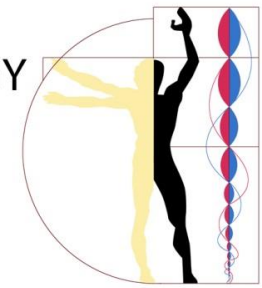

A methodology able to investigate the phenomenon of unauthorized building: the case of Giugliano in Campania

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Abstract

The present study tries to analyze the phenomenon of unauthorised building in a specific territory. The choice is due to the fact that the above phenomenon has a strong territorial impact, as well as a strong influence on the use and consumption of that land.

The final aim is to propose a methodology (based on the overlapping of different maps) able to figure out the phenomenon of unauthorized buildings in reference to the municipality of Giugliano in Campania. The choice of the above-cited municipality is based on two main reasons. First, it is characterized by a high rate of illegal building, in addition to a strong presence of racketeering. Second, it represents an interesting case, not only for the reading of the phenomenon per se, but also for the pivotal role it plays between the provinces of Naples and Caserta.

After investigating the phenomenon of unauthorized building in reference to a specific municipality, Giugliano in Campania, the paper tries to explain how the urban plan must act – or properly react – in reference to this phenomenon.

Keywords: unauthorized building; planning; housing; overlay mapping

Introduction

Despite what happens in most of European Countries, where there are well-established plans and laws ruling the building activity in cities and National authorities control that these planning laws are respected, in Italy the phenomenon of unauthorized building is very common and well known.

In order to understand unauthorized building in Italy – whose origin can be dated back to the Thirties and after the Second World War (Crainz, 2009) – we must start from the assumption that this phenomenon can be seen as a sort of reaction against the many planning and administrative laws impeding or delaying authorized building. This illegal reaction implies an inefficient development of cities and, above all, it does not guarantee the quality of cities. Unauthorized building is only one of the clearest symptoms of a warped process of modernization and of some unsuccessful paradigms of urban planning.

The terms “unauthorized building” are very common since they clearly represent what they stand for: an atypical use of a resource, the land, that is too much exploited and that takes advantage to those who use it in an illegal way rather than the whole legal community.

These terms have become so common after the landslide happened in Agrigento – in Sicily – in 1966 when the hill Girgenti collapsed because of very unexpected unauthorized buildings due to collaborations between entrepreneurs and politicians who had realized high buildings in a area subject to landslides (Zanfi, 2008).

In this vein, amnesties for infringements of building regulations were born, according to which unauthorized building were allowed and repressions were not applied. The firs amnesty took place in 1985 thanks to L. N. 47/85 and it established that all the unauthorized building realized before 1st October 1983 could be remitted. Similarly, the second amnesty took place in 1994 thanks to L. N. 724/94 and it established that all the unauthorized building realized before 31st December 1993 could be remitted. The third and last amnesty can be dated back to 2003 (D.L. 326/2003).

According to the above, the present paper illustrates a methodology useful to read and comprehend the phenomenon in one of the municipalities most known for unauthorized building in the province of Naples: Giugliano in Campania.

1. Unauthorized building

The evolution of unauthorized building can be due to several problems:

1. Housing necessity. This can be neglected because of typology and price in the legal market – public and private – and so unauthorized building has been wrongly considered as the only way to solve the housing problem (after the Second World War). Unauthorized buildings, which are often located in specific illegal zones, constitute a parallel market if compared to the legal real estate market;
2. Necessity of buildings. It may happen that buildings destined to second and third sectors (production and services) are not available or they are located in not suitable areas. Often, these buildings are created together with unauthorized houses or they complete unauthorized settlements;
3. Enlargement of building for production and services. These kinds of unauthorized buildings are born if new housing needs emerge or if there is the need to enlarge the productive activity;
4. Facilities, second house needs in not urbanized zones. This phenomenon, generally located on the seaside, can assume different structures (hotels, beachfront resort, restaurants etc) that are realized in already existing cities.

According to the above, unauthorized building represents the gap between urban planning, city management and market reasoning.

In order to understand the causes of a specific type of unauthorized building (houses), we need to consider both the low number of social housing compared to real housing needs by population and the growth in population (Italians moving from south to north or from rural areas to cities) during the Fifties and Sixties. For examples, the population in Turin grew up of 22,500 inhabitants per year over the years 1951-1971; Milan of 23,000 per year and Rome of 57,000. However, the relationship between causes and effect is not so clear: in Turin and Milan the unauthorized building phenomenon is not so evident, while in Rome and in the south of Italy whole unauthorized neighbourhoods were built (Gorio, 1985, pp 67 ss).

1.1. Typologies of unauthorized buildings

Typologies of unauthorized buildings are three. At the ends of a continuum there are the *necessity* unauthorized development and the *speculative* unauthorized development. In the middle there is the *convenience* one.

The *necessity* unauthorized development regards the very poor people who do not hold a house. The *convenience* one, instead, is generated by people who already hold a house but who want to improve or

enlarge it for different reasons. These improvements or enlargements are rent out or they are kept as incomplete in the short run and then they are completed according to emerging necessities. Subjects who do not aim to live there, then, start the *speculative* unauthorized development. They just aim to rent or sell unauthorized buildings destined to housing and services. The extreme case happens when illegal organizations dive birth to whole unauthorized neighbourhoods. The distinction between the three typologies of unauthorized development is not so clear. *Necessity* unauthorized development can evolve into *convenience* one. This last one can evolve into the *speculative* unauthorized development. However, the distinction between them is based on the specific functions of each settlement.

Beyond the housing unauthorized development, we can observe the phenomenon of productive unauthorized development. In this case, stores, handmade laboratories, small and medium size factories and warehouses are built. It is rare, however, that only productive activities are implemented in an unauthorized area. Often, in fact, housing and productive buildings are made in the same area.

A recent phenomenon, taking place in the legal residential areas, deals with the implementation of illegal stores and offices. These are illegal because the spaces were destined to another use.

The most important distinction in this field is between unauthorized neighbourhoods (destined to housing) in not urbanized areas (i.e. farm areas) and building that are realized disregarding existing urban laws ruling areas that are going to be urbanized.

As for unauthorized neighbourhoods in not urbanized areas, illegal entrepreneurs create *ex novo* urban laws. As for building realized disregarding existing urban laws ruling areas that are going to be urbanized, it is possible to foresee an urban impact because it is going to change the urban destination, to increase the volumes, to modify historical heritage and, of course, to adulterate the administrative processes.

The phenomenon of unauthorized building must be read according to different perspectives:

1. It is a social practice that creates new houses and shapes new neighbourhoods;
2. It is productive process of buildings of new volumes not guaranteed by public institutions;
3. It is seen as a way to access housing at a lower price.

This last perspective seems to be the most relevant one since it spreads illegal practices. In this last case, illegal practices affect the prize of area, the level of urbanization and building types and times.
The first advantage that inhabitants have consists in paying a lower price that the average of legal market; this is the most important feature of Italian unauthorized building since houses and volumes are realized in areas where urban plans do not foresee them. This type of unauthorized phenomenon implies two positive consequences:

1. The seller earns a higher income (rural areas sold as residential ones);
2. The buyer pays a lower price.

As for the seller, these areas, however, are cheaper than usual also because they are areas near polluting industrial plans or under the risk of hydrogeological instability.

The buyer, instead, saves money since the area is not urbanized. At the beginning, the buyer invests only in necessary infrastructures (like water and electricity supply network, and septic tank). Later on, the buyer aims to get urban public infrastructures by municipality (streets, schools, sports and cultural centers etc.). This way of proceeding has two positive implications:

1. To spend all the available money in order to buy the area and to build the house;
2. To obtain the infrastructures by urban plan or by amnesty for free.

In these cases we have talked of advantages in terms of time and way of unauthorized building. Another positive consequence for the buyer depends on the nature of labor whose cost is always lower than legal one. Incidence of this cost can vary: it is the lowest if the buyer builds by itself, it is the highest if the buyer turns to a building contractor. The most relevant cases are between them in which the buyer saves money by building by himself and with illegal labor, and by using poor quality materials.

1.2. Empirical evidences

According to the data related to the first national amnesty in Italy, between 1942 and 1983, 2.5 millions unauthorized houses were built (that are 7.5 millions chambers on a total amount of 24 millions at the national level); 830,000 property renovations and 825,000 interventions of emergency maintenance were carried out. Despite these data, the ongoing of unauthorized building does not change.

In order to frame the phenomenon at the present, we can refer to the report Ecomafia 2013, published by Legambiente and supported by Law Enforcement Agency. The incidence of unauthorized building in the market has passed from 9% in 2006 to 16.9% in 2013. New authorized houses have decreased passing from 305,000 to 122,000; new unauthorized building, instead, have quite decreased passing from 30,000 in 2006 to only 26,000 in 2013. This difference is due to market costs: while the cost to

support in order to build a legal house is up to 155,00 euro, the cost to support in order to build an illegal house is equal to 66,00 euro. Moreover, the illegal constructor does not pay any tax.

Of course, we cannot ignore a very important aspect linked to the presence of criminal organizations. It does not surprise at all that 81% of decrees that have dismissed the Municipalities in Campania – since 1991 up to now – include, among the causes, a widespread phenomenon of unauthorized building, real estate speculation and outstanding demolition. The record – in this reverse list – appertain to the Province of Naples, where 83% of municipalities have been put under temporary receivership (also because of the practice of unauthorized building), followed by Caserta where 77% of municipalities have been put under temporary receivership. Generally speaking, from 2003 to 2012, the phenomenon of unauthorized building has grown significantly: 283,000 new unauthorized houses have been built, whose sales volume is equal to 19,4 billions of euro (Agenzia del Territorio, 2012).

Another very relevant datum is expressed by the ratio between unauthorized buildings and total real estate stock. The average of this datum, elaborated by Agenzia del Territorio (ANNO) and referred to Italy, is 1.608%. However, differences emerge in reference to Italian macro-regions: in Padania the value is of 0.865%, in Etruria and Lazio it is equal to 1.154%, in the South and Islands it is of 2.839%.

In 2012, the phenomenon of unauthorized building has grown up significantly also in seaside areas. In reference to 2011, it has grown up of 2.8%. The increase of this rate started in 2010 and over three years it has reached a value equal to +14.4%, even if the Law Enforcement Agencies and the Port Captaincies have tried to contrast this phenomenon. This evidence is dramatic since it shows that unauthorized building on state property, illegal fishing, and pollution by hydrocarbons increase despite the ongoing of the economic crisis. Nowadays, the crimes are 13,518 (that means 1.8 crimes per each kilometer of coast), people charged are 16,902 and requisitions/seizures are 4,076. More that half of crimes take place in the four Regions where criminal organizations work. At the top of the list there is Campania where 2,101 crimes and an incidence of 4.5 crimes per kilometer of coast. Sicilia, Puglia and Calabria follow in the list. At position number five, we can find Sardegna. Lazio, instead, climbs the list positioning at number six because of 1,050 crimes that have taken place and an increase of 59.3% in comparison to 2011.

Unauthorized building on the state property increases as well. In 2012 there were 2,864 crimes, 4,615 people charged and 1,419 requisitions/seizures. At the top of the list we can find Sicilia, where 476 crimes took place, followed by Campania, where there was the highest number of requisitions/seizures (Legambiente, 2012).

2. Giugliano in Campania

In order to develop the case study of Giugliano in Campania we need to start from a preliminary test of urban rules and plans in force in the area.

The Municipality of Giugliano is located in the North-West part of the Province of Naples. The Regional Territorial Planning – PTR of Campania includes Giugliano among the Development Regional System – STS (rural and manufacturing areas) and, in particular, among the system C8, together with Calvizzano, Marano di Napoli, Mugnano di Napoli, Qualiano and Villaricca. Among them, Giugliano is the biggest municipality – its extension is equal to 94.17 squared kilometers and its inhabitants are 113,811 (Gerundo and Fasolino, available at http://www.areavasta.it/viewer/index.asp?xd=/scheda6).

The area is totally flat. The three kilometers coast starts from Marina di Varcaturo – Lago Patria (Castel Volturno) and ends at Licola (Pozzuoli). Another feature of the area is the presence of “Lago Patria”, a salt lake born in a crater.

In 1985, the inhabitants were 50,000. In 2006 they were 100,000. In little more that 20 years, the population has doubled. This is due to the flux of foreigners and, above all, to the movement of inhabitants from other areas in the Province of Naples (mainly from the suburbs). The increase of population has caused, at the same time, an urban growth that, of course, has not been planned. Nowadays, the population of this municipality is higher than the one of most of administrative center of the Provinces.

Distribution of population over the area is very unbalanced. Expansion of the municipality has been addressed towards suburbs because of the arrival of many families vacated after the earthquake of the Eighties and because of the growing request of low price houses. Because of the many buildings created in the area, the municipality of Giugliano has become a *unicum* with the other nearby municipalities (the area of Giugliano is made up of three main suburbs: Lago di Patria, Varcaturo, and Licola) so that they constitute a whole urban area. The main characteristic of this area is the missing of services and infrastructures and the so many unauthorized buildings. However, the building of the NATO base in Lago Patria can be the reason why urban and environmental requalification and reclamation processes can take place.

In sum, in order to face the housing demand, the municipality of Giugliano has been highly characterized by the unauthorized building, especially in the zone of Casacelle (in the north) and along the coast. In these areas, whole neighborhoods have been realized without any plans. These areas do need primary services in order to satisfy the inhabitants’ requirements.

The most common kind of unauthorized building in Giugliano is the micro one consisting of subtle modifications that, in the long run, alter the landscape. The difference cited above, between necessity and speculative unauthorized building, can be derogated here where it is possible to talk of opportunity unauthorized building. This means that the phenomenon is due to black market and to a culture that has ancient roots and current habits.

The micro unauthorized building must fit the landscape. In order to be subtle at the very beginning of the phenomenon and to advance in time it must consider the boundaries of the parcels, it must lay on an existing road or it must withdraw respect to existing greenery. In this vein, paradoxically the impact of unauthorized building can be less aggressive than expected (Zanfi, 2008, pp. 107-108).

3. The Methodology

Before analyzing the ongoing of the phenomenon in Giugliano, it is appropriate to list briefly the processes through which it has gone and the laws and rules promulgated in order to contain it. The items that we need to define are: 1) *Diffusion; 2) Expansion*; 3) *Infiltration; 4) Erosion*; 5) *Gathering; 6*) *Saturation*.

We are going to define the above items in a more specific way:

1. *Diffusion.* These allocations are scattered, characterized by low density and disconnected between them. Lands they are in are not rough, farmed or particularly profitable and so they indifferently available. The absence of services drives to adopt rationale principles linked to the use of already existing farming layouts or pre-existing water channels;
2. *Expansion.* This item refers to the enlargement of volumes that is due to one or more forces from the inside;
3. *Infiltration*. In this case, an external agent grows or develops trough small subsequent passages;
4. *Erosion*. This process snatches spaces from one or more sides to the detriment of natural or farming that cannot impede this.
5. Gathering. It deals with the increase of individual settlement in an area without modifying its extension. Generally, it is the result of adding some parts to existing buildings that, in this way, end up with joining one another;
6. *Saturation*. This is the process through which a settlement occupies all the available area (Zanfi, 2008, pp. 146-158).

In order to contrast and stop the unauthorized building, it is possible to recall three decisive approaches (as they were supposed to be) that are in force:

1. Repressive approach, consisting in demolishing the unauthorized building. This is largely disregarded;
2. Mitigating approach, consisting in confiscating the unauthorized building. Also this approach has been largely disregarded;
3. Sympathetic approach, consisting in giving amnesty and it results the most advantageous for treasury. This is expected when demolition and confiscation are excluded (Colombo, 2003).

Back to the analysis of the municipality of Giugliano, we have gone through two phases in order to develop this case study:

1. The first phase has dealt with the research of data and documents at the UTC. After direct contacts we have asked for: cartographies (not computerized), requests for building sanctions and decree of demolition. Administrative offices have only provided a part of the documents by turning to law n. 675/1996 ruling privacy management. However, the available data have allowed analysing the unauthorized building in Giugliano.
2. The second phase has concerned the elaboration of data whose results have been framed in tables by Overlay Mapping that is the computerized overlapping of cartographies showing the real aspctes of the phenomenon.

In Fig. 1, we have compared the zoning of Programma di Fabbricazione (PdF) in 1978 with buildings realized when the Piano Regolatore Generale (Prg) was approved in 18th November 1985. From the comparison, it results that differences exist in the zone E, F and in the zone Rispetto Cimiteriale del PdF.

In Fig. 2, by using the same methodology as above, we aim to compare the zoning of PRG with the buildings recorded by the last aerial photography dated 2009. This overlapping has underlined that many differences. In particular, we have noticed that in areas destined to farm or to public infrastructures many houses are built.

In Fig. 3, sanction instances have been translated into graphics, by distinguishing between: civil housing, commercial activity and mixed.

All the realized tables aim to underline the building realized illegally and in contrast with rules promulgated by approved urban instruments.

From data about building sanctions it emerges that the practices presented to authorities, in reference to L. 47/85, are 6,769 (3.410 have been granted and 3,359 are pending, in the phase of preliminary investigation). See Table 1.

KIND	STATUS	PRACTICES
1) Civil housing	Granted	3,200 (93.8%)
2) Commercial activity	Granted	50 (1.5%)
3) Mixed	Granted	160 (4.7%)
Total	**Granted**	**3,410 (100%)**

Table 1: Practices of building sanction granted by L. 47/85

Requests of building sanctions presented in reference to L. 724/94 are 7,860 (2,775 have been granted and 5.085 are pending). See Table 2.

KIND	STATUS	PRACTICES
1) Civil housing	Granted	2,364 (85.2%)
2) Commercial activity	Granted	398 (14.3%)
3) Mixed	Granted	13 (0.5%)
Total	**Granted**	**2,775 (100%)**

Table 2: Practices of building sanction granted by L. 724/94

Practices presented in reference to L. 326/03 are 4,286 (769 granted and 3,517 pending). See Table 3.

KIND	STATUS	PRATICHE
1) Civil housing	Granted	672 (87.4%)
2) Commercial activities	Granted	94 (12.2%)
3) Mixed	Granted	3 (0.4%)
Total	**Granted**	**769 (100%)**

Table 3: Practices of building sanction granted by L. 326/03

The sum of the practices presented over the years is 6,594, as noticeable in Table 4 and in Fig. 4.

CONDONI EDILIZI	STATO	PRATICHE
Law 47/85	Granted	3,410 (49%)
Law 724/94	Granted	2,775 (39.9%)
Law 326/03	Granted	769 (11.1%)
Total	**Granted**	**6,954 (100%)**

Table 4: Total amount of practices of building sanction granted by L. 47/85, L.724/94 e L.326/03

3.1 Ghost Houses

In 2010, Italian Government introduced a law concerning the revealing of unknown building, the so-called “Ghost Houses”, and charging the Agenzia del Territorio (according to DL 266/2006) with census of these buildings. Result of the census was of 1,200,000 buildings. The subsequent Italian Government has estimated the amount of euro that these buildings should have brought: nearly 500 millions euro. After estimation, notes and specifications have been done about the amount of money. What we want to highlight here is that that amount includes unauthorized buildings. These are not taxable but they should be demolished. Italian Government has established that Municipalities have to check if these buildings are conformal or not within a certain time. This activity is still pending or it has not started yet, while tax return

forms have already been sent. The law about “ghost houses” causes some hesitations. Very few explanations have been provided in order to clarify a fiscal norm. Similar to a mini building sanction, the law has allowed regularizing not registered buildings with deduction on the arrears (spontaneous requests for sanction have been reduced up to one third of the amount). Is it possible that inhabitants pay taxes on buildings that are going to be demolished? It is not unless spontaneous requests for sanctions imply that sanction itself refers to fiscal and urban aspects at the same time (Legambiente, 2013).

According to data provided by Agenzia del Territorio in Campania ghost buildings are 295,000. Salerno is the province with the highest number (105,228), followed by Naples (59,859), Avellino (55,161), Caserta (41,361) and Benevento (33,860) (De Biase, Forte, 2013).

3.2 Ghost housing in Giugliano: an analysis of the unregistered buildings

Before analyzing the phenomenon of ghost houses, it is appropriate to specify how the data used for plate N 4 have been collected. The *Agenzia delle Entrate* makes available the list of parcels on which there are not registered buildings and specifies the Province and the Municipality. For each parcel, it is possible to know the register buildings and its estimated income. Moreover, it is possible to check the status of the verification that can be:

1. *In progress***.** Verification is started but it is not ended yet;
2. *Ended with updating*. Verification is ended after that all the necessary documents have been produced by the involved inhabitants or by the dedicated Provincial Offices;
3. *Ended without updating*. Verification is ended but the dedicated Provincial Office has verified that there are not the necessary condition to proceed since the building is not conformal to minimum requirements for building sanction;
4. *Attribution of estimated income*. Verification is in progress and the dedicated Provincial Office, after verifying the minimum requirements for building sanction, has attributed the estimated income as established by art. 19, comma 10, D.L. 31st May 2010, n. 78, converted with changed by L. 30th July 2010, n. 122 and following changes and integrations (Agenzia delle Entrate, available at http://www.agenziaentrate.gov.it).

It is possible now to explain how we realized plate N 4. We have gone through two phases:

1. During the first phase we have collected data;
2. During the second, data have been computerized and parcels have been classified according to their status.

The realized plate underlines the diffusion of ghost buildings in Giugliano.

STATUS	AMOUNT OF PARCELS
Attribution of estimated income	1,046 (23.6%)
Ended with updating	1,342 (30.2%)
Ended without updating	1,650 (37.2%)
In progress	400 (9%)
Total	**4,438 (100%)**

Table 5: “Ghost Houses” in Giugliano

3. Conclusions

In sum, in order to frame the unauthorized building phenomenon in a municipality we should consider two more aspects. The former is the land use. This aspect would let us understand the weight of unauthorized building in the urban context. The latter is the ratio between population and houses. This last aspect would let us understand the need of legal public houses and services. All these aspects should be necessarily included in the urban plans.

TABLES

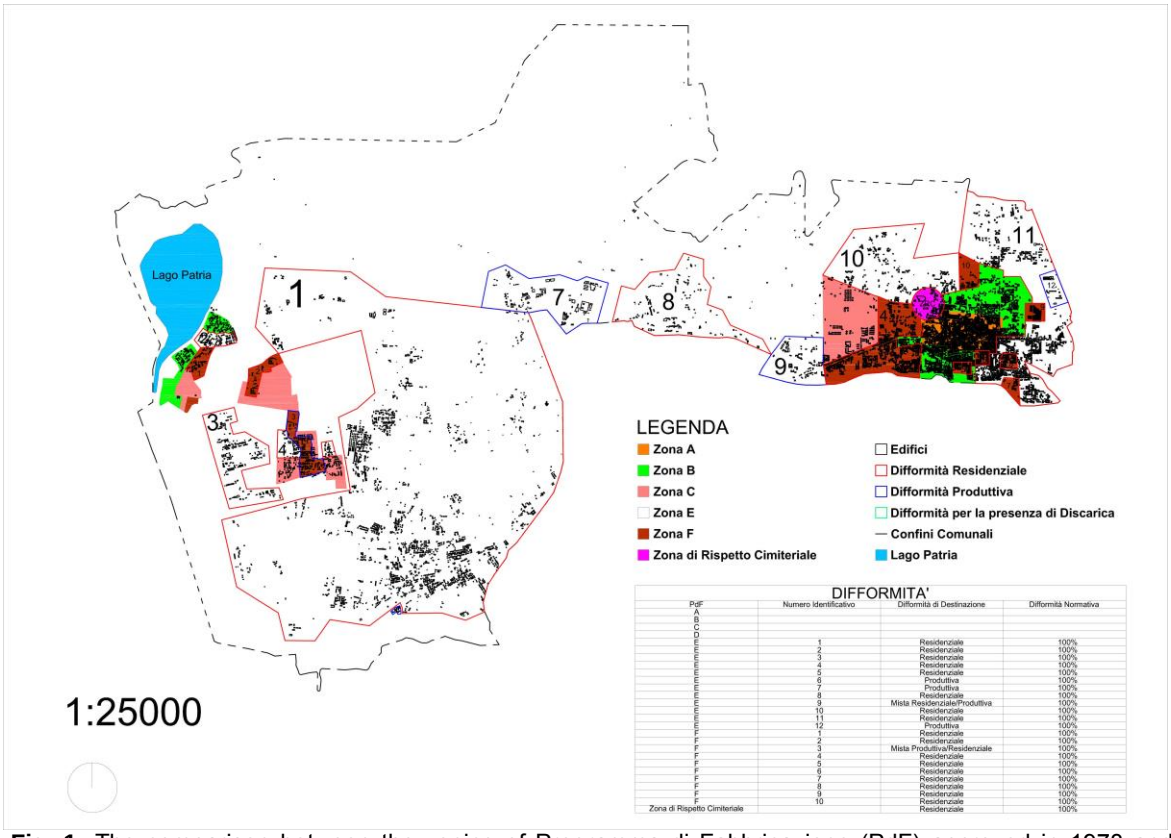

Fig. 1: The comparison between the zoning of Programma di Fabbricazione (PdF) approved in 1978 and the Piano Regolatore Generale (Prg) approved in 18th November 1985. This figure has been realized by the author and by Dot. Arch. Pietro Mallardo.

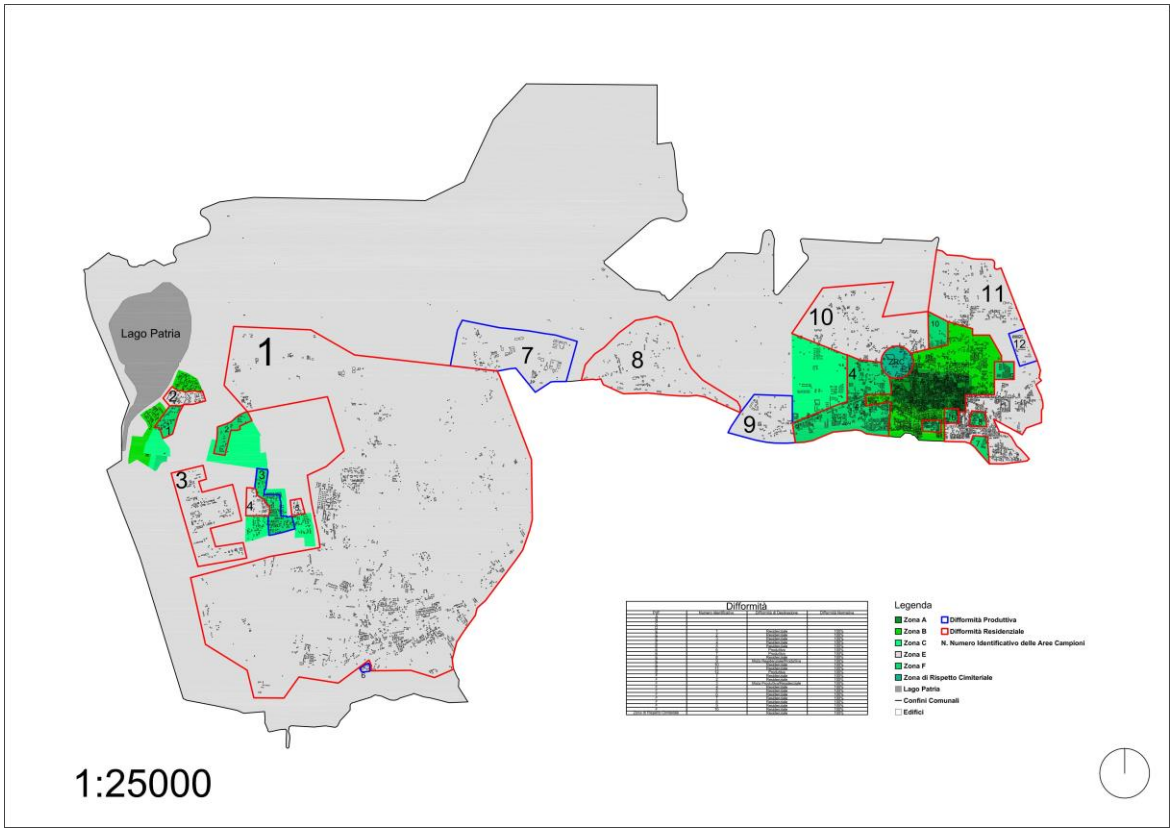

Fig. 2: The comparison between the zoning of PRG with the buildings recorded by the last aerial photography dated 2009. This figure has been realized by the author and by Dot. Arch. Pietro Mallardo.

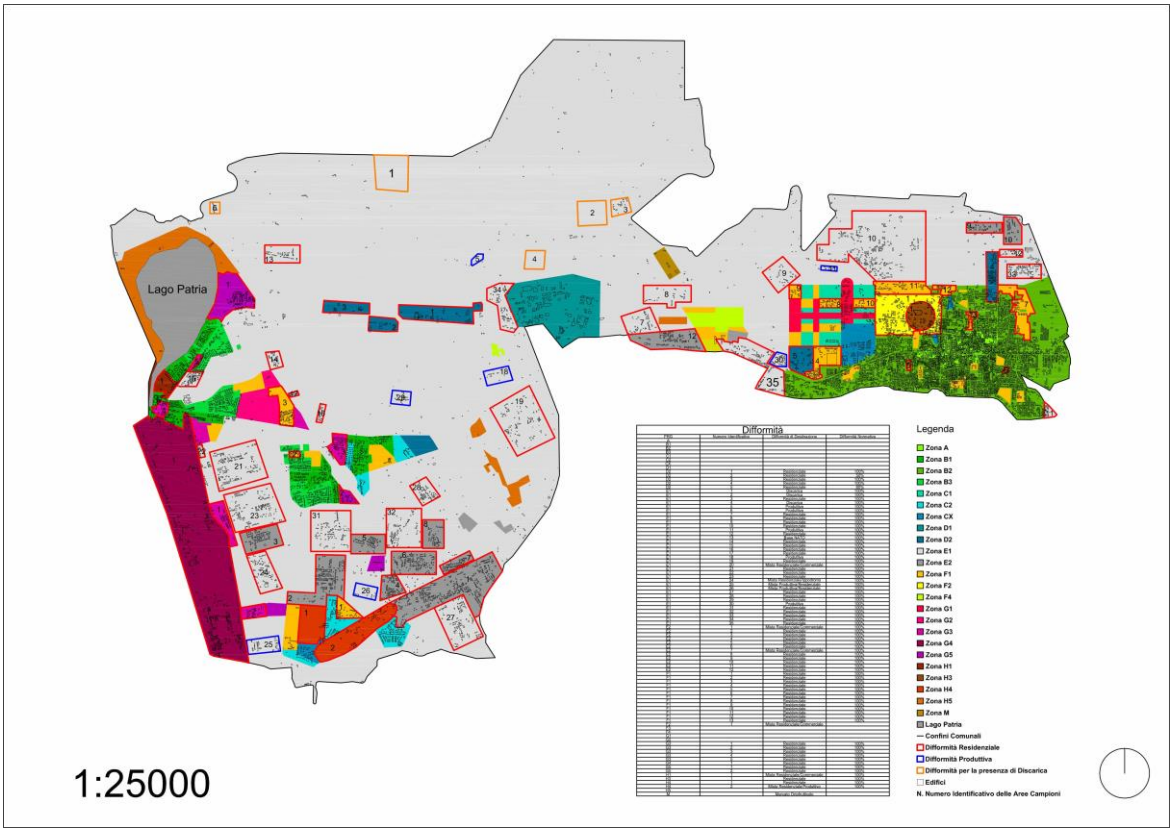

Fig. 3: Sanction instances have been divided into: civil housing, commercial activity and mixed. This figure has been realized by the author and by Dot. Arch. Pietro Mallardo.

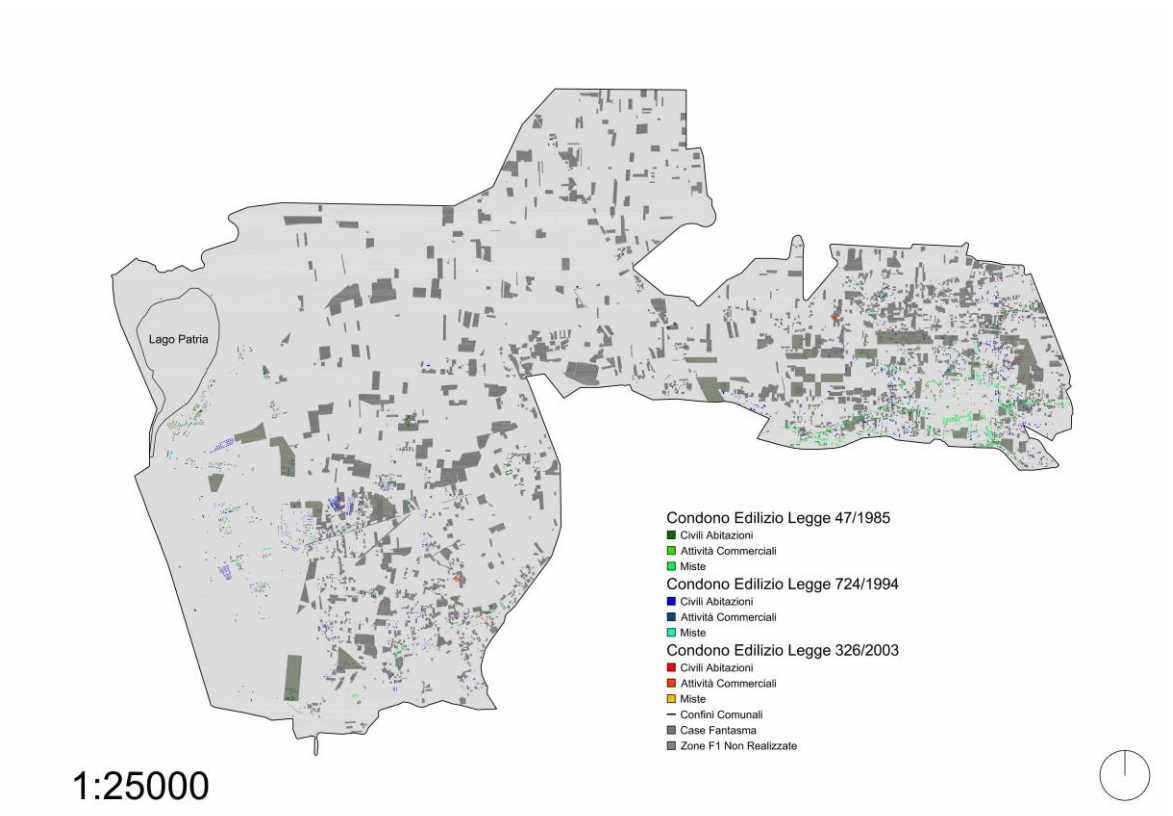

Fig. 4: The sum of the practices presented over the years. This figure has been realized by the author and by Dot. Arch. Pietro Mallardo.

Acknowledgement: The work is the result of the joint collaboration of Prof. Bianca Petrella. Tender mercies go to Dott. Arch. Pietro Mallardo and Dott. Arch. Gaetano Perillo.

References

Bellicini, L. (1990), “La costruzione del territorio meridionale”, in Meridiana n. 10 (pagg.11-44).
Borri, D. (1985), *Lessico urbanistico:annotato e figurato”,* Dedalo, Bari.
Colombo, L. (2003), “Abusivismo e pianificazione consensuale”, in Urbanistica Informazioni, N° 188.
Cremaschi, M. (1990), “L’abusivismo meridionale: realtà e rappresentazione”, in Meridiana n. 9 (pagg. 127-153).
De Biase C, Forte F. (2013), *Unauthorised building and financial recovery of urban areas: evidences from caserta area*, in EuroMed . vol. unico, ISBN: 978-9963-711-16-1
De Biase C. & Forte F. (2013), *Abusivismo nella provincia di Caserta: prime riflessioni su aspetti urbanistici ed estimativi*, METE, Rivista Ordine degli Architetti di Caserta, vol. 3.
Erbani, F. (2003), L’Italia maltrattata, Laterza, Roma-Bari.
Forte F., *Illegal Buildings and Local Finance in New Metropolitan Perspectives*, in Advanced Engineering Forum, Vol. 11 (2014), Trans Tech Publications, Switzerland, 2014, pp.600-606.
ISPRA (2014), *Il consumo di suolo in Italia*, Roma.
Istat (2014) Rapporto Bes 2014: il benessere equo e sostenibile in Italia, Roma (cap.9).
Legambiente (2003), *Rapporto ecomafia* (rapporto del 08/11/2003).
Legambiente (2004), *Rapporto Ecomafia 2004: i nomi, i numeri e le storie della criminalità ambientale*, Sistemi editoriali, Napoli.
Legambiente (2008), *Rapporto ecomafia* (rapporto del 03/11/2008).
Legambiente (2014), *L’Italia frana, il Parlamento condona* (rapporto del 21/02/2014).
Legambiente (2014a), *Basta case vuote di carta* (rapporto del 15/05/2014).
Legambiente, *Cemento Spa* (rapporto del 15/3/2012).
Legambiente, *I numeri dell'abusivismo edilizio e le proposte per il ripristino della legalità*, (rapporto del 08/01/2013).
Legambiente, *Stop a mattone selvaggio. I numeri dell’abusivismo edilizio e le proposte per il ripristino della legalità (*rapporto del 18/12/2011
Martini, A. (2003), *L’Italia vista dai Comuni*, Cresme.
Ricci, M. (2003), *Rischio Paesaggio,* Meltemi.
Talia, M. (1998), *L’urbanistica nelle città del sud. Processi insediativi e nuove politiche urbane nelle aree metropolitane,* Cangemi editore, Roma.
Zanfi, F. (2008), *Città latenti. Un progetto per l’Italia abusiva*, Mondadori, Milano.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Landscapes of repentance and of compensation

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Abstract
Too many times, lately, we heard the mantra "crisis as an opportunity". We are some how adapting to a state of gradual decay looking for arguments that could mitigate the sense of loss.
Even with regard to the landscape and its abandonment there are signs that indicate new opportunities; Clement shows a new and innovative way: the violent anthropization desists to let its signs to be reabsorbed and included in a natural re-appropriation of what subtracted [1].
We are forcing the hand, but in this strategy there is an extraordinary moral tension: a sort of rational ability to recognize, in the domestication imposed on nature, a kind of injustice, of undue acquisition.
In this abstract we push a bit over, that is to consider an operational disregarded possibility.
The thesis is about new skills to *compose* with elements of waste, using discarded materials, and without introducing new quantities or artificial presences. These practices have been extensively tested by art, seldom by architecture: artists, thanks to their freedom, can cross in advance the spirit of time (zeitgeist) and showed clearly the possibility of producing beauty by means of left over and refused materials, that is beautifying and redeeming the dull neglected.
Nevertheless we keep on proposing new buildings and huge infrastructure indifferently overlapping natural pre-existing layouts.
Hopefully the crisis compels us to a moratorium: to look with greater awareness to the "ruins" [2] we are leaving behind, to the many and various places of abandonment.
These *materials*, in a time when nothing can be left over, require for reparation, not just recycling, but a careful and respectful re-editing able to redeem the marginal carelessness.

Keywords: waste, leftovers, analysis, landscapes, regeneration, education



1. The waste redemption

The existing building heritage represents more and more a political and cultural issue (and disciplinarian, at various scales), which needs to mobilise and confront.

Each strategy will be, as a prerequisite, a major break with previous urban policies.

The demolition of spoiled manufacts (landscapes, suburbs, single building, outdate infrastructure, disused industrial districts) can no longer be indiscriminate: we should deal with regeneration that is functional and aesthetic renewal, by means of new instruments. A new ethic, founded on savings energy, on respecting the existing, on environmental impact, did shake up the traditional strategies of intervention.

Naturally the material preservation of landscapes and buildings without a monumental label, should occur with criteria that can no longer be similar to those of Restoration; but precisely in this new need of "repairing", of compensation, of returning value to contexts that are ruined, downgraded and marginalised, lies an opportunity for innovation, of research all internal to the discipline statutes of reference. [3]

To focus the waste – at different scales: from abandoned landscapes down to individual buildings in decay – will require the development of non-traditional and innovative analysis and observation strategies.

The consequences, first in economic terms, are very significant.

The need for intensive interventions, local, non-radical, will lead to a demand for more articulate skills; consequently, to the engagement of smaller companies; therefore to an essential fragmentation of the investment required. It should be of first evidence that a positive outcome will be the less attractiveness by those parasites systems that, till today (especially in Italy), looked to great works as easy opportunities for illicit profit. In fact smaller investments call for reduced margins of profit, especially when sophisticated skills are required, therefore those opportunities correspond to situations where illegal practices become more difficult and less convenient.

Another positive effect, by assuming rehabilitations and not full demolitions, concerns the sharpen of techniques that will both recover ancient operational technologies and develop new strategies for constructive solutions, re-evaluating a manual skill that more and more is going to be lost.

Many examples, especially in evidence in the last twenty years, confirm the possibility of aesthetic and functional redemption (compensation) of landscapes (and also of complex or of individual buildings), by intervening with original design criteria which can be, in some cases, unusual and unexpected. [4]

The analysis of the contexts where to intervene should fix as a priority, a distinction between parts considered essential and parts "modifiable", between “hard” and “soft” constraints.



Fig. 1: Martha Schwartz and Markus Katsch, *Power Lines* (Gelsenkirchen, Germany 1999)

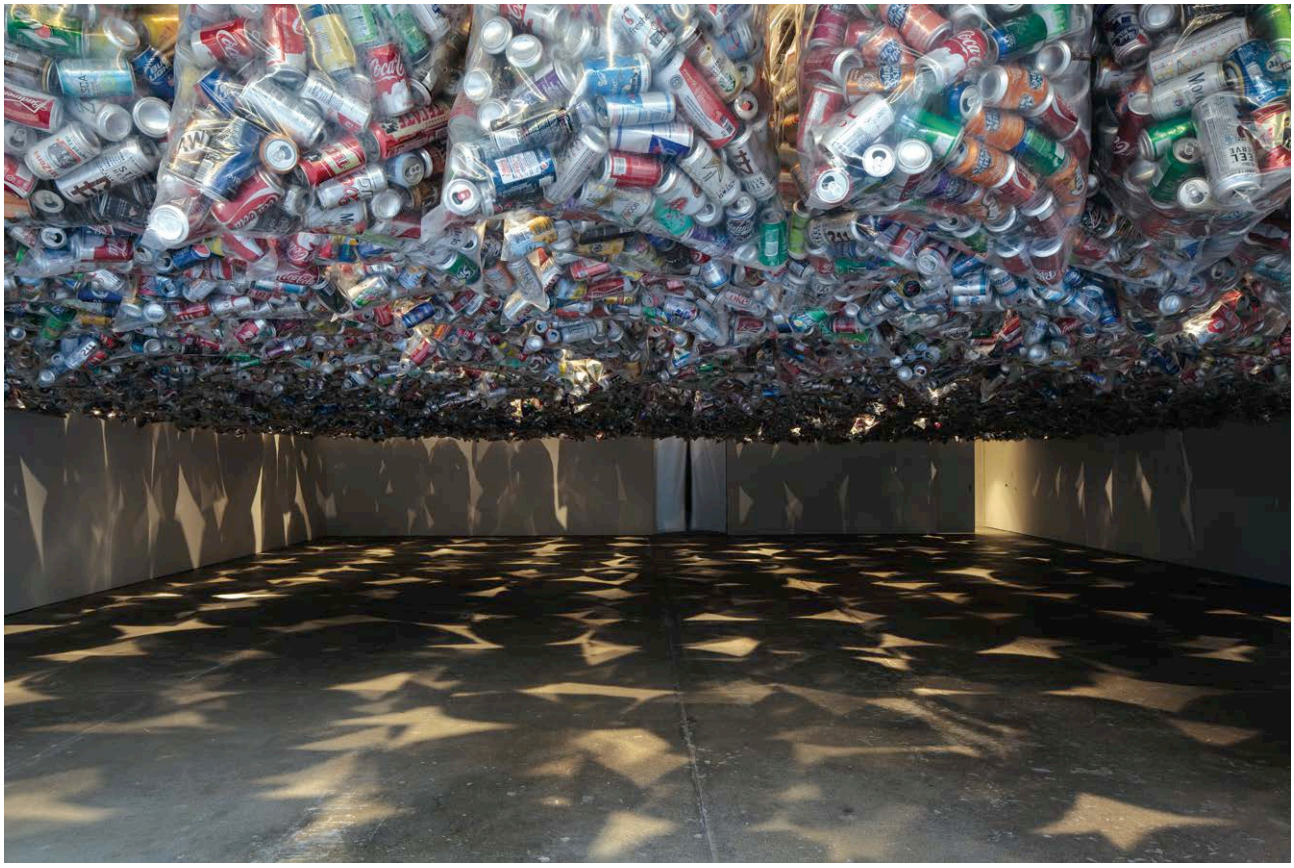

Fig. 2: Claire Fontaine, *Redemption* (2013)

1.2 Cooking with leftovers

Any future change will have to deal with *materials* already on area; it will have to consider the potential for change; it will have to intervene by developing different relations or by strengthening existing ones; or even introducing new catalysts. We are evoking scenarios that cast the term *composition* [5] under a new light: the return to the original meaning, that of com-position, to put together, to arrange into relation existing figures and objects for new combinations to further appraise them.

The reasons that will guide the modifying strategies (and thus for preservation) should be sought within the Vitruvian triad, in our work still valid bearings for methodological guidance. They can therefore be functional reasons (*utilitas*) that will address choices that, while acting on formal or even structural elements, will tend to preserve their original purposes. Or the strategy can be related to the enduring part, structural, which will be confirmed (and used), allowing the processing of cases to accommodate new uses and different destinations (*firmitas*). Or, finally, it may occur to be the formal character of the context to require protection (although we are not in the presence of monumental values), and therefore the regeneration project will tend to confirm the morphological characters by working on technologies, materials, or on the static (*venustas*).

We are affirming that an analysis, a reading for intervention [6], cannot be sterile, cannot claim to be objective and scientific, although it must be rigorous, rational. It must make clear, from the outset, the designer "point of view": the first and inescapable responsibility that, historically, always competes to whom is in charge of the Project.

This step, although obvious and even banal, when stated is source of countless methodological misunderstandings: we have already served heavy defeats when we felt it was possible to "read" the context as if it was a book written in clear characters, using a method of deciphering based on strict and indisputable protocols. It is not so. We learned it both from the many defeats (bad projects born by apparently incontrovertible analysis), and especially from the successes (wonderful outcomes born from logic short-circuits, from inspired intuitions, absolutely unpredictable).

In our opinion to spell out clearly and initially the practices for identifying constraints [7] is essential to the communicability of the experience and, above all, to accumulate repertoires to be used for next occasions of regeneration. This allows, in retrospect, a critical judgment especially in the case of disagree on the overvaluation of an aspect than others: but in this ethical demand resides the correctness of any act of design that wants to stand out from the pure arbitrary, from the "whim of artist ".

Pointing to the constraints, seen as the first act of design, however will have a dual nature.
On one hand, the mandate terms: those constraints are purely objective and out of the designer's culture/sensibility. I.e. economic and political constraints, urban policies, materials included in the area, etc.
We shall call this kind of condition the "hard" part of the commitment, non-negotiable.
On the other side, the constraints designers will want to see, considering them within a personal hierarchy, more or less rigid: we shall call this kind of condition the "soft" part of the commitment, modifiable, and it appears very crucial to the quality of the proposed change. This "propitiatory" practice is the description of those rules set before the project and that should be explicit as widely as possible, using not only text but also any other available tool [8].

At this stage, in our opinion and as we are trying to argue it, the destiny of the project is decided; at this stage rather than when traditionally considered more enlighten for the project that is when occur the conception, the figuration, the generator layout, the formal pretext, etc. We refer to the project dealing with materials *ready made*, with scraps and leftovers, which can introduce new signs only by means of graftings or additions. We do not believe that the ideational component will be less intense or that the designer responsibility will diminish: the entire *corpus* of contemporary visual arts showed how much creativity has been wielded on using poor materials or working with existing objects by mean of de-contextualisation and beautification [9].



Fig. 3: Irene Peron, *Balance* (2014)

1.3 Vision

We refer to culture / sensibility and we cannot separate the two meanings.
It's established, in fact, that the cultural choices we make, the authors we prefer and affect our work, the images fixed in our memory (and in our unconscious), the beauty we can see, the emotions each of us feel or nurture, is the individually accumulated heritage; it is what defines our position as intellectuals and represents our cultural identity.
But it is also true that for each of us the same text, the same image, the same sunset, is differently felt, depending on our sensibility, and even on our sensibility in that particular micro-historical segment that concerns us.
It is hardly worth bringing philosophy into it, Lichtenberg already said it in the most beautiful and clear way: «Each of us sees another rainbow» [10].

This brings us back to the issue of responsibility of the Project, tightens even more the field since we are

more and more asked to deal with situations already stratified, historically filed, even ruined, withered from neglect and abandonment, or simply lost of sense.
The analysis intended as participant research for signs, as recognition of opaque values, as respectful deciphering of failed intentions and lost opportunities, becomes itself a formidable engine for design and it allows to prefigure an aesthetic redemption, a second chance.

A sensibility / culture [11] is required, able to establish a kind of visionary empathy with impoverished contexts and materials mortified by disaffection.
Architecture lost ground in terms of its historical influence, at least in Italy. Since the digital advent [12], Architecture tends to over-structuralise, that is to assume that comforting role that, in times of crisis, has been attributed to, and has relegate architecture into the category of minor decorative arts.
The opportunity posed by the global crisis should not be lost; it calls Architecture for a historic responsibility.
The required transformation will need a brave disciplinary rethinking, the research of new skills (or the ability to remember forgotten skills), a respectful attention to the existing accumulations, an attitude to commitment that will also re-launch that social and civil role it was losing time.
We are confident that, starting from education, from the universities, this historical urgency of change will be recorded: an inescapable demand that hides, unsuccessfully, a redemption request: the return to Beauty, as right and not as privilege.
It will require a lot of patience, humility and tenacity.
Manzoni wrote of «modestia un po' guerriera» [12], it describes the situation well before us.

Notes
[1] On the domestication of nature, the reference is to the cultural models based on designed gardens and parks - Italian, English and other geometrical order - but it primarily concerns contemporary attitudes, which have produced powerful infrastructures that have altered assets and ecological balance; finally it concerns landmarks that for pure narcissism, without even the utilitarian pretext of energy resources, occupy horizons that should not belong them.

[2] Ruin, ruined. Uncertain etymology. From *ruina* (lat.), therefore *ruere* (lat.): to collapse. But also *druere* (lat.): to move precipitously, to run after. In both cases, it is about the sense of a movement, a dynamic state, in change. Landscapes in ruins are sites in change, a negative alteration of a previous condition; are in imbalance, in a time of precariousness.

[3] «La memoria collettiva e la sua forma scientifica, la storia, si applicano a due tipi di materiali: i documenti e i monumenti. Infatti ciò che sopravvive non è il complesso di quello che è esistito nel passato, ma una scelta attuata sia dalle forze che operano nell'evolversi temporale del mondo e dell'umanità, sia da coloro che sono delegati allo studio del passato e dei tempi passati, gli storici. Tali materiali della memoria possono presentarsi sotto due forme principali: i monumenti, eredità del passato, e i documenti, scelta dello storico.»
// «Collective memory and its scientific form, history, apply to two types of materials: documents and monuments. In fact, what survives is not the complex of what existed in the past, but a choice implemented both by the forces operating in the temporal evolution of the world and of mankind, and by those who are delegated to study the past and past times, historians. Such materials of memory can come in two main forms: monuments, heritage of the past, and documents, the historian's choice.»
(LE GOFF, «Documento/Monumento», in Enciclopedia Einaudi, Torino 1978. vol. V, pp. 38-43).

And more: «La nozione di *cultura materiale* è comparsa nelle scienze umane, e in particolare nella storia, in seguito al costituirsi dell'antropologia e dell'archeologia, e all'influenza esercitata dal materialismo storico. (…) Lo studio della cultura materiale (…) si dedica ai fatti ripetuti, non all'evento; non si occupa delle sovrastrutture, ma delle infrastrutture. (…) La cultura materiale tende infine a gettare un ponte verso l'immaginazione dell'uomo e la sua creatività e a considerare proprie tre componenti fondamentali: lo spazio, il tempo e la socialità degli oggetti. Per quanto rimanga ancora da definire con più esattezza, e per quanto vi sia ancora qualche ambiguità, lo studio della cultura materiale appartiene alla ricerca storica, e con essa collabora con metodo proprio a ripercorrere le spirali che ogni rovina del passato porta con sé.»
// «The notion of *material culture* appeared in the humanities, particularly history, following the establishment of anthropology and archaeology, and the influence exerted by historical materialism. (…) The study of material culture (...) dedicates itself to repeating facts, not to the event; it does not deal with superstructure, but infrastructure. (…) Material culture tends to build a bridge towards man's imagination and his creativity and to consider its three fundamental components: space, time and the sociality of the objects. Even though it remains to be defined with more accuracy, and even though there is still some ambiguity, the study of material culture belongs to historical research, and collaborates with its method to retrace the spirals that every ruin of the past brings about.»
(BUCAILLE, PESEZ, «Cultura materiale*»,* in Enciclopedia Einaudi, op cit, Vol. V. IV, p. 271-305).

[4] As example we can recall the work of French team Lacaton&Vassal, or that of French architect Édouard François. The museums of Herzog & De Meuron (Tate modern of London, The Küppersmühle of Duisburg) and Koolhaas's (Ruhr museum of Essen). But also the newyorker High-line by Diller and Scofdio, the Dora park of Turin, the ever green La Villete or Citrohan parc in Paris, etc. etc.

[5] Composition: in Italian *Composizionee* and *Progettazione* are the two words to define and frame the architectural design's discipline.

[6] We insist: analysis and reading of the context at the many scales: form the landscape to the single object.

[7] As extreme synthesis: each analysis concerns the terms of constraints identification.

[8] Let us think to those practices of layering, mapping, morphing, etc. that is to diagrams as effective tools for graphic narrative able to clearly express those conformations we want to highlight, the constraints system with which we'll dialogue and work with. As artist engaged with ready-made strategy it may seems banal to recall the Duchamp "Bicycle wheel" (1913), "Fountain" (1917), "Gift" (1921) etc. or Picasso "Bull Head" (1942), etc, till the recent works of Lawrence Carroll, of Italian-British team Claire Fontaine, etc. etc.

[9] LICHTENBERG (1966). The sentence id back to 1777.

[10] Sensibility / culture: we reversed the terms, perhaps with some justification)

[11] The advent of digital, the thrill of "parametric": there is something of mystic and provocative in the abuse that large brotherhoods by now operate under this sign!

[12] A possible translation could be: a bit of warrior modesty.
«Lucia usciva in quel momento tutta attillata dalle mani della madre. Le amiche si rubavano la sposa, e le facevan forza perché si lasciasse vedere; e lei s'andava schermendo, con quella *modestia un po' guerriera* delle contadine, facendosi scudo alla faccia col gomito, chinandola sul busto, e aggrottando i lunghi e neri sopraccigli, mentre però la bocca s'apriva al sorriso.»
MANZONI, Alessandro (1827), *I promessi sposi*, capitolo II.

Bibliographical References

[1] KOOLHAAS, Rem. *Fundamentals*, Venezia: Marsilio, 2014. Catalogue of the XIV Biennale di Architettura di Venezia.

[2] CARNEVALE, Giancarlo, GIANI, Esther, *Occasioni di ricerca. Ovvero il nuovo che arretra // Research opportunities. The retreat of the new*, Milano: Maggioli, 2014 (Ita/En).

[3] CARNEVALE, Giancarlo, GIANI, Esther, *Paesaggi umidi // Wetlands*, Roma: Gangemi, 2013 (Ita/En).

[4] CLÉMENT, Gilles, *Manifesto del Terzo paesaggio*, Macerata: Quodlibet, 2005. (*Manifeste pour le Tiers paysag*e, Paris, 2004).

[5] GINZBURG, Carlo, *Miti Emblemi Spie. Morfologia e storia*, Torino: Einaudi, 2000 (1986).

[6] LICHTENBERG, Georg C., *Osservazioni e pensieri*, Torino: Einaudi, 1997 (1966).

[7] Enciclopedia Einaudi, Torino 1978, vol. V et VI.
Headwords: «Documento/Monumento» and «Cultura materiale*».*

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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From the knowledge process to the representation of the built environment. The case of the "Istituto del Rifugio" in Naples

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Abstract
Naples like all historical cities lived, age to age, a cultural and architectural sedimentation that affects not only the formal appearance of the buildings but also the functional articulation both of them and of entire architectural aggregates. It particularly characterizes the urban tissue of the old town, where entire blocks, from the Greek era, have undergone a continuous process of layering and both assortment and configurations editing.
This is the case of the church of Santa Maria del Rifugio, located on Tribunali Street, the ancient decumanus of the Greek Neapolis, which over the centuries was built on lands earlier vacant and then used from religious 'Conservatorio del Rifugio', ancient charitable institution established since the sixteenth century.
This paper aims to investigate the architectural dynamics that such building, both individually and in the contextual building complex in which is confined, has undergone over the years up to reach its current configuration. In this sense, through an historical and cartographic documentary work and contextually a survey of existing structures, we investigate what were the building conditions at different times.
By providing several digital reconstructions, the aim is to set cultural tools for further studies, defining a methodological paradigm directed to alike religious structures belonged to one of the most popular and emblematic cultural heritage of the city of Naples.

Keywords: Via Tribunali, UNESCO, Cultural Heritage, Survey

1. Via Tribunali in Naples and its final section. An historical analysis and interpretation
The urban configuration of Naples, city of ancient settlement, is the outcome of a stratification particularly interesting to the extent that, since 1995, part of its inner city is a UNESCO World Heritage Site.
The cultural and architectural sedimentation has influenced in a very significant impact on spatial and functional articulation of some building structures or urban segments, to the point to preclude their perceptive attractiveness and making difficult its understanding about the transformations that led to the city's current configuration.
In a so hard comprehension of this environment, the survey executions and implementation unfolds its methodological and operational potential, and gives substances to the process of knowledge that allows to read, analyze, and communicate those architectural events or urban fragments that, although poorly documented, nevertheless are indissolubly related to the city's cultural and urban transformations.
The church of Santa Maria del Rifugio, sited in Via Tribunali in Naples, is currently enclosed in a built up area which in ancient times was located on the edge of the walled urban core, nearby one of the city gates.
This enclosure is located, at the beginning of Vico Santa Maria in Agnone (formerly called vicus Cornelianus), as shown in the graphical reconstruction of the greek-roman configuration of Naples made by Bartolomeo Capasso (Fig. 1), and currently confirmed by the discovery of tombs close to the religious complex called Ritiro of Biancolelle [1].



Fig. 1: The Decumanus maximus and its religious complexes

In its current configuration, the block looks like a collection of several irregular parts, as outcome of the gradual erosion of its planimetric plan and its dense volume; this fragmentation has been highlighted and supported by the creation of roads and paths, often as dead-end streets – i.e. the called vicus Malafracta, vico della Vicaria, vico di Santa Maria del Rifugio etc. - whose location and early place names are to be found in the plan of the eleventh century edited by Capasso. Even the buildings, consequently, in their historical evolution, follow this slow and continuous formal and functional adaptation.

In particular vicus Malafracta, currently identifiable in the second alley of Santa Maria in Agnone, as described by Capasso, carried on the inner gardens of the cloister of Santa Maria in Agnone and, with a sharp bend, was connected with the vico Vicaria, where a long pedestrian underpass is still present. From vicus Malafracta it branched off the vicus Curtis Marciana, moving in parallel to vicus Cornelianus, which came in via Tribunali. Today traces of this path remain on the western side of the large garden sited to the rear of the building - formerly Palazzo Orsini – in which is located the Church and the Conservatorio (an ancient dwelling) named of S. Maria del Rifugio (fig. 2).

It's only in the 1471 that Orso Orsini, Count of Nola, builds a palace for his family along the ancient decumanus. At the death of the last Orsini, which occurred in 1528, the palace was confiscated and bestowed by Charles V to Francesca de Mombel, the Princess of Sulmona. Subsequently, in 1559, the building backs to the widow of Enrico Orsini, Countess Mary Sanseverino, which allocates there the women's College of which she was the founder.



Fig. 2: Synoptic framework of the area where the Santa Maria del Rifugio Church lies (left) and the related Capasso's greek-roman reconstruction (right)

We don't know today the exact perimeter within which the organization developed, but the available bibliographical and historical documentation allows to make some valid assumptions, likely to further checks and in-depth analysis. The building lot, with its inner open space, which is represented in the views of Lafrery, 1566 and Duchetti, 1585 facing the square in front of Castel Capuano, can be identified as the site of implantation of the Palazzo Orsini. It's plausible that the vico of Santa Maria del Rifugio, already in the plan reconstruction of Capasso, had that designation only referring to the construction of the church of the same name and achieved in order to give a side to the internal facades of the church itself.



Fig. 3: The "layering" of the map of the Duke of Noja subjected to actual vector cartography of Naples

Even G. Araldo, in his "Report of some churches and companies of Naples", written between 1594 and 1596, confirms the presence of Santa Maria del Rifugio among the smaller churches counted in Naples in that period.
Trying an historical reconstruction, we can assume that the large area in which Palazzo Orsini was located and included with other buildings, like the eighteenth century Palazzo De Campora and Palazzo Torrecuso, owned, in 1692, by C. A. Caracciolo. Also incorporating the open spaces and the overlooking gardens, it's able to define the overall consistency and spatial articulation of the built area, with a adequately detailed idea of the buildings there sited, all residential ones.
The function of the buildings would drive to further study, also in relation to the current urban expansion and to its proximity to Castel Capuano.
At the end of the sixteenth century, about in 1583, by intercession of Cardinal Annibale di Capua, of some fathers Theatines and of the priest Alessandro Borla, a noble born of Piacenza in the Northern Italy, and of the noblewoman Constance Carretto Doria, Princess of Sulmona, the Conservatorio of S. Maria del Rifugio was founded, first hosted in indoors places of the called Spedale degli Incurabili (Hospital for Incurable Diseases), and later, in 1585, moved to Palazzo Orsini [2].
The purpose of the Conservatorio was to help and accommodate poor maidens, that is "[...] accogliere tutte quelle povere donzelle che havevano perso la loro verginità et honore: quale pio luogo viene governato da sei persone, due nobili e quattro del Popolo, e vi è anche eretta una conpagnia d'huomini civili sotto il titolo delle Cinque piaghe del nostro Redentore" [3].
In order to make it suitable to the new function, the building underwent heavy transformations that affected other neighboring buildings, as evidenced by the current presence of the overpass linking the original Palazzo Orsini and the building, located between Palazzo Torrecuso and a building with courtyard and still belonged, at the end of the seventeenth century, to the family Torrecuso, as reported by Labrot [4].
So, in that aristocratic building, now location of the Conservatorio, and in particular in the spaces previously hall and courtyard, was therefore "stuck" the church of Santa Maria del Rifugio. This church consists of a nave whose dimensions matches with those of the porch that contained. It widens in the middle, almost wedging in the courtyard with three chapels on each side, and then narrows again in the apse (fig. 3).
In Lafrery's map, 1566, it possible to find the wide open space that is largely built as formerly shown in the eighteenth century plan edited by Giovanni Carafa, Duke of Noja (fig. 4).
This in-depth morphological and functional transformation is described actually by Carlo Celano [5]: «[…] Poscia, nell'anno 1585 le comprò questo palazzo, che fu della famosa famiglia Ursina, del quale fin hora vedesi in piedi la porta che è quella della chiesa, su della quale se ne scorgono l'arme di marmo; e nel cortile accomodò la chiesa, e sopra l'habitatione per dette figliuole».

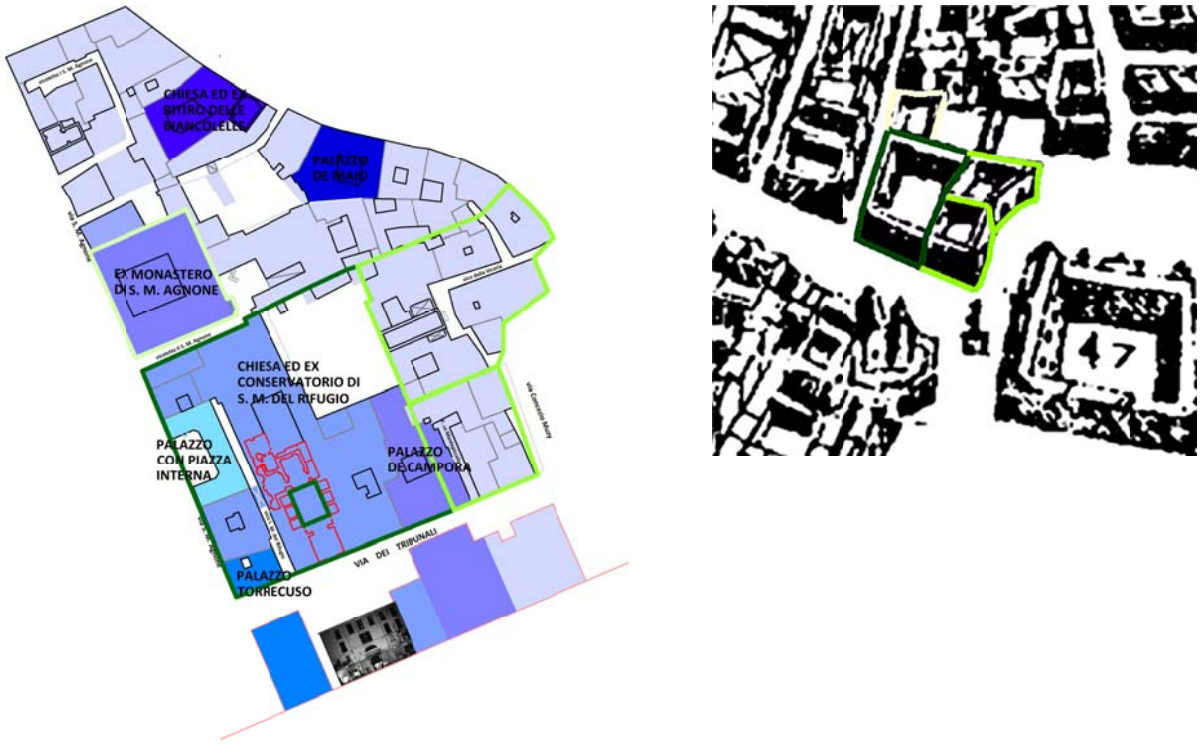

Fig. 4: The "insula" of the Santa Maria del Rifugio Church, comparing the configuration between two views: the Lafrary view and the current one with the prospect of the curtains in Via dei Tribunali

Only few traces of this building remains In the facade the aristocratic functional character of its original configuration and its further story, like the Renaissance doorway or baroque polylobated window, above the portal.
Some stages of the complex explained transformations need yet to be fully studied, especially if referring to the words of Pontano, that in 1975 said that «[…] l'impianto planimetrico originario è tutt'ora presente, malgrado le numerose aggiunte; mentre il vasto giardino...è scomparso per dar luogo a disordinate strutture, attinenti alla moderna funzione militare dell'edificio».

2. Characterization of a survey campaign about the Church of Santa Maria del Rifugio

As known, the practice of the survey substantiates the path of knowledge and allows to explain, analyze and visualize architectural or urban episodes that, although poorly documented, nevertheless are indissolubly related to the cultural transformations and to the urban tissue of the referred city.
In order to achieve an in-depth understanding of the building complex here in analysis, it was necessary to get and critically compare documents found from different sources, historical, bibliographical, archival, and iconographic ones. This phase in investigation was particularly problematic and thorny because of its complexity, both spatial and planimetric, about the context and the artifacts themselves.
Some digital visualizations, as shown in image (fig 5), adopt well-structured descriptive strategies that allow to virtually communicate what is actually hidden looking at the front of the building on Via dei Tribunali. They seek therefore to describe not really the architectural qualities of the religious complex, objectively insignificant, but particularly the relation between it and the parts that make it up, even its urban relation with via dei Tribunali.
Several graphical elaborations were carried out in order to perceive and display values belonging to the realm of the unseen (fig. 6). In particular the relations between the hidden religious building in the ancient courtyard and the surrounding ones are highlighted and, at the same time, its relation with neighbouring parcels.

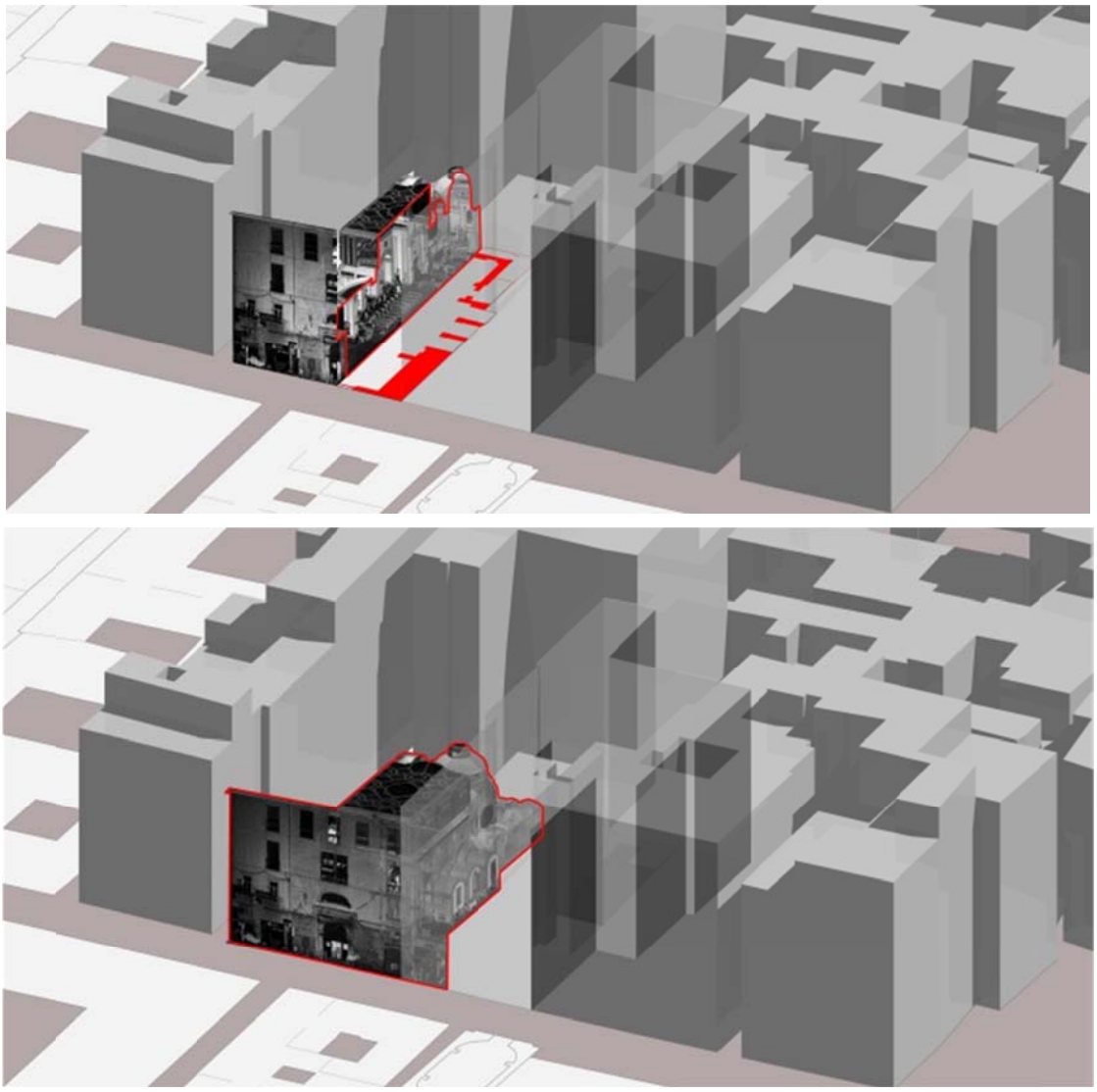

Fig. 5: Santa Maria del Rifugio, visualization of the relation between internal and external references



Fig. 6: Integration between the negative view of the cloud of points of the Santa Maria del Rifugio Church and the occlusion in the front side of the building recognized in the photo shoot.

The descriptive path defines models of diachronic and synchronic interpretation and decomposition of the real. Some of this models are deliberately simplified, to clearly disclose the timeline in the urban transformation and the overall spatial connotations.
The metrical and dimensional survey allowed to explore and define the features of the religious building. In particular, as result of a laser scanning survey campaign, from the related information, processing critical analysis of surfaces and volumes are derived. The further three-dimensional models visualizations, have substantiated a comprehensive review, based on the understanding and the re-composition of the clusters.
Starting from the reading of point clouds registrations of the several laser acquisitions in the internal location, we achieve the goal in order to describe significant parts of the spatial arrangement of the church. This arrangement regards also the full/empty relations as the understanding of the dynamic development of areas not immediately deducible and never shown in the whole graphical documentation, both historical and current, of the church itself.
The set of these operations answer with disciplinary relevance to the purposes of a much articulated survey aimed at revealing the phenomenological complexity, including, for example, the variation in height between the original and the current courtyard of Palazzo Orsini and Via Tribunali (fig.7).
It should be emphasized that this inconsistency in spatial perception was perhaps most clear at the time of the construction, where the open spaces were much able to be read about their orography. In addition, the former less fragmentation lets imagine a use less disjointed than the current configuration. For example, what was once referred to the only Palazzo De Campora is currently separated between different partitions, whose accretions intersect and overlap themselves and with the volumes of the church, once externally clear and visible (fig.8).

Finally, it need to underline that integrated set of visual tools allows to substantiate a significant and useful methodology in order to accomplish the understanding/appreciation of lesser religious architectural episodes, like the one here analyzed, sited in one of the most significant UNESCO World Heritage sites.

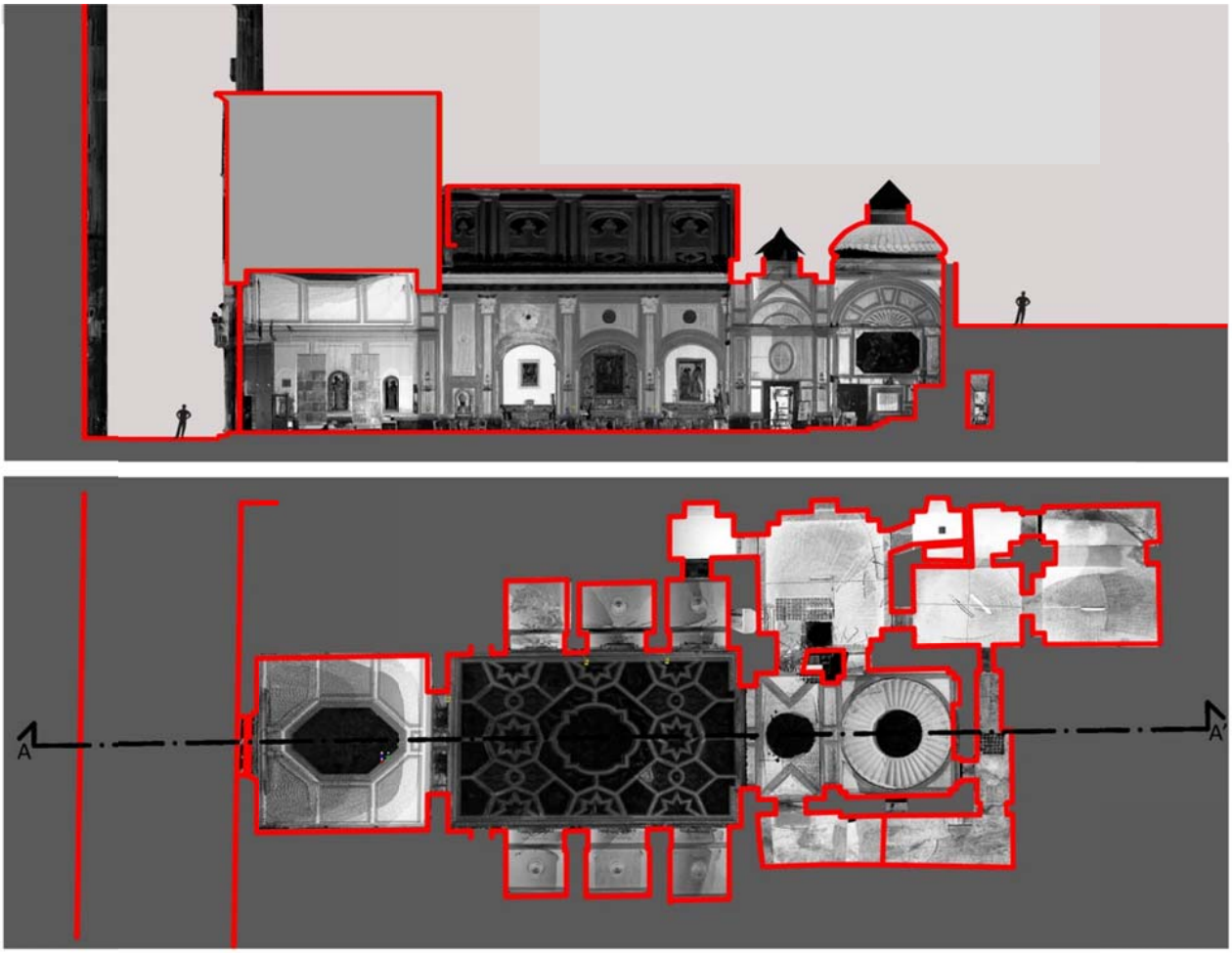

Fig. 7: Bottom-up plant and middle section of the Santa Maria del Rifugio Church

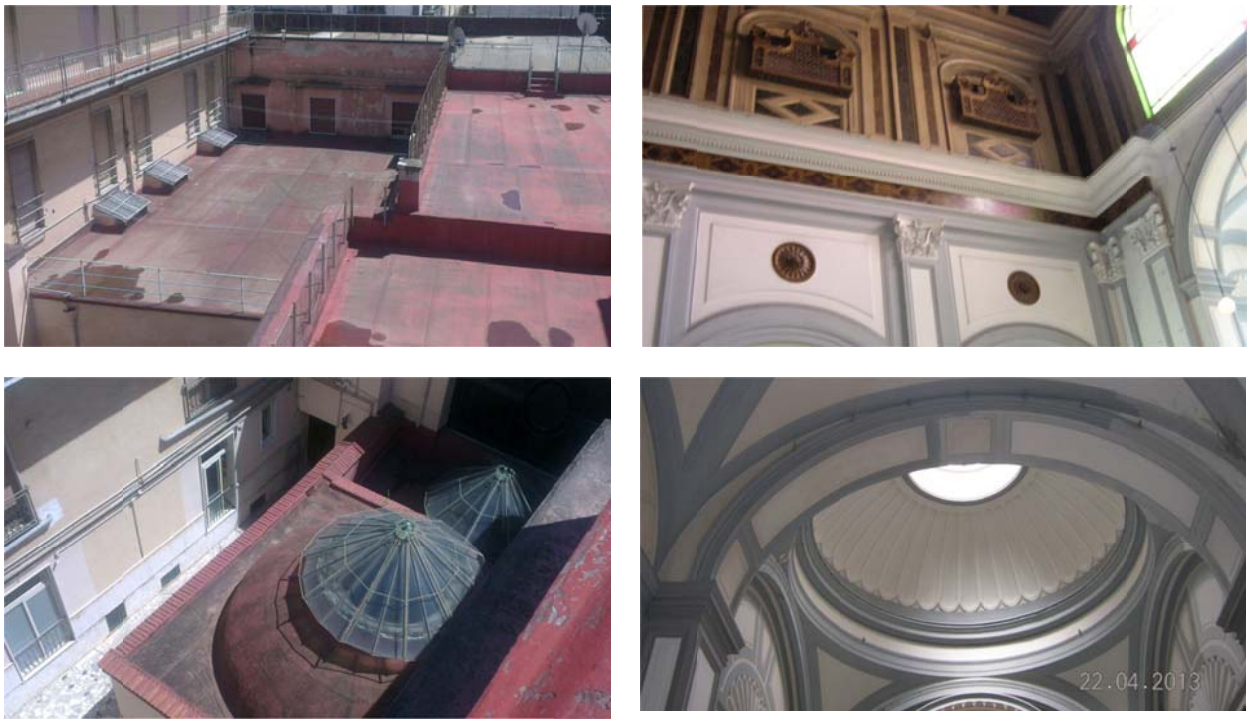

Fig. 8: Santa Maria del Rifugio, the internal and external views of the and archway and skylights and the inner court of the ancient Palazzo Orsini

Bibliographical References

[1] FERRARO, I. *Napoli. Atlante della Città Storica. Centro Antico.* Napoli: CLEAN, 2002, p. 287-299.

[2] DE FREDE, C. *Il decumano maggiore da Castel Capuano a San Pietro a Maiella. Cronache napoletane dei secoli passati*. Napoli: Liquori, 2005, p. 59-60.

[3] BULIFON, Giornali di Napoli dal 1547 al 1706, p.60.

[4] LABROT G., Palazzi napoletani. Storie di nobili e cortigiani 1520-1750. Napoli: Electa, p. 46.

[5] CELANO, C. *Notizie del bello, dell'antico e del curioso della città di Napoli. Giornata I*. 1692, p. 220.

[6] ARALDO, G. *Cronica della Compagnia di Gesù di Napoli*. 1594-1596, p. 230-232, 274-269.

[7] ARALDO, G. *Relatione d'alcune chiese et compagnie di Napoli*. 1594-1596, p. 188, 204-222.

[8] D'ENGENITO, C. *Napoli Sacra*. 1623, p. 146-147.

[9] ALVINA, G.A. *Catalogo di tutti gli edifici sacri della città di Napoli e suoi sobborghi*. In D'Aloe, S. *Archivio storico per le province napoletane.* Napoli: 1823, p. 523.

[10] DE LELLIS, S. *Supplimento a "Napoli Sacra" di don Cesare d'Egenio Caracciolo*. 1654, vol. 1, p. 245r-246v.

[11] RUOTOLO, R. *S. M. del Rifugio.* In Spinosa, N., Cautela, G., Di Mauro, L., Ruotolo, R., Soprintendenza ai beni artistici e storici di Napoli. *Napoli sacra: guida alle chiese della città. I itinerario.* Napoli: 1993, p. 41-42.

[12] AA.VV*. S. M. del Rifugio: il complesso monumentale e il restauro degli affreschi nella cappella dell'Immacolata.* Napoli: Altrastampa, 2000.

[13] RIZZO, V*. Il Real Conservatorio e casa Santa del Rifugio (1662-1762).* In Spinosa Fondazione Istituto Banco di Napoli. *Quaderni dell'Archivio Storico.* Napoli: 2000, p. 279-316.

[14] GALANTI, G.M. *Breve descrizione della città di Napoli e del suo contorno.* Napoli: 1792, p. 40.

[15] MOCCIA, D.M. *Il corpo di Napoli, Restauro urbanistico del centro antico.* Napoli: CLEAN, 1986, p. 44-45.

[16] ADRIANA VALERIO, FONDAZIONE PASQUALE VALERIO PER LA STORIA DELLE DONNE*. I luoghi della memoria. Istituti religiosi femminili a Napoli dal IV al XVI secolo*. Ediz. italiana e inglese. Voyage pittoresque, 2006.

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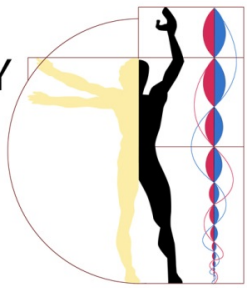

Which survey for which digital model: critical analysis and interconnections

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Abstract
The process of "critical analysis of measurement" and "taking the measure", before the current modern surveying techniques, followed a process that presupposed design choices by the surveyor/researcher. It depended on the object of study and on the purpose of the survey.
These choices lead to both elaborated two-dimensional drawings and digital models (verified and controlled), from whom starting new studies.
It is useful and appropriate, today, to make some reflections whether the process could be enriched, implemented and "slimmed down", to obtain an informative model that can be both "read" and “write” by multiple users according to their purposes of study.
Applying Building information model to heritage architecture could lead to build two different models. On one side, a so-called ideal model, which refers to spatial-geometric drawing study as an act of synthesis, on the other an as-real model, which answers the mimetic requirements in model geometry. Nevertheless, it is possible to go beyond these differences using a proper interoperable building information model to organize semantic enriched geometries and integrating the model with the digital survey. Effectively, some tools allow users to integrate the surveyed points into the model as an object. This leads users to pay attention again on building the model as a critical act, to articulate the architecture's system.

Keywords: Digital survey, Analysis, BIM, Knowledge, Heritage

1. Introduction[1]
The survey - and below we will highlight the subtle difference that distinguishes it from the "detection" - emerges as an articulated operation, fundamental and foundational to the understanding of architecture, originated from the reality observation. In particular, we can define it as a complex system operating for the definition and identification of those elements useful to realize the representation of material reality, where that reality in architecture consists in the construction: this, in all its forms, is always direct evidence of itself, as a place of decipherable signs and then comprehensible. Based on a methodology of deductive analysis and interdisciplinary research, the architectural survey becomes, then, rigorous scientific discipline with a wide-range application. Otherwise, the requirement to work with sequential stages, the precise verification that each stage must undergo regularly, the direct observation of the construction, structural and linguistic modes of the architecture, all this steps are likely to reach a comprehensive understanding of the object-architecture. The geometrical-structural key is useful not only to the knowledge of the single architectural space, but also to the understanding the spatial relationships that the space establishing with other spaces around, and more or less immediate. In this sense, the use of the survey as operating system translates into a knowledge paradigm of ancient and modern architecture, including for the purposes of design interventions.
Moreover, today, even more so, is exceeded the simple meaning of survey intended as correct measurement and graphical representation of a building, an object, an urban or territorial place. The survey is now recognized as complex operation, to be conducted with the highest scientific accuracy and through

the use of appropriate resources and tools, whose ultimate aim is to allow the knowledge of an architectural structure, understanding it through a critical feasible for different fields of application. Then, it appears significant the act of the graphic translation of what has been surveyed. As we have already mentioned, the typology of drafts required for the individual fields of application of the survey will differ depending on the needs.
For this reason, it is useful and appropriate, today, to make some reflections whether the process can be enriched, implemented and "slimmed down", to obtain an informative model that can be both "read" and “write” by multiple users according to their purposes of study. Applying Building information model to heritage architecture could lead to build two different models. On one side, a so-called ideal model, which refers to spatial-geometric drawing study as an act of synthesis, on the other an as-real model, which answers the mimetic requirements in model geometry. Nevertheless, using a proper interoperable building information model to organize semantic three-dimensional geometries goes beyond these differences. Effectively, some tools allow users to integrate the surveyed points into the model as an object. This leads users to pay attention again on building the model as a critical act, to articulate the architecture's system.

2. Survey: yesterday, today and…[2]

Since the 70s of last century, the vast and articulated issue of the surveying was investigated reaching its definition as a discipline, and recognizing it as an instrument of knowledge and, in some cases, as the operational arm of the history. It is a discipline that, through a process (often not fully developed) making use of all available information (from the metrical ones), leads to knowledge of a building in all its aspects, allowing the interpretation of the layers from the state current and going back in time (possibly up to its plant), in a survey that essentially aims to recognize, at various stages, the characteristic features identified by Vitruvius in *De Architectura*: the *firmitas, venustas* and *utilitas*. The importance of drawing from many kinds of documents (iconographic, archival, bibliographic), to support the surveying activities for the purposes of its critical processing as complete as possible, and the awareness that an action of knowledge can not be consider never ended (naturally enriched in time with the adjustment, if required of the building) have led to the conception of the “surveying process" as “knowledge open system" whose focus remains, however, in the assumption that every building declares spontaneously its history (provided that the detector can interpret). In this paper, some aspects of metric survey will be analyzed, omitting to consider definitional issues to develop, however, some considerations on new detection techniques and its development process, in constantly changing, even in comparison with what systematized until the eighth decade of the last century, before the explosive spread of electronic-digital processes. In fact, the first mental operation that the surveyor was usually called to do was to “build” a Conceptual building model, on the basis of own several inspections, useful to define the graphic processing necessary for the documentation and communication of the building. According to this prototype would be acquired the necessary steps, and then were drafted the drawings useful to visualize that "mental" model (reduced in size but significantly interpreted). The construction of the latter one replied, obviously, to solve the scale reduction problem and to prepare an appropriate reading from the artistic synthesis’ aspect and from the purposes of graphic refunds. The next evolution of electronic pickup of the measure, along with the evolution of the tools used (e.g. laser scanner), led to believe that this step is no longer necessary for the ability to capture all the architectural surfaces in the site, and to re-assemble them in the laboratory in "scale" in the digital virtual space (infinitely large and in which "enter" through the computer screen) and then proceed to its synthesis. Experience has shown that this possibility, true in principle, collides with the difficulty of reading without misunderstandings architectural shape in the "cloud of points", and with the problematic generated by both the management of huge amounts of information - that require computers more and more powerful - and the consequent difficulty of being able to manipulate the data acquired in return for their architectural forms. At the same time, the search is still progressed to derive elements of knowledge about the nature of the materials through the electronic scanning. The answers which are obtained, even today, are not always effective for the variability of the conditions of the materials. Is indisputable, however, that this measurement technique, despite the many uncertainties, qualifies today as the most versatile data acquisition metric, and therefore every effort will be directed to the improvement of its use as part of the architectural survey, especially taking into account of its usefulness in the three-dimensional modelling. In this direction, some reflections are possible based on an articulated experience recently completed on an important monument in Padua. Given that the whole process of survey consists of two key moments - the measures’ collection (detection) and critical analysis of those measures (survey) -, it is known that the study of an architectural refers to basic questions: what is it necessary to “measure"? how and to what plot scale is it possible to represent the measured data? In order

to answer this last question is to consider that it is now possible to derive measures from a graphical model (as was necessary until a few decades ago) and even a three-dimensional model (appropriately / possibly textured). Also in the field of survey - that at this point we can define as a technical process and the preliminary phase of a broader process of planning[3] - is to consider the possibility of a synergistic interaction of different specialists (not only on the various two-dimensional graphics, but also on the three-dimensional model) according to the principle of interoperability ("core" of the interdisciplinary nature of the project but also of knowledge), favored by the software that for many years have been implemented in order. Without going to consider as regards the planning in particular, there is no doubt that it is desirable (for example) interoperability in the recognition of the elements that contribute to the definition of its Vitruvian characteristics - such as, for example, the structural model that ensures *firmitas*. This consideration highlights, today, that is no longer sufficient to think about "printing" as the last surveying media, but it is possible to consider devices as a tablet / smartphone allowing a quick and fast viewing of the 3D model among technical people or to the general public. At this point, is it inevitable to consider, simultaneously with the size reduction related to the plot scale, the problem of the scale of resolution / display? Or is it to refer the evaluation to the production of three-dimensional computer model? The answers to these questions are related primarily to the evolution of surveying techniques that occurred over the years. It should therefore be specified that, for both scales, refers to recognize their role in the communication of survey, because each of them is delegated a "unique" level of information (knowledge of the building in all its aspects). Without any doubt, a problem of this type, today, also improves the process of new knowledge of the architecture and / or the architectural heritage, in view of a desirable cataloging, far more detailed and available at various levels of information. As usual, through a detailed and documented surveying project, after determining what and how to represent the data acquired, the detection technique's choice to be adopted is often almost implied. In recent years, the technique of laser scanning, coming from the industrial world, has been gradually used in the fields of architecture and plant engineering, specializing more and more in the specificity and instrumentation, so as to allow, sometimes mistakenly, considering the product obtained - the point cloud - as a survey. The continuous experimentation (which is reflected in the specific bibliography) has instead demonstrated, on the one hand, it is essential to integrate the point cloud with other information of a metric that contribute to the accuracy of the computer data collected. This integration will allow to validate the data laser scanner thanks to the intervention of other techniques, comforted by the many years of tradition and experimentation, and even by the rigorous procedures. It is important to reiterate that pencil and paper are not to be abandoned nor the use of the topography (remembering that the reliability of topographic measurements is supported by the Theory of Measurements and Errors[4]. On the other hand, is an activity necessary post-processing critical interpreters that the huge amount of points gained and is thereby two- and three-dimensional the representations necessary. At this point, it is appropriate to consider in addition to the "digital weight" of the scans (single and assembled) which easily results of several GB, also the relationship between the data acquisition time in the site, and the processing time and post-processing (ratio that can be currently estimated at one to ten hours). These considerations call to mind the situations that proposed in the 80s of last century, when under the stereophotogrammetry aimed to achieve the documentary archives of monuments, was a recommendation made by the Hague Convention in anticipation of new armed conflicts[5]. These files would have to be made up of "*stereomodelli*" acquired in a widespread to document the cultural heritage and then adapted to the subsequent processing and return, with a view to use in the event of damage to the buildings. Decades have passed, and although the Convention has been confirmed at the international level, certainly archives documentaries have not been realized. Today, electronic scans can be adjoined to those photogrammetric models, with the advantage that the first ones present an intrinsic three-dimensional characteristic dynamically perceptible. It is worth noting that no initiative of their storage yet been undertaken for use in the public interest and in anticipation of natural disasters or armed conflicts. Finally, we live in times that have been lovingly called “The Third World War", witnessing systematic destruction (made for ideological reasons) of a significant part of the cultural heritage of civilisation important, despite that most countries worldwide adhered to many conventions and declarations elaborated at the supranational level: this situation should lead, more so, for preventive action documentation in order to guarantee future generations a testimony helpful to know the previous history.

3. Survey+Model=Knowledge[6]

Tools and algorithms for the digital survey [7] are a suitable example of the complete transfer of the experimental science from the models' theory to the analysis tools [8]. Although, there are at least two reasons why using this instrumentation creates a crisis in a part of the representation's discipline.
On the one hand, it alters the standard thinking of the user who renders the building survey: while measuring the inside and outside three-dimensional space of the factory, he was abstracting the reality on a two-dimensional support (survey *eidotipo*, india ink drawing, CAD drawing). This intellectual procedure represented the first feedback of the understanding and knowledge of the architecture's shapes.
The digital survey of a space, instead, suggests using three-dimensional modeling. At a later stage, users can obtain two-dimensional outputs through common operations of horizontal and vertical sections.
On the other hand, it generates a problem concerning the precision of the measurement [9]. It affects both the quantity, from a group of measures to a considerable quantity [10], and, above all, the quality. Once the user obtained a point cloud, he may create an extremely detailed representation, which maintains the same accuracy as the survey, reducing margin of error.
This dissertation describes the existence of two main issues: if it is executed with traditional three-dimensional modelling tools, it becomes extremely time-consuming. Whether it is rendered through semi-automated techniques, applying sophisticated algorithms, there are fewer occasions for critical observations. Therefore, within the representation on an architectural scale, and considering as essential the increase of the knowledge during the passage between the survey and its representation, these modelling procedures are necessary for a figurative purpose ("image-based mimesis"), rather than for its complete representation ("deep mimesis"). As a result, it is possible to obtain a precise building depiction. Among these procedures, mesh generation and point cloud segmentation are noteworthy: the first is suitable for complex geometric areas, the second is necessary for creating procedures of modelling automation [11].
The production of a model should represents an occasion in increasing building knowledge through an intellectual operation.

- It is believed that the researcher's intervention regards the architectural survey and consequently the increase of knowledge. In this way, it can overcome the depiction of the heritage and become a fundamental critical tool.
- In order to be a critical tool, every model needs to describe the state of things and its relations [12]. It highlights the application of a correct taxonomy for architectural and virtual objects and the description of its relations. Moreover, the model needs to consider the surveyed objects, which are related through grouping, splitting, linking operations, in order to originate a "deep mimesis". This becomes the representation's real aim, compared with the previous "image-based mimesis". Whether we compare the description of the architectural model to the mathematical model, "speaking of mathematical model process, we think about measures of things. Instead, their ordering should reveal as primordial" [13].
- The production of an architectural model presupposes analogy/difference reasoning, in comparison with other reference models (geometric, configurational-structural, historical, ornamental, etc.).

With these considerations, the rendered model could only have an ideal-configurative nature. Its equivalent "as-real" model cannot be regarded neither as a target nor as a working methodology. In the first case, the actual modelling tools make the operation economically unsustainable. In the second case, the methodology does not permit to apply a critical individuation of the architecture's qualities.
It is clear that a so complex model's visualization cannot be a simple drawing. In this sense. Therefore, it is useful to analyses a technology, the Building Information Modelling, which by default incorporates semantically defined objects and the three-dimensional representation. These are two definition:

- Building Construction Information Model: shared digital representation of physical and functional characteristics of any built object (including buildings, bridges, roads, etc.) which forms a reliable basis for decisions [14];
- Building Information Modelling (BIM): the creation and use of coordinated, internally consistent, computable information about a project in design and construction [15];

Consequently, the model needs to include the coherent and compatible geometrical, numerical, textual, hyper-textual information, in order to be a reliable basis for decision. Coherence and compatibility represent the most important contribution of BIM to the knowledge of the heritage building. In fact, it is possible to apply to historical buildings those features provided for the new buildings' coordination, construction and management [16]. In this sense, the native mechanical approach to modeling by using building components, meets the cited essential model's taxonomy [17].
The result is the advantage generated by organizing the architectural components in libraries of semantically object: grouping similar objects in terms of differences and similarities is fundamental for the model's correct working. Obviously, subdividing the organism in simpler components means to increase the impact of the detachable relations. Through these procedures, the risk is to propose rigid, inclusive and unifying structure, which can weaken every difference [18]. It is possible to avoid this risk by linking the digital survey into the model, as a separate object. Consequently, its role is not limited to simple geometrical reference and it operates during the whole modeling procedure though deviation analyses [19].
This is the optimal process for a model's production (fig. 1):

- data entry of the digital survey (point cloud) within the modelling software;
- after a generative geometry finding, construction of geometry, referenced to the points cloud (in case, automation procedures could substitute this phase [20]);
- deviance analysis between modelled components and point cloud [21];
- documentation of the previously obtained information;

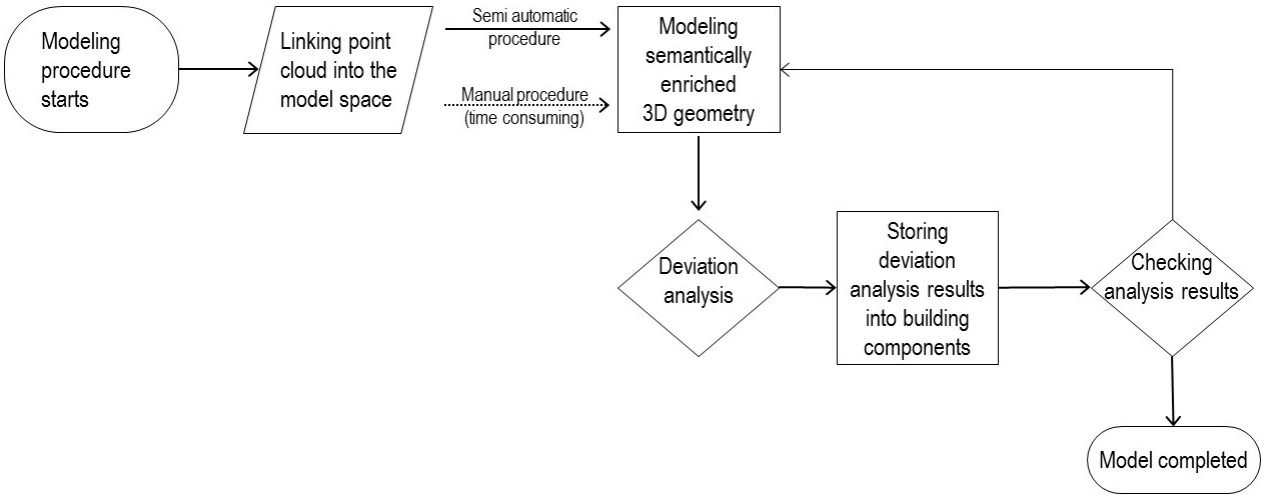

Fig. 1: Modeling process Integrating model and digital survey

The integration of the survey in the model enables a crucial change for the representation procedure and for a critical interpretation of the building. On one hand, the point cloud guarantees the "*image-based mimesis*" requisite. On the other, it is possible to reach a real "*deep-mimesis*" through the model and the deviance analysis between them.
It is consequently possible to optimize the process: the point cloud, which is the digital survey's result, does not function only as documentation, but mainly as analysis. Moreover, this proves that the "as-real" model is unnecessary [22].
It would be limiting thinking that this feature could be useful only to find modelling issues [23]. This process will have best effects on conservation and preservation/condition survey. Firstly, a deep deviation analysis is valuable for collapse mechanisms and failures. Case histories demonstrated which this methodology concerns both out-of-plane walls' conditions (fig. 2) and horizontal elements such floors, vaults, to evaluate local damages and failures (fig. 3).

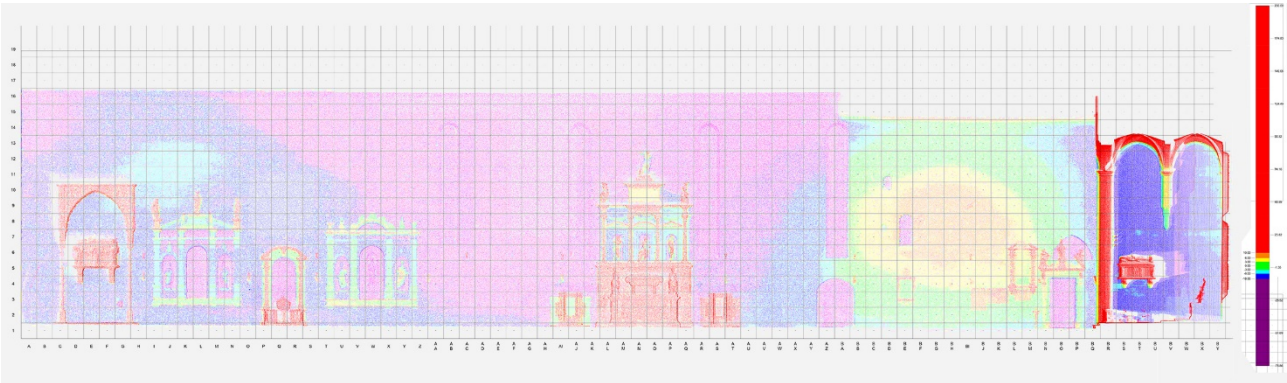

Fig. 2: Out-of-plane mechanism found by a deviation analysis on wall (length 71.55 meters).



Fig. 3: Above, step 1: floor's deviation analysis shows it is not perfectly horizontal. Below, step 2: deviation analysis after correction.

This is, for example, the vaulting system's process application:

- study of the vault's geometric configuration, through the detection of the element's generative geometries (increase of knowledge);
- objects placement from external libraries;
- deviation analysis between the modelled surface and the point cloud, taken as the "as-is" (increase of knowledge);
- conservation or restoration project.

Moreover, the comparison between the model the point cloud could lead to a new area of applicability of the condition survey. It is effectively possible to detect, as a process' consequence, all the building conditions that have generic missing part (gap, loss of material, loss of matrix). During the actual procedure, there is a preliminary in-site condition survey; users than implement this information in a two-dimensional coded representation and in the project's database. Using deviation analysis, users could improve the actual saving procedure.
In order to model heritage architecture, user should evaluate critically the current survey's technologies and point out best modeling procedure to achieve a so-called "image-based mimesis". It could lead to build two different models. On one side, a so-called ideal model, which refers to spatial-geometric drawing study as an act of synthesis, on the other an as-real model, which answers the mimetic requirements in model geometry. Nevertheless, it is possible to go beyond these differences using a proper interoperable building information model to organize semantic enriched geometries and integrating the model with digital survey. The overlapping operation allow deviation analysis between model and survey, which participate in building a "deep-mimesis" model.

Bibliographical References

[1] A. Giordano

[2] M. R. Cundari

[3] CUNDARI, Cesare. Il Rilievo architettonico. Ragioni. Fondamenti. Applicazioni. 2012. p. 19-30

[4] CUNDARI, M. R. Rilievi integrati del patrimonio architettonico. Dalle nuvole di punti ai modelli digitali: Ravello, il Chiostro di Villa Rufolo. 2013.

[5] C DOCCI, Mario. MESTRI, Diego. Manuale di rilevamento architettonico e urbano. 2009

[6] P. Borin

[7] The direct reference is to LIDAR and photogrammetry survey, but there are new procedures, as videomodelling [24] and new devices that integrate optics and sensors, like Google's Project Tango.

[8] KOYRÉ, Alexandre. From the Closed World to the Infinite Universe. Baltimore. Johns Hopkins University Press, 1957

[9] KOYRÉ 1957

[10] The actual need in measurement accuracy is certainly due to technology improvement (which represents the perfect synthesis between *episteme* and *techné*). However, the process impoverished as an ordinary technical procedure.

[11] DIMITROV, Andrey and GOLPARVAR-FARD, Mani. Segmentation of building point cloud models including detailed architectural / structural features and MEP systems. Automation in Construction [online]. 2015. Vol. 51, p. 32–45

[12] WITTGENSTEIN, Ludwig. *Tractatus logico-philosophicus*. Einaudi, 1983

[13] CANGUILHEM, Georges. *Mort de l'homme ou épuisement du cogito*. Critique. 1967. No. 242, p. 599–618.

[14] ISO. ISO 29481-1: Building information modelling -- Information delivery manual - Part 1: Methodology and format. 2010.

[15] AEC (UK) BIM Protocol v2.0. 2012. Available from: https://aecuk.files.wordpress.com/2012/09/aecukbimprotocol-v2-0.pdf

[16] There are some differences during creation's process of a BIM and an historic BIM: in BIM the information flow increases as the design phase grows, in hBIM, it decreases.

[17] Students' case histories at University of Padua demonstrated the possible building decomposition, in order to classify architectonic and decorative components. For instance, it is possible to decompose

decorative wall setting in punctual elements, linear vertical elements and linear horizontal elements. The decomposition could increase, subdividing elements by materials, sweep profile, generative profiles, ect.

[18] UGO, Vittorio. *Fondamenti della rappresentazione architettonica*. Bologna, Progetto Leonardo, 1994

[19] ALBY, E. and GRUSSENMEYER, P. From Point Cloud To 3D Model, Modelling Methods Based on Architectural Knowledge Applied To Fortress of Châtel-Sur-Moselle (France). In AAVV : XXII ISPRS Congress. Melbourne : International Archives of the Photogrammetry, Remote Sensing and Spatial Information Science, 2012. p. 75–80.

[20] TANG, Pingbo, HUBER, Daniel, AKINCI, Burcu, LIPMAN, Robert and LYTLE, Alan. Automatic reconstruction of as-built building information models from laser-scanned point clouds: A review of related techniques. Automation in Construction [online]. 2010. Vol. 19, no. 7, p. 829–843.

[21] ANIL, Engin Burak, TANG, Pingbo, AKINCI, Burcu and HUBER, Daniel. Deviation analysis method for the assessment of the quality of the as-is Building Information Models generated from point cloud data. Automation in Construction. 2013. Vol. 35, p. 507–516.

[22] Technological improvements could lead to full-automatic semantic modeling procedures: the “as real” semantic model could represent an efficient process.

[23] In order to guarantee the models’ quality, modeling standards have to produce quality matrix that compare design phases and deviation limits. See U.S. GENERAL SERVICES ADMINISTRATION. GSA Building Information Modeling Guide Series: 03 – GSA BIM Guide for 3D Imaging. [online]. 2009. Available from: http://www.gsa.gov/graphics/pbs/GSA_BIM_Guide_Series_03

[24] BRILAKIS, Ioannis, LOURAKIS, Manolis, SACKS, Rafael, SAVARESE, Silvio, CHRISTODOULOU, Symeon, TEIZER, Jochen and MAKHMALBAF, Atefe. Toward automated generation of parametric BIMs based on hybrid video and laser scanning data. Advanced Engineering Informatics. 2010. Vol. 24, no. 4, p. 456–465

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3D modelling in Architecture: from tangible to virtual model

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Abstract
Models as useful tools within architecture practice have been used for centuries. While information about their use before Hellenistic civilization is limited, we have evidence to suggest that ancient Greek society used models in their architectural practice. This trend continued until the Renaissance. After this period this trend began to decline as a result of the influential theories presented by Galileo Galilei, who demonstrated how models cannot provide a reliable structural assessment.
Current practice is once again embracing the use of 3D modeling, even if not in the tangible form rather in the virtual and digital form. Tangible and virtual 3D models used by architects have changed in type, scope and function. They play different roles within the design processes and in the project management in both new and existing architecture.
The paper presents an overview of the ethical and practical dimension of models along history and their roles in architectural practice. The analysis of the historical transformations, in particular of the legacy of Leon Battista Alberti theories and thoughts, inspires some reflections on the current applications of 3D virtual models and on their role in the design as well in the construction phase.
To gain awareness of the current uses of the virtual 3D models and their further possible developments, an overview of the transformation of the tangible models within the design processes along history will be provided.

Keywords: 3D modelling, tangible models, architectural practice, design, virtual models.

1. Introduction
From the tangible models to the virtual 3D modelling
Models as useful tools within architecture practice have been used for centuries. While information about their use before Hellenistic civilization is limited, we have evidence to suggest that ancient Greek society used models in their architectural practice. This trend continued until the Renaissance. After this period this trend began to decline as a result of the influential theories presented by Galileo Galilei, who demonstrated how models cannot provide a reliable structural assessment. Current practice is once again embracing the use of 3D modeling. Presenting the role of the model from the ancient Greece until the Renaissance and its last decline following the theory by Galileo Galilei the use of this technique and its current declination in the virtual 3D modelling are analyzed.
The importance of the models as drawing improvement
Model, as an architectural tool has been used for generations as a starting point in the architecture practice. It has allowed for members of the profession to foresee the development of large scale construction on a small scale model. This method is one of the most ancient approaches to the practice of architectural design.

2. The architectural model throughout the centuries: roles, uses and associated ideas
The use of the model in architecture has got its roots far away in the history. It is possible to find some example in the ancient Sumer society, in the ancient Egypt as well as in the Etruscan society. In both cases the models were not used in the design phase having only an "*exhibitive and votive function*"[1]. Another

[1] PIGA, Claudio. *Storia dei modelli: dal tempio di Salomone alla realtà virtuale*. Roma: Enel, 1996.

example of the use of models in the ancient times can be found in the Bible. In, *Chronicle I* it is described how the temple of Salomon in the X century BC., was built on the basis of a model, defined by the Jewish term "Tabnit"[2].

The Greek epigraphic sources show the use of models in the Hellenic world[3]. For example, Aristotele (384 - 322 a.C.), in the *Constitution of the Athenians*[4] describes how the Fifty's Council judged proposed projects of public buildings. These buildings had to be built according to models made of clay or wood. Architects were obliged to develop models in order to gain public approval and funding for their developments. These models were necessary to obtain the client's approval. Nevertheless, it is not yet clear if these models were used also during the building's construction phase. The use of clay and wooden models in the Greek world has been discussed in two passages of the *De Architectura*[5] by Marco Pollione Vitruvio (80 - 15 a.C.). Within the preface of the second book Vitruvio writes how the architect Dinocrates of Rodi[6] showed models to Alexander the Great in the attempt to get a contract.

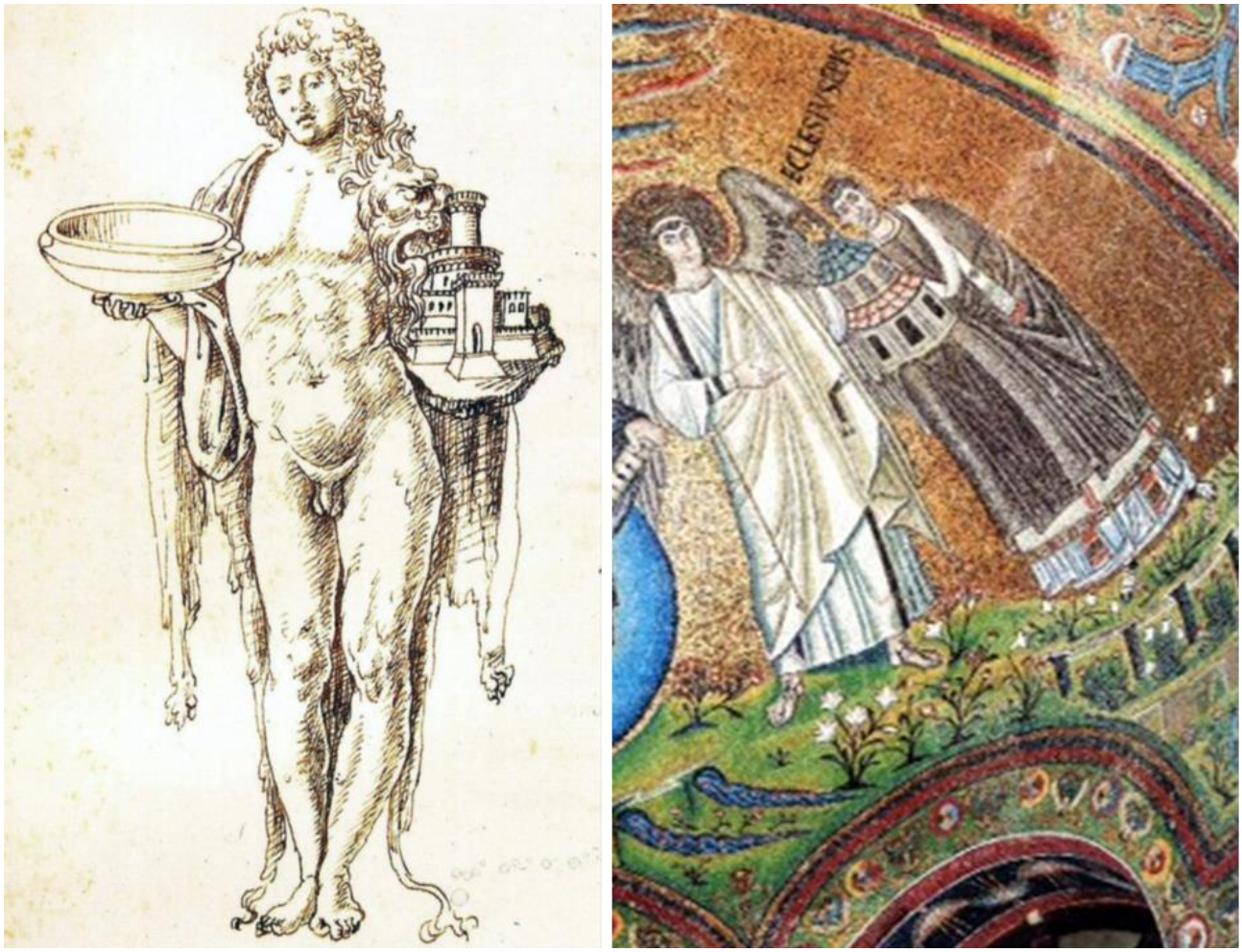

Fig. 1: The image on the left depicts Dinocrates holding in his left hand the model of the project to re-shape the Mount Athos. He holds also, his idea for a cistern for the water collecting of the city, in his right hand. Drawing, XV century, by Francesco di Giorgio Martini, in Cod. Magliabechiano II.I.141, f. 27v Location Biblioteca Nazionale Centrale, Firenze. Source:http://www.atlantedellarteitaliana.it/index.php?artwork=10939&lang=English. The image on the right presents the mosaic of the apsis of the Basilica of San Vitale, in Ravenna. Source: Angiolini Martinelli Patrizia. La Basilica di San Vitale a Ravenna. Modena: Franco Cosimo Panini Editore, 1997. («Mirabilia Italiæ», VI).

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[2] The decision of building a temple dates back to king David. Even though David started all the preparation for the temple's construction, included the model for the construction, was is son Salomone who built the temple. PIGA, Claudio. *Storia dei modelli: dal tempio di Salomone alla realtà virtuale* Roma: Enel, 1996.

[3] Nevertheless, information about these models are poor and difficult to recover because usually quoted in contexts outside the architectural one.

[4] LOZZA, Giuseppe, trans. *Aristotele, Costituzione degli Ateniesi.* Milano: Mondadori, 1991. It is a short text formed by two parts concerning the history of the Athenian state - in the first part – and its constitution at the time of Aristotele - in the second part.

[5] SCHOFIELD, Richard, trans. *De Architectura /On Architecture*. Toronto: Penguin Books, 2009.

[6] Dinocrates, was a Greek architect who lived under Alexander the Great, IV B.C.
Source: http://www.britannica.com/EBchecked/topic/163942/Dinocrates

Then, in the last but one chapter of the book X Vitruvio writes about Callia displaying his model of a technological solution, for the defensive walls of a city, in front of the authorities.[7]
It is interesting to outline how this trend is still modern. Indeed, even if the virtual models have replaced the wooden ones, they share a common function. Both are important to provide an immediate understanding of the project also to non-architects. According to Carlo Amati[8] the use of models was common between architects to show their ideas to the clients and to give real feeling of their concepts.
Based on Greek tradition the architectural models were given less credit than theoretical project ideas, despite their main role in the acceptance process of a project. On the other hand, they were considered secondary to the intellectual development phase of a project[9]. This lack of recognition has been demonstrated by the inclusion of the model within the production costs, and thereby retracting its value as an individual entity[10]. Up until the XIV century, literary sources did not provide information on the use of models in architecture. Nevertheless, models are depicted in the coins of the late-empire as well as in pictures, frescoes and mosaics of apsis of some Christian basilicas.



Fig. 2: Enrico Scrovegni offering the Model of the Scrovegni Chapel to Maria, Giotto, 1303 - 1305. Image source: http://www.forlinews.it/wpcontent/uploads/2009/12/Cappella_Scrovegni_enrico.jpg

[7] Dinocrates presented to Alexander the Great his project for a huge fortified city on the Athos mountain and a cistern for the water collecting and management. Callia presented a technological solution for the fortified wall, able to neutralize possible enemies' attack and sieges.
[8] MOROLLI, Gabriele. *L'architettura di Vitruvio nella versione di Carlo Amati (1829-1830).* Firenze: Alinea , 1988..
[9] GUARDUCCI, Margherita, COARELLI, Filippo. *Sull'artista nell'antichità classica, in Artisti e artigiani in Grecia*. Roma, Bari: Laterza, 1980.
[10] PIGA, Claudio. *Storia dei modelli: dal tempio di Salomone alla realtà virtuale*. Roma: Enel, 1996.

In the Middle Age there are many medieval depictions of models of buildings (constructed or to be constructed) offered to superior authorities such as: emperors, popes or to God. An example is the Scrovegni chapel, where Giotto depicts Enrico Scrovegni offering his building to Maria. This can be interpreted as a proof that the use of models was common. This explains why we do not find written documentation. During the XIV century, documentation of models in written sources appears once again. According to Richard A. Goldthwaite model was a kind of guarantee of the feasibility of the project as a tangible evidence, and it was also a tool to resist to pressures of those wanting to change the original design during its construction phase[11]. Moreover, in this period the architectural models served as a type of copyright for clients. In addition to this, models provided a method to engage clients in the full comprehension of the project, as they do not always understood the intricacies of architectural drawing, recognizing the importance of the projects and of the idea behind it. In addition to that, the evidence of the models played a key role to show a clear and scaled realization of the future project, without requiring capability of abstraction for the clients as required by the drawing technicalities. During the Renaissance period, the model gained a new dignity and the first theoretical settings for its development and its function were formulated. The architects of this period used models in a different and personal way locating them in different manners within the design steps. Nevertheless, the models were elaborated to gain the clients' acceptance for their development in a 1:1 scale.

In the Islamic world the use of the models was fundamental to obtain an approval for the construction of the project[12]. An example is the use of model by the Architect Sinan[13] in Turkey during the XVI century. For instance, there are written records of the model of Süleymaniye Mosque decorated by wood and ivory. It was so detailed in its construction that it was virtually identical to the original[14]. The role of architects in Islamic civilization was not limited to architectural drawings, but it was extended to the making of miniature models of buildings. This practice was common among Muslim rulers and was used in several circumstances. The use of prototypes became common practice in the Ottoman era. Wooden and silver models, such as the one of the Izet Pasha Mosque, became common. Records also mention models decorated by wax. For instance, the Ottoman Sultan Mohammed I only became convinced of constructing an Ottoman building after seeing a miniature model of it[15].

Different uses of the model in the Renaissance

As already mentioned, during the XIV century there is a huge written documentation about the use of models in architecture practice for example the model of the Duomo of Florence, the Cathedral of Milano and the Cathedral of Bologna.



Fig. 3: The image on the left presents the wooden model of the Cathedral of San Petronio, Bologna, 1514. Source: http://www.arte.it/foto/600x450/97/3923-df7ca03d-46dc-4bfa-b2cf-74a4c3d4b6cd.jpg Consulted on December 17, 2014. The wooden model on the right presents the completion for the San Lorenzo's facade, in Florence, designed by Michelangelo Buonarroti, 1518. Wooden, 216 x 283 x 50 cm Casa Buonarroti, inv. 518. Source: http://www.friendsofart.net/static/images/art1/michelangelobuonarroti-model-for-the-facade-of-san-lorenzo-florence.jpg

[11] GOLDTHWAITE, Richard. *The Building of Renaissance Florence: An Economic and Social History*. Baltimore: Johns Hopkins University Press, 1980.

[12] GULRU, Necipoglu. *The age of Sinan Architectural Culture in the Ottoman Empire*. London: Reaktion books, 2005.

[13] Sinan, called Mimar Sinan (Architect Sinan) and Mimar Koca Sinan (Great Architect Sinan), is the most celebrated of all Ottoman architects. Sinan was nicknamed "the Michelangelo of the Ottomans" because of his key role in the definition of the Ottoman architecture. Source: GULRU, Necipoglu. *The age of Sinan Architectural Culture in the Ottoman Empire*. London: Reaktion books, 2005.

[14] Source: http://www.kanyak.com/sinan.html Consulted on December 18, 2014.

[15] Source: http://www.arabworldbooks.com/Articles/architectinisl amic.htm Consulted on December 19, 2014.

During the XIV century there is a huge written documentation about the use of models in architecture practice. In the Renaissance architects used models as common tools in the design process. The sequence of this process is: concept/idea – drawing – model. The model as physical visualization of the project was the tool used to deliver the architect ideas to the client. Indeed, the model was an unequivocal, immediate, tangible three-dimensional representation of the building to be achieved, easy understandable also by non-architect. In the Renaissance the model has become a dynamic role as tool to be used to build the final project.



Fig. 4: Wooden model of the Duomo of Pavia,1497. Engraved in cypress, oak and walnut wood by Gian Pietro Fugazza based on the design by Giovanni Antonio Amadeo and Gian Giacomo Dolcebuono.
Source:http://mw2.google.com/mwpanoramio/photos/medium/37081815.jpg Consulted on 20 December.

In the *De re Aedificatoria* Leon Battista Alberti expressed the cultural dignity of the models within the architectural practice. Indeed, he claimed the importance of models to obtain a perfect building execution.

> *"To avoid such pitfalls, therefore, I must urge you again and again […] (to use) scale models, re-examine every part of your proposal […] tile there is nothing, concealed or open […] for which you have not thought out, resolved, and determined […]" De re Aedificatoria,* Book 9, 8[16].

About ten years later since the publication of the *De re Aedificatoria*[17], Filarete wrote his treatise *On architecture*[18]. In his treatise he dealt also with the opportunities of using models. The treatise defined a model as the final output of a project, «*disegno piccolo rilevato di legname*»[19], which is responsible for the whole design process. For Antonio Averlino, known as Filarete, the model leads to a less hermeneutic and theoretical dimension, providing a bi-univocal interaction with the drawing, fixing its ratios. In the book VII of the treatise he deals with the combined use of wooden models and drawings and how to overlap both in the execution phase. The key role of the model in architecture design as well as in the construction and building phase, during the Renaissance, is proved by Filippo Brunelleschi. Thanks to Vasari, it is possible to know the function of models for the structural analysis, in the constructive technique choices to be adopted as well as in the design phase.

[16] RYKWERT, Joseph, LEACH, Neil, TAVERNOR, Robert, trans. *Leon Battista Alberti On the Art of Building in Ten Books*. Cambridge: The MIT Press, 1998, p.313.
[17] The first five books were apparently written between 1443 and 1445. The five others were written between 1447 and 1452, if Poliziano's brief letter can be believed. Leon Battista Alberti apparently intended to publish his work, dedicated to Lorenzo de Medici. In spite of this, the first version was presented to Pope Nicolas V in 1452. Alberti gave a copy of his treatise to Pope Nicholas V because the pope was rebuilding Rome. Source: RYKWERT, Joseph, LEACH, Neil, TAVERNOR, Robert, trans. Leon Battista Alberti *On the Art of Building in Ten Books*. Cambridge: The MIT Press, 1998.
[18] SPENCER, John R., trans. *Filarete's treatise on architecture. Being the Treatise by Antonio di Piero Averlino, known as Filarete*. New Haven and London: Yale University Press, 1965.
[19] FINOLI, Anna Maria.,GRASSI, Liliana. *Antonio Averlino detto il Filarete. Trattato di Architettura.* Milano: il Polifilo, 1972.



Fig. 5: Wooden model of the Lantern of the Cathedral of Florence, by Filippo Brunelleschi. Museo dll'Opera di Santa Maria del Fiore, Florence. The model may have been made by Brunelleschi or it may be one of the models made for him by Ciaccheri in 1436. Source: http://media.vam.ac.uk/media/thira/collection_images/2006BB/2006BB3221.jpg

The importance of a model is then stressed in a passage of Vasari which points out the secrecy of the model during the project step[20]. Moreover, according to the historian Piero Sanpaolesi, the impossibility to find a

[20] MANETTI, Antonio, DE ROBERTIS, Domenico, TANTURLI, Giuliano. *Vita di Filippo Brunelleschi.* Milano: Il Polifilo, 1976.

model precise date of the cathedral of Florence, is an evidence of its development *"contemporary with the construction*"[21]. Massimo Scolari reports how models, as in the ancient Greece, were used to compete for a project.

> *"The jury[…]selected Brunelleschi's design as being the most robust and at the same time, the lightest; moreover, it permitted better lighting and formed efficacious protection against elements".* [22]



Fig. 6: The wooden model of the dome of the cathedral of Santa Maria del Fiore, XV century (measuring 100 X 90 cm central part, 55X63X35 cm side parts), is kept in the Museo dell'Opera di Santa Maria del Fiore. It includes parts of the apse and the block formed by the dome and drum, with a portion of the piers and arches underneath. Source: MARCHIN Giuseppe*. Il balllatoio della cupola di Santa Matria del Fiore*. In *Antichita' viva* 16, no 6: 39, 1977. Image source: http://insidethevatican.com/wpcontent/uploads/2013/10/2.05_130306124954-973x1024.jpg. The image on the right presents the interior of the wooden model for the Basilica of San Peter, by Antonio da Sangallo il Giovane, XVI century. Source: http://www.afterauschwitz.org/itinerari/arte/Numeri/html/img/modello_1.jpg

Some years later, Antonio da Sangallo[23] and Michelangelo Buonarroti, used the model not only for structural assessment and design purposes but also as a reference tool within the building site activities. Their models used for the construction of the Basilica of San Peter in Rome[24], were used as main construction tools. These scaled models were used by the workmen in the building site, to the construction in a 1:1 scale. In addition, the models were also tangible demonstrations of the good or bad work of the architect. Michelangelo, for example, used the model of the roof to show the accuracy of his project and the mistakes of the workmen during the execution phase, to defend his own work.[25] Therefore, it is possible to claim that the architects of the Renaissance used models as effective reference tools for construction and design.

[21] SCOLARI, Massimo. *Oblique drawing a history of anti-perspective*. Cambridge: Mit Press, 2012.

[22] Ibidem, p. 187.

[23] The model of the project by Antonio da Sangallo elaborated by Antonio d'Abaco was completed between 1539 and 1546.

[24] In 1505, the pope Giulio II charged Bramante of the reconstruction of the Basilica of San Peter. He presented a project of reconstruction of the Basilica. Not totally convinced the Pope asked the point of view of Giuliano da Sangallo. He developed in 1506 the definitive project, including some of the ideas of Bramante. When in 1516 Giuliano da Sangallo died he was replaced by his nephew Antonio in the works on San Peter. In 1519 a new project was approved by Pope Leone X who followed Giulio II. Only in 1534 Paolo II Farnese charged Antonio da Sangallo to re-elaborate the project and to build a detailed wooden model. The model was made in 1:30 scale and it is the biggest model ever built in the Renaissance. The model is elaborated in order to have a tangible guarantee of the project. Moreover, it was used as communication tool between the architect and the workers. Its elaboration required more than seven years and it was developed in parallel with the construction works of the Basilica.

[25] PACCIANI, Riccardo. *I modelli lignei nella progettazione rinascimentale*, in "rassegna", a. IX, Milano, 1987.

The crisis of the model

The crisis of the model started when Galileo Galilei published his *"Discorsi e dimostrazioni matematiche intorno a due nuove scienze attenenti alla mecanica ed i movimenti locali ",* in 1638[26]. The Galileo's theories demonstrated how the models were not able to provide a reliable structural assessment.

> *"I modelli delle costruzioni sono utilissimi per valutarne l'aspetto, ma inutili perché si possa trarre qualche conclusione sulla loro resistenza."*[27]

Which translated means*:*

> *"The models of the buildings are very useful to evaluate the appearance, but useless to draw assumptions about their strength."*

The theory started a crisis of tangible models. Their purpose was relegated to represent an aesthetical preview of the project and its perception, denying their capability as tools for structural analysis.



Fig. 7: The Discorsi e Dimostrazioni Matematiche, 1638. Source: http://www.christies.com/lotfinderimages/d50841/d5084169x.jpg

3. 3D Virtual model

The historical consideration of the model's practice is useful to understand the impact of the computer-aided design in the 1980s that has radically transformed their generative process. 3D modelling is a procedure of graphic representation of an object in three dimensions in a virtual space. It is based on algorithms, employing dedicated software using, as starting point, data coming from 3D surveys or from other sources of information. Currently the techniques of 3D modelling can be divided into: manual modelling with 3D computer graphics; procedural modelling and modelling based on real measures (with data coming from 3D scanning). The manual modelling with 3D computer graphics consists in the creation of three-dimensional models based on imagination or imitation, not on survey or real data measurement. This technique is principally used for the representation of scenes and figures, both still and moving, through complex surfaces, based on math formulas and algorithms designed with specific software (Sketch-up, 3DStudioMax, Maya, etc.,)[28]. The second technique is the procedural modelling that generates 3D geometries using commands and functions of extrusion, on the basis of automatic or semi-automatic methods (for example through software like City Engine) including an analytical and a generative phase. The analytical phase entails the definition and the use of a vocabulary of shapes and rules classifiable for the designing phase and the indication of formal archetypes to assemble many geometrical elements on the basis of similar algorithms. The generative phase entails the reproduction of complex architectural or urban structures (i.e. housing, palaces, temples, churches, fortifications, bridges, aqueduct, etc.,).

[26] GIUSTI, Enrico. *GALILEI GALILEO. Discorsi e dimostrazioni matematiche: intorno a due nuove scienze attinenti la mecanica ed i movimenti locali.* Torino: Einaudi, 1990.
[27] Ibidem.
[28] They are especially used in movies, television, architectural and engineering and in many scientific sectors.



Fig. 8: Point cloud coming from 3D scanning. These data are the first step for a 3D model based on real measures. The image presents the 3D point cloud to be used for the tridimensional reconstruction of the 352 Somerset building in Ottawa, Canada. The capturing data phase employed a Total Station Leica TS11, a Laser Scanner Leica Scan Station C10 and the software Cyclone, used to merge and manage the different scanned Point Clouds. The project has been developed by Professor Mario Santana Quintero, Architect Davide Mezzino and Architect Ken Percy of the Carleton Immersive Media Studio (CIMS), Carleton University, Ottawa.

Finally, the modelling based on real measures obtained through a 3D survey in the field of the historical-artistic studies for the conservation and use of the Cultural Heritage has the following purposes:

- creation of digital archives allowing the re-unification of resources distant from each other and the possibility of consulting and studying masterpieces, monuments and urban complexes from remote positions;
- metrical investigation aimed to the knowledge of the dimensions, shapes and ratios of the resources in order to be able to elaborate comparative studies between monuments and contexts;
- investigation of the original constitutive materials and of those required for restoration;
- diagnostic studies before a particular intervention;
- assessment, analysis and monitoring of different kinds of pathological degradation (chemical, physical, micro-climatic and accidental);
- simulation of specific physical phenomena on the building surface (or single part of it) for the prediction of effects, for instance: the exposure to atmospheric agents, artificial light, the deposits of dust and the prediction of the static behavior of buildings or urban contexts under particular stress conditions (i.e. catastrophic events);
- planning of routine and special maintenance;
- restoration project, giving a visual data base with a layered referencing of data coming from diagnostic surveys and from the different steps of the intervention and, consequently, chance to simulate integrative or reconstructive hypotheses (i.e. the determination of the methodologies to follow and the use of materials and products);
- communication and cultural dissemination, exploiting the potentialities of 3D visualization for information, not easily understandable by the direct contact with the monument and the context in which it is inserted[29].

[29] MEZZINO, Davide, RINAUDO, Fulvio. GIS and 3D modeling for Cultural Heritage. In TAMBORRINO, Rosa. *Telling the history of the city in the age of the ICT Revolution*. Rome: CROMA - Università di Roma Tre, 2015.

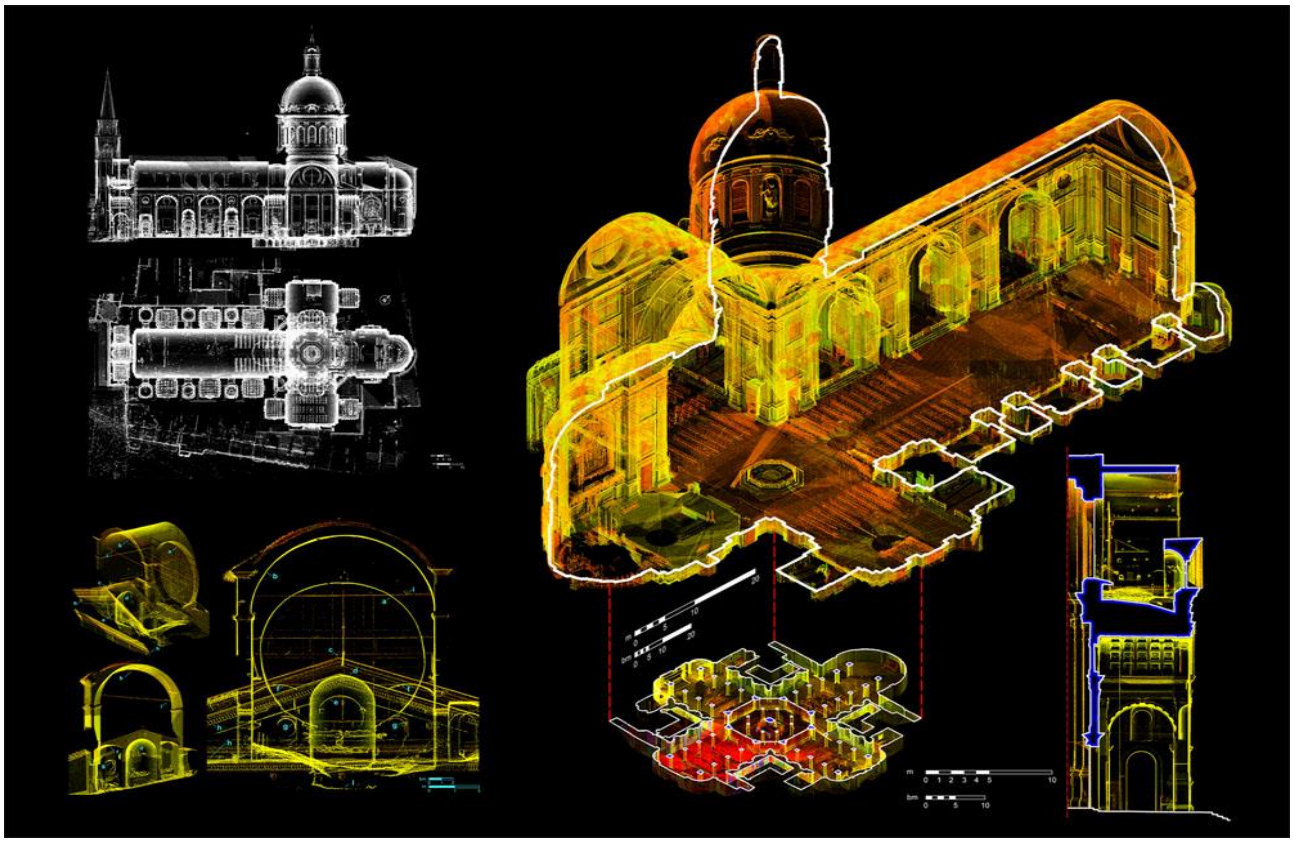

Fig. 9: Example of 3D modelling based on real measures. 3D model of the Church of Sant'Andrea, Mantova, developed by the University of Ferrara's Research Department Centre for the Development of Integrated Automatic Procedures for the Restoration of Monuments (DIAPReM). The modelling is based on real measures (with data coming from 3D scanning). Image source: http://www.unife.it/centri/diaprem/Settori%20di%20ricerca/esempi/Rilievoarchitettonico.jpg

In conclusion, 3D virtual modeling can be used for different kinds of analysis to better visualize and understand the design ideas. In addition, it allows the reconstruction of historical buildings as well as ancient urban and rural landscapes providing an understanding of their actual development and their modification over a certain period.

4. The Homo Universalis's legacy

The legacy of Leon Battista Alberti: writer, architect, humanist, philosopher, towering genius and *homo universalis*[30] remains a legacy that continues to influence current concepts of architecture. His principles on urban planning, foresight in scripting architecture[31], care to the use of models in architecture as well as the role of history as a progressively and constantly growing experience serving to orient design choices, make relevant his theories in current architectural debates. Leon Battista Alberti used[32] and theorized the employment of models. In the *De Re Aedificatoria*[33] he gave the model a role of fundamental importance within the creative process of the architect:

> *«[…] I will always comment the time-honored custom, practiced by the best builders, of preparing not only drawings and sketches but also models of wood or any other material […]» De re Aedificatoria,* Book II, 6[34].

The architect presents the importance of a context in models in order to understand its spatial relations.

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[30] BURCK, Hardt. *La civiltà del Rinascimento in Italia*. Roma: Newton Compton, 1974.

[31] CARPO, Mario. *The Alphabet and the Algorithm*. Cambridge: the MIT press, 2011.

[32] Even if all his models have been lost.

33 The Alberti's work is a humanist treatise devoted to architecture, very densely erudite. According to the trend of the recovery of the classics, driven by the rediscovery of the Vitruvian treatise by the Florentine humanist Poggio Bracciolini in 1414, "*the treatise has been written with the aim of organize the architecture discipline"*. Source: RYKWERT, Joseph, LEACH, Neil, TAVERNOR, Robert. trans., *Leon Battista Alberti On the Art of Building in Ten Books*. Cambridge: The MIT Press, 1998.

34 RYKWERT, Joseph, LEACH, Neil, TAVERNOR, Robert, trans. *Leon Battista Alberti On the Art of Building in Ten Books*. Cambridge: The MIT Press, 1998, p.34.

> *"[…] these models…will examine clearly and consider thoroughly the relationship between the site and the surrounding district, the shape of the area, the number and order of the parts of a building, the appearance of the walls, the strength of the covering, and in short the design and construction[…]" De re Aedificatoria,* Book II, 6[35].

The importance in the analysis of the impact of the new intervention and the role of the model to understand the spatial relationship outlines the importance of the representation of the context in the model. This consideration is still current for virtual 3D models. In fact they usually depict only the building without delivering a comprehensive understanding of the project and its possible impacts.

> *"When examining the model…nothing should be attempted that lies beyond human capacity, nor anything undertaken that might immediately come into conflict with Nature. For so great is Nature's strength that, although on occasion some huge obstacle may obstruct her[…]she will always overcome and destroy any opposition or impediment[…]" De re Aedificatoria,* Book II, p. 35

Alberti considered models as the best tools to study and develop an idea as well as the finest tools to improve drawing documentation. Moreover, the model was conceived as a tool to test the distribution features of a building and to meditate on its position, orientation, location of the main walls, appearance of the facades and suitability of the roof. The model is a good and flexible tool to change, move, review and rethink the designing choices until everything fits together. In the book IX of the *De re Aedificatoria,* he claimed how models are useful to correct the imperfection of the ideas and how they should be used for practical purposes such as the building site organization and management.

> *"I have often conceived of projects in the mind that seemed quite commendable at the time; but when I translated them into drawings, I found several errors in the very parts that delighted them into drawings, I found several errors in the very parts that delighted me most[…] finally, when I pass from the drawings to the model, I sometimes notice further mistakes in the individual parts, even over the numbers." De re Aedificatoria,* Book IX, 10[36].

> *"Questions such as these should be projected and debated by the use of models; these models should be employed not only at the outset but also during construction, so that on their advice we may determine in advance what is necessary and make preparations in order to avoid any hesitation, change, or revision after the commencement of the work, and so that we may form a concise overall picture of the whole, in order that appropriate and useful materials might be procured, stored, and made readily available." De re Aedificatoria,* Book IX, 9[37].

Furthermore, he stated the importance of a model for the design choices, for the understanding of the spatial relations as well as for cost analysis. He claimed that models allow calculation, experiments, cost assessment, providing information about width, height, and depth of the structures of its composing elements. According to these considerations, in the Book II – materials - he stressed the importance of the model in providing a precise indication about the costs of each building elements.

> *"(the model)[…]will provide a surer indication of likely costs – which is not unimportant – by allowing one to calculate the width and the height of individual elements, their thickness, number, extent, form, appearance and quality, according to their importance and the workmanship they require. In this way it is possible to form a clearer and more certain idea of the design and quantity of the columns, capitals, bases, cornices, pediments, revetment, flooring, statues, and everything else relating to the construction of the building and its ornamentation." De re Aedificatoria,* Book II. P.34[38]

Here it is evident that there is a connection with the current virtual 3D modelling systems such as the Building Information Modelling (BIM) system and its management features. In this case the word "modelling" does not mean only a three dimensional geometry but it is a combination with descriptive semantic information. It seems evident here how L. B. Alberti would have approved the BIM system for a comprehensive management of an architectural project. This system consisted of an integrated approach including parametric design and a tridimensional model integrated with a semantic database. BIM as the ancient models described by Alberti, is used for the cost analysis and archiving of every building element that has a geometrical as well as a semantic description.

[35] Ibidem, p. 34.
[36] Ibidem, p. 317.
[37] Ibidem, p. 314.
[38] Ibidem, p.34.

5. Conclusion

According to Branko Kolarevic the models of design "*capable of consistent continual and dynamic transformation*" are replacing the classical architectural drawing[39]. Therefore, can we speak of a digital revival of the model? In contemporary architectural design, digital media is increasingly being used as a tool to generate, visualize and control new and existing architecture. Alberti believed that the project could be developed only through the construction of a miniature model because he believed that an idea which exists only in the mind was essentially imperfect. He believed that the perfection in architecture could derive only from the model, (even though he claimed that the model should be completed not only by the architect himself but by other specialists[40]).



Fig. 10: Symbolic representation of the transformation of the use of models, from the tangible to the virtual ones, within the design processes along history. Image source: author's elaboration.

[39] KOLAREVIC Branco. *Architecture in the Digital Age design and manufacturing*. New York: Spon Press, 2003.

[40] This opinion agrees with the Alberti's conception of the Architect, who believed that architects role is fundamentally theoretical, consisting of the harmonic configuration of the functionality and solidity requirements.

Therefore, it is possible to interpret these ideas as an Alberti's legitimation of current 3D printing techniques for the elaboration of a scaled model as well as the current virtual 3D descriptive models. Following this idea it is possible to claim how he would have approved the 3D virtual models according to their adaptability of :

> *"[…]examine, with the advice of experts, the work as a whole and the individual dimension of all the parts, and […] any farther, to estimate the likely trouble and expense" De re Aedificatoria,* Book II, p.34

The proposed overview of the transformation of the use and importance of tangible models within the design processes along history, has been useful to gain awareness of the current uses of the virtual 3D models and their further possible developments. For instance, the model that Alberti suggests should be plain and simple «*nudos et simplices*»[41]. He condemns the celebrative models full of ornaments and paintings, considering them as deceptive.

> *"Better […] that the models are not accurately finished, refined, and highly decorated, but plain and simple, so that they demonstrate the ingenuity of him who conceived the idea, and not the skill of the one who fabricated the model" De re Aedificatoria*, Book II[42]

This consideration is still actual. It is possible to recognize the Alberti's assumption about the importance of a *"plain and simple*"[43] model within the current use of 3D models and rendering. Alberti's concept is against a representation delivering an improbable visualization, with unreal colors and shadows, and a misleading depiction. Quoting L. B. Alberti:

> *"striving to attract and seduce the eye of the beholder, and to divert his attention from a proper examination of the parts to be considered, toward admiration of himself ", De re Aedificatoria*, Book II[44].

In another passage, he describes the differences between architect and painter, expressing his concept of technical architectural drawings.

> *"The difference between the drawings of the painter and those of the architect is this: the former takes pains to emphasize the relief of objects shading, but takes his projections from the ground plan and, without altering the lines and by maintaining the true angles, reveals the extent and shape of each elevation and side […]* "[45].

This raises a reflection about the current level of accuracy in virtual 3D reconstruction and its role in the design and construction process. In fact, in the conservation field, for instance, the documentation and design phases require increasing high detailed and photo-realistic models. According to this trend, is this kind of photorealistic models always necessary in practice?

If a high level detailed model can be useful for the comprehension of a building and in the dissemination of its features, some questions should be answered:

1. What is the usefulness of a detailed model in the conservation practice, particularly if compared with a time/cost analysis?
2. In which cases is it better to have a simplified model that could be integrated with additional time and cost effective processes (i.e. photography, sketching, etc.)?
3. Can a simplified model satisfy the same requirements of a highly detailed model in the architectural conservation practice? What do we gain from it?

Following Alberti's teaching, maybe a simplified model could be considered to satisfy the requirements in architectural conservation practice as well as a highly detailed model.
According to William W. Braham and Jonathan A. Hale, through the course of the nineteenth and twentieth centuries architects have become largely technocrats.[46] Therefore, being aware of the change brought about by the relationship between technology and architecture, how would it be possible to rethink the role of the model and how has it changed in its ethical dimension as well as in its uses and application?

[41] ORLANDI, Giovanni, PORTOGHESI, Paolo. Leon Battista Alberti, *De Re Aedificatoria*,. Milano: il Polifilo, 1966.
[42] RYKWERT, Joseph, LEACH, Neil, TAVERNOR, Robert, trans. Leon Battista Alberti, *On the Art of Building in Ten Books*. Cambridge: The MIT Press, 1998, p.34.
[43] Ibidem, p. 34.
[44] Ibidem, p. 34.
[45] Ibidem, p. 34.
[46] BRAHAM, William W., HALE, Jonathan A. *Rethinking Technology A Reader in Architectural Theory*. New York: Routledge, 2007.

The proposed reflections aim to consider the level of accuracy and the detail of the virtual 3D models to understand and drive the architectural practice. The digital revolution redefined the way models may be conceived, produced and used, defining a new relation between technology and architectural production[47]. New experimentations could be carried on in order to check if a more simplified conceptual representation can provide a good projects control capability and effectiveness of getting results such as good building quality and fast execution time.

Bibliographical References

[1] ANGIOLINI, Martinelli Patrizia. *La Basilica di San Vitale a Ravenna.* Modena: Franco Cosimo Panini Editore, 1997.

[2] BRAHAM, William W., HALE, Jonathan A. *Rethinking Technology A Reader in Architectural Theory*. New York: Routledge, 2007.

[3] BURCK, Hardt. *La civiltà del Rinascimento in Italia.* Roma: Newton Compton, 1974.

[4] CARPO, Mario. *The Alphabet and the Algorithm.* Cambridge: the MIT press, 2011.

[5] FINOLI, Anna Maria.,GRASSI, Liliana. *Antonio Averlino detto il Filarete. Trattato di Architettura.* Milano: il Polifilo, 1972.

[6] GIUSTI, Enrico. *GALILEI GALILEO. Discorsi e dimostrazioni matematiche: intorno a due nuove scienze attinenti la mecanica ed i movimenti locali*. Torino: Einaudi, 1990.

[7] GUARDUCCI, Margherita, COARELLI, Filippo. *Sull'artista nell'antichità classica, in Artisti e artigiani in Grecia*. Roma, Bari: Laterza, 1980.

[8] GOLDTHWAITE, Richard. *The Building of Renaissance Florence: An Economic and Social History.* Baltimore: Johns Hopkins University Press, 1980.

[9] GULRU, Necipoglu. *The age of Sinan Architectural Culture in the Ottoman Empire*. London: Reaktion books, 2005.

[10] KOLAREVIC Branco. *Architecture in the Digital Age design and manufacturing*. New York: Spon Press, 2003.

[11] LOZZA, Giuseppe, trans. *Aristotele, Costituzione degli Ateniesi*. Milano: Mondadori, 1991.

[12] MANETTI, Antonio, DE ROBERTIS, Domenico, TANTURLI, Giuliano. *Vita di Filippo Brunelleschi.* Milano: Il Polifilo, 1976.

[13] MEZZINO, Davide, RINAUDO, Fulvio. GIS and 3D modeling for Cultural Heritage. In TAMBORRINO, Rosa. *Telling the history of the city in the age of the ICT Revolution*. Rome: CROMA - Università di Roma Tre, 2015.

[14] MOROLLI, Gabriele. *L'architettura di Vitruvio nella versione di Carlo Amati (1829-1830).* Firenze : Alinea , 1988.

[15] ORLANDI, Giovanni, PORTOGHESI, Paolo. *Leon Battista Alberti*, *De Re Aedificatoria,.* Milano: il Polifilo, 1966.

[16] PACCIANI, Riccardo. *I modelli lignei nella progettazione rinascimentale, in "rassegna"*, a. IX, Milano, 1987.

[17] PIGA, Claudio. *Storia dei modelli: dal tempio di Salomone alla realtà virtuale*. Roma: Enel, 1996.

[18] RYKWERT, Joseph, LEACH, Neil, TAVERNOR, Robert, trans. *Leon Battista Alberti On the Art of Building in Ten Books*. Cambridge: The MIT Press, 1998.

[19] SAKAMOTO, Tomoko, FERRE, Albert. *From control to design Parametric/Algorithmic Architecture.* Barcelona: Actar-D, 2007.

[47] SAKAMOTO, Tomoko, FERRE, Albert. *From control to design Parametric/Algorithmic Architecture.* Barcelona: Actar-D, 2007.

[20] SCHOFIELD, Richard, trans. *De Architectura /On Architecture*. Toronto: Penguin Books, 2009.

[21] SCOLARI, Massimo. *Oblique drawing a history of anti-perspective.* Cambridge: Mit Press, 2012.

[22] SPENCER, John R., trans. *Filarete's treatise on architecture. Being the Treatise by Antonio di Piero Averlino, known as Filarete.*. New Haven and London: Yale University Press, 1965.

[23] Web: http://www.un-documents.net/our-common-future.pdf

[24] Web. http://www.buildingconservation.com/articles/anatomytheory/anatomytheory.htm

[25] Web: http://vitruvio.imss.fi.it/foto/isd/icona/icona44694_800.jpg Consulted on December 14, 2014.

[26] Web: http://insidethevatican.com/wpcontent/uploads/2013/10/2.05_130306124954-973x1024.jpg Consulted on December 17, 2014.

[27] Web: http://www.atlantedellarteitaliana.it/index.php?artwork=10939&lang=english Consulted on December 14, 2014.

[28] Web: http://www.forlinews.it/wpcontent/uploads/2009/12/Cappella_Scrovegni_enrico.jpg Consulted on December 15, 2014.

[29] Web: http://www.kanyak.com/sinan.html Consulted on December 18, 2014.

[30] Web: http://www.arte.it/foto/600x450/97/3923-df7ca03d-46dc-4bfa-b2cf-74a4c3d4b6cd.jpg Consulted on December 17, 2014.

[31] Web: http://www.friendsofart.net/static/images/art1/michelangelo-buonarroti-model-for-the-facade-of-san-lorenzo-florence.jpg Consulted on December 14, 2014.

[32] Web: http://mw2.google.com/mw-panoramio/photos/medium/37081815.jpg Consulted on December 19, 2014.

[33] Web: http://www.arabworldbooks.com/Articles/architectinislamic.htm Consulted on December 19, 2014.

[34] Web: http://www.afterauschwitz.org/itinerari/arte/Numeri/html/img/modello_1.jpg Consulted on December 19, 2014.

[35] Web: http://www.unife.it/centri/diaprem/Settori%20di%20ricerca/rilievo-3d Consulted on March 19, 2015.

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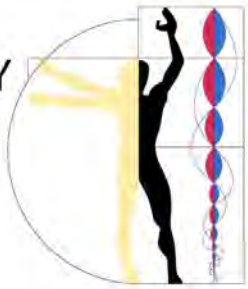

Critical Vision

Innovation and Creativity of Architectural as a tool to Confrontation and Observation the Changes in the Mosque Architecture During Different Eras

"An Empirical Study of the mosques in the Egyptian environmental built"

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Abstract:

In the era of globalization and openness informational. Contemporary societies living developments and scientific knowledge and explosions. Creativity and innovation have become crucial for the progress and backwardness of communities. And become architectural innovation and creativit1y, especially in the mosque architecture as a explanatory lens of technical innovation for the structural Creative Product of mosque in its final form during different eras. Which requires creativity and innovation from all institutions when developing strategies to confrontation the challenge and problems. Secretion of innovative and creative able to solve the problems of our Egyptian's environmental built (architecture and urbanism) with new vision. To confront ideas such as globalization and the dialogue of civilizations and clash of cultures, including the process of Westernization and duplication of thought and the ensuing impact on the formulation of our contemporary mosque.

The purpose of the fundamental research is the trial to reach to a real vision To find out the role of Innovation and Creativity of Architectural as a tool to Confrontation and observation the changes that have affected in the mosque architecture during different eras. Which Start from the beginning of the era of Conquest until to the contemporary reality. It explained the role of the architectural innovative and its impact on the formulation of thinking innovative and creative design in different eras. To achieve the society needs when the formulation of novel designs and new. Its impact on the formulation of architectural design thinking techniques and the architectural building creative product. And the extent of architectural product agree with the controls of the ruling legitimacy in different eras.

The study shows a modern vision to identify the mosque and culture during the different eras. Through the study of creative innovative concepts which drafted of its construction, Modernist concept of the globalization to observe the change and development, the recognition of the truth of the conceptual cultural clash and the its effectiveness upon the architecture. The importance of the ruling concept and its role in maintaining it to reach a true vision of what it has reached. They have been showed by the mosque architecture and the cultural characteristics. the ruling concept and the conceptual significance of the term and the effectiveness of its acceptance within ourselves, the intellectual trends that have associated with the globalization, a critical vision for thought conceptual creative inventiveness of the mosque in our contemporary reality have been showed by a critical study of the mosque during the different eras, which have confirmed the change of the conceptual thought and the current effectiveness in our culture as a result of the coming western ideas, The impact of technological and technical development in the mosque architecture across different era, confirming on the importance of maintenance or re-identification through a new vision.

We conclude from the search the importance of theoretical and critical studies of the architectural creativity and innovation to Confrontation and observation the changes in the mosque architecture (design and construction techniques), and the development of architectural and urban thought and theories which governing the formulation and development of the design and construction process., creating a new vision to solve the existing problems of our environmental built. and to provide for future needs, The importance and strengthening of the ruling concept, strengthening the criticism, the fundamental role of the traditions, customs and the legitimacy rules have been extracted in maintaining the distinguished cultural identity of the mosque and the necessity of forming the suggested vision to re-form the conceptual thought for the area distribution sketch for our contemporary mosque to be harmonize with our traditions and the legitimacy rules,….etc. in the globalization age and the debate of cultures as an entrance to solve our cities problems and confirm their identities to re-form the coming generations manners as we form our buildings and buildings which then re-form ourselves.

Keywords: Virtual reality, Innovation, Mosque Creativity, Globalization, Architecture, Criticism of design & informatics.

1. Introduction:-

In the era of openness informational. Creativity and innovation have become crucial for the progress and backwardness of communities. And become architectural innovation and creativity, especially in the mosque architecture as a explanatory lens of technical innovation for the structural Creative Product of mosque in its final form during different eras. Which requires creativity and innovation from all institutions when developing strategies to confrontation the challenge and problems. The purpose of the fundamental research is the trial to reach to a real vision To find out the role of Innovation and Creativity of Architectural as a tool to Confrontation and observation the changes that have affected in the mosque architecture during different eras. Which Start from the beginning of the era of Conquest until to the contemporary reality. It explained the role of the architectural innovative and its impact on the formulation of thinking innovative and creative design in different eras. To achieve the society needs when the formulation of novel designs and new. Its impact on the formulation of architectural design thinking techniques and the architectural building creative product. And the extent of architectural product agree with the controls of the ruling legitimacy in different eras.

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2. Research Problematic Issues:-

The fertility of any concept is represented in its ability of generating the greatest amount of research problematic issues. The concept which we are discussing now is rich in a number of problematic issues that are summarized as follows:-

- The mosque is the house of worship, center of the city and the center of attention since the very beginning of Islamic Dawah, also it was the first place to be build when planning Madinah, additional to be the house of worship it was the courthouse, hospital, and center of Dawah, school, and other social rules.
- The mosques architecture is formed of our traditions and legal controls derived from Quran and Sunnah then we reform our traditions, our thoughts, our values and ourselves.
- Identity of the mosque in our contemporary living in respect to clash of cultures, between surviving and challenging, and its role to maintain the unity of Islamic nation.
- Solidarity of architectural view of Contemporary mosques between modernity, conservatism and globalization in respect to treating with creativity, innovation, techniques and technology of the era regardless the place or time.
- Form of mosque's architecture between the solidarity and changing because of development, creativity, innovation through the eras, and how much is its line between conservatism and modernity architecture clear?!
- The compatibility of traditional mosques, because of innovation and creativity in its architecture through the different eras), with the legal rules which derived from Quran and Sunnah, and is following these rules lead to creativity in architecture of Contemporary mosques or not?!.
- What is the expected effect of creativity and innovation during the eras on the common basic principles of mosque's architecture.
- The digital revolution led to virtual gaps which weakening the spatial material connection, but could it effect or change the material connections in the mosque's architecture, as a center of muslims meetings and social connections.
- What is the intellectual significance of the informational technological revolution and its virtual gaps and what is its effect on modern and future mosque's architecture, and what is the role of mosque to confront it?
- Creativity and innovation in mosques' architecture led to lose a part of their principal identity and hided some of the elements and activates and turned it to a place to pray and spread Dawah .
- Architecture of the mosque related to concepts of different absolute grandiose beauty measures, which related to different meaning of feeling and emotion, whereas the mosque's form was not randomly but it built according to legal basics, measures, rules, and mathematical or geometrical law, or absolute images.
- The essence of creativity and innovation of mosque's architecture between the romance and rationality, materialism and psychologism, materialism and spiritualism.

3. Research hypotheses:-

- In the contemporary living in the era of informational revolution, the mosque tries to maintain its identity and reform its lost identity to maintain the intellectual connection of the society and preventing loss of its identity whereas it plays the role of the guard to maintain our values and rules.
- Our contemporary mosques, despite the changes which happened to them during the last two centuries. Because of clashes of civilizations and dialogue of cultures and localization, duplication of thought ….etc, which have become hidden rule control the mechanisms of creativity and innovation during the designing process, which has different essences than the traditional from the modern, which has occurred creativity crisis reflected clearly in mosque's architecture. Despite what mentioned above, all what have occurred in mosque's architecture, because of creativity and innovation, was external change but the mosque's architecture maintained its essence without changes.
- Because of creativity and innovation of mosque's architecture, during the different eras and clash of cultures, the popular culture played roles to revive the conceptual thought of mosque, and maintaining its basic characteristics that are compatibility to the legal rules and traditions of our society.
- The mosque's architecture transformation hadn't clear lines between what was traditional and what was modern. Whereas changing was gradually during the most of eras, the new mosques built on the ruins of what was traditional before, except the post-Fatimited era and the beginning of Ayyubid era, the architectural school that has halls appeared to spread Sunni doctrine and removing the Shia doctrine, which led to appearance of halls instead of porticos in the mosques.
- Mosque's architecture is the mirror of creativity and innovation and reflections of the cultures, behavior and social aspects ….etc. that control its compatibility with modernity and informational revolution. Additional to legal rules control the form of traditional modern mosque's architecture, these legal rules maintain the safety and health of designing ideas to create but they do not lead to creativity neither innovation.
- Despite the effects of technology, modernity, innovation and creativity on the mosque's architecture that did lead to hide the main characteristics of its traditional architecture, whereas the mosques do not accept to submit to globalization's concepts.
- Criticism vision and architectural criticism is the way to correct the conceptual creative thought of theory of modern mosque architecture, according to concepts and rules reform it derived from Sharia.
- It's important to study the effects of innovation and creativity during the different eras on the form on traditional mosque architecture in our recent days. The importance of react between, mosque's architecture, creativity, innovation and technological thoughts in adopting new or creative thoughts or maintaining and developing our stand mosques, sometime the creativity leads to commit the Beddah.
- because of the digital informational revolution. The mosques play basic role to maintain our societies and their identities in the virtual gaps to confront westernization and the imported thoughts- that is not compatibility with our legal rules.to become a tool to meet our needs in all life aspects, and to reform the imaginary concept of mosques to return as the beginning of Islamic dawah and conquest.

4. Research Objective:-

The main objective of the fundamental research is the trial to reach to a real vision To find out the role of Innovation and Creativity of Architectural as a tool to Confrontation and observation the changes that have affected in the mosque architecture during different eras. Which Start from the beginning of the era of Conquest until to the contemporary reality. It explained the role of the architectural innovative and its impact on the formulation of thinking innovative and creative design in different eras. To achieve the society needs when the formulation of novel designs and new. Its impact on the formulation of architectural design thinking techniques and the architectural building creative product. And the extent of architectural product agree with the controls of the ruling legitimacy in different eras.

There are subsidiary objectives for the main objective that help in achieving it. These are as follows:-

- Clarifyinghe concept of the digital cities and the digital heritage-based cities in light of the digital and information revolution, and this concept is different from the traditional heritage-based cities.
- knowing the effects of imported thoughts and cultures and the technology on the creativity and innovation and intellectual thought during the different eras to observe the changing and development of mosque's architecture.
- knowing the mosque's architecture among its ruled conceptual field of its form, with its verbal significance and our popular cultures, and our derived legal rules from Quran and Sunnah
- linking the modernity and culture and the problem of the cultural characteristics to form the characteristics of our future mosques.
- Measuring how do events, revolutions, technology and informational digital revolution effect on mosque's architectures.
- How to reform the intellectual concept of mosque's architectures, and what is the designing concepts, to overcome the recent problems and crisis and to meet the future needs of our society in the era of informational revolution.
- How to improve and reform the imaginary concept of mosque's architecture whether in the reality or virtual world, as an element to spread Islamic Dawah., Maintaining the social connection between the societies ad

reforming and correcting the recent concept, that the mosque is only a place to worship- to return to its first role as a center to spread dawah, courthouse, school, hospital … etc. in addition to its role as a center of social connection and worship house.

- Studying the effects of materialism, reality, romance, the legal rules and using the aesthetic proportions on the innovation and creativity in respect to mosque's architecture, to make the external compatibility with the religions essence.

5. Research Methodology:-

The research will adopt a theoretical inductive methodology with benefitting with all theoretical tools and the available applied evidences. The study is divided into two parts; the first part discusses the theoretical frame that is related to the conceptual mosque architecture, legitimate rules adjusting the mosque's architecture,in the Quran and Sunnah & the mosque position in the city designing, philosophy of development and innovation in the mosque architecture of the historical respective, creativity and innovation in the mosque architecture. The second part shows the problematic issues of the existing mosque historical and in our contemporary reality,Creativity and innovation in the mosque architecture between the disciplines of faith, legality and contemporary concepts; to reach to innovation vision to the future mosques.

6. Thought for the conceptual architecture of the mosque:-

Islam is considered as the essential entrance for Islamic architecture. Succinctly, the mosque is the house of worship and it have a Sacred position at the head of Islamic Architecture which was produced by our Islamic Civilization, in addition, it's an Islamic social center and the most important Visual element. Especially, Aljama mosque which represents the city center and its beating heart that performing ritual and different services.

Since, the prophet (saw) emigrated from Makkah to Al-madina, mosque was the believer world and symbol for his doctrine , its house of Intimate ,meditation, magnification and rituals. It's house of worship and allah's house which exalted and that his name may be remembered in them. In addition, it's muslims worship house where they are meeting to utrahamo, praying and learning their religion and worldly matters. It has a private rulings and there are a lot of Ahadith (sayings) which narrated about the prophet (saw) in mosque matters and his Provisions. It has a strong relationship with social, it consider as the main element for religion and the way for connect between all muslims in one structuring, where they meeting themselves when performing prayer, it refers to that by the writings of muslims travelers which told us that when they entering any city they are heading to its mosque to meeting its people and asking them about living methods . And there is no one who controls in it excepted allah (swt). In past, Judges took it as a place for judgment because that make them feeling as they are far away State authority and no one control in them excepted allah who rule by his rulings. Constantly. Mosque consider as a school or an institution for knowing and epicenter of the culture of the community. It is consider as the basic stone for building any Islamic community and his architecture virility arises construction community and It starts formed.

Mosque is idea and spirit, it's purify area specialize for praying , It is necessary to receive the qiplah and whatever, the styles of mosques differenced, it has the same purpose which connected by the essential Pillars of Islam. Praying is the basic pillar of Islam and its movements are representing spiritual connection between the slave and his god. Because muslim performing prayer when he want to speak with allah (swt), and he is reading the Quran if he want allah speak to him. the mosque consist of dimension temporal and spatial (20,22,28). And the **Sufi view**, mosque is considered as space in the event, and this space consist of shadow and light. Light is allah's light because (swt) in **the name of allah the most Gracious the most Merciful** [*allah is the light of the heavens and the earth;a likeness of his light is as a niche in which is a lamp, the lamp is in a glass, the glass is as it were a brightly shining star, lit from a blessed olive-tree, neither eastern nor western, the oil whereof almost gives light though fire touch it not.]*

بسم . لرحمن لرحيم

"اللهنورلسموات والأرض مثلنوره كمشكاةفي ها مصباح ولمصباحفي زجاجة ولزجاجةكأ ها كوكب دري
يوقد منشجرة مباركة زيتونة لاشرقية ولا غربيةيكاد زيتها يضيء ولولمتمسسهنار"سورة --ليلة-----

And then, mosque consist of light relative and absolute, Spiritual development for mosque in islam connect with sharia was extracted from the quran and suunah which mentioned about the relation between the slave and his god, slave and his society. Islam not leave any thing without speaking in it and showing the individual relationship Dynamic surrounding urban and architectural and natural (17,24).

Thought for the conceptual architecture of the mosque has developed through the time. The Islamic country was controlled in its Formulated and Formation features by a collection from sharia rulings which extracted from the quran and the sunnah and we took all aspects of life from them. And produced a lot of customs and traditions, this factors got together building its buildings and his distinctive prosperity and that gave a distinctive impression make us able to see the principles which achived in Almsagdah architecture.As follows in .[Vertical : (allah (swt) is greatest)]. ["Horizontal :(every one heading horizontal in his prayer and his sleeping to the qiplah)].

[“ central: (kabah is the center of the world ,its dish center of the earth, and court is House Center)] (18,17). As shown in Figure-1.

6.1. Mosque architecture in the content of faith and doctrinal:-

Grand mosque different about the other mosque that allah (swt) distinguished it excepted his other mosques in most things. We see that it is first worship house and it has two distinguished movements firstly: Circular motion for people who expatiates around the kabah and second straight Horizontal motion “Seeking between Safa and Marwa” and this clear in its design we saw that the kabah is the center of Allah’s house for expatiates around it and qiplah for all Muslims . So, the Circular motion don’t fit in any other mosque except it to make circuits in its Circular motion because what is narrated by Graeeh. (11) *“Ibn Gareeh has narrated about Atta from his Father about Ibn Abbas, May God Be Pleased with Them” that Allah’s Prophet “Peace Be Upon Him” said:” The house is a direction of prayers for the Mosque’s people, the Mosque is a direction of prayers for Sanctuary’s people, Sanctuary is a direction of prayers for Earth’s people in its east and west from my people Ummah. “Al-Qortoby Explication”.*



Fig.1. Thought for the conceptual architecture of the mosque **(Vertical , Horizontal, central**) Mosque is Facing to the Qibla,& the court is central to the Mosque. **source**:(internet & Dr. wafeek)

لقد روي بن جريج عن عطاء عن أبيه عن بن عباس رضي الله عنهما أن رسول الله صلى الله عليه وسلم قال: "ليت قبلة لاهل المسجد والمسجد قبلة لاهل الحرم والحرم قبلة لاهل الارض في مشارقها ومغاربها من أمتي" تفسير القرطبي")6(

The Mosque in its sense is about a place where all Muslims are gathering in the same heart mention Allah, as Allah, Glory Be To Him, says in his Holy Book **“Mosques are for Allah, So Don’t invoke anyone but Allah ”** El Jenn Chapter, Verse -18. 1 **لقوله سبحانه وتعالى "وإن المساجد لله فلا تدعو مع الله أحدا"** سورة الجن – اية These Mosques are houses allocated to invoke Allah, Glory Be To Him, bases upon piety and good deeds. (6) Also, the mosque in its sense is about refined places kept against roads where the Muslim stands in Allah’s hands for prayers and Mercy. In this situation, the Muslim feels chastity and purification tending to his Creator by his soul before body as the Muslim’s true Mihrab is his heart. The Muslim who prays in the most precious mosques and the other who prays in a prayer rug are equal. The proper sense of the mosque is about a clarified plot of land (straight and purified) in which the direction of prayers is determined. These mosques may be edged or not and may be furnished with prayers rug, carpets or small stones. Also, great buildings may be built upon these mosques that are built for prayers in a purified place. These mosques are considered as holy places whether the simple or great one.((17, 22)

The mosque is considered as an idea or soul; the idea has been put by the Prophet, Peace Be Upon Him at the time of building the first mosque, and the soul is the Islam soul that comes in its absolute simplicity satisfying People’s needs and identical to the Islam soul.

6.2. Legitimate Rules (Derived from Holy Quran and Sunnah) adjusting the Mosque’s Architecture:-

Rules derived from Holy Quran and Sunnah and influenced the design of the mosque are representing in giving instructions, knowing the importance of catching the first row in prayers, differing the direction of prayers wall, not breaking the prayers rows, hating decorations, the place of make ablution and water closet, neighborhood bearing in mosques, Not reach the grave with mosques,…etc.actually the origin of things in islam is lawful except what Allah made it forbidden in the Quran or sunnah and we will begine with hadith about facing the Qibla.

6.2.1. Facing the Qibla:-

The original thing in design the mosque to make the qibla face the Kaba. Queues of prayer should be parallel to the wall of the qibla and This is evident in Allah Glorified and Exalted Be He said (*We have seen you turning your face towards the heaven, We shall surely turn you to a direction that shall satisfy you. So turn your face towards the Sacred Mosque (built by Abraham); wherever you are, turn your faces to it. Those to whom the Book was given know this to be the truth from their Lord. Allah is not inattentive of what they do*) sura Al-Baqara- aya -144.

بسم الله الرحمن الرحيم

"قد نرى تقلب وجهك في السماء فلنولينك قبلة ترضاها فول وجهك شطر المسجد الحرام وحيث ما كنتم فولوا وجوهكم شطره وإن الذين أوتوا الكتاب ليعلمون أنه الحق من ربهم وما الله بغافل عما يعملون" سورة البقرة -اية 111

6.2.2 .The Excellence of Standing in the First Row (In prayer):-

Muslims fill all the gaps in the pray and the first row is preferable so Longitudinal elevation to shadow qibla So that the biggest side Parallel the qibla adequate to the virtue the first row. so that the designer marked the ideal kind (that the biggest width for rows which Parallel the qibla) throw basics of the belief .

6.2.3. Distinguish the Qibla wall and Undesirability the craved prayer chamber:-

The distinguish is extended from the messenger peace be upon him did he made it when he built the mosque in Madina .It was the trunks but the another wall of the mosque was Adobe .and when the qibla turned to kaba the wall of the qibla became made from stone and another walls from adobe .and its distinguish to the wall of the qibla with element differed about another walls. (7,17)

6.2.4. Its preferred free architectural for the place of pray with less number of columns:-

And that's not interrupt the rows of prayer with this columns . and even they can see the imam through sermon without barrier (7,17)

6.2.5. Undesirability adornment on the wall and roofs:-

Because it make the prayer concern about his pray so the simply is preferred which make the prayer abidance in his pray and **(malikia ,shafaia,hanfia,hnablh**) the forth creeds agree on this. Bukhari narrated in Saheeh - Omar bin al-Khattab **ordered the** construction of what the Prophet's Mosque, said: **"I have people from the rain, and beware of red or yellow Vfn people** (17, 22) **." ("** اكن للناس من المطر وإياك أن تحمر وتصفر فتفتن للناس **")**

6.2.6. Forbiddance about the presence of incisors:-

Becouse it disuniting among muslims rows and separate among the rows but the separate among men and women scholars see it is desirable because it protect women from men look. (17, 22)

6.2.7. Place of make ablution and water closet:-

Taking into account not facing or giving back to the qibla and detachment the toilets about baths and that's good for purity and also preferred make ablution tanks facing qibla . and cleanser out of the mosque and body of the mosque. **(**لقول رسول الله صلى الله عليه وسلم **"** واتخذوا على أبوابها المطاهر **"** رواة ابن ماجه**)** To the Prophet said .make places for purification at their gates (Abn Maga narrated). (7,17)

6.2.8. Undesirability tall pulpits:-

The prophetic pulpit h was simple in its form logically on its mission but the pulpits now are unfounded because it is cutting the rows and separate among the prayer.

6.2.9. Minare:-

Umar ibn Abdelaziz entered it in his era to Reported Azan and according to principle of islam what is obligatory can not be done with,is obligatory .So that it was lawful but now it becomes Symbolic not useful because it isn't used in in Azan there is loud speaker and its not consider from sunnah in any thing. (17, 22)

6.2.10. Not compete in construction building:-

Urge dos not compete in construction building because it may prevent the sun and wind about the neighbor because its from hour signs. To the Prophet said when he built a mosque **"built it a bower like Moses" (**لقول رسول الله صلى الله عليه وسلم عند ما بنى مسجده قال "أبنوه عريش كعريش موسى عليه السلام**"** it said to Hassan what Moses pole ?he said if he raised his hand reach the arbor it means ceiling. (7,17)

6.2.11. Prohibition about plant the trees and ponds in the body of the mosque:-

This is made clear in the prophet said "and do not sweat the unjust right " **"** ليس لعرق ظالم حق **"** the intact Hadith is sahih (correct speaking of the prophet) because it make a person busy about his pray .if it found take off but it doesn't its fruit for the needy. (17, 22)

6.2.12. Neighborhood bearing in mosques:-

Not building a mosque beside another unless in the necessary like the narrow the first mosque

6.2.13. Other criterions:-

- Not reach the grave with mosques
- It's prefer to mosque to be in ground floor because that will make it easy for prayers to entrance the mosque especially for the elderly and disabled people. So, it's better to be not contain from grades Ladders.
- Multiple entrances from all sides and rear walls.
- Providing the natural lighting as we can, in addition, providing an condition of reverence and not extravagant and lavishness in construction. (17)

7. Uurbanizations' in the Quran and Sunnah & the Mosque position in the city designing:-

Urban and architectural features of Islamic thought is unrivaled in the principles and specialization in the application. Urban and architectural features of Islamic thought is unrivaled in the principles and specialization in the application comes Balaam, a construction and end audit and customization in small things which relating to architecture and urbanism. Islamic city is always the appearance and essence and appearance expresses the

essence and application controls over the legitimacy of the ruling labor and the teachings of Islam. It can be recognized in the genesis of the city when the Islamic **" Yathrib"** was exchanged by the messenger (saw) to the city where the concept of civilization occurred obvious changes basis of Sharia. (11,24,26)

The features of the urban city has changed appeared reconstruction and construction of the Islamic model and was the first work that is created is the Mosque of the city was the nucleus of the new urbanism. The next to the mosque from eastern side put home of the messenger. Around the mosque they made plans for the homes of immigrantsin the land which gave to them by Ansar. It was constructed in the sectors which allocated to each tribe. And left the distribution plan among members of the tribe and mosques distributed in plans and numbered nine to meet the needs of the congregation in daily prayers. But juma prayer was performed in one mosque (prophetical mosque) and there was a space for performing Eid prayer this space are called by festival (Eid) prayed. (24,26)

The true about the prophet (saw) established the shape of Islamic city which we should follow in the field of urban and architecture to achive the benefit for individual and clan. Then **he began by chose the place for the mosque**, the ruler house distributed in plans and leave the freedom for every individual inside the plan area according to the rule of (no harm and no Dirar) and this is the Islamic way for the reconstruction and building the land which we must follow it with the Sharia rulings this rulings extracted from the Quran and Sunnah and we saw that all of **"Alkufah, Albasrah, Alphastat"** followed the map of **"Madenah"**. So we see in them the model of prophetic planning the first thing choose the site of the city so that water not separate in it like Phostat on the hanf of **"Amr ibn El_aas"** in Egypt. the firs thing he think in it to built mosque in the middle, market around it and ruling home beside it and around the mosque the planning put until it reached forty seven plan and increase construction in it mosques distribution into contrive. (4,24,26) As shown in Figure-2

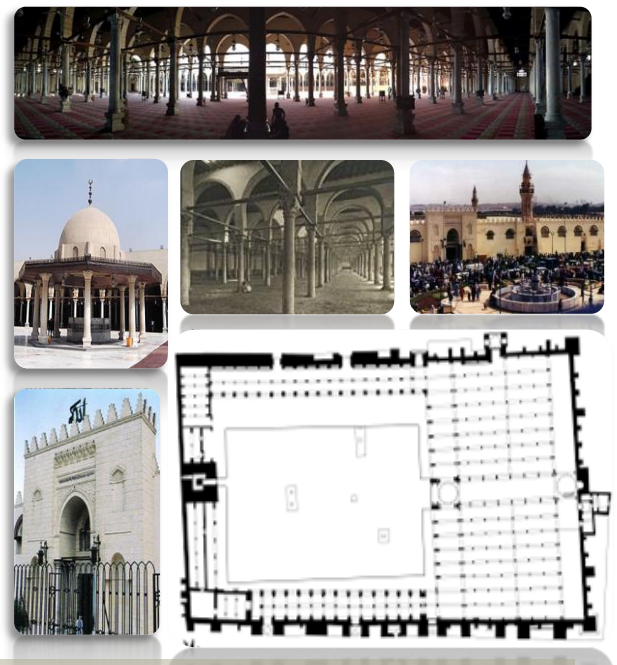

Fig.2. Mosque **Amr Ibn El_aas** in Alphastat –Cairo – Egypt (plan &view).
source:(internet)

The summary :after we offered planning the Islamic city beginning from Medinam, Kufa, Albasra, and Phostat and the method of construction and building for them whatever their variety reasons and factors of founds .the planning started with choose the location of the mosque. Its importance & position unit the city then the emirate home, and around it, put the planning and land marking

8. Mosque is model society:-

Mosque is established with Islam found it has a social and political role in the era of the prorhet peace and blessings be upon him. it was the meeting place leadership solders. from it the caller call when the risk threaten the Muslims by his said "collecting prayer" Muslims mujahedin quickly .it is not just place for worship but school Muslims receive their religious and secularism instruction like what said before. It was light of education and home of prayer and its space used a hospital to treat the wonder during the war ,it was the center of media to connect with Muslims ,place of their concourse in daily prayer, it was a central of call and social connection people knowing the news about declaimer (Khatib) and it was the home of judgment where the judged made it residence. (4,17,24)

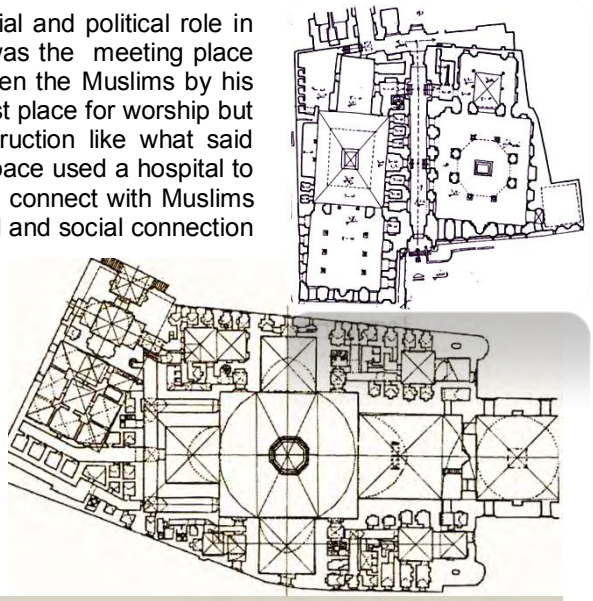

Fig.3 Mosque the era **"Mamalik"** ingeniousness where the group appeared mosque ,school (Madrassa) and Pmarstan(hospital) . –Cairo – Egypt (plan &view).
source:(Mohamed Amin)

so that the mosque was at the beginning of the messenger peace and blessings be upon him connect with Muslims group so it was hole home for religious and world affairs, source of reporting ,and keep save its possession on all ages. Such as place shura council, treaties and social connection .it had " multi able function and combine "it was one of the era **"Mamalik"** ingeniousness where the group appeared mosque ,school (Madrassa) and Pmarstan. so that mosque is one of marked which must importance with it and teach because it has a leading social role to turn with it to first possession and observance that in architecture design in our reality. It played a main role in the Islamic history with its political meaning in Islam. As shown in Figure-3

9. Mosque in contemporary reality objection "vision and review":-

To know the essence of the mosques in our days from the Intellectually and substantively side. We 're Going to study his architecture Through hostile outlook in this days In terms of cultural, social, creativity and innovation faithful to resist Some analysts and business experiences expressive damn true reflection in the different heel attempt to get to the truth drafted and its compatibility in his creativity and his innovation with the rulings of Sharia which controlled in his wording.

Also to reach to a group of basics and standards taken into account so that show how to treat with creativity in its architecture to reformulated and its impact on population quarter and towns as a realistic sight to architecture the mosque and the conflict that happen in it between old and new ,originality and contemporary and how mix between them the originality extend us with architecture thought which able to continue and find contemporary in creative , innovation development, techniques and methods of implementation to see impact of cultural, political and social transformation in creative and innovation to architecture the mosque in the different age. It will be does through our review to development ,creative and innovation to architecture the mosque in Egyptian building through a different since the beginning the conquest until the modern age through Tolonid, Fatimi ,Ayubid, Mamluks (Bargis & Alshorksi,) Ottoman, Mohammed Ali age, khedive Ismail age, east Paris project, Alienation duplication thought, socialism, liberality, capitalism and our modern reality.

Through this age we will review different models to mosques forms features and designed formulation to know on its feature contain constants and changes and what happen unexpectedly from changes because the creativity and innovation in all ages we can extracted from it constants and its and rule design basics , architecture particulars ,its elements and development.

10. Application Study of Some Mosques Forms in the Egyptian Environment:-

In our application study, we will tackle our mosques in our contemporary reality through considering forms of mosques and knowing the changes occurred to them, so that it is possible to reshape the map of the design of the contemporary mosque so that it becomes appropriate to the environment intellectually and objectively built. Observing and analyzing some experiments truly expressing the architecture of contemporary mosques. Let us see the impact of cultural and intellectual transformations on the architecture of the modern mosque, represented in seeing the contradictions in the contemporary mosque and how it deals with popular cultures and their cultural heritage. We will also tackle the mosque of Ahmed Ibn Tolon, El Refaee, El Fatah, El Zahraa, and Salah El Din.

10.1. Ahmed Ibn Tolon; Mosque:-

It is a form of the era of the beginning of the conquest. It was built in 265 A.H, and it is the third Jami mosque in Egypt. Through studying the projections and facades, it is possible to clearly know about its architectural features as follows:

This mosque is a form of the mosques which are reached to by stairs. It consists of yard surrounded by four porticos, the biggest of which is the portico of the Qibla, which consists of five row. The portico of the Qibla contains five mihrabs (niches), with the dais right to the **Mamluk** manufactured hollow mihrab; the fountain is in the middle of the body and it is octal. The minaret is at the end of the western increased part, and it is the only minaret in Egypt which has the external stairs and it is twist like such as that of Samaraa. The place for performing ablution is in the back increased part. The most is characterized by its several gates and plaster decorations above the level of sight, so that the performers of prayers are not distracted. This mosque was built in the **Tolonic** era in the pattern of Samaraa`s mosques. (1,7,17) As shown in Figure-4.

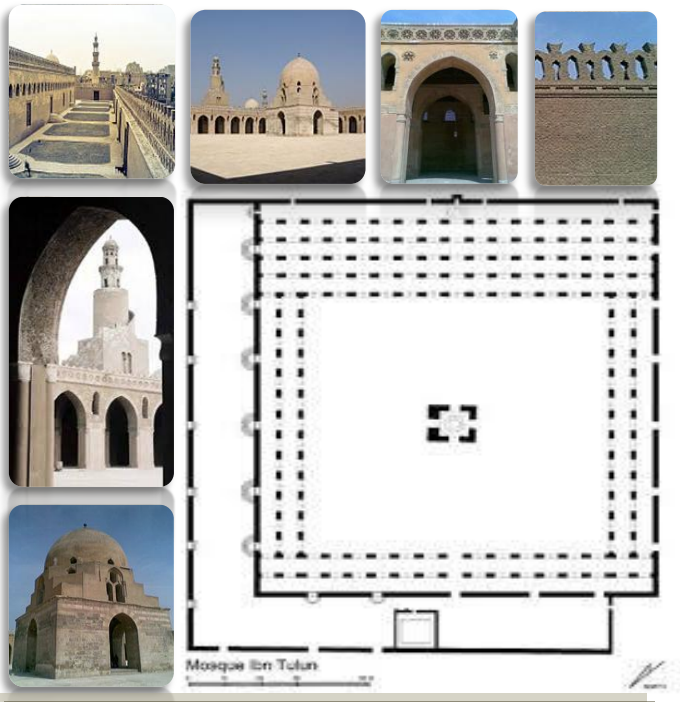

Fig.4. Mosque **Ahmed Ibn Tolon** (plan &view).
source:(internet)

10.2. El Refaee; Mosque:-

It represents the era of khedive Ismail, as it was built in its rule and was the idea of **"Khoshiar Hanem"** who wished to have a monument which bears her name. Its location was chosen in the Ramila neighborhood next to Sultan Hassan Mosque, which imposed on its design to have sublimity so that it does not become less than Sultan Hassan Mosque. The idea of this mosque was to build a mosque attached thereto is graveyard which includes the white angle, so it was built in coordination with the size of Sultan Hassan mosque. The mosque

internally consists of a yard assigned for performing prayers. It has several entrances and the other part is a graveyard and its attachments. The mosque has several entrances, and the royal entrance is in the middle of the western façade. The entrances have a sort of grandeur and the common characteristic thereof is that they are suspended and are ascended to by a number of stairs. Some of the entrances are metaphor (Magaz) and the hall of prayers is square-shaped and there is a hollow mihrab and next thereto is a wooden dais. The two minarets are slim and beautiful on a rectangle base and square yard, then there is an octagon with holes, then there is a cylinder and work villa consisting of 8 pillars, then there is a pear-shaped helmet. A terrace separates every floor and the main mausoleum in the middle of the hall of prayers was decorated with muqarnas. The mosque is high in terms of construction, extravagance, lavishness and attachment of graveyard **"the shrine of Abu Shebbak El Refaee",** and its walls have a lot of decorations, and in the middle of the hole there are huge brackets. (17, 20)) As shown in Figure-5.

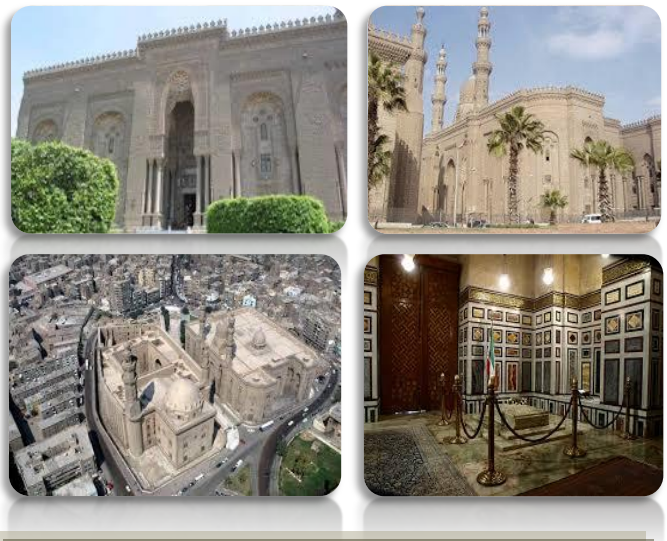

Fig.5. Mosque **El Refaee** (view).
source:(internet)

10.3. AL-Fatah; Mosque :-

It was built in the place of **Awlad Anan** Mosque, and the mosque was moved to the place of the shrine of **Sayyeda Aisha** (so a mosque was demolished to build another mosque). It is a form of contemporary patterns and is a mosque that has compound overlapping functions; it consists of a Jami mosque, attached to it is a library, an Islamic museum, a small hospital having external clinics and a part assigned for lessons and halls of lectures and Quran memorization. It is then an attempt to take the mosque back to the pattern of **mamluks** and it was designed by the architect **"Hussain Bakry".** The mosque consists of a square-shaped hall for prayers having four brackets, and is covered by a mausoleum based on pillars, the place for performing ablution is outside the mosque and the shrine is attached to the mosque. There is also the library and the small hospital. The mosque contains several entrances and suspended stairs, includes a hollow mihrab, a minaret shaped as a square, then as a hexagon then as a octagon then as a circle then there is a terrace, then a circle, then a smaller circle, then a terrace then it ends and a crescent is built on it. The minaret is 136 meters high. The mosque contains five mausoleums; a main mausoleum over the hall of prayers and corner mausoleums. It has a long wooden dais of arabesque which separates the rows of those who perform prayers and which is full of various decorations, even it is a masterpiece of decorations which distract those who perform prayers. (17) As shown in Figure-6.

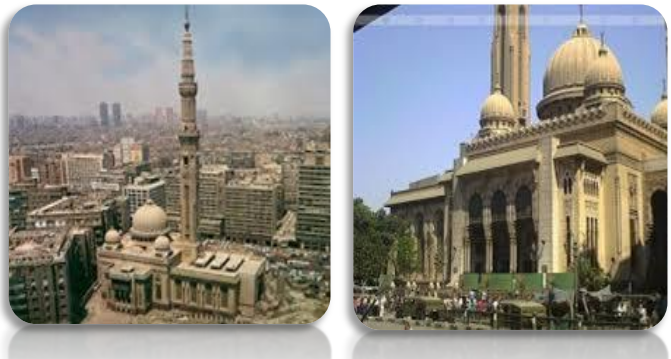

Fig.6. Mosque **AL-Fatah** (view).
source:(internet)

10.4. EL-Zahraa; Mosque :-

It is of the patterns of contemporary mosque. It was designed by **"Dr. Abd El Baqi Ibrahim"**, may Allah have mercy upon him. He made in its design vitality and activity of compound functions in mosques. It is an experiment aspiring to fulfill the changing and compound needs and functions. It is transformed to be used as classrooms for the Faculty of **Daawa** (Call to Islam) in times other than times of Friday Prayer as an investment of Muslims money. The designer in this mosque tried to apply as Sharia regulations in its design. The mosque constitutes of a yard, four porticos, the biggest of which is the portico of the Qibla and the yard is not covered, and the place for performing ablution is in the basement and attached to the mosque warehouses and a hall to teach the computer sciences. In the mosque there is a place for the prayer performed by women and elements to serve Faculty of Daawa. The mosque is divided by movable works so that they become classrooms of Faculty of Daawa and the portico of Qibla is left for daily prayers. The mausoleum covers the middle parts and the intersected mausoleums cover the empty spaces of prayers. The mihrab exists in the wall of the Qibla and is covered with mosaic. The whole mosque was covered exteriorly with filto marble and interiorly with faience with soft colors, so that the one who prays is not distracted. (17)

10.5 Salah al-Din; Mosque:

It represents the form of Ministry of Endowments in the period of Socialism in 1960. It is accused that it is one of the classic-shaped mosque. In this mosque, it was taken into consideration the possibility of using the form in different places, either by removing or adding some of its element. The mosque draws the current popular pattern; the yard provides us with tranquility and the building is harmonized. It consists of a square hall of praying surrounded by four rectangle porticos. It has two minarets at the two sides of the entrance and they are very high. Attached to the mosque is a place for praying of women, a library, and the place for performing ablution is in the basement. Its walls are internally decorated by tapes of writings, and its mihrab is in the middle of the wall of the Qibla. The mausoleum is over the hall of prayers. It has several entrances. (5,8,17) As shown in Figure-7.



Fig.7. Mosque **Salah al-Din** source:(internet & Dr. wafeek)

11. The vision and review of the creativity & innovation in the Mosque Architecture over eras in Egyptian environment:-

If we tackle the forms of mosques in the different eras in Egypt, we find that the mosque in the era of the beginning of the conquest and in the Tolonic Era follows in its design the pattern of prophetic designing (i.e. a yard surrounded by four porticos the biggest of which is the portico of the Qibla), but a sort of elevation in building had happened in the Tolonic age, while in the Fatimid era, the change, creativity and innovation in the architect of the mosque have started. So we found high daises which separates the rows of those who pray and high buildings. As shown in Figure-8.

At the **Ayubi** era, the features of the design of the mosque had changed, so the School Mosque pattern has appeared, which was begun by the School of **"Al Saleh Nagm El Din"** as an attempt to ordain the Sunni doctrine and eliminate the Shiite doctrine, which had been spread. So this was a real creativity and innovation as a result of religious elements. The problem of the spread of the Shiite doctrine in the **"Fatimid"** rule and the **Ayubis** and clerics keenness on revive and hold the Sunni doctrine led to the change of the shape of the mosque consisting of a yard and four porticos to become a yard and four halls, the biggest of which is the hall of the Qibla. In every hall, a doctrine of the four doctrines (**Maliki, Shafee, Hanafi, and Hanbali**) was taught. Housing for the students was attached to the mosque. After this age, changes in the patterns of mosques continued and their architecture began to move away from Sharia without intention or awareness. We see this starting from attaching shrines to mosques, as in **"Al Saleh Talaee"** Mosque.

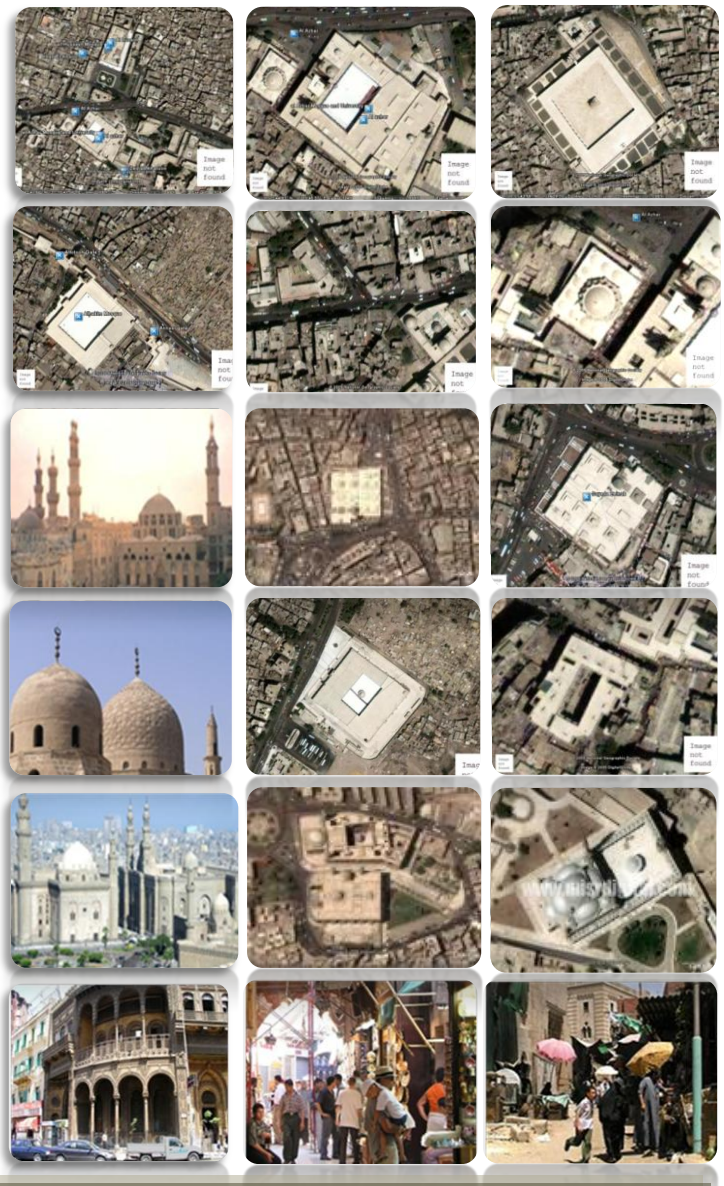

Fig.8. The forms of mosques in the different eras in Egypt **source**:(internet & Dr. wafeek)

Attaching shrines to mosques continued thereafter (until the matter reached building mosques on the basis of attaching graveyard thereto, such as **"El Refaee"** mosque). The Sultanic closet appeared thereafter in mosques in the **"mamluki"** age, so we see a more deviation from Sharia, with the continuance of the attachment of graveyard, high building and increase of decorations. Thereafter, we see the change of the pattern of the mosque, the creativity and development by the appearance of the group consisting of the mosque, Pmarstan (hospital), school, shrine, housing, and Khanqah (hotel), such as the group of **"Sultan Qalawoan and Sultan Ghoury"**, etc…, so that a new pattern appears which never existed before which is the multi-function mosques. The decorations and elevation of building and breaching regulations increases so it reaches its top in **"Sultan Hassan Mosque"**, which is considered one of the greatest mosques in the Islamic Architecture, not only for elevation of its building, extravagance and lavishness, but also for the fact that the shrine is not only attached to the mosque, but also it was located in front of the wall of the Qibla (this may be due to the fact that the district was the market of El Ramila neighborhood, and the architect wanted to make it visible for the visitors of the market in order for them to pray for the dead person, which made him make the shrine apparent and give it that importance. So the target to pray for the dead person and its impact on the design made the mosque move away from Sharia. This led to a design though is creative and innovative, it is incompliant with Sharia. Thereafter, we do not see in the **"Ottoman"** era and "**Mohamed Ali**" rule continuance to make high buildings, extravagance or lavishness. Mosques were characterized by a great number of stairs so the aged people and the disabled find difficulty in going up them. The design of the mosque became consisting of a hall of prayers surrounded by four porticos, and their mausoleums and minarets became many. (*, 17)

By considering creativity and innovation in the architecture of mosques in Egypt, we see that moving towards or away from Sharia is due to several reason:-

- In every era, the creative from is affected by the personality of the architect and his creative ability to innovate, and as a result of the agreeability of the work by the public and the elite concerning its correctness and innovation, the work was repeated and accepted.
- The attempt of the craftsman to reach the best form of decorations in the mosques led to creativity and innovation.
- The attempt to remind the people of the pious people made the architects build shrines, even they were attached to the mosque, despite this breaches "Sharia".

Despite the change, development, creativity and innovation made to the architecture of the mosques over the eras, this was a change in form not in content, so the mosques kept their entity and value.) *(.

12. Philosophy of development and innovation in the mosque architecture of the historical respective:-

The fact that evolution depends mainly on its ability to balance with the necessary variables to develop the progressive movement and the extent of its response to internal and external changes that stretched out across the city where history was the development of a variety of factors beyond the temporal and spatial. Impact directly on the architecture formality has not been able to change it because of its association controls the legitimacy deivied quran and suunah. And that made the architecture keeps remained proud across age Because the extinction comes when you can not blame architecture with developments that accompanied the progress.

The mosque has played an important role in the creations of his innovations; fit with the different needs of the Muslim community composition and brilliantly drafted. With different temporal spatial dimension The signs of change is evident in the beginning of its construction from an era of conquest so far ,It has been characterized by its construction With reservations on some of the spatial and temporal variation. Such as construction materials for a briefing as an external wall of the mosque Tolonid, confined to differences in architecture in Nekasat prevailing ideological thought, such as the revival of Sunni Islam and the elimination of the Shiite doctrine that led to the design change outwardly from the corridors of the mosque. (17,22)

In the contemporary era and the impact of the information revolution and digital what happen a change . The mosque will remain as it can not reduce the cycle or globalization can not be praying through the Internet so the status of the mosque must be appropriate to the customs and traditions islamical Adhering in building controls legitimacy adhering is the governing entity and the Islamic nation must work to protect it standing mosque has always been a beacon and a proud guardian of the ideas of the West Gate expatriate Center invitation, making it relevant jobs boat. As mentioned above groups Consisting of the **"Mosque, Madrassa (mosguue &school), Albamrstan (hospital), Khanqa (hotel), Sabeel (place can eat and drink free in it)"** way reflect the function of the mosque appeared this hard work is required to Aute to its position in the Islamic society .

(*) Criticism by Researcher

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12.1. The mosque architecture in our contemporary reality:-

The phonem of architecture the mosque as industrial product and aproblem thought extracted from the globlization in our modern realitas as avision an intellectual framework curse another .and got through making encounter and idolgist conflicts and architecture the mosque its achive our calm human needs and spiritual it make sure connecting its form with ideological sense from traditional to modern extended to investigation mechanism .the developed the relationship between investigation mechanism ,Forum and the means to transmitt the innovation and creative in all ages and get out from national to international .it cant profiling mosque architecture.

The mosque is building phonem and exprees about community entity and include requirements and relationships all of them have affect on form operation and renewable to its architecture form .including the think and dpiritual in addition to financial ,Core and apperance ,form and content .its architecture been like out come the culture low which like pacific ,constant and stable tank .innovation ,creative and society aspiration like volatile and unstable force and the mosque which stand in facing unsuitable aspiration with islam to defend community entity in the context globolization and global. (2,3,17,27) The mosque always stand as aguarder to the gate to keep on the ideology and islamic character becouse we cant accept globalization our mosques whatever happens to globalization our economy.

13. Religious and creative thought in the Mosque architecture:-

Was common that innovation and creativity is an attempt to keep religion far from the state and make religion prayer range only. But as we know, Islam does not restrict the hearts, minds, intellectual, creativity and innovation. It encouraged a sense of creativity and diligence in various fields of life even in the field of architecture & urbanism and specialist In a mosques architecture. Creativity and innovation in the traditional architecture of mosques characterized by the centrality and uniqueness of doctrine and adherence to the sacred. The basic source of religion, which gained efficiency and consistency. difference of modernist working to marginalize the sacred. The traditional creativity located under value system, including distinguishes its from the unity, continuity, iterative and diversity.(17, 18) As shown in Figure-10

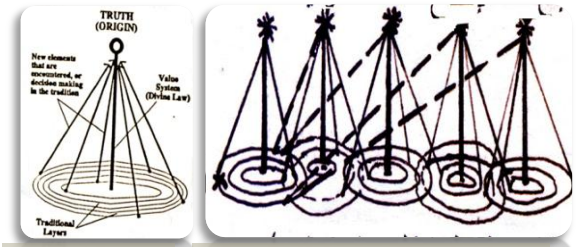

Fig.10. Creativity and innovation in the traditional & modernist Mosgue architecture
source: (Aly Gaber & wafeek Ibrahim)

13.1. Creativity and innovation in the mosque architecture between the disciplines of faith, legality and contemporary concepts:-

We were wondering Do you follow the legitimacy ruling from the Quran and sunna will lead us to the creativity and innovation or not ? Or is the hindrance to the creative process of innovation in architectural design for mosque . to answering for that we should know the creative process and its mechanism and their tributaries and sources and things affecting them and of creative system in its entirety. The creativity of spontaneous expression of architectural work and rendered to his idea of needs and requirements Often they attributed creativity to beauty with the beauty one of its tributaries While the main Rafter is dazzling we be dazzled by the pyramids but we admire the beauty of a particular heritage building with different values according to the different temporal and spatial dimension . The dazzling is the way to innovation while beauty is a Rafter , The beauty of imitation and simulation of natural and physical forms, but the fascination is the result of the effort and imagination to reach an architectural miracle But they are not enough for the mass of architectural innovation to secure and expressive with the surrounding environment, and its expressive that is the source of beauty in architectural innovation. There are differences in architectural innovation, of whom only innovation arising from physical form as blocks and vocabulary without ideological content is expressed with the building of mosques without the substance of life without a soul. (17,19,23,25)

Conclusion: For creative three tributaries are beauty and dazzling and expressive and different sources is human nature and the creator and recipient depending on effort, Islam and Sharia controls his ability to produce creative alternatives through expression of honesty and openness in content, the mosque reflects the reassurance and comfort and justice ... Etc. And creativity architecture mosque comes from its expressive Sharia through physical formations, creativity is not creative in form but the embodiment of beliefs .

- may be trying to creativity and innovation in the design of mosques is objective but creativity creative mechanisms and its tributaries to reflect automatically and reflective of the idea . The mosque is the substance and appearance of the spirit and reflect its mass on its merits and controls governing legitimacy derived from the Qur'an and Sunnah.
- In our mosques, traditional creative one final reference is the Sharia move innovative creative movement closer or away from it a brass cone movement and creative move in closer or away from the center of creative work is more the location close to the Centre of its compatibility with controls protect the legitimacy

and doctrinal authority ,While in our contemporary, creativity, self driven individual mosques works which highlight architectural personality unlike traditional architectural character appears self it melt under the religious content.

- Depending upon the formulation of creative effort-creative mosque effort and drafted by its ideological content to reflect honestly and sincerely through its expressive fine mass material for Shariah to be a ingenuity Mosque embodied the idea of expressing beliefs appropriate to its environment and not only a creative format. (11,25)
- The mosque is not a function and use leads to beauty as MOT (miss the cycle) are oblivious to its spiritual rules and legality. It skips in the typical functional boundaries of the sense of spirituality and expressive vectors legitimacy, whether modest or impressive mosque The Shariah is the essence, content and composition of the material to be Muslim but is not a requirement to be creative is a creative creativity other factors , But those controls that made the mosque agreed in essence no matter in his spiritual and material selection of different eras throughout . It led to the standardization of thought and the essence and content and let freedom of innovation and creativity and creative area for the creator to apply the idea of depending on the temporal or spatial.
- Sharia controls such as ablution before prayer with a simile, ablutions and professionalize its condition for the validity of prayer is not to accept that prayer to accept other conditions. Well not meaning a controls will lead to innovation but ensures the integrity of the architectural work of creative and innovative design that is compatible with the Canon. (17,18,19) The architecture of the mosque is the physical form of perceived ethics of Islam that can be found only by a Muslim community itself.
- Everyone agrees the creativity of Sultan Hassan mosque with it is not compatible with the Shariah and out of scope for being specific and bypass is a tomb to the mosque before the Qibla wall and taunted in architecture which confirms that the Shariah which ensure that the product creator and innovative architectural essence no matter the virtualized platform.

13.2 .The influence of Concept& conceptual transformations on creativity& innovation in the mosque architect:-

The ruling concept and change plays key role in creativity and innovation for building the mosque and configured across eras and in the formation of intellectual production. the concept of the variable and evolving to where man can forge the interactive relationship between the society and its environment built architecturally and structurally . The Governor is the concept of frame of reference for thinking and cognitive tool for communities . Conceptual change occurs as a result of the failure or inability of the current concept of developing solutions to the crises which pushes out the old frame and accept change and it doesn't happen in the building only after the **"Fatimid"** era mosques in Egypt and "**Al ayubin**" in the redeployment of the Sunni and Shiaa eradication that has spread the style makeover a hallway to mosque schools (Madrassa) with classes It was this reason led to creativity and innovation in school design with four rooms the largest room is Qibla room and examine every one of the four Sunni doctrines (**Maliki, Shafee, Hanafi, and Hanbali**).

Ruling reference framework concept has ideological constructs derived from Sharia are reliability and ideological variables as a result of secular science and is a bipolar as conscience and reason. Spirituality and materialism, constants and variables. The constants of the sharia ruling gate guard is to ensure the safety of the creativity and innovation in architectural innovative action for the mosque. It is always a reminder of what should be avoided and not done making the door of diligence open to creativity and innovation in accordance with the conditions and reconstruction of communities that we find different formal mosques body over the decades but all agree substantially. (16,17)

13.3 .The basic ideas of beauty in the creativity and innovation of mosque architectures:-

The aesthetic thought of has changed with the rise of Islam it was superficial beauty and knowledge he was direct in his moral character transformation with Islamic physical character to become rational and romantic with a sense throughout the time the worker thought was influenced by the spirit and belief that interesting substance and content rather than appearance and rationality , And is influenced by the surrounding desert and created a system of social life, the idea of unity and diversity and structural elements blended with a spirit of faith, the dome symbolizes the sky and the dome and a Spire was the most widespread and widely used because it symbolizes the vertical and top as well as the Minaret stands for vertical , And brides of sky building sky connection is figurative things her philosophy .

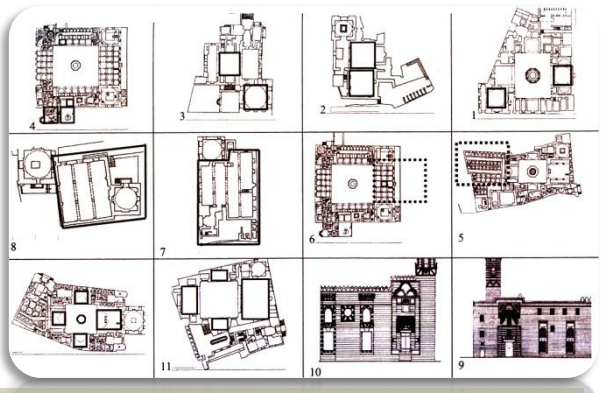

Fig.11. The basic ideas of beauty in the creativity and innovation of mosque architectures
source: (Sabah soliman)

It can be concluded from the foregoing thought beauty and creativity in Islamic architecture of mosques in terms of frequency of repeat environment domes, contracts and forms. And the predominant color is yellow color and rhythm with repetitive elements in ascending or descending order at equal distances linking the system as in the art of alarabesk, abstraction of the Islamic decoration stripping elements forming and unity and diversity by repeating an element in different scales but with the same ancestry . For the architecture of the mosque, including all the above also collected between spiritual faith in the content and material in shape with its Shariah ruling controls. (7,13,16,17,25) As shown in Figure-11.

13.4 .The Stage of development and innovation in mosques architecture :-

Stage of develop the mosque divided into four stage in islamic society like **"Hussien Moans"** make it in his book **"Mosques "(Almsaged)".** We will start with the first stage its beginning of the conquest With review .

First stage : The open era -The mosques on the pattern of Prophet's Mosque planned a yard surrounded by four arcades the oldest is Qibla arcade And where the Qibla wall has recognized and many doors are open from the sides and rear as already mentioned in the Prophet's mosque design.

The second stage : From the 10th century to the middle of the twelfth century after the Abbasid State weakened and disintegrated and created around its parts Semi-autonomous States as Fatimid , Umayyad and Andalusian which led to the role of tradition to the role of creativity and innovation and local vulnerability and diversified the architectural trends and styles with the preservation of the Islamic character It appeared the "Samarra" mosque style and "Ahmad Ibn Tolon" mosque quoting minaret building traditions and magnificent Minaret of Samarra architecture Then the Fatimid Egyptian art was a continuation of the rooks with the construction in carved stone, luxury, balance and beauty for example "Talaee Ibn Rozbak" mosque. As shown in Figure-12 To come the Seljuk state to put an end To put an end to the domination of Jewish and Shiite on Iraq ,and Alayobia put an end to the domination of the Fatimid Shiite on Egypt . They worked hard to spread sunni gilded ,They created and invented the mosques with "Iwans" (Madrasa). And they succeed by creating such schools (Madrasa) .(17, 22)

Third stage : At the end of the fifteenth century as the dangers surrounding of the Islamic world after the war with the Crusaders See Mongols . Despite the Mongol aggression disasters valid artistic creation. After entering Islam have taken up the construction of mosques, schools, kindergartens and clothed the building with marble and faience decoration and domes of the long round the Green-eyed oversight .



Fig.12. Mosque **"Talaee Ibn Rozbak"**
source: (internet)

Fourth stage : From the sixteenth century until the 18th When the Ottoman Turks managed of the stability of their country and relied on architects to build their own empire It featured mosques known to many and varied architecture and sheer walls decorated portals and its beautiful high minaret as pencils or as arrows and enhance the use of plaster and mosaics to cover the walls and a distinguished building mosques for the layout of the mosques where we found The courtyard is surrounded by Marble of arches And the Qibla wall is decorated and adorned with marble its minarets is rounded and mostly eight-ribbed and one has a balcony at the end but the domes is covered with carved stone. (22)

13.5 .Mosques and creativity and how Muslim architects in architecture :-

Mosques, despite its long history and multiple forms has not formulated on the structure of the Prophet's Mosque and it architects in the tumbler to forms of prayer houses, Saucers and arcades and the large sitting room and Qiblas and platforms and domes and niches, but did not add one main element . It was a place for prayer in mosques are equally humble with Rio's richest .

The architecture is both creative and innovative capacity of the decorative elements of the building entered the mosque without becoming essential parts in its functions as a minaret and dome and Brides of heaven, balconies ,platforms and Chapels . The dome construction method was to cover the place of prayer without columns so as not to break the ranks of the faithful now with technological development, with the Minaret symbolic elements of the mosque with minaret technology report become unnecessary.

Probably because the mosque is likely to increase something on basic composition, however the large is just immaculate place devoted to prayer there is no room for a Muslim Imam can lead the brothers in prayer as familiar with the elements of the forward section of the prayer is a novelty, the mosque was still House of prayer

where prayer and learning school where Sheikh sits on a column wraps around him disciples of ....Etc. For its functions as mentioned . A good example of this **"Al-Azhar"** mosque and the increases they have Egypt's history through eras was rarely in the past that is action on in Egypt unless the role of Al-Azhar, was the beginning and end of the many minarets of various models and 80 domes all decorated and his Niches and its doors, each reflecting a particular era from the adorned door upon entering and passing through its critical section exit even have passed the thousand years of the history of Egypt. (17, 22) As shown in Figure-13

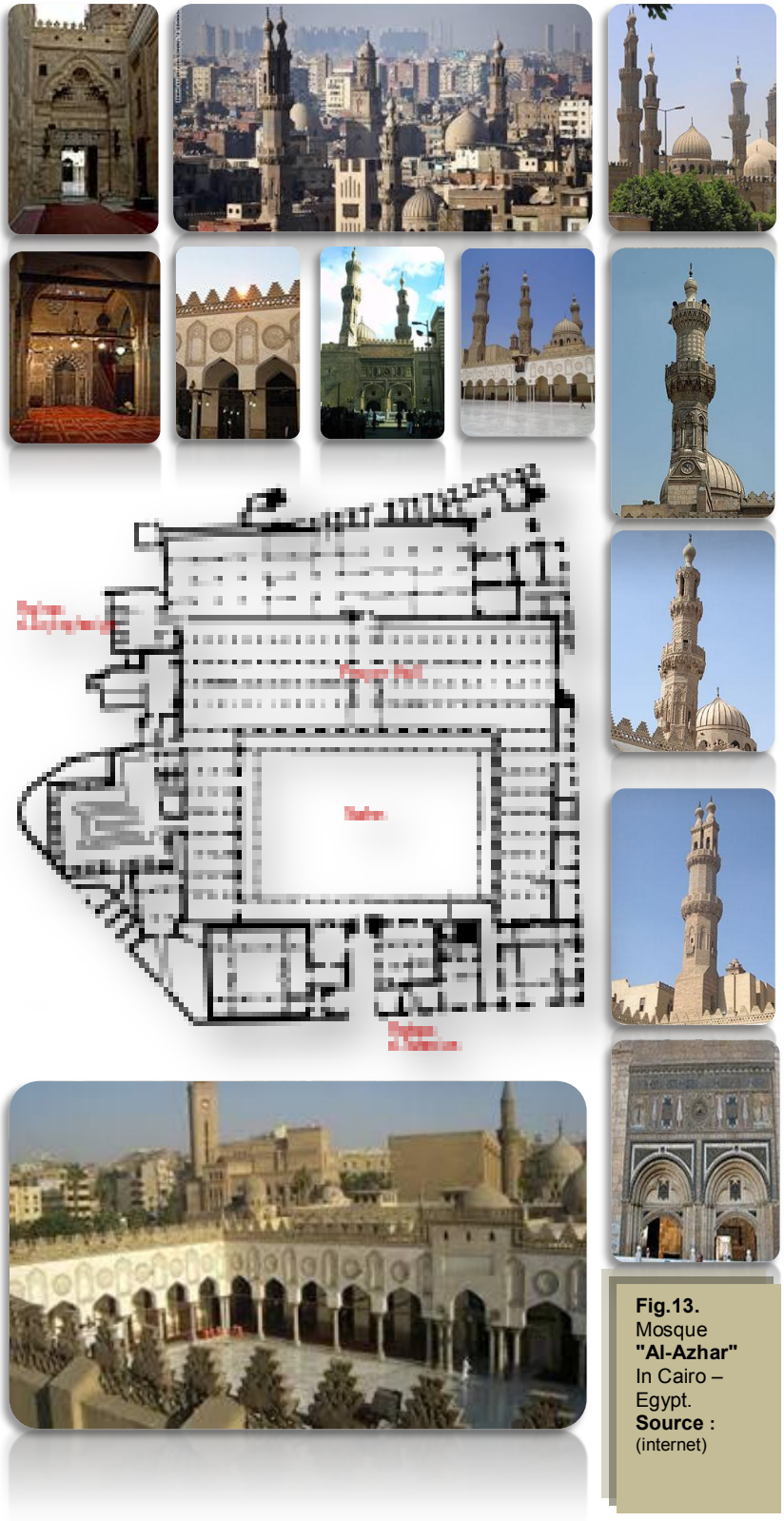

Fig.13. Mosque **"Al-Azhar"** In Cairo – Egypt. **Source :** (internet)

13.6 .Creativity and innovation in the mosque (minarets and domes and contracts) :-

One of the most important architectural elements of the mosque which was characterized by creativity and innovation will talk about are the minarets and domes and contracts .

13.6.1.Creativeness and innovation in develop minaret in the Mosque architecture:-

Minaret was contain four Cloisters such as IN era amr ibn alas, mosque inqustas to praying ,then becons was built, after that appeared mosque andminaret, it was composed two parts the base and body and it was a thick square building ,inside staircase leading to surface and followed minaret above tower in the form two builders , one above othe another the higher is youngest and the bottom is oldest,and the bottom is youngest .the rise of a beacon by a small ladder and this is the first thing.

In **"Egypt"** we find minaret in tolony area is the twisted style of sameraa were of an external staircase ,consists of a sequare base topped with Octagonal base and last-shaped incense burne. In the **"Fatimia"** era tended towards decrease hull minaret and attention to the provisions of the building despite a narrow base and height, then converted from the form boxes to thehexagonal shape of eight and then sometimes to the canister and then to established honorable this is topped jawsag on eightcolumns crowned by simple decoration and inside minaret is spiral staircase up to the top of the body and other up to the balacony.Minarets has evolved in the"**Fatimid and Ayubid"** period even reached its peak in the **"Ottoman"** period by the turks, the minaret was a such apen or form high up to the sky. (17, 22)

in the contemporary reality in Egypt. We see two minarets in rifai mosque shaped base and then began a round square and ocagonal have slots then cyclinder then josag have eight columns and helmet pineapple and separates each floor from the previous honor him amd minarets inside the mosque.in the front **"Salah Edine"** ,mosque has two high minarets located on both sides of the entrance contain square turns into an octagon turns

into a cylinder and then and columns helmet spherical located to the top.while **"Zahra"**,mosque has two minarets located on the right path and the entance and 23 mmeters height with conical shape and has a bar ballagha honor of finishes written on it the word allah and the prophet muhammad and they are a circular staircase to the second round arrive. But the modern era **"Al-nour"** mosque minaret a high of 16 meters topped a copper crescent with a hight of 6 meters and has an elevator up 65 meters where the alleged opens on the balcony home. To the minaret and above in it prevented the thinderbolts and awarning plans bulbs .its made of quadra turn to by eights then to palace end with cargo and pointed collar the brass crescent moon is granted at the end of it . (17, *) As shown in Figure-14

We notice in the innovation thought : The palace is made of mounted above eight pillars ,and the quadra turn to eights then circle ."roll".or collar.its refer to in the islamic idoligy that the number who bear the throne are eight.) *(.



Fig.14. Creativeness &innovation in develop minaret in the Mosque architecture
Source : (internet)

13.6.2. The innovation and creative in develop the dome in the architecture mosque:-

its one of the architecture and mosque elements is connected in mental picture with architecture the mosque that days.and muslims architecs had innovated in its establishment and turned it from Square into eights then to circle (about triangles) and over the dome (collar). (22) The progressive creative and innovation to develop the dome (collar) reach with the highest level of the innovation we see transition the square to circle about eights **(about islamic its yhe number who bear the throne are eight)** .its attempted to make the form axpress the Sense .untill that if transition withiut eights it made a symple wood of eights to express the same idea like theh croll which rise the grave in "Sultan Hassn" mosque. after that turned the eights to circle it was happened by using or stalactites .and its forms in number of seven rows **(rate in guaranteed to seven heavens)** to built the dome (collar) above the circle which symbolising in guaranteed to express about heaven dome (collar). (*)

Conclusion: actually muslims arhitect connect the form with content express about Legitimate Rules. He also innovated in its form and beauty unites with the minaret its disription the harmony view to the architecture mosque. untill they became from the necessary elements in mental picture for architectuer mosque.

13.6.3. The innovation and creative in develop the Arches in the architecture mosque:-

The famous for arches forms in Islamic mosque architecture. half an egg arch; which uses a rare., flat arch, horseshoe, half circular, holding horseshoe who appeared innovative ways., But more arches spread and impression in mental picture to the mosque its **"Pointed Arche"** becouse its stronger than another and also its refer to vertival up .so that its agreed in its staggering in the form and contents and this may be the reason for its spread. (22)

13.6.4. The innovation and creative in develop the heaven louts in the architecture mosque:-

Architecture the mosque is one of the innovation that the roof not present the end of the beauty to any building but find aconnevtion between the mosque and the genuflection with the sky so that the heaven louts are appeared or windows put as a serried unites decorative as a parapet to the end of the mosque (22)

Conclusion: The muslims architects expansion in use the domes ,contractes and heaven louts so they creative and innovated in its forms its referd to their architecture and substantive skills .and appropriate this elements with

(*) Criticism by Researcher

agreed in the form with ideologist content . And the architect annovated in used the Apses to ensure and distinguish the wall of the qila whether differed the material of construction or put handprint on the wall or used the apese which differed from the forms and kinds untill its reached 13 apses in **"Al azhar"** mosque through different the age are left of them 6 untill now .the architect annovated also in the pulpits it was simple in the era of the messenger peace and blessings be upon him .but after that it become tall it cuts off the rows between the prayer but its innovation in reformulated whether made of arabesque wood or marble like in the sultan Hassan mosque. The pulpit wood distinguished with repeatand diversity.(17,22,*)

14. Exception innovation vision to the future mosques :

After we offered a little trip to innovation and creative in architecture the mosque and its history in Egypt , most Style and abeauty elements .we try with cash vision to check what mosques will be in the future. stable from direction ,creative and basis innovation in our tradition our mosques in the future, the mosques in **Egypt** kind of like **"mamluki"** mosques in its innovation and developed then it became the revlotion mosques is a a hall for pray there to agraft , library and dispensary ,the hall of consolation, place to memoies the Quran and servies like in **"Fatah"**, **"Alnour"** and **"Slah eldien"** mosques. Its style for mosques complex jobs and it as acontiune for agroub style to **"Mamlukies"** mosques.

The technology and number revolution opened anew fields to innovation and creativety Building architect in the mosqueIs creative architect in architectural forms and creative engineering solutions as it pleases of architectural forms new open new doors for renewal, creativity and innovation Will appear in future creative propensity self-designed traditional reverse that shows. it does not But whatever the architect tried to innovate in the Building of the mosque will be committed to the same rules and Shariah diligent in aspects of technical and Most of the new facilities of mosques became the role of the mosque in which to worship only.the mouth of the mosque becomes a school or university, such as mosques yesterday so that the **"al-Azhar"** mosque broke his university. House of worship and science and is now being taught at his university, but became mosques closes its doors after dawn prayers, until noon and no longer used to house strangers and school libraries benefit only a few. Although. From all these confrontations able mosques maintaining the prestige and Kantha in Egypt is a country of a thousand . Architects do not tend to Building the mosque out of the ordinary special mosques and what happens is out of the exit scrupulous such as increasing the extravagant and many of domes enlongation minaret, to high about houses.(22,*)

The main idea is to maintain the idea Building the mosque, which ended with her **"mamluki"** what led him to accept the **"Ottoman"** minarets and many domes . Architect should diligence and innovation if familiar Sharia aspects governor of the Qur'an and Sunnah and not advisable to walk automatically. With that demand creativity, but he may walk away from the Sharia, which affects the behavior of future generations. Like the idea of the shrine instead of facing a Muslim slave to his place must go to God Almighty, because there is no intermediary between a person and God . It is a creative attempt to make his name immortal change from tradition .we are form our buildings and minarets and then it will repeat form our thelve.(*)

15. Summary & Conclusion:-

Changing of mosque's architecture because of creativity and innovation during the eras because of political, economic, social circumstances, westernization, duplication of thought, communism, capitalism, technology, revolution until the informational revolution, all of these didn't reflect clearly on mosque's architecture, all changes were external without any change on the essence.The study shows how much is compatibility between the legal rules and the architecture, which shows maintaining of the religious reference, according the following:

- The changing during the eras did not have clear lines between eras, the creativity was gradual to meet the spatial or temporal needs to solve the standing problems like spreading Sunni doctrine and confronting the Shia doctrine.
- Creativity in the traditional mosque's architecture reflected the vision of people and elite while in the modern architecture it reflects an individual vision of the architecture designer.
- Our creativity & innovation problem of the contemporary mosque is not about the type of building but it is about the Innovation itself.
- Our contemporary creative crisis happened because we do not live whether full traditional neither full modernity life, so everyone is creative according to its own view.
- Our view that the standing mosque's architecture is wrong and needs to be fixed by creativity and innovation is a wrong view, taking us away from the modern reality including the pros and cons, and the real problem of innovation and creativity.
- The main reference of traditional and modern mosques is religious reference controlled by the legal rules, but some approaching and other getting away.
- The violations in respect to apply the legal rules on mosque's architecture, because of trying of the architect to create or innovate without knowledge of the legal rules. Other violations is because of trying of the workman to improve and exaggerate the work for seeking the satisfaction of Allah, like what appears in exaggeration of decorations in the mosques, or as effect of the western thoughts, or localization or thought

duplication. From the other imported thoughts that we adopted it without considering if they are compatible with the legal rules or not.

- The study of creative architecture of mosques during the different eras we find that the final reference is tending to the singleness and holding the sacred and its principal source is the Sharia, which gives it solidarity and efficiency against the modernity that leads to misprision sometimes.
- The system of values is specialized by a basic unite and the creativity & Innovation in mosque's architecture submitted to it.
- The prophet (PBUH) made the Idea of mosques, and it lasted during the different eras since conquest, Tolono and till now, and the designing changes which occurred it the Ayyubi era was for spreading the Sunni doctrine and confronting the Shia doctrine, it was only external changes. The mosque has maintained its spirit and idea during all eras.
- The study ensured how much the creativity in mosque's architecture related with the legal rules, values and submitted to Sharia
- The study showed that not all what is traditional submitted to the legal rule, so we have to treat carefully with the heritage, because the creativity does not has separating line. So it approaching or getting away of the legal rules because of trying of creativity as we mentioned above, for example what happed to Refaee mosque in Ismail era who added tombs to the mosque, and the mosque of sultan Hassan.
- Architecture of the grand mosque in mekkah is different from the rest of mosques. It has two type of movements, circular movement during Tawaf and horizontal movement during the waking between Al-Safa and Al-marwa.
- The rest of mosques only have horizontal movement toward the Qibla in Mekka, reflected on the designing of the mosque so the octagon and ring designing are not acceptable except in the Grand mosque in mekkah
- The mosques are the centers of connection between the muslim individuals where people meet each other. It is the core of the Islamic societies and it is the centers of Dawah too. The mosques is the book of Islamic nation which shows the aspects of its history, for example Mosque of Azaar in cairo which was a witness of developing Cairo since the very beginning up to the recent days.

16. Recommendations:-

Through this study, a future predicative vision can be identified for the significances of the mosque identity, creativity and innovation, to which occurred during the eras and on its identity in our recent days, as well as its character, its role and its activities occurring in it during the eras to our contemporary reality in the era of the information revolution and dialogue of civilizations. Thus, the study is like a comprehensive vision of conceptual clash of the two mosques between the traditional and modern, showing the characteristics and basic elements to maintain its identity depending on how to realize and criticize it for its positives and negatives.

The study shows a future vision to mosque's architecture to spread the modern thoughts by concepts of modernity. It also shows the changes and developments occurred in the mosque's architecture some of them reflect positives and others reflect negatives as a result of being affected by concepts of other civilizations and cultures, which contributed to the change of the knowledge pattern and affected the creativity and innovation trying in pursuit of the trend of maturity and modernity in mosque's architecture in order to deduce the following:

- The mosque must be designed according to contents, bases and theories coming from our governing legitimate rules, customs and traditions.
- Studying the architectural beauty, aesthetic proportions and thoughts, which are different in mathematical, psychological, reality, intuitive and rational terms in order to achieve creative, neutral and non-bothering mosque architecture, as there was a aesthetic proportions governing the shaping of our mosque “as mentioned in the Brethren of purity concerning the aesthetic proportions in Islam”.
- Emphasis on the role of the architectural critic, who plays a role as a guard of entrance who permits the passing of appropriate thoughts and prevents thoughts which are incompliant with our Islamic society.
- Activation of the effect range of criticism in general and architectural criticism in particular for architects and the public.
- The Shaira must be studied to its role in building and development to avoid any violation,remoteness or alienation therefrom in our mosques while making creativity and innovation therein, and to get rid of disharmony and exacerbations which befall their architecture as a result of the continuance of alienation and being affected by it.
- Emphasizing that the architect must work hard, create and innovate if he is knowledgeable of Sharia and their governing rules concerning the shaping of mosque architecture, otherwise it will be traditional so that the mosque will not be remote from Sharia. Although independent judgment and creativity are permitted in our designs, we by the mosque’s architecture form the features of the coming generation and ordain therein the values and beliefs which make it move towards or away from Sharia (such as sanctification of shrines, graves when attached to mosques, high building ….etc. Which are things making us move away from Sharia in the mosque designs).
- Emphasizing the importance of complying with the legitimate rules in the creativity and architectural innovation upon designing mosques. It is like ablution before prayers. It is indispensable for ensuring the

work validity and accuracy; however, it does not lead to creativity. Creativity and innovation in the architecture of mosques begin by the attempt to create, then it becomes heresy (Bid'ah), whether it might be compatible or in violation of Sharia.

- Emphasizing that the creativity and innovation in the architecture of mosques does not mean breaking the regulations, legislationsand and the laws, as there is no society without legitimate rules and laws.
- Necessary to deal with the architectural heritage and inheritance carefully, whereas not all acceptable creative is compatible with the guidelines of sharee'ah to the legal rule. It could be heresy (Bid'ah) that would lead to misguidance as a result of non-awareness of the designer of such heritage by the governing guidelines of sharee'ah (like adding the tombs to mosques)

17. Future Vision of Mosque's Architecture:-

We talk about the future vision of mosque's architecture through the creativity and innovation in its architecture; could we return to tradition in our mosque's architectures with the development and technological innovation and the digital revolution? Could we learn Tradition with creativity, innovation and new technologies? How to mix between traditional and modern architecture of the mosques? If mixing cannot be done, does this means that we should live modernist, strangers from our regulations or we should live traditionalist separate from the technology of the era. As shown in Figure-15.



Fig.15. Mosques revolution in Kosovo Creativity Without Borders

Source : (internet)

18. Bibliographical References:-

1- Abdel Wahab, Hassan. mosques and ancient history, the Egyptian General Authority of the book, edition two 1994
2- Abdel-Karim, Amr. A political science researcher, the concept of globalization, the Internet.
3- Abdul Rauf,Tariq. Almanfestu role in stirring architectural transformations, PhD Thesis, University of Cairo in 2003.
4- Akbar, Jamel Abd EL-Kader. earth architecture in Islam, Resalah Foundation for printing and publishing, Dar Al-Furqan for Publishing and Distribution, 1998.
5- Architecture Of the contemporary mosque academy group. LTD, 1996.
6- Attia, Iman Mohammed. Department of Architecture 1993.
7- center planning and architectural studies and others, founded the architectural design and urban planning in the Islamic eras are various, logic Islamic cities, Cairo, 1990.
8- EL-Din, Maha Salah. Message MA, Helwan University, Faculty of Fine Arts.
9- Eleishi, Alaa Mohammed Shams El-din. Aesthetic values in the Architectural Heritage of Egypt, PhD Thesis, University of Mansoura, Department of Architecture, 2006.
10- EL-Sayed, Sabah Soliman. Mamluk architecture between engineering and engineering Allifez shape, his Anglo-Egyptian, Cairo, 2006.
11- EL-Wazer, Yahya. reconstruction of the Qur'an and Sunnah, the first edition, 1992.
12- Gaber A.ty. The influence of traditional Muslim belief on medieval K, religious architecture" PHD thesis department of architecture university of Edinburgh 1995.
13- Hamouda, Olfat Yahya. Theories and values of architectural beauty, Knowledge House, 1990 edition two.
14- Hussein, Azza. the visual characteristics of the Islamic city in the medieval period, a message MA, Department of Architecture, University of Cairo in 1984.
15- Ibrahim, Abdul Baqi. the Islamic perspective of the theory of architectura, center planning and architectural studies,cairo,1986.
16- Ibrahim, Wafa. Safwaa culture and the culture of the popular, online.
17- Ibrahim, wafeek. The Influence of Secularity and Traditionalism on Architecture and Urbanism, a message MA, Faculty of Engineering, Department of Architecture, University of Cairo in 1998.
18- Ibrahim, Wafeek Mohamed. critique vision housing in reality lecturer and the future of the coming generations, Journal of Faculty of Engineering, Ain Shams University, the number of No. 0.2009.
19- Ibrahim, Wafeek. A critical vision of beauty sports theories and their relationship on Islamic thought, Journal of Faculty of Engineering, Ain Shams University, the number of November 2009.
20- Max herzbey. la mosque el- rafai aux cairo " paru l`occasion de la consecration de la mosque, 1906.

21- Muhammad, Amin Mohammad. Muslim communities building in Cairo until the end of the Mamluk era, PhD Thesis, Cairo University, Department of Architecture in 1987.
22- Munis, Hussein. mosques, a series of books the world of knowledge, the number 34, the National Council for Culture, Arts and Literature in Kuwait.
23- Nofal, Mahmoud Hassan. The problem of planning for the future of the Arab City between constants and variables, Assiut University.
24- Osman, Mohamed Abdul Sattar. Muslim city, a series of books the world of knowledge, the number (128), issued by the National Council for Culture and the Arts and Fon, Kuwait 1988.
25- Raafat, Ali Ahmed. Three-dimensional "artistic creativity in architecture" enter concept Research Center, Giza, Egypt, the first edition, the second volume in 1997.
26- Tbekja, Emad Mohammed Adnan. architectural theory to the issues of housing and housing, “Dar Damascus” to print, and the press, Damascus, the first edition in 1991.
27- Tisch, Mustafa facilitate. The future of the dialogue of civilizations and cultures, chairman of the scientists and the Grand Mufti state of Bosnia and Herzegovina, the Internet.
28- Wally, Tariq. appropriate architecture Islamic in Egypt for building mosques Egyptian contemporary" Letter MSc, Department of Architecture, University of Cairo in 1982.

19. Internet Websites:-

http://ar.wikipedia.org/wiki/%D8%AC%D8%A7%D9%85%D8%B9_%D8%B9%D9%85%D8%B1%D9%88_%D8%A8%D9%86_%D8%A7%D9%84%D8%B9%D8%A7%D8%B5_(%D8%A7%D9%84%D9%82%D8%A7%D9%87%D8%B1%D8%A9
http://ar.wikipedia.org/wiki/%D9%85%D8%B3%D8%AC%D8%AF_%D8%A7%D9%84%D8%B3%D9%8A%D8%AF%D8%A9_%D8%B2%D9%8A%D9%86%D8%A8_(%D8%A7%D9%84%D9%82
http://ar.wikipedia.org/wiki/%D9%85%D8%B3%D8%AC%D8%AF_%D8%A7%D9%84%D8%AD%D8%A7%D9%83%D9%85_%D8%A8%D8%A3%D9%85%D8%B1_%D8%A7%D9%84%D9%84%D9%8
http://articles.islamweb.net/media/index.php?page=article&lang=A&id=98017
http://www.alukah.net/culture/0/59591/#ixzz3TnZtVJUx
http://www.qantara-med.org/qantara4/public/show_document.php?do_id=1064&lang=ar



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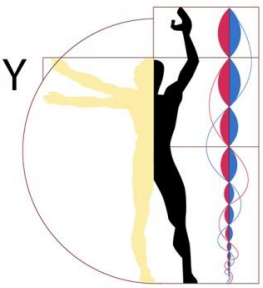

An online multilingual dictionary as a technology platform for heritage studies and development

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Abstract
Given the pace of change in science and technology and the increasingly rapid flow of information generally, the creation of multilingual dictionaries of terminology deserve high priority. The shortage of multilingual thesauri hampers international scientific contact and causes problems with translation. Trailblazing research is a source of important new experiments and discoveries, but the development of science influences language and professional terminology. For this reason, once up-to-date dictionaries quickly become outdated.
During the project at Cracow University of Technology, we have developed a ground-breaking multilingual dictionary designed for professional use. Structuring the database was the initial step, while the main task was to add professional terminology. We focused on heritage studies, because of its interdisciplinary and cross cultural character, with an emphasis on terminology used in painting restoration in English, Polish, German, Italian and French.
The result is a freely accessible website with search engine and numerous facilities to enable constant exchange of concepts between users. As the final version is planned to be released this year, the paper will discuss the project, difficulties faced and problems overcome during the three year programme, along with possible enhancements we would like to explore in the future.

Keywords: heritage studies, multilingual dictionary, terminology

1. State of the Art
Various projects aimed at developing a database for heritage studies terminology have been carried out for over a dozen years. Starting with the ARGOS project initiated in Italy [1] to a systemic database being developed by the Getty Institute [13] to numerous programmes undertaken in various academic centres, museums, to glossaries developed by individuals [12]. The foregoing is evidence of overwhelming demand for such studies on the one hand, while on the other it is also a consequence of the proliferation of new technologies which enable the online construction of databases [8] and, as a result, ensure the worldwide reach and unrestricted availability of such sources.
An analysis of the materials in the English language proves that this task can be approached in a number of ways. Online resources include very general terminological databases for heritage studies [5] and art restoration [4], but also highly specialised glossaries developed by teams of international experts [6], individual specialists, amateurs or devoted fans of a particular field. The resources are usually of a monolingual nature, but one can also come across materials that offer equivalents in other languages. In the latter case, European languages prevail: apart from English we may encounter Italian, French or German.
The thematic range is fairly broad, but it seems that the dominant fields are related to heritage studies theory, heritage protection in the context of the rules of protection, legal systems, organizational and administrative issues, etc., as well as the restoration of architectural structures. There is a relatively

sizeable pool of studies with lists of the various substances used to produce a work of art (pigments, bonding agents), while some of them mention major damaging factors (weathering) and key procedures (consolidation).
Online heritage studies terminology databases appear in various forms. In some, terms are displayed hierarchically, whereas others offer alphabetical lists or thematic sections. One special form of lexical studies consists of pdf documents published online. Most dictionaries equipped with a search engine offer – apart from the term itself – an explanation in the search language.
The key aim pursued by the authors of multilingual dictionaries of heritage studies is to standardize concepts and terms. Consequently, certain terms are accompanied by a definition written in the source language and translated into other languages. Yet another, more professional solution, is the development of a glossary (where definitions are agreed jointly by the authors) by a panel of experts representing various countries. Nonetheless, whenever this approach – correct in view of international conventions, studies, legal activities – is adopted, we lose the diversity of approaches to handling historic artefacts that has developed across the world and that relies on local artisanship or the development of restoration treatments which have not been widely discussed, also due to the fact that the terminology relating to these procedures is, in a way, untranslatable [7]. In consequence, we face a vital challenge involving the organisation and translation of "local" terminology into other languages. The only viable solution in these cases is the development of a glossary and its translation. What is more, it should be emphasized that **issues related to the protection of tangible and intangible cultural objects are crucial to all cultures. Meanwhile, each of them has developed its own theory, methodology and procedures, as well as an original conceptual grid. The untranslatability, or ambiguity, of these terms, should not hinder intercultural cooperation – on the contrary: we should strive to include them into the bloodstream of global heritage studies** [9]. This task is of key importance, because if an obligatory, top-down terminological standardization is imposed, cultural diversity will suffer and to protect this diversity, paradoxically, is the very purpose of the protection of the heritage of humanity and the rationale for the existence of heritage studies as a science.
Consequently: a multi-lingual dictionary of heritage studies must allow for the preservation of terminology typical of a variety of cultural areas (for various languages).
Heritage studies is interdisciplinary and as such combines terminology from various fields – from craftsmanship to biological sciences or art; it relies on terms from the areas of botany or chemistry, wood processing, the history of painting, practical physics and, last but not least, vast areas related to practical conservation-restoration in various specialties: the restoration of paintings (on various supports e.g. wooden panels, paper, textiles), the restoration of sculpture (executed in a variety of materials e.g. stone, wood, ceramics), the restoration of architecture (brick, stone, concrete), etc.
Consequently: a multilingual dictionary of heritage studies must take account of the immense diversity and complexity of those disciplines; as a result, one needs to allow for a non-homogenous structure of sections and develop the right algorithm for the dictionary structure [3].
It is also worthwhile to analyse the resources available online from the prospective (target) user's perspective, who may not necessarily be a specialist in a specific sub-field – for instance a geology student, a history student not familiar with medieval wooden panel technology, a practicing restorer looking up the meaning of an acronym, such as GF ASS. It may also happen that the user **does not know** the term they are looking for – this is a relatively frequent case e.g. when it comes to terms from the field of architecture. Using currently available resources it is quite hard to find a term concerning, for instance, a specialist technique, such as gilding (e.g. applied relief brocade) or art restoration practice itself, especially if the term pertains to a procedure referred to only with the use of jargon expression or purely practical nature or a specific collocation (e.g. flattening warped panel)
Consequently: a multi-lingual dictionary of heritage studies should be user friendly and should enable the user to find a term the name of which the user does not know. The dictionary structure must facilitate the database search – this means that the entries should be organized in the form of a thematic dictionary. Due to the very broad scope of issues related to art restoration practice, which includes the area of heritage studies, it is essential to include certain common nouns in the dictionary, such as the names of activities and procedures (nouns derived from verbs), which, though available in general dictionaries, are also applied in art restoration in specific contexts (e.g. coating, tapping).

2. Project description

The multi-lingual art restoration dictionary project conducted at the Cracow University of Technology was mainly research-based. Its main objective was to look for terminological equivalences in the specified areas of the discipline, i.e. the restoration of easel paintings and wall paintings between English, Polish, German and, in selected chapters, also French and Italian. It was agreed that the database would include up to 10,000 terms (for the first three languages), divided thematically and

obtained on the basis of corpus research. The key sources included two studies of crucial importance for these conservation areas, which have also been translated into other languages [10], [11].
The work was divided into three stages:
- the development of a database structure which could be modified if necessary with the use of database construction software; the specification of useful and desirable functions; ensuring collaboration during research for several editors at the same time;
- filling the database with entries: the first stage included the entry of English terms, followed by looking for Polish and German equivalents (alternative process: German terms with Polish and English equivalents). (Polish was the source language for one chapter only). The second stage involved translation into French and Italian. The preparation of drawings, selection of illustrations and uploading illustrative material;
- proof-reading, editing and subject matter consultations.

2.1. Database structure

The database building software was customised to meet the needs of the project from the perspective of usefulness in dictionary making. The dictionary was developed on the basis of an online application: this feature made it available to all editors who could follow changes on an ongoing basis, exchange comments and make corrections. As agreed in the preliminary assumptions, the dictionary has a hierarchical structure which, in this case, is represented by thematic chapters: main chapters, sub-chapters and sub-sub-chapters, depending on the degree of specialization of terms in a specific area. The assumed rule was that in one thematic chapter one term may have only one equivalent in the other languages. These terms form the so-called main entries, visible as a list. The list is displayed in the language specified by the user. Apart from the main entries, the software offers the option of adding content in the so-called descriptive fields where, depending on the nature of the chapter, additional data is placed, including: related terms, synonyms, collocations, definitions, examples of use in full sentences, links to other entries and to illustrations (Fig.1).

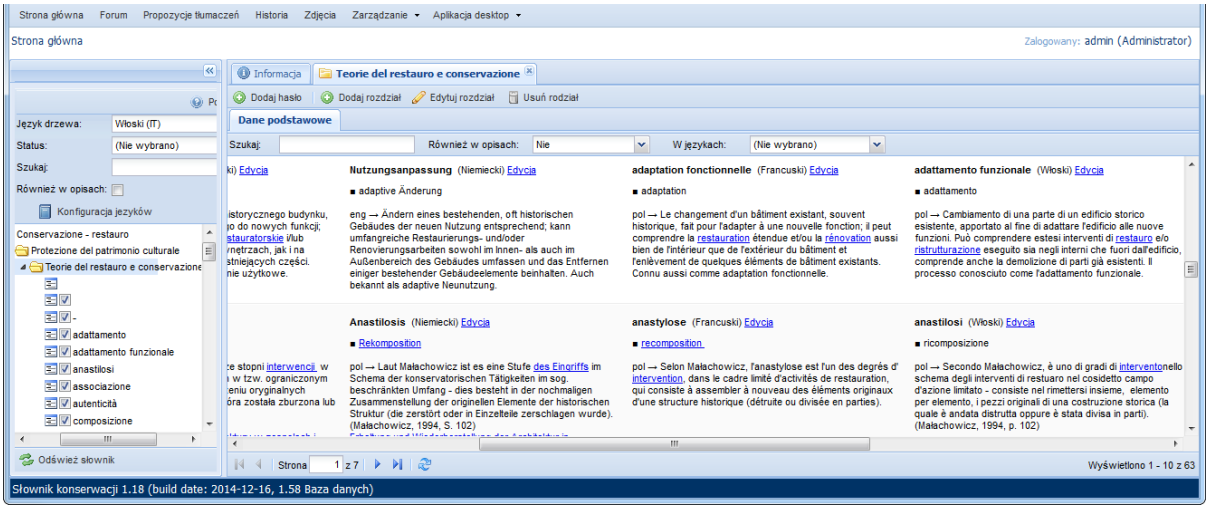

Fig. 1: The structure of the dictionary database (editors' application). The hierarchy of the chapters on the left with the list of terms in Italian below, on the right – entries in horizontal arrangement (various languages), with bold main entries, synonyms following a square and translation of the definition below.

2.2. Filling the database with terminology

The methodology assumed that **no new definitions** would be developed for the purpose of the dictionary. If a term requires a brief explanation, it includes a reference linking to a specific editor of the dictionary. The vast majority of entries with explanations include either quotes or paraphrased quotes from reputable published sources. Apart from explanations, entries include fragments of sentences illustrating the use of the main entry, collocations, synonyms. The works used as terminological corpora included two publications on the conservation of easel and wall painting, published in English and other languages. Specialist chapters were developed on the basis of terminology extracted from specialist articles, books, professional journals, etc. Terminological resources are mostly based on English sources, and, to a lesser degree, on sources in Polish and German. French and Italian terminology was based on translations of these sources made by licensed translators, with the reservation that in certain chapters a published French translation of the book included in the corpus resources was used, while the Italian section relied also on the original

version of a book on wall painting conservation. Every translation of a definition, quotation or paraphrase was marked with an arrow specifying the source language. The illustration in Figure 1 presents a translation made from Polish.
The only chapter where the source language was Polish was a chapter dedicated to a unique procedure which is not known in other countries and, as a result, has no equivalent terminology. This is why it was necessary **to suggest** the translation of key terms (and to translate definitions) related to this procedure into English, German and French. This procedure involves the separation of two layers of a painting made one after another in different periods, i.e. repainting of the (easel) painting in such a way, that the removed secondary layer is transferred to another support and, once the procedure is completed, forms a separate painting [2]. From a technical perspective, this procedure is similar to the transfer applied to wall paintings. Based on the Polish terminology, the suggested English term is: "Painting layers separation treatment [7]". This chapter, from an academic perspective and in view of the research task carried out within the grant, is one of the most important ones. It may be used as a basis for further exchange of experiences with scientists – art restorers from other areas - and, at a later stage, adjustments to the suggested terminology and the dissemination of this unique procedure (which, nevertheless, should be used only in exceptional cases). From this perspective, this chapter is similar to the one dedicated to nanotechnology. Also in this case the terminology is developed on the basis of Italian and English, and, in consequence, it is necessary to start by collecting terms and a terminology list divided into topics, to subsequently develop translation into other languages.
Another specific chapter is the chapter dedicated to gilding. It was developed by a gilding master, who had been gathering terminology inherent to this field for years, in cooperation with the editor of the German section – an art restorer who holds a gilding technician diploma. This chapter may form a separate gilding dictionary: it was developed in three languages and probably is the first trilingual glossary offering such a vast range of entries. It is important to note that in the case of areas related to craftsmanship the variety and abundance of terms are immense. Artisan traditions, tools and techniques were developed locally and semantic connections between them are often hard to find. Some of the terms have multiple equivalents across languages, others in turn have none because the techniques were little known or became forgotten once a specific craft became extinct.
The chapter "Conservation biology" inspired a lot of questions. Although the initial assumption was that the Latin interlingua would facilitate translation into other languages, serious problems and inconsistencies related to binominal names and taxonomy appeared. For instance, many sources rely on common names of fungi which are difficult to classify into specific species. Moreover, many species have local "endemic" variations, and thus also names the equivalents of which can be hardly found in other languages.
The work on wall painting triggered the development of a very interesting chapter. Many of the terms appearing in old sources have been forgotten, are no longer used or defined in a number of manners. Based on the available sources, the chapter covering a selection of these terms was prepared. The main entry in this chapter is the historic name, without any equivalents in other languages, while the descriptive fields include brief explanations. In consequence, it may be the only dictionary where these rare terms can be found (Fig. 2).

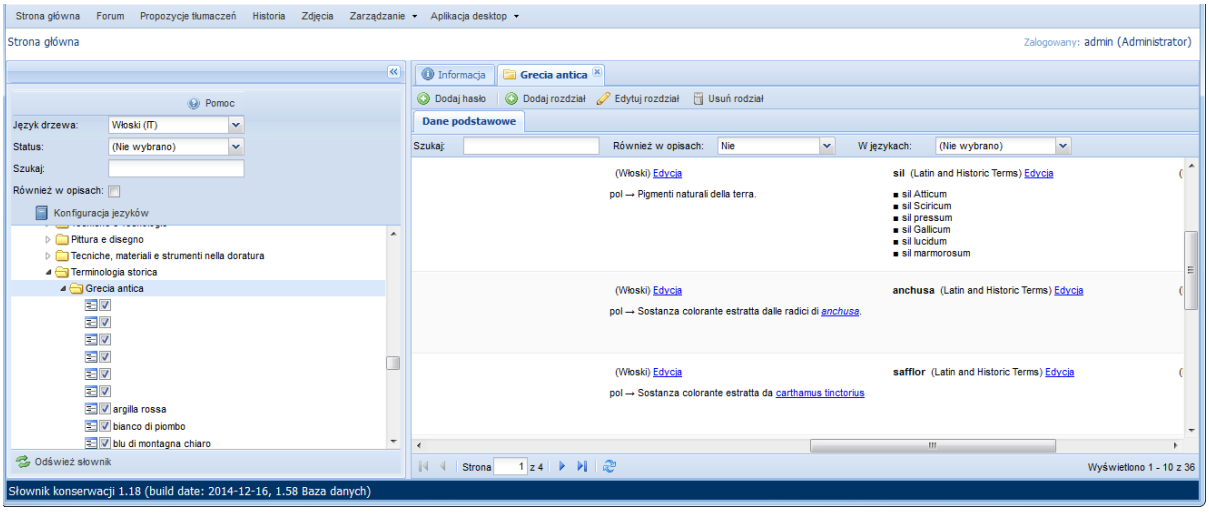

Fig. 2: One of the chapters dedicated to historical terminology with exemplary terms and their explanation (Italian and historic name).

2.3. Dictionary organisation

The dictionary was divided into three main chapters: Conservation-Restoration, Techniques and Technologies of Painting, Associated Disciplines. What is more, there are two additional chapters (acronyms and bibliography, with reservation that the sources were classified according to languages and further into publications and websites). The first chapter includes, among other things, subchapters dedicated to the conservation theory, conservation research, documentation and painting conservation generally, with particular focus on easel painting (with the use of traditional techniques). Due to the broad range of issues covered by the "restoration treatments" umbrella term, the category has been divided in compliance with the commonly recognized technical classification into types of supports (wooden and textile). Particular technological layers (support, ground, paint payer, varnish) have their chapters divided into types of damage, causes of damage and treatment methods. Professional practice, storage and transport of historic objects have their own, special sections. The issues related to wall painting with respect to historic techniques, damage and treatments are included in a separate chapter.

The second main chapter covers painting techniques and technologies. Relevant subchapters list terminology on Tools, devices and materials, Techniques and technologies (lists of pigments, oils, balsams, consolidants, insecticides etc.), Painting and drawing (e.g. Theory& Practice, various techniques).

Auxiliary disciplines whose key terminology is listed in the third chapter include: architecture and building, biology, chemistry, physics, petrography and art history – with numerous subchapters (Fig.3).

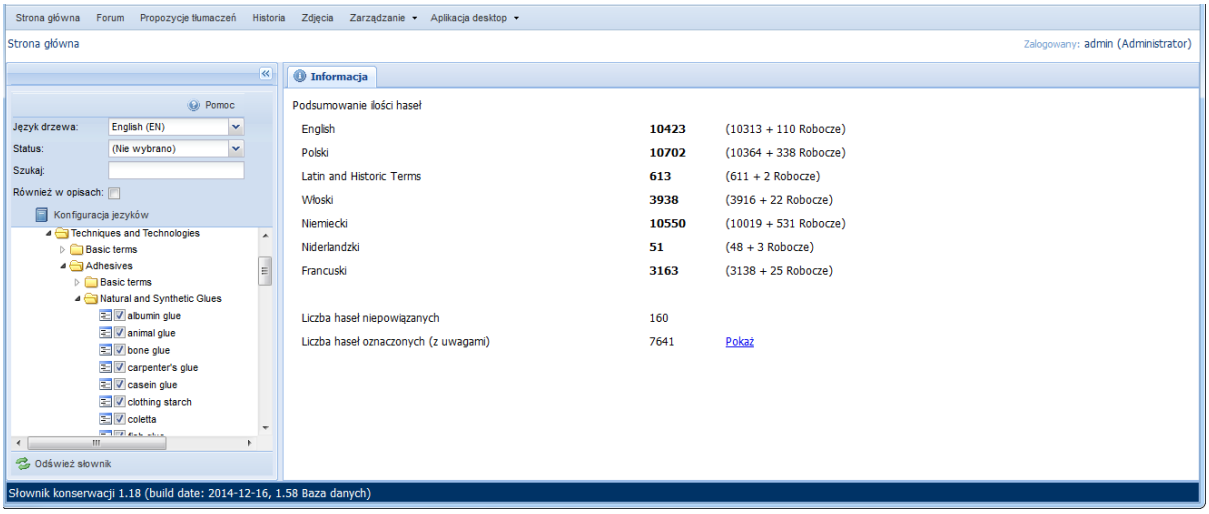

Fig. 3: Hierarchical structure of the dictionary; entries count on the right.

2.4. Special solutions

An exceptional solution was applied to the chapter dedicated to conservation and restoration: it is a "cross-translation" of definitions, where definitions from publications in the English language were translated into Polish, whereas definitions from Polish sources were translated into English. This is why certain terms have several definitions – the user will decide whether the understanding of the term in the target language matches its meaning in the user's language. During these works multiple cases of inconsistency in the "cross understanding" of terms were revealed, both in the intralingual context (various authors provide different definitions of basic terms) and in official translations of laws, documents (for instance, the study has disclosed serious discrepancies in the translation of the Venice Charter into other European languages).

At the stage of editorial work, the dictionary may be printed in bilingual view for any languages selected, which significantly facilitates proofreading and corrections. The editors found it important to offer this function also to future users, however, legal problems involving the publication and the printing of materials prevented the implementation of a similar solution. However, it was assumed that the users will be able to download printouts from **selected chapters** (limited to approx. 30% of entries) for their private use. In consequence, the user will be able to use a reference glossary including terms from the selected chapter. One should emphasise that none of the available online dictionaries offers such a possibility (apart from ready pdf files, which are available for download).

3. Conclusion

The risk of failure or the need to verify original assumptions are inherent to every research project. However, all failures are of crucial importance, since they enable us to identify the areas that need to be reconsidered or require special solutions. Each of the members of a project team consisting of more than ten people contributes their individual knowledge, but also suggestions which are not always acceptable to the others. For instance, one of the significant problems consultants found difficult to accept was the fact that the dictionary is only a pool of terminology, and not a handbook listing only correct and recognised procedures applicable to objects subjected to restoration treatments. A frequently repeated charge was that the sources used to extract terminology for the dictionary were to some extent obsolete, especially given the dynamic development of a specific discipline. Meanwhile, these sources were selected purposefully due to the fact that they met the criteria for corpus sources. What is more, the editors of the dictionary concluded that the dictionary must also include terms that are no longer used but may be encountered in publications or documentation of conservation works. Likewise, they believe that the terminological database should be developed in the future, to include state of art achievements in the discipline.

A critical assessment of the entire project identified significant areas to be verified if the dictionary project is to be continued:

- sub-dictionaries (specialist terminological dictionaries from specific disciplines) must be developed by specialists from these areas. The participation of translators in these works should be of limited scope: e.g. proof-reading, consultations, translation support.

- the problem of equivalence across several languages should be addressed. Two solutions have been suggested: the specification of the source language for translation and a “vertical” subdivision of the chapters, instead of the “horizontal” layout (where one term has an unlimited number of equivalents), i.e. the application of the bilingual layout (but for any number of languages).

- the inclusion of hyperlinks to “external sources” (i.e. terms outside the database) leading to selected websites.

- with respect to terminology, historic art terminology which may be collected using a corpus of historic treatises offers an interesting research area worth pursuing. Such documents contain a vast variety of names relating to pigments, chemicals and treatments.

- all the dictionary chapters require further extension, conversion and correction. This is why the user interface for the dictionary version will offer the possibility of information exchange (a forum) between registered users.

The multilingual dictionary of heritage studies should be co-created by editors coming from diverse cultural backgrounds. Its main task is to provide a platform for the exchange of opinions and presentation of individual, culturally determined concepts. Only then can the dictionary become an area where the abundance and diversity of tangible and intangible (terminological) heritage are fully protected.

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Bibliographical References

[1] www. ARGOS, (Art and Restoration Glossary Operating System). Access invalid.

[2] BOGDANOWSKA Monika, *Translation of the Krakow Conference Glossary*, The Picture Restorer, No 31, Spring 2007, pp. 28-29.

[3] BOGDANOWSKA Monika, TAYLOR Martin, IMD interdisciplinary multilingual dictionary a new online tool for communication. *International Journal of Conservation Science.* Vol. 4, spec. issue 2013, pp. 723-728.

[4] www. Draper Conservation, Painting Conservation and Restoration Service. http://www.draperconservation.com/glossary.htm

[5] www. Euromed Heritage, HEREIN-European Heritage Network multilingual thesaurus. http://www.euromedheritage.net/intern.cfm?menuID=8&submenuID=27&subsubmenuID=11

[6] Illustrated glossary on stone deterioration patterns. Glossaire illustré sur les formes d'altération de la pierre. ICOMOS-ISCS. Available on-line in pdf format.

[7] LEMPART-GERATOWSKA Marta, OSTASZEWSKA Maria, KOSSAKOWSKI Edward, (tr. M. BOGDANOWSKA Monika). Glosariusz terminów z zakresu rozwarstwiania malowideł / Glossary of Painting Layers Separation Treatment. Studia i Materiały Wydziału Konserwacji i Restauracji Dzieł Sztuki Akademii Sztuki Pięknych w Krakowie, Vol XVI, Kraków 2007.

[8] LEONI Lucijana. Multilingual Multimedia Thesaurus for Conservation and Restoration – Collaborative Networked Model of Construction. Available on-line in pdf format.

[9] MAHDY Hassan. Glossary of Terms for the Conservation of Cultural Heritage in Arabic Alphabetical Order. ICCROM. Available on-line in pdf format.

[10] MORA Paolo, MORA Laura, PHILIPPOT Paul, Conservation of Wall Paintings, Butterworths, London, Boston, Durban, Sydney, Toronto, Wellington, 1984

[11] NICOLAUS, Knut. Handbuch der Gemälderestaurierung, Könemann, Köln 1998; idem. Restoration of Paintings, Koenemann 1999); idem . Manuel de restauration des tableaux, Könemann, Köln 1999

[12] www. Punchmarks. net.; http://punchmarks.net/index.html

[13] www. The Getty Research Institute, The Art and Architecture Thesaurus (AAT). http://www.getty.edu/research/conducting_research/vocabularies/

HERITAGE and TECHNOLOGY
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Geophysics and Cultural Heritage

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Abstract
A fine but strong thread links together issues apparently not contiguous: the enhancement of the archaeological and cultural heritage of our territory, the future of human knowledge, and the improvement of the living conditions for the human beings. As for the progress in the studies, it is worth mentioning the considerations about the benefits resulting from the cooperation of different fields of knowledge, the so-called *coincidentia oppositorum*, to be kept in mind as a metaphor for the production of knowledge. Considering the immediate usefulness of the combination of various intellectual contributions, it should be remembered that science is at the disposal of men not only make their cultural heritage enjoyable, but also to make the local services provided by the government more accessible and safer.
On the one hand, this contribution aims at drawing up the guidelines on a correct interpretation of the geoarchaeological survey, thus outlining the potential that may result from its application to the study, recovery and enhancement of some prestigious archaeological sites. On the other hand, it presents the main, and sometimes complex, non-destructive geophysical survey methods - with a special attention paid to the ground penetrating radar - in a simple and understandable way.
Applied geophysics may feature considerable resources: the familiarity with certain sophisticated approaches to the investigation of the subsoil, together with a special sensitivity acquired through humanities, can turn a student into a valuable resource in the protection of the territory and its inhabitants.

Keywords: Geophysics, Ground Penetrating Radar, Archaeology, Excavation, Geoarchaeology.

1. Introduction
Archaeology studies the human past, both ancient and recent, through material remains. From fossil remains dating back to millions of years ago and belonging to our early human ancestors in Africa until contemporary buildings of the twentieth century: archaeology analyses the physical remains of the past in search of a broad and global vision of human culture.
Archaeology provides a unique perspective on the human and cultural history that has given a significant contribution to our understanding both of the ancient and of the recent past. Archaeology helps us understand not only where and when ancient populations lived on the Earth, but also why and how they used to live, examining the changes and the related causes that have occurred in human cultures over time, looking for patterns and explanations; how and when the ancient populations started to live on the continents as well as the origins of agriculture and complex societies. Unlike history, which interprets the most important events mainly on the basis of written records and documents, Archaeology provides an in-depth knowledge not only of aspects dating back to a time even preceding the existence of written languages, but also of the everyday life of ancient populations through the analysis of the objects that they shaped and left behind. Archaeology is the only field of study which covers all the historic periods and all the geographical regions inhabited by human beings and not only. It helped and still helps us understand fundamental issues such as the relationship between the Greeks, the pre-Roman populations and the Romans, the ancient Egyptian

religion, the origins of agriculture in the Near East, the lifestyle in the colonies of North America, and the evolution of trade routes in the Mediterranean region [1].
Obviously, there are various branches that deal with different types of Archaeology: Prehistoric Archaeology focuses on past cultures that did not put their language in writing and, therefore, is mainly based on excavations and data recovery to reveal their cultural heritage. Historical Archaeology studies the cultures that had existed (and still exist) during the period of recorded history - for several thousand years in some areas of the Old World, but only for some hundred years in the New World. Historical Archaeology includes some sub-fields of study, for example Classical Archaeology, which focuses on ancient Greece and Rome, the archaeologies related to pre-Roman populations (Celts, Etruscans, etc.), Aegean Archaeology, which ranges from the Minoan civilization to the classical period, Biblical Archaeology, which seeks evidences and explanations for the events described in the Bible, Medieval Archaeology, Archaeology of the Americas and, finally, the archaeology that deals with ancient Near, Middle and Far East. There are also studies of Underwater and Nautical Archaeology which investigate the physical remains of human activities that lie beneath the surface of oceans, lakes, rivers and swamplands. They also include Maritime Archaeology, namely the study of shipwrecks, cities and ports now submerged, houses as well as agricultural and industrial sites along rivers, bays and lakes. Among the other archaeological doctrine, it is worth considering Urban Archaeology, Industrial Archaeology and various methods applied to archaeological surveys.
Finally, a special mention must be made for the management of cultural resources in Archaeology, internationally known as "CRM" (Cultural Resource Management), which refers to the effort made to enforce federal and state regulations on the protection of archaeological sites [2, 3].

1.2 Geoarchaeology as Cultural Heritage

The term "geoarchaeology" was introduced in the late Sixties of the last century with the diffusion of a new scientific discipline, which, through the typical concepts and techniques pertaining to Earth Sciences, aims at providing solutions to archaeological issues with a multidisciplinary approach [4].
This discipline started to expand thanks to the initial contributions of Cornwall [5] and Butzer [6], who actually introduced the typical methods used in Geology for the classification of prehistoric sites and the relating paleoenvironmental reconstruction. Consequently, the time interval in which geoarchaeology operates corresponds to the one marked by the appearance and the evolution of human beings, thus trying to reconstruct their chronology, stratigraphy and palaeoenvironments.
Ultimately, given the general nature of such surveys, geoarchaeologists aims at understanding the effects resulting from human impact in terms of changes of the territory, trying to find out how to rebuild a settlement pattern from a given site of interest, identifying any recurring phenomena and the possible causes. Not least, their role also includes the study of the state of preservation of artefacts and stone materials, as well as the environmental conditions underlying any signs of deterioration [7].
Therefore, Geoarchaeology, with the addition of Earth Sciences to the disciplines traditionally applied to archaeological purposes, can lead to a more accurate and efficient collection and interpretation of data, moreover, it allows for additional space-time connections among various sites.
For this reason, Archaeology should be complemented by those branches of Earth Sciences which refer to the most recent geological periods and deal specifically with the Earth surface dynamics.
The application of the techniques and methods developed by Earth Sciences to archaeological surveys is justified by the consistency of the processes that form and transform the Earth's surface: the association of the finds in the layers of the excavation is not simply the result of human activities either simultaneous or episodic, but more often a consequence of the influences of several natural formation processes during long periods of time [8].
Useful techniques and methods are particularly offered - within a large geoarchaeological framework - by Physical Geography (the study of Earth surface dynamics), Sedimentology (the study of the sedimentation processes and sediments), Geophysics (with its non-destructive investigation techniques), Pedology (the study of the soil and the transformation processes of the Earth's surface) and Geomorphology (the study of terrestrial forms, as well as their origin and evolution) [4].
In this perspective, Geoarchaeology offers an original and unique contribution to the reconstruction of the (dialectical) relationship among human activities and environmental changes, to the history of the exploitation of natural resources, to the history of technological processes applied to the transformation of these resources.
Geoarchaeology tends to apply techniques and methods of study in a specific way, such as detection, investigation, paleoenvironmental interpretation, enhancement of archaeological sites, recovery and analytical characterization of archaeological objects and cultural heritage.
In this sense, Geoarchaeology relies on two fundamental elements which operate at two different scales. The macroscale tries to interpret the layers of historical landscapes in relation to human activities; conversely, the microscale has the purpose of quantitatively characterizing the objects resulting from the interaction between human beings and their environment [9].

This leads to certain specialized in-depth analyses, such as the identification and detection of geoarchaeological evidences in their geomorphological context (by using methods such as the Geographical Information System - GIS), the interpretation of the formation processes of the archaeological sites and landscapes as well as their paleoenvironmental and paleoclimatical implications, the identification of the interactions among human activities, natural environment and global climate changes on the basis of geological records, and finally the analysis of the exploitation of geological resources as well as of the technologies applied to the transformation of materials in ancient times.
In short, Geoarchaeology is a new and evolving professional field, which uses the technologies and concepts of Earth Sciences to examine issues that provide archaeological information. The field of research shared by Earth Sciences and Archaeology is specifically focused on the Earth surface dynamics in relation to the Quaternary period. The application of geotechnologies to archaeological survey is justified by the processes that form and transform the Earth's surface. The association of archaeological finds brought to light in the layers of an excavation is not simply the result of human activities, but more often the result of the influences of several natural processes during long periods of time.
The use of the latest non-invasive investigation technologies for the management of data offers, within a wider cultural heritage approach, a more accurate and effective interpretation of these data, and allows for the identification of additional space-time connections among various sites.

2. Methodology

In order to introduce geophysics as an integrated study of geo-archaeology and cultural heritage must necessary start from the concept of remote sensing, which is based on a fundamental assumption that might seem obvious, but rarely is duly considered: every action performed on the soil results in a series of side effects on the soil itself which facilitate the identification of the buried body or object. They can be divided into anomalies of the surface (vegetative, topographic or related to the ground, etc.) and anomalies below the surface (geophysical).
What is buried in and by the ground, be it small (for example, a modest treasure) or large (for example, a domus) inevitably leads to a variety of disorders both above and below the surface. These disorders, commonly defined anomalies, can be easily identified using aerial photographs or satellite images, and are very useful to carry out a preliminary survey of the larger areas under investigation. However, these anomalies are mainly "captured" by a number of geophysical instruments that investigate the subsoil.
Frequently, after the location of a potential archaeological site, archaeologists would immediately start digging as a first reaction. The result of this alacrity would be a considerable loss of energy and financial resources, but also lead to the risk of destroying part of the related stratigraphic evidences, if not perfectly documented. Obviously, this happens when the archaeological excavation brings to light what the archaeologists were seeking. However, when this does not happen, it would be better to use modern non-destructive and effective techniques, such as the archaeological investigation methods (Figure 1).
One of the greatest achievements of modern physics is the unification of its various fields, such as electricity, magnetism, and radiation. They are all aspects of similar phenomena, interacting with one another; and can be described by means of mathematical equations and algorithms. This is all the technical background that geoarchaeologists need to have in order to understand the following concepts.
In every case, it must be noted that geophysical investigations aim at detecting differences and anomalies in the data collected. A skilled operator can identify anomalies that are not perceptible to the untrained eye. For this reason, the access to these data is granted only to experienced and expert operators, not only in physics, but also in archaeology.
Applied geophysics is a science that studies the physical properties of the inner part of the Earth. The geophysical methods are divided into two types: active and passive. Active methods are based on artificial sources which, for example during seismic phenomena, transmit signals in the subsoil which change on the basis of the properties of the material through which they pass. Conversely, the passive methods analyse the variations in time and space of the signals related to natural sources, such as gravimetric and magnetic fields.
The geophysical methods, both active and passive, are able to detect any anomaly, represented by variations of a certain physical property, which differs according to the geophysical method used [10, 11]. The main geophysical methods are illustrated in Figure 2. The necessary condition to be met for anomalies to be detected by the above-mentioned methods is a strong contrast between the physical properties of the object to be investigated (target) and those of the material that surrounds the object itself (the background) [12].
Therefore, depending on the target to be identified, each geophysical method features a specific field of application. Hence, a branch of the scientific research in the field of cultural heritage preservation is based on a non-invasive method that helps develop on-site intervention and planning strategies in a quick and timely manner. These techniques of geophysical survey can be used to examine the subsoil of

archaeological areas not yet excavated, but also to diagnose the state of preservation of masonry in ancient structures.
The applications in archaeology mainly concern the following methods: magnetism, electrical tomography, electromagnetism/ground penetrating radar (GPR) and gravimetry. Sporadically even induced polarization, VLF electromagnetic method and radiometric dating are used. Hereafter a brief description of the methods mainly used and listed above will be given; obviously, given the importance, the versatility and the frequent use, the GPR system will be particularly highlighted.

2.1 Magnetic Method

The magnetic method measures the intensity of the magnetic field. The degree of magnetization of a material in a magnetic field is given by its magnetic susceptibility. In other words, the magnetic method detects the magnetic field relating to magnetized bodies, wherever there is magnetic susceptibility contrast.
The instrument used to carry out this magnetic investigation is the magnetometer. The latter outlines some profiles, within the area of investigation, in order to detect any anomaly in the magnetic susceptibility due to the possible presence of buried objects.
The magnetic method is very effective and particularly quick. However, one of the drawbacks is the fact that, in case of a magnetic anomaly probably due to an archaeological target, it is not able to provide information on the depth of this anomaly. In fact, the result of a magnetic survey is a map instead of vertical sections [13].

2.2 Electric Tomography

The electrical resistivity method (or electrical tomography) consists, in principle, of the application of direct current to the ground by means of two or more electrodes, called current electrodes, and the calculation of the electrical resistivity starting from the measurement of the potential difference resulting from the circulation of the electric current. The electrical resistivity also depends on the array of the electrodes that is their arrangement and the distance between them.
Therefore, this method is able to detect anomalies due to resistivity contrasts. In archaeological applications, finds usually appear as resistivity anomalies in a medium quite conductive and relatively homogeneous. This is due to the fact that archaeological structures are often covered by alluvial soils, typically conductive.
Unlike the magnetic method, electric tomography provides an analysis of the subsoil including the depth at which anomalies have been detected: in fact, the profiles carried out can result in vertical sections [13].

2.3 Gravimetric Method

The gravimetric investigation method has the purpose of detecting, in a delimited area, the anomalies of the Earth's gravitational field caused by variations in the density of the bodies near the Earth’s surface. For this purpose, it is necessary to detect the relative value of the field at the measuring stations appropriately arranged on the Earth's surface and possibly at a regular mesh properly sized according to the purpose of the investigation. Then, from the archaeological point of view, anomalies are detected only if there is a sufficient density contrast between the archaeological target and the surrounding ground [13].

2.4 Electromagnetic Method

The electromagnetic method measures the conductivity of the materials passed through. The instrument used is called electromagnetometer, which is able to detect any buried target featuring a sufficient conductivity contrast with respect to the surrounding ground.
In other words, a low frequency electric current is applied to the ground. Conductive bodies present in the ground induce secondary fields that interfere generating changes in terms of phase and amplitude in the primary field. Thus, it is possible to obtain the conductivity of the ground and the phase shift of the electromagnetic wave generated by metal objects.
This leads to maps that illustrate in plan with isolines the electrical conductivity and the phase shift of the electromagnetic wave, however this method is rather superficial, since its investigation capacity is limited to the first 3-4 meters [13].

2.5 Ground Penetrating Radar (GPR)

The Ground Penetrating Radar (GPR) has recently become the most important geophysical technique applied to archaeology and cultural heritage [14-20].
The GPR is a geophysical method which uses radio waves, typically in the frequency range 10-3000 MHz, to map structure and features buried in the ground. Radar transmitting antenna emits an electromagnetic impulse which can be reflected or scattered by a dielectric discontinuity in the ground, and gathered by receiving antenna [21-24].
The equipment used in all GPR systems consists of four main elements: a transmitting unit; a receiving unit; a control unit; and a display unit. The transmitter produces a short duration, high voltage pulse. This pulse is applied to the transmitting antenna, which radiates it into the ground. This transmitted signal travels in the

ground with the reflected or scattered signals travelling back to the receiving antenna and then to the receiver. The latter amplifies the signals and formats them for display by the control unit. Many GPR can operate at different frequencies. The antennas are the bandwidth limiting devices, so the same transmitter and receiver can be used with a number of different antennas [25-30].
The electrical properties of geological materials are primarily controlled by the water content. Variations in the electrical properties of soils are in fact usually associated with changes in volumetric water content, which, in turns, give rise to radar reflections [31-35].
The velocity and the attenuation are the factors that describe the propagation of high frequency radio waves in the ground. These factors depend on the dielectric and conductivity properties of the materials.
The factors which affect radar signal range in the ground are: radar system performance, attenuation in the ground and the reflection properties at boundary where the electrical properties vary. From the attenuation values in geological materials and the nature of the frequency dependence, it follows that for a given signal detection threshold the maximum depth of investigation decreases rapidly with increasing frequency, and almost all subsurface radar systems operate at frequencies less than 3 GHz. The GPR system measures the signal travel time, and creates a 2D image of the subsurface, with the antennas position on the X and Y axes during the two-way travel time. Because different antennas frequencies can be used, different vertical and horizontal resolution can be also achieved. Resolution is the ability of the system to distinguish two signals close to each other in time; therefore, the shorter is the time pulse width, whilst the higher is the resolution, i.e. the closest is the distance between two reflectors in the subsurface [36, 37].
A useful summary of the most appropriate GPR data processing techniques can be found in literature such as Annan [22], Conyers e Goodman [38], Conyers [23] e Leckebusch [25].
Finally, the graphic representation of the GPR data is a key step for the understanding and interpretation of the results. The final investigation report should present the data in a clear manner for the experts, the whole industry as well as non-expert clients, in order to make interpretations solid and easy to understand for everyone. In most cases, reports show radargrams in grayscale and the most advanced software packages provide a high visual resolution and definition. In addition, if the acquisitions resulted in parallel profiles within an x, y coordinate system, it is possible to obtain and, therefore, display maps (plans) of the investigated areas that represent, at various depths, not only the geometry of the buried objects but also their size, by using an algorithm also known as average envelope amplitude. Finally, on the basis of the data quality, it is possible to perform a 3D representation of the data. This representation is also known as 'pseudo' representation, as it is the result of a model of false perspective section (isosurface), in which a threshold value is set according to an average envelope algorithm. This GPR data processing method is held in high regard due to the fact that it is able to better interpret the spatial relationships between the anomalies (Figure 3).

3. Archaeological and Cultural Heritage Investigations using GPR

Taking care of the cultural heritage, with particular regard to buried archaeological structures, requires interventions that do not alter or damage the surrounding buildings and territory, both visible and still buried. The GPR system is particularly suitable for providing high-resolution data, identifying elements not yet brought to light, managing and developing any restoration strategy. This is especially true in case of buildings or sites of great historical importance [32, 33, 39, 40].
In particular, the results of a couple of GPR surveys carried out in different archaeological contexts are listed below.

3.1 Santa Maria Antiqua (Roman Forum, Rome)

Excluding the representation of the apse in 1702 in a watercolour and a diary, the history of Santa Maria Antiqua begins in 1900, when the church was brought to light after a series of systematic excavations in this area of the Roman Forum (Figure 4) [41].
However, after this first intervention between 1900 and 1902, the gradual decay of the structures and the frescoes remained a major issue. For example, in 1912 and subsequently in 1945, 1947 and 1954 and between 1956 and 1957, the critical condition for the frescoes led to remove some wall panels and transfer them to a new support. However, the percentage of the frescoes removed is quite low, about 12% of the total area. The most recent preservation treatments on site were performed in the Eighties [42].
Since 1980 the monument has been closed to the public and the access is limited to scholars and researchers who carry out complete restoration and in-depth archaeological excavations in order to reconstruct the chrono-stratigraphic phases of the site[1].
Within the SMA project - Santa Maria Antiqua - a GPR survey was carried out in order to better understand the nature of the subsoil of a complex archaeological area inside the church.

[1] The recent results of the archaeological excavations at Santa Maria Antiqua have not been published yet, however it is possible to visit the updated website < http://mchiuini.iweb.bsu.edu/sma/index.html>.

The GPR survey made use of a bistatic GPR system, equipped with 500 MHz antennas mounted on a structure (Smart Cart) provided with an odometer. The system was manually pushed and positioning data were acquired through a commercial GPS (Global Positioning System) system.
The measurements were based on points and were carried out using the step-mode technique in order to obtain a constant sampling pitch of 2 cm, with GPS location every 50 traces recorded. This technique allows for the positioning along the profile, with great accuracy, of any anomaly detected by the radar. Finally, in all the sections of the radar a stacking (average of traces) equal to 4 has been used.
Due to the presence of several structural obstacles (for example, narrow passages, scaffolds, etc.), the GPR system was the best non-invasive diagnostic instrument.
Figure 4 shows the map of the GPR anomalies at a depth of about 1m which probably discloses the presence of several anomalies both elongated and partially at right angles. Because of the complex history of the Church over the centuries - from the Roman to the medieval period – it is impossible to define the typology (and, consequently, the history) of these geophysical and probably anthropic anomalies.
An accurate archaeological investigation of the site revealed the presence of a complex stratigraphy. However, it was possible to compare the results of this excavation with the GPR survey. Thus, not only the presence of structures detected by the GPR system has been confirmed, but also, and more importantly, it was possible to understand the type of structures and to which period they belonged. Figure 4 shows the relationship between the GPR map and the one performed after the excavation: they indicate the presence of two thick walls of the Christian period (the elongated anomalies) as well as the remains of a sewerage system (right-angle anomalies) of the Late Roman period.

3.2 The ancient town of Uscosium (San Giacomo degli Schiavoni, Campobasso)

Historically, in the town of San Pietro (to the east of the current town of San Giacomo degli Schiavoni, Campobasso), on a large flat area not far from the L'Aquila-Foggia cattle track, the remains of a large Roman settlement were found where several activities in addition to agriculture were carried out. The oldest layers attest to the attendance of the site as early as the fourth century BC; however, the visible structures mainly date back to the first two centuries of the Empire. The part brought to light features an extraordinary hydraulic system including a large underground tank, covered with bricks and a sewer. The first has a rectangular shape (6.30 x 9.20 x 3.40m), with the remains of a central pillar that supported the roofing. Linked to this, but at a higher level, there is another smaller tank made with the same technique, known as lime pool, namely a water-decanting tank. The sewer situated at a depth of 3m with respect to the old planking level is paved with bricks and covered with tiles arranged as a sloping roof; along its path there are two wells, the first situated at the beginning - at the point of connection with the tank - and the second at an intermediate point with control function. This area also featured other small tanks, a well with a depth of 4m, pipes, rooms and traces of pavements made of bricks arranged in a herringbone pattern. A room located on the northern side, only partially explored, contained some terracotta barrels and two smaller reservoirs [42-44].
The local evidences refer not only to this Roman structure, but also to a real settlement dating back to the period of the Frentani, still in use in Roman times. The strategic position along the Via Traiana-Frentana (the ancient street built by the Samnites and later restored by the Romans, which connected Rome, Benevento and Brindisi, passing through Abruzzo and the Tavoliere) facilitated a permanent settlement in this location (Patterson, 2004, pp . 51-68). So far the only residential typology identified in this area was the Roman villa previously mentioned; however, Professor Graeme Barker, during his excavation along the Biferno river, had vaguely circumscribed a wide surrounding area that can be credited to the ancient town Uscosium, never accurately localized [45].
Thanks to recent agricultural works and satellite photographs it was possible to focus on a smaller area; in fact, the analysis of remote sensing images clearly shows a series of anomalies on the ground related to the different crop growth (Figure 5).
In this area geophysical surveys were backed up by the GPR system and the magnetometer in order to obtain different coverage, resolution and details. The magnetometer used, equipped with GPS, had the following characteristics: 0.01nT resolution, cycle rate of 0.5sec, frequency of acquisition of 10cm, 1m distance between the sensors and a 0.5m equidistance among the individual parallel profiles. The investigations made use of a bistatic GPR system, equipped with 500 MHz antennas mounted on a structure (Smart Cart) provided with an odometer. The system was manually pushed and positioning data were acquired through a commercial GPS (Global Positioning System) system.
The measurements were based on points and were carried out using the step-mode technique in order to obtain a constant sampling pitch of 2 cm, with GPS location every 50 traces recorded. This technique allows for the positioning along the profile, with great accuracy, of any anomaly detected by the radar.
Finally, in all the sections of the radar a stacking (average of traces) equal to 4 has been used.
The first maps, those produced with the aid of the magnetometer, clearly show not only the intersection of several straight anomalies, perfectly coinciding with the remote sensing images, but also a series of intense and dense anomalies, to the east of the previous investigation and probably related to it. The second map,

created with the GPR system, despite having been acquired in a smaller portion of the territory with respect to the first ones, reveals not only how effectively the particular “V” intersection disclosed by the satellite photographs and the magnetic map is also detected by the latter, but also a strong circular anomaly near this intersection, at a depth of about 1m (Figure 5).
It is easy to deduce from these results how such anomalies are relevant to a roadway passing near a large settlement which might have been Uscosium. The presence of roads and intersections, as well as of houses (or masonry structures) particularly dense suggests a settlement far from being shed or temporary, but rather organized and wide, as the town of Uscosium might have been at the times of the Romans and the Frentani.
The results obtained this year lead us to think that the handover between the Samnites and the Romans was not only gradual but also the result of the evolution of Roman settlements on the basis of that experienced by the Samnites, identifying the most strategic areas for communication purposes (near cattle tracks and provided with widespread infrastructures throughout the lower areas of Molise) as well as for agricultural production (a milestone of the economy of Molise over the centuries.)
The analysis of the historical landscape of the lower areas of Molise, has shown, so far, a settlement continuity between the sixth and fourth centuries BC, between the Samnites and the Romans, and reveals how this step had been gradually achieved starting from the three Samnite wars up to the Roman awareness of the Italic value in the social economy of the Republic [46].

4. Conclusions

Who "knows" the territory with its stratifications knows for sure that it is the result of complex dynamics, produced by what is generally understood as a cultural process. This leads to think about the importance of the approach to the planning steps; only geoarchaeologists know that the object of their investigation is the result of several changes that may have been either gradual and long-term or sudden and traumatic. The task of this paper is to broaden the 'archaeological views' and throw light on the solving capacity of modern technologies
GPR surveys, when used in the protection of cultural heritage in general, and in archaeology in particular, provide crucial information that not only increase our knowledge of the past, but also facilitate and properly plan any restoration and conservation strategy. The results can be interpreted also with a 3D representation, thus allowing for an accurate reconstruction of the evolution of a historical site and answering crucial questions for archaeological survey.
Thanks to their data acquisition speed, high sensitivity to moisture and costs now relatively low, GPR systems are one of the best non-destructive technologies used to investigate and analyze cultural heritages such as archaeological sites not yet brought to light. Moreover, this method can be used to accurately detect the presence of any architectural damage in areas where moisture and detachments ma affect the state of preservation. This geophysical approach (sometimes combined with other technologies, such as in the discovery of the ancient town of Uscosium) enables the development of a precise multidisciplinary policy of protection, restoration and enhancement of both famous archaeological sites (for example the Roman Forum in Rome) and little known sites of great cultural value (such as the site of Montecastrilli, Terni). The results presented in this study demonstrate that it is possible to define some non-invasive diagnostic standards for historical structures, with the draft of a non-invasive diagnostics intervention protocol which combines science and culture.
Nowadays, geophysical investigations represent the preliminary, unique and effective technology to be used to carry out archaeological data investigations, recovery and protection.

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6. Bibliographical References

[1] CARANDINI, A. *Storie della Terra*. Laterza, Bari, 1981.
[2] HARRIS, E.C. *Principi di stratigrafia archeologica*. trad. it., Carocci, Roma, 1983.
[3] RENFREW, C., BAHN, P. *Archaeology. Theories, Methods, and Practice*. 2nd ed., London, 1996.
[4] GOLDBERG, P., MACPHAIL, R.I. *Practical and theoretical Geoarchaeology*. Blackwell, 2009.
[5] CORNWALL, I.W. *Soil for the Archaeologists*. Phoenix House, 1958.
[6] BUTZER, K.W. *Environment and Archaeology: An Ecological Approach to Prehistory*. Taylor & Francis, 1964.
[7] BUTZER, K.W. *Archaeology as Human Ecology: Method and Theory for a Contextual Approach*. Cambridge University Press, 1982.
[8] BARONE, P.M. *Geoarcheologia ed “Antropocene”: esempi di conflittualità tra archeologia, geologia e sviluppo moderno in alcune zone della costa molisana di epoca sannitico-romana*, in MELIS M.G. (ed.)

Uomo e territorio. Dinamiche di frequentazione e di sfruttamento delle risorse naturali nell'antichità. Nuova Stampa Color, 2009.
[9] RAPP (Ripp), G. HILL, C.L. *Geoarchaeology: The Earth-Science Approach to Archaeological Interpretation*. Yale University Press, 2006.
[10] MILSOM, J.J., ERIKSEN, A. *Field Geophysics*. Wiley, 2011.
[11] MUSSETT, A.E., KHAN, M.A. *Esplorazione del sottosuolo, una introduzione alla geofisica applicata*. Zanichelli, Bologna 2003.
[12] REYNOLDS, J.M. *An Introduction to Applied and Environmental Geophysics*. 2nd Edition, Wiley, 2011, ISBN: 978-0-471-48535-3
[13] WITTEN, A.J. *Handbook of Geophysics and Archaeology*. Equinox, London, 2006.
[14] ORLANDO, L., SLOB, E. *Using multicomponent GPR to monitor cracks in a historical building*. *Journal of Applied Geophysics*, 67, 2009, pp. 327-334. DOI: 10.1016/j.jappgeo.2008.09.003
[15] PEREZ-GRACIA, V., CASELLES, J.O., CLAPES, J., MARTINEZ, G., OSORIO, R. *Non-destructive analysis in cultural heritage buildings: Evaluating the Mallorca cathedral supporting structures*. *NDT & E International*, 59, 2013, pp. 40-47. DOI: 10.1016/j.ndteint.2013.04.014.
[16] PETTINELLI, E., BARONE, P.M., DI MATTEO, A., MATTEI, E., LAURO, S.E. *Radio waves technique for non-destructive archaeological investigations*. *Contemporary Physics*, 52, 2, 2011, pp. 121-130. DOI: 10.1080/00107514.2010.545208
[17] PETTINELLI, E., BARONE, P.M., MATTEI, DI MATTEO, A., E., SOLDOVIERI, F., *Archaeology and Cultural Heritage*. In TURK A.S., HOCAOGLU A.K., VERTIY A.A. (a cura di), *Subsurface Sensing*, Wiley, 2011, pp. 644-667.
[18] BARONE, P.M., FERRARA, C., PETTINELLI, E. *How could Archeo-Geophysics help garbage disposal? A fortuitous discovery in Central Italy*. *Antiqua*, 2, 1, e3, 2012. DOI: 10.4081/antiqua.2012.e3
[19] BARONE, P.M., FERRARA, C., PETTINELLI, E., *Advanced ground penetrating radar applied to landscape archaeology and cultural heritage*. in VERMEULEN F., CORSI C. (eds.), *Non-destructive approaches to complex archaeological sites in Europe: a round-up*, Ghent University, 2013. ISBN 978-94-6197-109-8
[20] BARONE, P.M., PETTINELLI, E. *Non-destructive techniques in archaeology: recent GPR investigations in Crustumerium*. in ATTEMA P.A.J., DI GENNARO F., JARVA E. (a cura di), *Crustumerium. Ricerche internazionali in un centro latino. Archaeology and identity of a Latin settlement near Rome*, vol. 1, 2013, pp. 45-53.
[21] JOL, H. *Ground Penetrating Radar Theory and Applications*, Elsevier 2009.
[22] ANNAN, A.P. *Ground Penetrating Radar: principles, procedures & applications*. Sensors & Software, Inc, Technical paper, 2004.
[23] CONYERS, L.B. *Ground-penetrating Radar for Archaeology*. AltaMira Press, Walnut Creek, California 2004.
[24] CONYERS, L.B. *Ground-penetrating radar for landscape archaeology: Method and applications*. In CAMPANA S., PIRO S. (eds.), *Seeing the Unseen*, 2009, pp. 245-255. ISBN 978-0-415-44721-8
[25] LECKEBUSCH, J. *Ground-penetrating radar: A modern three-dimensional prospection method*. *Archaeological Prospection*, 10, 2003, pp. 213–240. DOI: 10.1002/arp.211
[26] GREALY, M. *Resolution of ground-penetrating radar reflections at differing frequencies*. *Archaeological Prospection*, 13, 2, 2006, pp. 142-146. DOI: 10.1002/arp.283
[27] ANNAN, A.P. *Ground-Penetrating Radar*, in BUTLER D.K. (a cura di), *Near-Surface Geophysics, Investigations in Geophysics*, 13, SEG 2005.
[28] DANIELS, D.J. *Ground-Penetrating Radar*. 2nd Edition. IEE Radar, Sonar, Navigation and Avionic Series 15, 2004.
[29] SCHMIDT, A. *Geophysical Data in Archaeology: A Guide to Good Practice*, Oxbow Books 2002.
[30] NEUBAUER, W., EDER-HINTERLEITNER, A., SEREN, S., MELICHAR, P. *Georadar in the Roman civil town Carnuntum, Austria: an approach for archaeological interpretation of GPR data*. *Archaeological Prospection*, 9, 2002, pp. 135-156. DOI: 10.1002/arp.183
[31] BARONE, P.M., MATTEI, E., PETTINELLI, E. *Non-invasive archaeological exploration in stratigraphically complex rural settings: an example from Ferento (Viterbo, Italy). Archaeological and Anthropological Sciences*, 5, 3, 2013, pp. 267-273. DOI: 10.1007/s12520-013-0138-3
[32] BARONE, P.M, DI MATTEO, A., GRAZIANO, F., MATTEI, E., PETTINELLI, E. *GPR application to historical buildings structural control*. *Near Surface Geophysics*, 8, 5, 2010, pp. 407-413. DOI: 10.3997/1873-0604.2010017
[33] BARONE, P.M., LAURO, S.E., MATTEI, E., PETTINELLI, E. *Non-destructive technique to investigate an archaeological structure: a GPR survey in the Domus Aurea (Rome, Italy)*. In *Proceedings of the 13th International Conference on Ground Penetrating Radar*, Lecce, GPR 2010, IEEE 2010. DOI: 10.1109/ICGPR.2010.5550087

[34] FERRARA, C., DI TULLIO, V., BARONE, P.M., MATTEI, E., LAURO, S.E., PROIETTI, N., CAPITANI, D., PETTINELLI, E. *Combined GPR and unilateral NMR for water content measurements on a lab scale test site*. *Near Surface Geophysics*, 11,2, 2013, pp. 143-153. DOI: 10.3997/1873-0604.2012051.
[35] FERRARA, C., BARONE, P.M. *Detecting moisture damage in archaeology and cultural heritage sites using the GPR technique: a brief introduction*. *International Journal of Archaeology*, Special Issue: Archaeological Sciences. Vol. 3, No. 1-1, 2015, pp. 57-61. DOI: 10.11648/j.ija.s.2015030101.17
[36] BARONE, P.M., BELLOMO, T., MATTEI, E., LAURO, S.E., PETTINELLI, E. *Ground-penetrating Radar in the Regio III (Pompeii, Italy): Archaeological Evidence*. *Archaeological Prospection*, 18, 3, 2011, pp.187-194. DOI: 10.1002/arp.405
[37] ANNAN, A.P. *Practical processing of the GPR data*. Sensors & Software, Inc, Technical paper, 1999.
[38] CONYERS, L.B., GOODMAN, D. *Ground Penetrating Radar: An introduction for archaeologist*. Altamira Press, London 1997.
[39] BARONE, P.M., FERRARA, C., PETTINELLI, E. *La localizzazione del caposaldo B con la tecnica georadar*. In AEBISCHER T. (a cura di) *La scoperta del caposaldo B della base geodetica di A. Secchi lungo la via Appia Antica*, Ed. Nuova Prhomos, 2013, pp. 26-30. ISBN: 978-88-97900-57-3.
[40] BARONE, P.M., FERRARA, C., PETTINELLI E. *Prospezioni georadar in località Colle Rotondo (Anzio - Roma)*. In CIFANI G., et al., *Colle Rotondo (Anzio, Roma): le campagne di scavo del 2010 e del 2011*, «Lazio e Sabina 9», Soprintendenza per i Beni Archeologici del Lazio 2013.
[41] AVETTA L., *Scavi e scoperte (1935-1950) nella costruzione delle Terme di Caracalla e di via Cristoforo Colombo*. Tituli 3, Roma, 1985.
[42] CAPINI, S., DI NIRO, A. *Samnium. L'archeologia del Molise*. Roma, Casa Editrice Quasar, 1991.
[43] LLOYD, J., BARKER, G. *Rural settlement in Roman Molise: problems of archaeological survey*. In BARKER, G., Hodges R. (eds.), *Archaeology and Italian Society. Prehistoric, Roman and Medieval Studies*. BAR International Series 102, Oxford, 1981
[44] MASSULLO, G. *Storia del Molise*. Donzelli, Roma, 2006.
[45] BARKER, G. *A Mediterranean valley. Landscape archaeology and Annales history in the Biferno Valley*. London, 1995.
[46] BARONE, P.M., FERRARA, C. *Geophysics Applied to Landscape Archaeology: Understanding Samnite and Roman Relationships in Molise (Italy) Using Geoarchaeological Research Methods. International Journal of Archaeology*. Special Issue: Archaeological Sciences, Vol. 3, No. 1-1, 2015, pp. 26-36. DOI: 10.11648/j.ija.s.2015030101.14

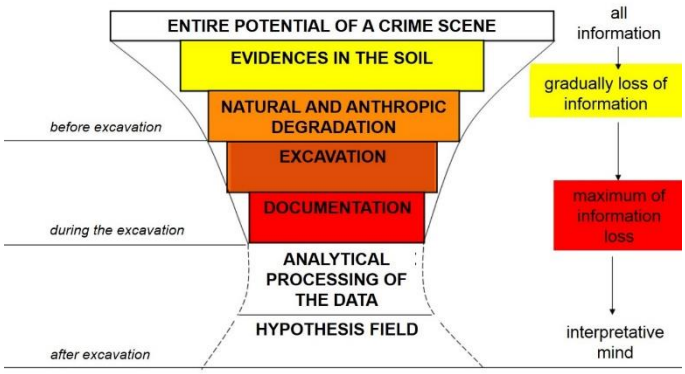

Fig. 1: The flow of the information lost before, during and after the excavation.

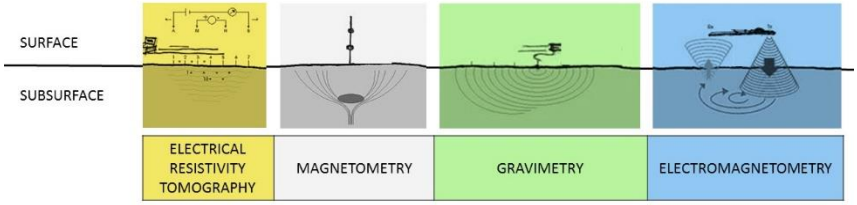

Fig. 2: Schematic representation of the main geophysical methods used in archaeology.

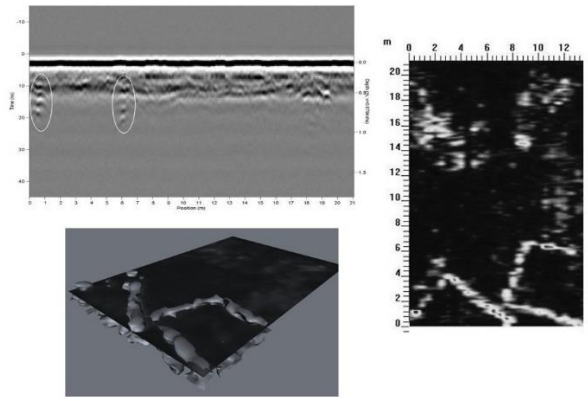

Fig. 3: The three typical representations of the same GPR element: the radargram (upper left), the depth map (right) and 3D reconstruction (lower left.)

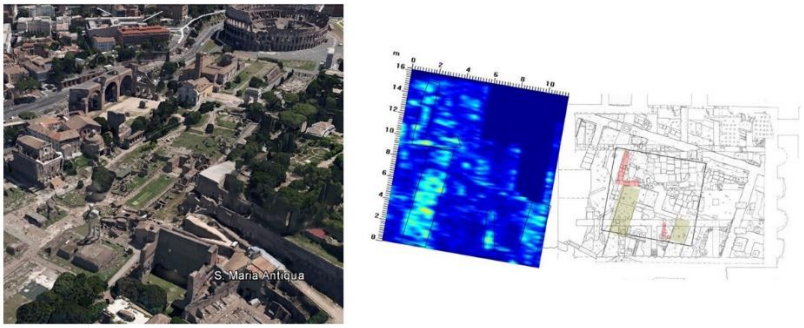

Fig. 4: On the left, location of the church of Santa Maria Antiqua inside the Roman Forum. In the background it is possible to discern the Colosseum. On the right, the GPR map, at a depth of about 1m, clearly shows a series of both elongated and right-angle anomalies. In particular, these anomalies perfectly match with the archaeological evidence brought to light (walls of the Christian era highlighted in green, and sewer gullies dating back to late antiquity highlighted in red).

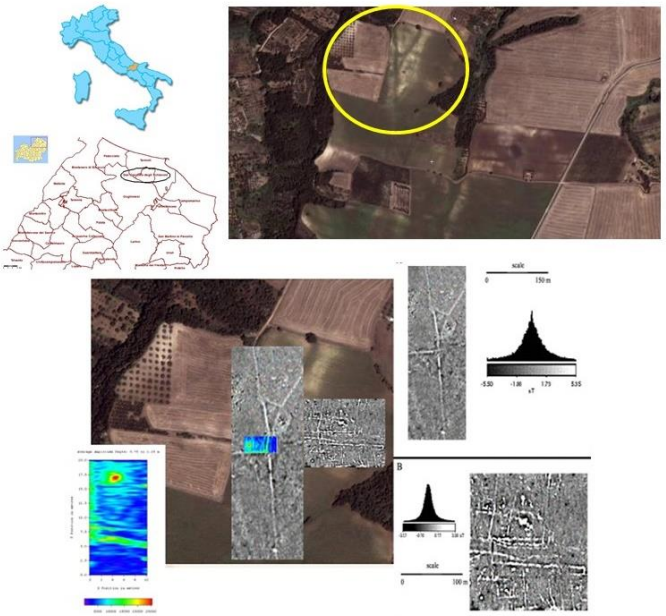

Fig. 5: Localization of the remains of Roman structures in the town of San Pietro (San Giacomo degli Schiavoni, Campobasso) (upper-left). The satellite image clearly shows some areas characterized by the so-called crop marks (different crop growth), which enabled a better localization of the surveys (upper-right). On the bottom, both the magnetic and the GPR maps reveal the presence of evident anthropic anomalies. On the upper right, the magnetic map perfectly matches with both the remotely sensed anomaly and the GPR map at a depth of about 1 m, and can be attributed to a crossroads; on the lower right, conversely, the magnetic map, acquired near the previous one, could be interpreted as the core of the ancient town of *Uscosium*.

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The architectural perspectives in the villa of Oplontis, a space over the real

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Abstract
Essential element of architectural design in the villa of Oplontis, the wall decoration is characterized by the research of daring perspectives tending to dilate the surfaces of the interior environments: these are paintings in II and III style that depict architectural perspectives according to a marked taste for the theatrical stage design applied to painted decoration; it's aimed to determine the illusion of environments that you happen endlessly in a game of feints architectures, often processed with extreme wisdom.
The working method is related to the establishing the relationship between the container and the space created by the perspective illusion and has its starting point in rigorous photogrammetric survey technique and rendering; then it move on to examine the specialties of roman painting, analyzing both the general characteristics and specific aspects.
This study also uses of a philological analysis with reference to vitruvian rules and to greek-romans typologies in order to reconstruct the painted space; finally the painted space, in 3d model, is recomposed with real space, thin to land to representations more effective than they allow to gather better still the experience of a quite new space, in a reconstruction of the architecture integrated by the illusion, as if it were real In this simulation of virtual spaces, the digital graphics helps to lead the experimentation that is developing, as part of the PRIN 2010-2011 research (Architectural Perspective: digital preservation, content access and analytics, scientific coordinator Riccardo Migliari), by the Salerno Unit, with the annexed unities (University of Naples 'Federico II', Second University of Naples, University of Basilicata). Of this research, which puts particular attention to the architectural, archaeological and iconographical heritage in Campania, are presented here only part of the achieved outcomes.

Keywords: architectural perspectives, painted space, Oplontis

1. Real space and painted space[2]
In current science, and, more precisely, geometric-representation, projective analysis of prospective conjuring postures used in Pompeian paintings reconstructs the architecture represented, their relationships and the virtual space that they comply. From the results of the perform graphic operations diversified are visible the personal choices of the authors, or of the author, conditioned by a search of perceptive fruition of every painting in the *cubiculum* in which it is situated; it's evident, from the metric and figurative restitution of every painted architecture and from the consequent construction of suitable structural axonometries, as those represented architectures are also been planned by the same authors of the paintings.
Particularly, principal purpose of our study is to clarify the hold relationship that the deceptive space establishes with the architecture that contains it, to the point that is possible to imagine before, and to represent then, the space simulated as it departs integral of real space.
The working method is related to the goals and the characteristics of the work designed: the issue of establishing relations between the container and the space created by the perspective illusion has as a starting point, without a doubt, the rigorous photogrammetric survey technique and rendering, then move on to examine the specialties of roman painting of the II style, analyzing both the general characteristics and more specific aspects relating to object of study.

Such study uses besides, of a philological analysis with reference to Vitruvius's rules and to greek-romans typologies (e.g. the temple, the *portico*, the *peristilio* etc.) what recurrent motives are in the examined paintings and directly model available in the near Pompeii. The reconstructed virtual space, is recomposed finally with real space, thin to land to more effective representations as axonometries and perspectives that allow us to gather better still the experience of a quite new space.
The architectural space returned through these successive steps was then represented according to the techniques that are now encoded the central perspective: in this way, it was possible to operate a comparison between the perspective of the divined of ancient paintings and the correct perspective representation, comparison that has allowed us to reveal the errors of perspective, distinguishing it from corrections and adjustments aware.
Through the subsequent phases of the work was therefore reached not only to define the parameters of a rigorous project of illusion that lies at the base of architectures and spaces paintings, but it was done well as a reconstruction of the integrated architecture in the illusion, as if it were real and in this simulation of virtual spaces computer graphic has helped to bring this forward experiment.

1.1 Pompeian painting

The ancients, who began the fashion of the wall decoration, at the beginning walked the different types and the placement of the coatings in marble and followed the various provisions of frames and blocks [1]. The first pictorial technique in Pompeii, in fact, looks like a plastic imitation of variegated marble, alabaster or of porphyry; in this initial phase of ancient painting, reintroduction in the internal spaces of the elements of the apparatus external brickwork in the building [2].
Monochrome clogs or in false marble, you tan of stone and frames that represent the decoration adopted in the public buildings and in the environments of representation of the private residences beginning from 150 B.C. up to 80 B.C. From the formal point of view the imitation of various covering materials suits it for the measures and dimensions of the wall for which it is realized; from the chromatic point of view such decorations are performed with predominance of red and black and with a yellow band in low that forms an effective shades contrast; to Pompeii and Ercolano the paintings of this style also contain often small architectural elements as simple pillars that articulate the vertical division of surfaces.
This way, adjust and elementary, to decorate, or better, to easily pace the walls, through a sober breakdown in colorful paintings, demonstrates how the wall decorations, since its earliest manifestations, were to be regarded as essential to the embellishment of a building, and they are just the murals to be the most extraordinary aspect of Pompeii art that, starting from the simplicity of the style, it evolves to the point up to reach the representation of complex scenarios and great prospects.
From the beginning and until the last quarter of the I century BC, we assist in painting to a veritable upheaval: the painters that in principle walked the changing appearance and the placement of wall marble revetments, as a result it did also in the imitate of building structures, with columns and pediments detached from the bottom and in perspective [1]. The architectural theme takes over the wall decoration: architectures painted on walls and ceilings expand a perfect likeness space and expand the environment itself toward the outside through depictions of several plans, open between podiums and columns architraves, enriched with moldings and friezes, up to the representation of large scenes with bucolic landscapes and gardens.



Fig. 1: Oplontis, villa of Poppea. The perspective frescoes of the *atrium*

A series of wonderful paintings coming from a room in the *Villa di Fannio*, one of the many homes of existing campaign in the suburbs of Boscoreale, constitutes the apogee of the evolution of this style and of this technique. The panes, which are now visible at the Metropolitan Museum of Art in New York, there are as many masterpieces divided from one another by slender columns which contributed to give the room the appearance of a cloister which had a view of an amazing scenario and lively streets, houses and colonnades.
The fantastic baroquism excessive which had come, in its latest manifestation, the II pictorial style, it replaces the Augustan age is that Nero (20 B.C. - 50 A.D.) a new decorative style, not free from cultural influences relative to the passage between the Republic and the Empire.
In this period the painted architectures were totally subordinate to a flat and decorative effect that recalls partly that of the tapestries and of the draperies that, as they reveal the nails and the hooks, were used for covering the walls. Abandoned the illusionisms and the fanciful redundancies of the architectural apparatuses, the painted wall leaves ample central spaces to small pictures with landscapes or mythological subjects, that the colored fund almost island on the same wall, making them appear even more of dimensions redoubts, they were almost miniatures or easel pictures. Yet it didn't deal with easel works because the picture was directly painted on the wall becoming integral of it.
More than that of real wall should we talk about absence of wall, as if this became a space undefined [3]. This is the case, for example, the lovely frieze with cupids of the *Casa dei Vetti* in Pompeii: on a black surface, with brush strokes clear, light, almost a stain, are paintings cupids that await you at various trades and occupations; the bottom of the wall is a single color, red, coated in a compact manner.
With a few touches of color is made a quick painting that contemporaries was even defined *compendiaria* [4] because compared to the previous painting II style summary appeared, almost improvised. A few architectural elements, in fact, with the function of frame and division of the surfaces more that reason perspective, are filming scenes of the II style and it’s alternate track also more widely to paintings of landscapes, marine villas and gardens with trees, flowers, fruit, birds: the space of a room widens beyond the four walls, in a mutual and fictitious integration between the interior created by the man and the free external nature [3].
Between A.D. 50 and the eruption of 79 A.D., it witnessed the birth and spread of a new pictorial style whose pillars had certainly come in large buildings like neroniane *Domus Aurea*. Features of the new painting are the sumptuous architectural shooting scenes from the II style but reworked theatrically richer and tastefully sumptuous: statues and painted columns bind to frames and trabeation, sometimes made of stucco painted too, to which then interweave draperies, curtains, winged figures and landscapes suspended. A key feature of this style is the reaction of the artists III style trends, manifested through a return to the II style; these artists, however, only partly follow the road backwards, since the architecture from their imagined dissolves in the imagination: are rare cases of realistic studies of buildings or city; more frequent are the images of fanciful architectural elements and thin and almost flimsy structures, prepared in an aerial perspective. Some of these drawings are definitely derivatives, as well as previous paintings, from theatrical scenery; each item is made with great care and refinement and skillful use of color, often contrasting, which corresponds to a new



Fig. 2: Oplontis, villa of Poppea. The frescoed ceiling of the thermal baths

taste of the customer, a Pompeian bourgeois commissions, which flaunts its financial resources with the exuberance of decoration, often lacking moderation and balance [3].
Since the IV style paintings belong to the later years of the vesuvian cities, they have come to us in greater quantities than the specimens of previous ways and therefore the different varieties of the IV style, seen in their complex, numerically far outnumber all other put together.

1.2 Painted space in II style

The II style painted architecture were represented without codified rules: ancient art knew only conventional perspectives, the so-called “parallel perspectives”, which alluded to the three-dimensionality of space, representing the deep lines; however the pompeian paintings, with the architectural II style, are an example of impersonation founded on precise perspective principles that will be then more various and multiple in fanciful architecture of IV style.
The wise introduction, in these paintings, of false windows or handed that drive the eye over the wall to not only show luxurious gardens or seen harbors, but also fountains, ancient monuments and colonnades in perspective escape, determine in the spectator a particular deceptive vision that expresses a particular concept of space. From these paintings it emerges, in fact, a space that is not static and objective, but dynamic and subjective, that becomes a continuous creation, an illusion that uses of color effects, lights, perspective and it also includes other themes as the landscape, the still-life and the architecture. The illusion of reality seems to win, in this way, the flat surface of the wall: painted shapes come off from the bottom and place themselves on the surface, while the scenic background, landscape, architectural or shatters appears immense, infinite in illusion of depth. This illusionistic architecture represented in perspective, so that beyond the walls seem to see open an environment, is a plaintiff in the roman wall painting II style that not only testifies to the particular vision of the space for the Latins, but offering a tangible example of that style that Franz Wickhoff has called illusion [5]. With the Romans figurative art tends to express a space understood as a place of infinite human action, characterized by the relationship with the subject and measured only by this relationship; that space is defined as tangible, according to that style of illusions, of course, where all, air, shadow, light, must cooperate to give the illusion of reality.
The creation of similar intangible space becomes deeply the meaning of figurative heritage that Rome inherits from Greece: those forms of space streamlined fit Roman taste away from the bottom and smashing the background itself, whether architectural or landscape, whose elements are, in this way, on the surface.
The material continuity of the wall is thus interrupted, but the picture is rather fragmentary, but comes back together on a plane where colors, lights, shadows form a *continuum* illusory, one breakthrough of the limit, an openness toward architectural environments imaginary.



Fig. 3: Oplontis, villa of Poppea. The illusory space of the “*sala dei melograni*”

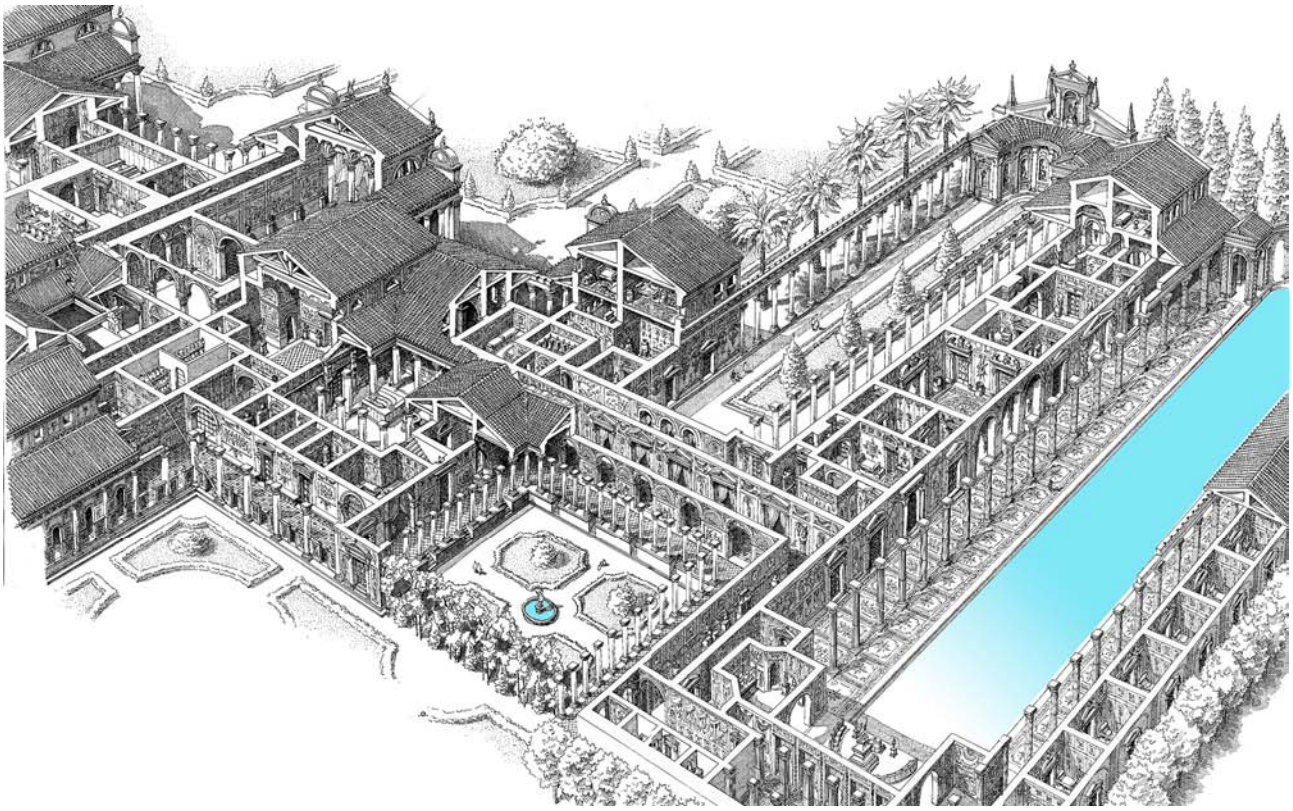

Fig. 4: Oplontis, villa of Poppea. Archaeological reconstruction by Samy Fayad

For this type of representation, which is a completely replaces the previous conception of the wall painting itself as perspective view of an illusory landscape can be understood beyond the wall, the wall is no longer the place where we can move from one compartment to another, but becomes the place decorated with central framework in which we can move from one compartment to one space made with illusionistic means.
This type of representation that characterizes the painting space II style finds its maximum expressions in painted walls of the *villa di Poppea* in Oplontis: entire environments of this villa don't seem to have tangible limits in the walls that define them, indeed, it seems to be just that the walls are almost a pretext to frame another architectural environment or a landscape. The abundance of the frescoes in Pompeian residences more wealthy you must not only to their obvious desire to live surrounded by a rich ornamentation of the chromatic tones glorious, but it can also be expected from the unconscious need to exorcise the sensation of closed through the choice of scenes in and outside of subjects which brought the nature in the house: trees, fruit, fountains [6].
These details, as well as in the kinds of painted architecture into the various villas, there is such a similarity to induce to think that the walls of these residences are outputs from a same pictorial tradition and, if not by the same hand, at least from the same laboratory, in Campania region, that operated under the mastership of Hellenic world. It's indeed an excellent hand-painting and there's just enough to imagine operating in each villa, to the days when the Republic fell, some author or more than one creator whose intelligence it poured the whole name, in the sign of dissipating in the wind and his chronicle.
And let us not forget that when the ville rose was also the sign of that worry human limit wants to break through as well as the artist made with these walls [7].

1.3 The technique of roman wall painting

Roman wall painting doesn't stop surprising the modern public not only for its high artistic quality and fantasy decorations and figurative subjects (although it's widely spread handicrafts, as you can clearly see from the extensive documentation provided by the Vesuvius area), but also for the extraordinary technical perfection of its realization. A detailed description of execution's techniques of plaster paintings is provided by ancient writers such as Vitruvius and Plinio il Vecchio, but the direct testimony of taste and technical expertise is provided by the work of the artists in more places remained interrupted due to the eruption of 79 A.D.
From analysis conducted on the vesuvian area roman paintings have been able to identify a series of workshops in Campania region, probably operating by a parietal painting mainly fresco. The process was to lay out the colors on the plaster lime-based first that the socket was finished; once completed the grip, the color was well penetrated and, due to the reaction caused by lime contained in the plaster and the carbon dioxide

contained in the air, created a surface film of calcium carbonate to which the color was well linked. It was therefore necessary that the painter had a layer of plaster to preparation still fresh, and then it was working as quickly as possible, preparing a limited surface and masking off the stitches made necessary by the partition work.
Vitruvius describes in detail the procedure to be followed for the preparation of fresco painting: seven following layers had to be realized, one of polishing of the wall, three of mortar and sand and then three of thin mortar and dust of marble on which the real color was stretched then. Through some reliefs to the microscope it has been possible to measure indeed the layers described by Vitruvio: on the first layer if it finds a second consisting of guidelines made at intervals to allow you to have perfect horizontality in the compact of successive layers; the third and fourth layer often are indistinguishable in section and are unified into a single big thickness of 3.5 cm or 4 cm, sometimes instead are two distinct layers, respectively 2 and 4 cm and 0.5 and 1 cm; the same situation occurs for three successive layers of lime and marble dust, carefully sanded, constituted the background color of the wall.
The overlapping colors to the bottom when they were applied when the plaster was still wet support, were mixed with lime to remain firmly anchored to the part though less strongly than the background color; to improve the capture of certain colors were used whose natural glutens is difficult to find. Painters' work departed from the top down: painting the ceiling came before, then realized in plaster the frame of crowning, then he passed to the walls of which the tall part painted before, then the central field and finally the clog; there was the painter called *dealbator* who operated for first bleaching the walls and stretching the color leading of the decoration, then the painter called *parietarius* traced and performed the panels and the decorations with recurrent motives even if you don't deprive of variations, finally the painter called *immaginarius*, the best remunerated, painted the central picture of the wall.

2. The ancient perspective between codification and intuition[2]

The linear perspective conical allows not only to represent the space, as it appears to our sight, on the plane of the drawing or painting, but also to obtain, by means of particular solutions, effects exasperatingly illusionistic once being extended to the structure of a built space and its entire decoration. These effects lead to perceive not the true reality space, but a reality completely fictitious suggested in the illusion perspective.
The search for a conceptual construction of the space is the problem of both physiological perception of the space and its representation: perception and representation are therefore closely connected in the same process expressive, while the search for a spatial representation coincides with the research of the means to achieve it; these, offered on a sometimes strict, sometimes empirical, the geometry, constitute the choices made according to the dominant trends and according to the different artistic spirit of every historical era. The perspective is, in fact, as an extraordinary intellectual construction as a genial mathematical invention, that it implies an endless and homogeneous space, in which the void has the same value of the full one and the objects and the spaces between them, constituting an inseparable unity, are observed by an only and immovable property eye. The perspective has therefore the goal to represent the reality, of way that the represented image coincides with the direct vision, succeeding in rationalizing that image of the space realized and represented, also without rigorous rules, already in the paintings of II style. Only following the scientific theory and to the geometric procedure formulated by the Renaissance artists, the perspective representation of the space is directed in a conventional direction, since it offers the possibility of use the mathematical procedures to the artists, but at the same time it doesn't condition their creative liberty or their vision of the world.
However II style paintings seem perspectives of represented architectures really according to the Renaissance rules: the problem it's to investigate if the ancients possessed and used in their works the perspective construction which we are familiar, or if the representations had casual character. In reality the ancient II style paintings repeat particularly a whole same scheme, even if with numerous and fanciful variations, that it makes us exclude entirely the hypothesis of a casual space's representation. The analysis and comparison of various architectures painted in II style was first noted a possible type of painting that is common to all the paintings of this style: a first layer that acts as a frame and that delivers the real representation, like a fake window open on the wall; a second layer where are the pillars that support an entablature or a blue ceiling; beyond this a colonnade surrounding a garden. You can talk about layered perspective or even broken in which the space is represented a results united more matters. At this point it is worth mentioning the Panofsky's theory that the ancients, especially in Hellenistic Roman, point out a prospective system, a curve perspective with vanishing axis only, which corresponds to the classical concept of space as discontinuous entity, place of conflict between bodies and space, as well as the flat perspective is in relation with the modern conception of the infinite and homogeneous space. It's certainly not easy to define the terms curved space of the ancients: If on the one hand, in fact the historical process leading first unification in the vanishing point for the single plan, then the integration, in the masters of the Renaissance, all orthogonal in space in a single point, you pay very well to the Cartesian notion of three spatial coordinates, on the other hand the ancient spatiality and perspective construction put us in front of a major complication; it seems rather that the classical antiquity has not achieved a consistent solution of certain difficulties that relate directly to the spatial problem, like those of the finite-infinite report. It has left those difficulties existed that they could find a solution through a progressive and radical modification of human spiritual attitude. Insufficient

domain of spatiality on a theoretical plan has its parallel in the inconsistency that is proper to the curved perspective, and in particular of that building with the axis of flight that must be occasionally masquerading as a fig leaf perspective. This contradiction of space's idea doesn't exclude some for antiquity to express a particular spatial feeling, well documented by the II painting style; and, in fact, the technique of representation of this space and the architecture define it to be the most interesting aspect of the paintings in II style. A representation that the Lessing in the ninth of his Antique Letters, in 1755, called perspective, stressing that deny the ancient perspective in its broadest sense it would be a true madness, because this would be tantamount to denying them the perspective, but the art of drawing in which they excelled.
In this sense it seems directed an authoritative tide of the most recent criticism, that recognizes to the ancients the mastery and the use of the modern perspective: Decio Gioseffi, for example, starts from a non recent wise man of Beyen, which, since 1939, reacting to the diffused conviction that the ancients didn't possess our perspective; he had wanted to show the knowledge both theorist and practice of it in the classical world, supporting itself to the testimony of some frescos Pompeian in II style, more or less properly constructed according to a vanishing point. Gioseffi has a new demonstration in this sense, demonstrating that despite the seriousness and methodological validity, however, reveals their own limits through the words of the author: in his essay Gioseffi explain that survivors old paintings with representations of buildings in the vast majority have no perspective if no approximations and partial reductions and scattered and uneven prospects the other, those strict, doesn't constitute a tiny minority and should not exempt themselves from referees and contamination. [8]
This acquisition becomes then for Gioseffi the starting point to continue in his demonstration: at a later time he faces the arduous task of demonstrating the uniqueness of perspective at all times and places of art history-from Pompeian painting to the byzantine, from Giotto to Alberti, Brunelleschi to Leonardo to Galli Bibbiena and prove the scientific validity and adherence to visual reality. Referring both to descriptive geometry and optics, Gioseffi proves the inconsistency of every scientific perspective curve: the demonstration is detailed, suspense and the basic axiom is that as the framework perspective and vision of a natural object give rise to the same image on the retina provided that in both cases there is monocular vision and eye property is the right distance. This kind of vision, therefore, is the base of the perspective representation of the antiquity, a representation that, while not supported by a strict injunction like the Renaissance, it is proposed in more variations as a scientific representation and adherent to visual reality.

3. The space of the image, the digital space[1]

The space represented in the Pompeii's frescoes is, therefore, the image of an illusory world, of an alternate reality to that tangible, with which, however, it interacts. In a magical play of overlaps, the real space enters into the picture, that precisely evokes, in the drawing, concrete elements with such fidelity of detail to make them almost materials. In contrast, the illusory space of the frescoes blends with the physical one, expanding its limits and simulating, in a depth often impossible to achieve, intangible environments that complete the real space. These representations, as Argan observes, "[...] indicate that the mind has the faculty to conceive a space beyond the limits that the static and the economy require to the architectural construction, and that the painting, in turn, can visually realize a space that the image can conceive, but that architecture can not achieve constructively". [9] Just this illusionistic interweaving, of the real with the virtual, makes the Pompeian pictorial art extraordinarily up-to-date: it proposes, anticipating of many centuries, the idea of being able to integrate the real architecture with the imaginative one, namely that of perspective drawing, thanks to the evocative power of painted images. However, analyzing in depth the relationship "[...] between the architectural space and the pictorial space, we see that the second does not replace the first, but follows and complete it without contradiction" [9].
The pictorial representation, therefore, allows to go beyond the physical limits of the wall that, almost like an interposed veil between the painter and the object – to say as Alberti –, marks the transition from the physical space to the image's space. So, the wall becomes an opened window above an immaterial space which, however, visually blends with the surrounding architecture. Yet, as said by Argan "[...] the theme of painted wall, as a diaphragm between the world of the true and what's verisimilar [...] aims not to replace an enclosed real space with an open and fantastic space, but to make the vision accessible, that is credible. [...] The miracle that painting realizes, through the ideal destruction of the wall, therefore, is not to throw open to the astonished eyes a wonderful and almost unbelievable vision, but to make it accessible and normal as an optical view [9].
The perspective drawings of architecture, in the Pompeian painting, explicit, then, the sense of interpenetration between reality and virtuality, typical of the latest systems of technological and visual communication of architectural space, but that has its roots far back in time. In fact, if already Plato, in the Myth of the Cave, distinguishes the true reality from that perceived, that is, made of shadows and objects' reflections, will be with the emergence of the perspective that this duality will find a real graphical translation. Albeit with some differences, obvious consequence of the potential linked to the new technologies, the architectural perspectives – both those intuitive, drawn by Roman and Pompeian artists, both those scientifically constructed by painters during the Renaissance – seem to anticipate the illusory world today proposed by the augmented reality, offering

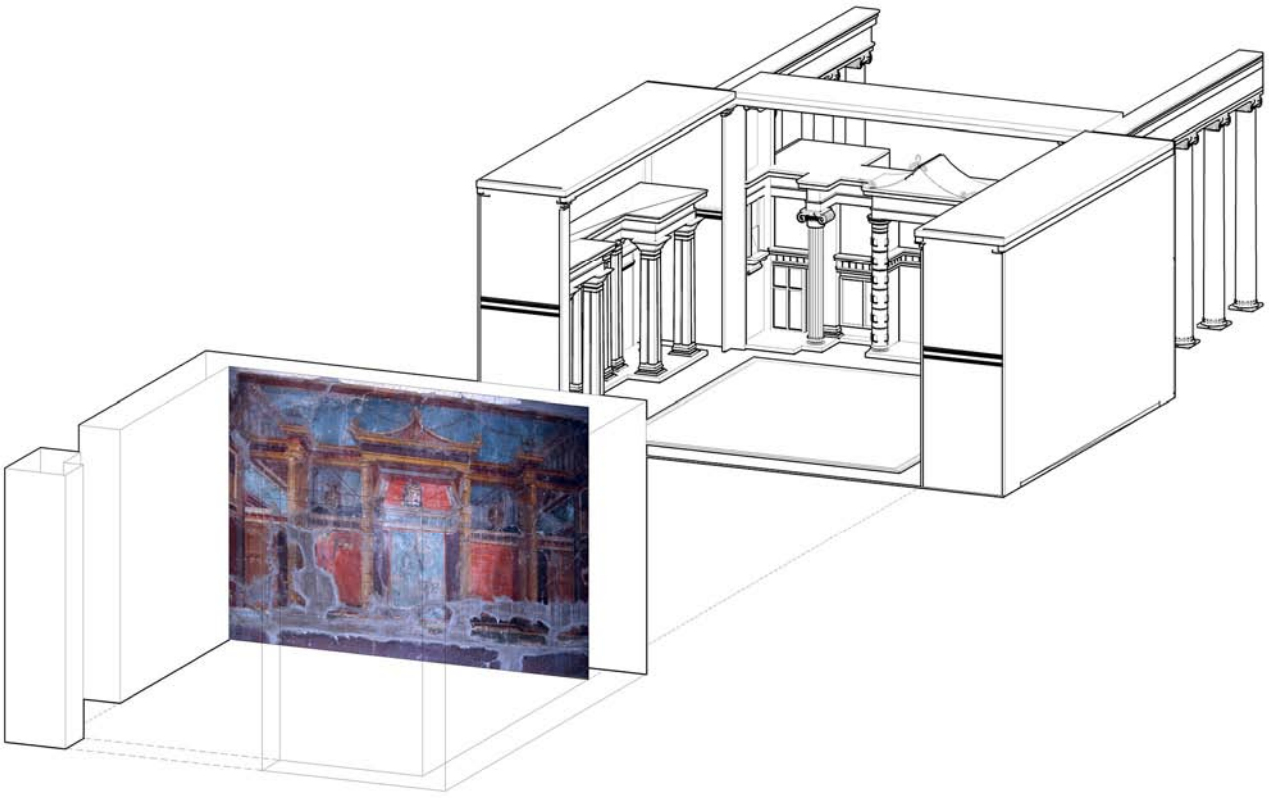

Fig. 5: Oplontis, villa of Poppea. The virtual space beyond the wall, in the "*Sala dei melograni*" (Processed by G. Manzo; coordination B. Messina, M.I. Pascariello)

the viewer the opportunity to participate in the painted space, or to enter an alternate reality than the physical. A reality, however – as noted by Maldonado – fully shared only if inserted in his "life space" [10]. Of course, the visualizing systems of the illusory reality that now we have, allow to produce infographical simulations – with greater accuracy and ease of use – that seem to destroy the fleeting boundary between the real world and the virtual one, superimposing digital information to the sensory reality. In fact, the augmented reality, precisely because of artificial vision's algorithms, makes visible, directly in the actual scene, a space designed and modeled only by computer graphics, which is therefore perceived as physically present. And, what's really significant, making the observer integral with the viewer of graphical interface, the augmented reality continuously acquires the scene and, simultaneously, analyzes and decodes information from the digital model, translating them in images, from time to time consistent with observer's point of view. Then, the overlap appears totally convincing, so much to lead to the conclusion that the two spaces, real and digital, are actually one.

Starting from these considerations, the presented research – which is part of a broader experimentation on visual communication's forms and dissemination of the Campania's pictorial heritage with an architectural subject, conducted within the PRIN 2010-11 – lingers, as already anticipated, the illusory spatiality of the frescoes' complex in the Poppea's Villa, at Oplontis, considered an emblematic example in order to determine what the role of the representation, in terms documentary, cognitive and informative. And, consequently, determine how, by exploiting the full potential of the graphical tool, you can identify appropriate strategies for prevention and enhancement of the investigated heritage. The presence, in the villa, of a heritage so rich in perspective scenes, or else strongly characterized by *ante litteram* virtual architectures, imposes the need to establish a scientific methodology that enables the correct use of three-dimensional architectures examined, digitally reconstructing not only their physical space, but also the illusory reality represented on the wall surfaces. That is, it is necessary to interpret, and then translate in infographical models, all the geometric and formal qualities of those fictitious architectures, ideally an integral part of the environments that incorporate them.

In order to reach the correct interpretation of spatiality evoked by perspective images, which are in many rooms of the villa, it appeared necessary to employ rigorous procedures of photogrammetry, by virtue of which we obtain all formal and metrical information, later useful to define the infographical models [11]. It should to note that to transform the projective image of the painted scene, in orthogonal projections we had to retraces, in reverse, the process of the space's drawing. And this process presupposes a critical approach, which often goes beyond the simple metrical interpretation derived through geometrical procedures.

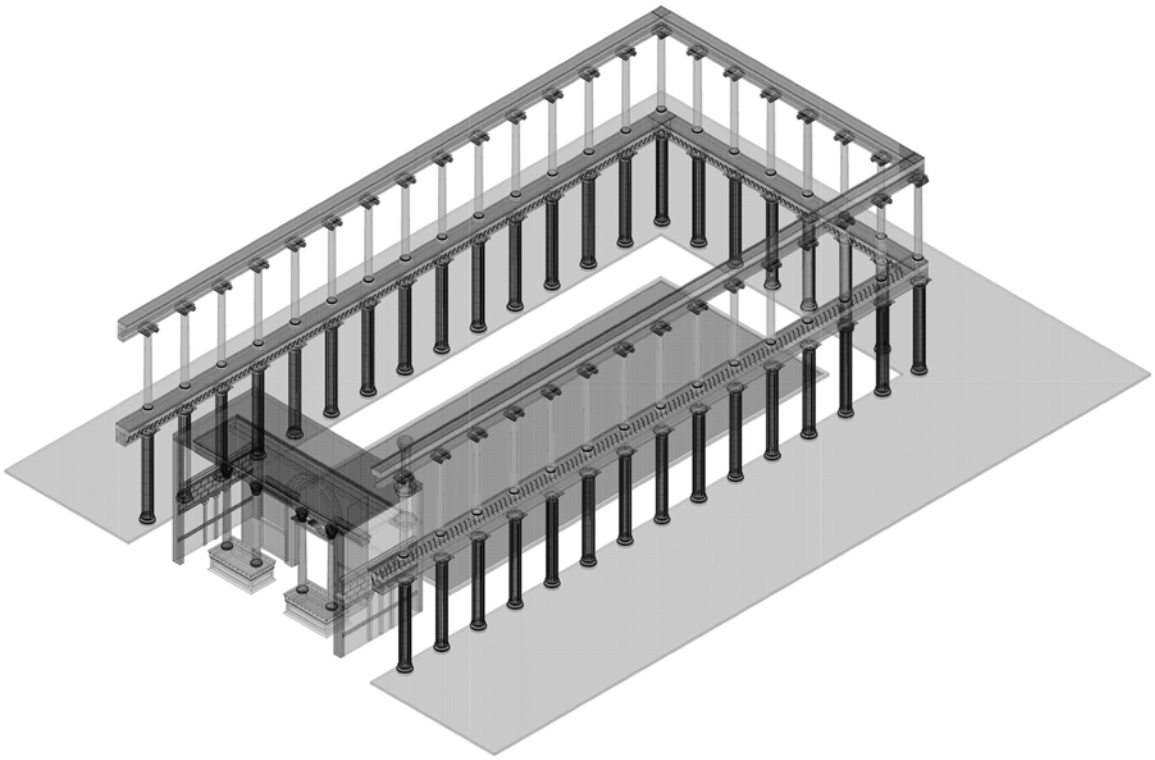

Fig. 6: Oplontis, villa of Poppea. A digital re-construction of the illusory architectures painted in the "*salone*" (Processed by G. Manzo; coordination B. Messina, M.I. Pascariello)

These are not photographic images with a unique point of view – which allows the use of automatic straightening techniques through specific photogrammetric software. In fact, on closer analysis, the Pompeian perspectives of Oplontis, although optically well controlled, show inconsistencies typical of the perspective images generally produced by the Roman art [12].
Obviously, this implies the need to intervene on the re-constructed space, refining the raw data, directly obtained by the photogrammetric process, or providing for the metrical correction of some elements, which are not consistent with the whole figuration, and that required to be resized in function of a module, taken as reference of the entire composition, but always in accordance with the architectural principles and rules theorized since Roman times. The volumetric interpretation of the designed spaces requires, in any case, a verification of the spatial coherence, with reference to the individual elements and of each part in relation to the whole. Only in this way it is hypothesized, that is, proceeding to the metric correction. In this way the illusory architectures, which sometimes would include not feasible spaces or clearly 'oversized' elements, can be made compatible with hypothetical real architecture [13], contemporary to structures that house them. Thus, the process of visual integration between the real and the simulated space is simplified.
Obtained the needed metrics information, the designed architectures were reconstructed in a computer graphics: the painted illusory space, so, achieves a physically perceptible three-dimensionality, even if only in the digital reality. In operational terms, it should be noted that the elaborated models, firstly, have been treated as *maquettes*, or were processed regardless of the material treatment and the texture's use, because at this stage it is considered necessary to emphasize the quality of the spaces, rather than the nature of the surfaces that make up those spaces. And, on the other hand, a scientific representation must allude to the architectural essence, objectively reconstructing its forms, its mutual relationships and the complexity of its spatial articulation. Only at a later time, or after having caught the sense of the designed space, we have intended to represent all its other perceptive qualities, with the intent of superimposing the digital image on the true reality, or to allow an immersive visualization of the virtual space.
In fact, thanks to the techniques and systems specific of the infographic representation, becomes possible to imagine to live those spaces. That is, in a space-time dimension, absolutely inconceivable at the time, highlight the composition and the design intents, that can be caught by moving in such architectures. Through digital modeling is possible to multiply the space, virtually adding to the real rooms of the villa those fictitious environments drawn in perspective, order to cross the walls' physical limit not only with the imagination, but by living these in a full perception which is characteristic of infographic reality.

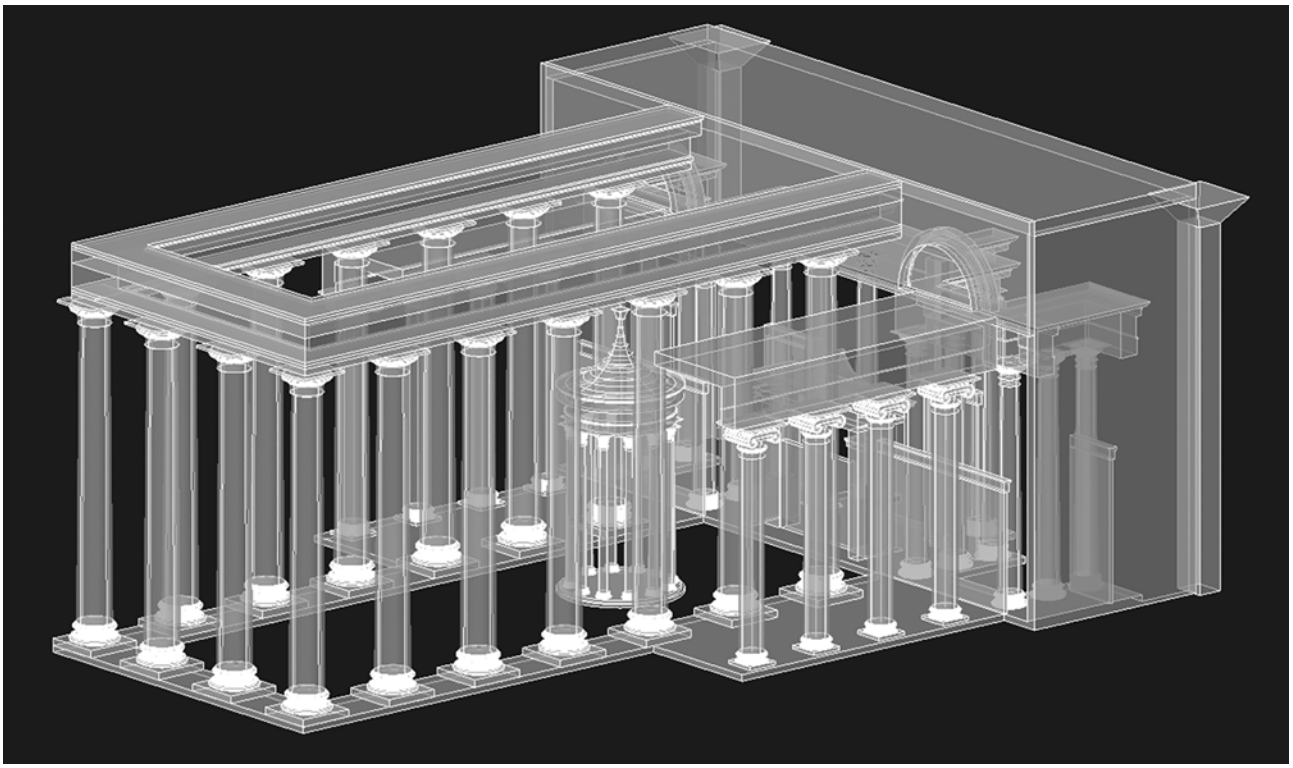

Fig. 7: Oplontis, villa of Poppea. An infographic representation of the imaginative space painted in the *triclinium* (Processed by G. Manzo; coordination B. Messina, M.I Pascariello)

And this, to arrive at a participated fruition of the visitor who, by virtue of a sensory involvement much more effective than the passive viewing of the painted scene, may understand in all its fullness, the artistic and graphic strength of a cultural heritage so sophisticated and valuable.

Bibliographical References

[1] Vitruvio. *De Architectura.* Milano: Giulio Einaudi, 1997, VII, 5, 1-8.

[2] ELIA, Olga. *Nota per uno studio della decorazione parietale a Pompei*. In *Pompeiana, raccolta di studi per il 2° centenario degli scavi di Pompei*, Napoli: Macchiaroli,1950.

[3] ADORNO, Pietro. L'arte italiana. Firenze: D'Anna, 1994.

[4] PLINIO IL VECCHIO, *Naturalis Historia*. Milano: Einaudi, 1985, XXXV, 50.

[5] WHICKHOFF, Franz. *Die Wiener Genesis*. Vienna, 1895.

[6] *Bell'Italia*, n° 26 Aprile, 1999.

[7] BRACCO, Vittorio. *Tra Ercolano e Pompei*. Roma: Newton Compton, 1982.

[8] GIOSEFFI, Decio. *Perspectiva artificialis. Per la storia della prospettiva; spigolature e appunti*. Università Degli Studi di Trieste, 1957.

[9] ARGAN, Giulio Carlo, *Pittura e architettura*, in Enciclopedia Universale dell'Arte. Novara: Istituto Geografico De Agostini, 1983, X, 626-635.

[10] MALDONADO, Tomàs, *Reale e virtuale*. Milano: Feltrinelli, 2005.

[11] DELL'AQUILA, Mariella, 2002. Lo spazio onirico e la sua rappresentazione. In DELL'AQUILA, Mariella, DE ROSA, Agostino, a cura di, *Realtà virtuale o visione reale?*. Napoli: Arte Tipografica, 2002, 95-124.

[12] PANOFSKY, Erwin, 1994. *La prospettiva come "forma simbolica", e altri scritti*. Milano: Feltrinelli, 1994.

[13] MIGLIARI, Riccardo, 2005. *La prospettiva e Panofsky*. Disegnare. Idee Immagini, 31, 2005, 28-43.

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Investigations on building techniques of the defensive walls in Kınık Höyük excavation (Turkey)

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Abstract
The paper presents part of a research about the walls at Kınık Höyük, a multidisciplinary activity carried out by researchers from universities of Italy, USA and Turkey.
Kınık Höyük is a mound in Southern Cappadocia, in which traces of a site inhabited for about 4000 years were found. The portion of the city walls in the northern part of the mound is quite important: it is characterized by a 5 m thick dry masonry and a well preserved mud plastering. Soon after the exposure to weathering, holes appeared in the plaster due to mud powdering; holes are arranged in horizontal rows at a regular distance (45 cm), inside of them fragments of wooden poles were found up to a depth of 70 cm.
The preliminary dating of the walls (archaeological stratigraphy and radiocarbon analysis on some fragments of poles) attributed them to the Late Bronze Age (XV-XII century BCE). At that time Kınık region was under the hegemony of Hittite empire, that in XIV century BCE codified rules (building techniques, materials and dimensions) for building fortifications in subjugated towns. Archaeological remains of Hittite cities support the existence of common building techniques for defensive walls, but Kınık walls seem to have different features.
The paper will investigate construction techniques in order to validate historical knowledge with the support of architectural surveys, analyses of mineralogical compositions and provenience of building materials, and comparison with coeval cases.

Keywords: archaeological heritage, building techniques, defensive walls, mud plastering, timber poles.

1. Introduction: excavations at Kınık Höyük
Archaeological excavations at Kınık Höyük are located in Southern Cappadocia, in the province of Niğde, at the foot of Melendiz Dağlari, a volcanic mountain north of the Bor-Ereğli plain [1] [2]. The region was strategically very important from prehistory to modern times due to its position on the main route connecting Central Anatolia to eastern regions (Cilicia, Syria, Mesopotamia), through the Taurus passes [1] [3]. Furthermore the territory of Kınık Höyük is rich in raw materials (gold, silver, tin, iron, obsidian, alabaster, marble), useful for a huge local production [4].
Therefore the region is important from historical, archaeological and geological points of view, even if it remained quite unstudied until 2006, when a research team from the University of Pavia (director: prof. Lorenzo d'Alfonso, research coordinator: prof. Clelia Mora) carried out an archaeological survey in the region (2006-2009) [5]. Afterwards the archaeological excavation at Kınık Höyük started as a joint project of the University of Pavia and the Institute for the Study of the Ancient World of New York University, with the participation of the Universities of Niğde and Erzurum [2] [6].

The earliest investigations on an area about 800 km^2 brought the research group to find 37 archaeological sites from the Chalcolihic to the Middel Ages [2], among which Kınık Höyük seemed to be the most important for the pre-Classical periods. Indeed the peculiarities of the site lead to suppose it had a key role in Southern Cappadocia in the period 1500-150 B.C.E. [5].
The archaeological site is a mound (in Turkish *höyük* means mound, hill [7]) that is c. 20 m high and 180 m in diameter. The remains of the citadel are at the top of the mound, but the presence of several ceramic sherds in the surrounding fields confirms the existence of a lower town [1] [3].
In 2010 magnetic and ground-penetrating radar surveys showed an elliptic structure, that was supposed to be the trace of a defensive wall [8]. Therefore in 2011 an excavation survey was made in north side of the mound and in a south-western part of it [9]; the southern survey revealed an interesting portion of the citadel walls.
The features of this part of the walls seem very interesting. Indeed it is made of irregular stones, but it preserves a plastering made of mud mortar. This kind of plastering have seldom been found and probably never in this good status of preservation, therefore it's quite significant in the field of ancient Anatolia building technology [4]. Another significant characteristic of this fortification is the presence of a rampart (a sloped embankment) laid against the walls and probably built in two distinct phases.
For this reasons, a deeper study on this structure was motivated and started in the summer 2013. The preliminary investigations concerned building materials and technology of the walls at Kınık Höyük, and the comparison with other Anatolian fortified structures found in archaeological excavations.
Thanks to these researches another peculiar feature of the walls was discovered: the presence of horizontal courses of timber poles laid in the masonry at a regular distance (45 cm).
These preliminary technical investigations are even more important if we take into account that a preservation programme and – in the future – a valorisation plan are necessary in order to ensure the in situ preservation of artefacts and therefore the possibility of further investigation and of gaining more knowledge.

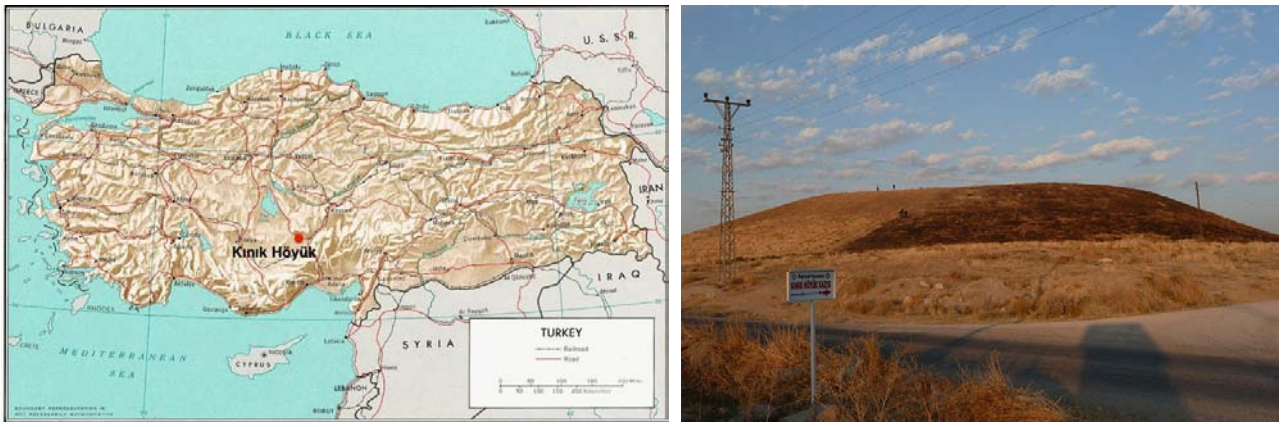

Fig. 1: The position of Kınık Höyük in Turkey and a photograph of the mound before 2011, when the archaeological excavations started (source: http://www.kinikhoyuk.org/).

2. An outline about the period between Late Bronze Age and Early Iron Age in Anatolia

To enable a historical contextualization of the specific subject of this research, a short excursus on the political conditions of the region is necessary.
In the period between Late Bronze Age and Early Iron Age, Hittite empire was one of the major political powers of Anatolian region. Before the establishment of the Hittite state (around 1650 B.C.E.), the supremacy on the central Anatolia was competed by a series of local principalities [10]. Studies on Late Bronze Age textual source suggest that the Hittite state had obtained almost immediately a wide power, that its territory expanded rapidly to neighbouring regions, that it made military expeditions in western part of Turkey, in Syria, and in upper Mesopotamia [10]. During this period in Cappadocia Hittites exercised their political control remaining in the balance between a total technical and cultural hegemony and an attempt of integration of the territories and subjugated populations [11].
Nevertheless – as the analyses of material evidences demonstrate – a cultural homogeneity and the total control over local entities were rarely achieved and they were probably only a goal of early imperial polities. Indeed this territory was a combination of diverse local economic and productive systems, that the empire aimed to integrate [12] [13].

After the fall of Hittite empire (around 1175 B.C.E.) South-eastern Anatolia was characterized by a multitude of local/regional centres – called neo-Hittite – with limited regional control as it can be deduced from the fortification of a plethora of citadels [11].

3. Syro-Hittite architecture of defensive walls

It's important to clarify the meaning of the terms Syro-Hittite, neo-Hittite, late Hittite and Aramean-Luwian that can be found in literature. All these phrase are used to label many urban centres sited «in a geographical area limited by the river Halys (north), the river Khabour (east), the Ad-duruz mountains (south) and the river seyhan (west)», whose growth process started in the late Bronze Age – when the above-mentioned area was mostly under the influence of the Hittite empire – and which later prospered during the first centuries of the early Iron Age [14]. During this period, the capital of the Hittite empire was Hattuša Boğazköy, in North Central Anatolia, some 400 km north of Kınık Höyük. At that time, Kınık was located in a region named the Lower Land, today known as Southern Cappadocia. It's not known whether this region was a province of the Hittite empire or at the edge of it [15]. Although this territory came in the Hittite sphere of influence very early, for a long period it was contended with the neighbouring kingdom of Arzawa

It's known that in Anatolia Hittites exercised their hegemony over conquered towns through a systematic construction of fortifications; in this context, the Hittite king Arnuwanda I (ca. 1400-1380 B.C.E.) issued a normative text – known as the instructions for the governor of the border posts [16] [17] – which codified building techniques, materials and dimensions of fortifications. Unluckily the text is damaged and incomplete, and many technical terms have not been deciphered yet; however this text is an essential evidence of the existence of written instructions on how Hittites used to fortify towns and it offers lots of useful information about that.

There is evidence of the fact that the text has been copied several times in the last 200 years of history of the Hittite empire. This suggests us two considerations: that at that time the fortifications spread considerably; that probably the buildings were built by local craftsmen (and not by itinerant skilled workers) to which it was necessary to provide specific instructions for a construction technique that they did not fully mastered. Furthermore archaeological remains from Hittite Anatolia seem to testify the existence of a common construction technique for town walls. Fortifications are usually built as casemate walls (i.e. an inner and an outer sidewall and spaced evenly transverse walls) with squared towers or bastions protruding at regular intervals outwards from the outer perimeter [18] [19]. Usually quarry stone masonry was used to build a base socle, while the upper part was mede of mud bricks; however – as the excavations of the gates at Kuşaklı Sarissa recently showed – was also possible the use of earth fill masonry and of timber [20]. This technique for fortification walls derived from Anatolian forerunners of the early second millennium, which are known from Konya-Karahöyük and Alışar Höyük. Later, as many excavations indicate, it became common in many centres of Central Anatolia, Upper Euphrates, and Cilicia (Böğazköy, Kuşaklı Sarissa, Alaca Höyük [21], Alışar Höyük, and Mersin [22] [23] in the south, Korocutepe and Arslantepe Malattiya [24] in the east).

Even if the types of stones employed in the construction of the citadel walls of Kınık Höyük are the same as in these Hittite fortifications, the use of cobbles and unhewn stone collected on the soil surface or in riverbeds (*Lesesteine*) instead of quarried and hewn squared stones or ashlars (*Bruchsteine*) calls to mind construction techniques in use in Anatolia in pre-Hittite period [23] [25].

The height of Kınık Höyük stone socle (ca 3,5 m) is major than in most of the other coeval fortifications of the region, yet an analogy can be found in the city walls of Alışar Höyük [22].

Alışar fortifications have another interesting feature: they are erected against a mound slope. Only further analysis will show whether or not Kınık walls are similar to Alışar ones under this point of view; indeed the investigation of the inner face of Kınık walls hasn't been carried out yet. The slope of the mound ensures that the stone socle height is uneven between the inner and the outer sidewall, the inner being only ca. 1 m high. The infill between the two sidewalls was made of earth and stones, only the top part (1 m high) was more regular and provided a platform for the mud brick superstructure which formed the upper part of the fortification [22]. Although the overall design of the fortification of Alışar and Kınık is similar, in the second the already-cited presence of wooden poles courses alternating with stone masonry makes the construction technique more complex and singular.

Furthermore, from a general point of view, the use of timber in the construction of coeval fortifications of the region has little evidence [22].

While in the later walls of Zincirli Höyük it's attested the presence of a timber frame laid on the stone socle to make a platform for the upper mud brick wall [26], the alternation of rows of timber poles with stone masonry is in Late Bronze Age fortifications is attested in the postern corridor of the western fortifications of Porsuk-Zeyve Höyük [27].

Between the techniques employed in Porsuk-Zeyve and Kınık Höyük some differences can be found, mainly due to differences in geological sites; indeed in Porsuk-Zeyve the masonry is made of hewed gypsum blocks quarried in a cave of gypsum beside the site of Zeyve. Nevertheless the use of rows of timber poles in masonry in these two Late Bronze Age sites of Southern Cappadocia suggests the presence of a common technical culture, perhaps due to the persistence of pre-Hittite construction practices. Indeed, at least in the

case of Kınık, it's evident that – even if the site is in a Hittite region – the construction technique is quite different from the one prescribed by Hittite governors and employed in other Hittite fortifications.
On the other hand the presence of mud plaster in the citadel walls of Kınık is a typical feature of pre-classical fortifications of Anatolia. However, as it is scarcely resistant to degradation due to weathering, without continuous maintenance mud plaster tends to disappear in a few years, hence in most excavated sites it was found only on small areas or not at all.
Therefore, the state of preservation of Kınık Höyük plastering can be considered exceptional, indeed only in the Early Bronze Age citadel walls of Troy II a similarly well preserved plastering was found [23]. However this fortification was excavated at the end of the 19th century, and today no more plaster is preserved.
Another analogy between the walls of Troy II and those of Kınık Höyük can be highlighted: in both of them not only the mud-brick elevation – as already attested in many sites – but also the stone socle of the walls was plastered; therefore the citadel of Kınık offers the material evidence of the permanence of this technique in 2nd Millennium B.C.E.

4. Kınık Höyük citadel walls

4.1 Ongoing investigations on building materials of the citadel walls

In-depth investigations on materials composition and use are useful both for the study of the history of these constructions, and because they supply an adequate knowledge base for future effective and compatible conservation works.
The investigations on building materials used for the construction of Kınık Höyük city walls started in 2013. During the 2014 excavation campaign, the research group started an investigation activity on materials used for mud bricks and plasters found in Kınık Höyük (prof. Massimo Setti, Dipartimento di Scienze della Terra e dell'Ambiente, Università degli Studi di Pavia). The survey cannot be considered closed yet, however the analysis already carried out through X-ray powder diffraction provided the first results on the mineralogical composition of the materials analyzed.



Fig. 2: Images of the samplings of mud plaster (two pictures on the top) and of the rampart (two pictures on the bottom) (photos: Massimo Setti).

Three types of materials were analyzed: plasters, mud bricks, and (in order to compare the results of the analysis of building materials with the mineralogical composition of the earth present on the site) a sample of loose soil collected at the foot of the rampart. The most common decay/alteration forms are: powdering, sanding, splittering, and missing of parts (of plaster, mortar, mud-bricks, …).
For the research discussed in this paper, the investigation on the mineralogical composition of mud plaster and of the materials used for the rampart are quite important. The results of the analysis revealed that all of these materials have a very similar mineralogical composition and contain the same components, with variation in proportions. Indeed, the present materials are: quartz, cristobalite, trydimite, feldspar, calcite and a minor amount of mica, pyroxene and gypsum. The most important information is the lack of a quantity of clay capable of carrying out a binding function for the earth mixture, we must therefore hypothesize that the cohesion of the materials is due to other mechanisms, which can be clarified only by further analysis.
Another important investigation field concerns the dating of the walls. From the relative chronology based on stratigraphic data it was possible to get a first hypothetical dating, however this date was later corroborated with methods of absolute chronology derived from the ^{14}C analysis of wood fragments found in one of the holes in the visible face of the wall during the 2013 campaign (Catherine Kuzucuoğlu, Laboratoire de Mesure du Carbone 14, CNRS, Saclay, France). This analysis gave a date 3160±50 B.P. (15th-14th century B.C.E.), completing the preliminary analyses on the diagnostic sherds dated to between the Late Bronze Age (L.B.A.) and the Early Middle Iron Age (ca. 1300-900 B.C.E.) [4] [28]. After the 2014 campaign ^{14}C analysis have been carried out also on charcoal samples taken from the rampart.
The whole of these investigations supported the preliminary assumptions made on the presence of two different construction phases of the structure: the wall dates back to a period around 1400 B.C.E., while the rampart was built later, between 1000 and 800 B.C.E.
Additional analysis on wood fragments found in the inside of the walls are in progress, in order to recognise the wood species and from that draw useful information to better understand the original function of those timber elements (Lorenzo Castellano, Institute for the Study of the Ancient World, New York University).



Fig. 3: Top row, from left: fragments of wood in a hole into the mud plaster of Kınık Höyük citadel walls (photo: Uğur Yalçinkaya); the first portion of the wall excaved in 2011 with some revealed holes in the plastering (photo: Marco Capardoni); the rampart in 2014 (photo: Massimo Setti). Bottom row, from left: status of façade of the revealed portion of citadel walls at the beginning of July 2013 (photo: Valentina Cinieri); ongoing excavation of the rampart at the end of July 2013 (photo: Uğur Yalçinkaya), ongoing excavation in summer 2014 (photo: Massimo Setti).

4.2 Architecture and building techniques

After that in 2010 magnetic and ground-penetrating radar surveys showed the presence of a wide elliptical ring structure inside the mound, the research group supposed that it could be the trace of an ancient fortification [29]. In 2011 an excavation survey in a south-western part of Kınık Höyük confirmed this hypothesis revealing a 3,5 m high stone masonry socle; in analogy with other coeval fortifications of the same area, the presence of a mud brick superstructure on the top of the stone socle was supposed even if no remains of it were found [30]. However during the 2014 campaign the excavations have brought to light some portions of mud-brick masonry, which are probably part of the original crowning of the city walls.

Currently the exposed part of the walls is about 4 m thick as a whole, but it's composed of two 70 cm thick side-walls, and an infill made of unshaped stones with various sizes irregularly laid leaving many voids. From the observation of the already excavated part of the walls is impossible to affirm whether or not transversal walls – typical of the casemate construction system – are present.

Presently excavations have brought to light only the northern façade of the walls, which is the face of the external side-wall; instead the façade of the walls towards the citadel is still hidden by later remains, however some parts the internal sidewall can be seen, since in antiquity the infill was plundered and probably used as a quarry to get stones for building the Hellenistic constructions found on the top of the hill [2].

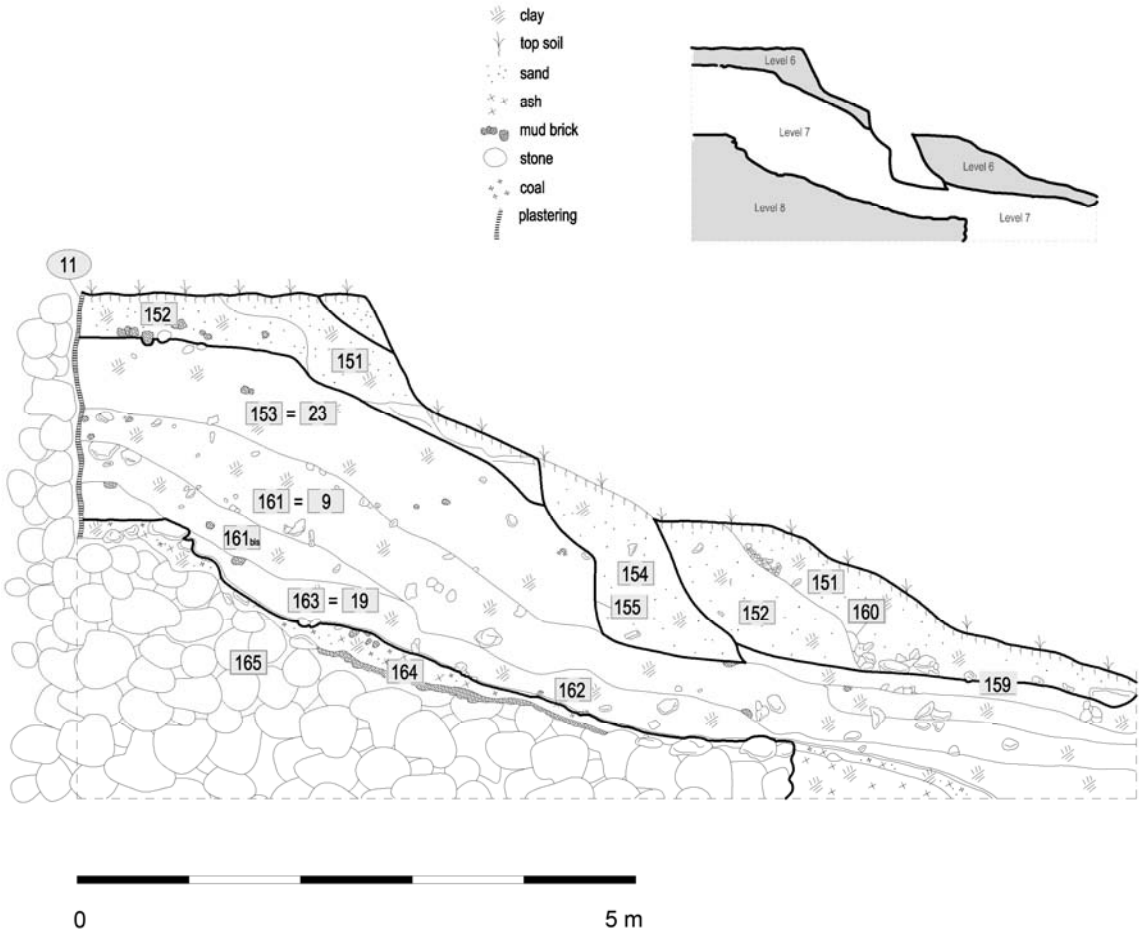

Fig. 4: Stratigraphic study on the western section of the excavation site of the walls (survey and drawing by Leonardo Davighi).

In 2011, when excavations began, archaeologist brought to light a small part of the external façade of the walls which was protected by the mud plaster. Soon after the exposure to weathering, some holes appeared in the plaster and revealed the presence of voids inside the masonry. However only after the successive excavation campaigns – when the excavated part of the walls was widened – a clear survey of the position of the holes was possible, and it appeared clearly that the holes were quite regularly disposed in horizontal rows vertically spaced about 45 cm from each other. Furthermore the holes have a diameter of 5÷10 cm and inside them traces of severely decayed timber were found. In horizontal the centres of the holes were about 15 cm distant from each other, and remains of these timber elements were found up to a depth of about 70 cm in the masonry, measure which corresponds to the thickness of the side-wall and that leads us to affirm

that these wooden elements crossed at least the entire thickness of the side-wall. Between one hole and the other a mortar made of mud and gravel was found.
A rampart is present in adherence to the north façade of the walls; this structure is made of two different phases, the first about 2,50 m high and the second about 2 m high; the two together hide a 4,50 m high part of the walls.
As a synthesis of the surveys and analysis carried out, we can say that each side-wall is made of large cobbles and unhewn stone but that these principal elements were quite well arranged filling the voids with stone chips and mud mortar; the stones are bigger at the base of the structure decrease of measure in the upper part, possibly for static reasons; the masonry is divided in horizontal “strips” by the courses of timber poles incorporated into the wall. The materials used in the construction of the walls have a volcanic origin: masonry is made of andesite and basalt stones and local earth with volcanic minerals and volcanic glass is used for mud mortars and bricks. Furthermore these materials are locally sourced, indeed – as geological investigations report – the territory around the site is characterized by: colluvial slopes generated by the accumulation of andesitic and basaltic rock fragments from nearby volcanoes; alluvial and lacustrine plains composed of flat and carbonate silts [28]. As said additional analysis on the timber are needed for their characterization, in particular to understand whether or not the employed species have differentiated heartwood.



Fig. 5: On the left: top of the excavated remains of the walls in which it is possible to see the core of unhewn stones and the external side-wall. On the right, from top: projectiles stones found in the excavations near the walls; detail of some fallen mud bricks, probable residual elements of the superstructure of the walls.

The plasticity of mud mortar and the periodic renewal of plaster make so that it's not possible to detect any sign of the settlements that certainly occurred over time due to the progressive degradation of timber elements included in the masonry. Furthermore the presence of mud mortar placed between the log residues inside the masonry can lead to two possible interpretations: the first is that since the beginning timber elements have been put in place separated by mortar strings; the second – in our opinion the most likely – is based on the assumption that the logs had differentiated heartwood and that originally they were placed in adherence to one another, later as the sapwood gradually decayed and began to leave voids, these were

gradually and intentionally filled during plaster maintenance. This second hypothesis seems more likely because the utility of 5 cm thick timber elements is extremely dubious, on the contrary elements of about 15 cm in diameter could have a substantial structural effectiveness.
However, the function of the logs in the masonry is still unclear. Since the distance between the rows is very short, – and since the walls had a defensive function – a relation with scaffoldings for construction and maintenance of the plaster coating seems unconvincing. Otherwise timber elements could play the role of diatones, "tying" the masonry in its thickness, however further investigations should aim to verify the possible presence inside the wall of longitudinal beams, that – linked to the already surveyed transversal wooden elements – would have formed a very effective system of seismic reinforcement.
Since the ^{14}C analysis showed that rampart was made a few centuries after the walls – a time in which timber elements were probably already decayed causing significant settlements in the masonry – we can assume that the rampart was built not only for a defensive purpose (it could prevent war machines from approaching the city walls in case of siege), but also for the strengthening of the walls, as assumed also for other examples of fortifications built using similar construction techniques [31].

5. Conclusions

The archaeological heritage is characterized by the fact that buildings are not used, but they are the residual testimony of historical evolution of a civilization.
Studies on evolution of building techniques have a preeminent importance in researches on ancient civilization, since the knowledge of architecture – to be intended as a technical and cultural fact – and of its developments allow to deepen the knowledge of reconstruct the technical, economic and – in summary – social context of a people in its settlements [32] [33], just like the more common analysis of other artefacts (e.g. ceramic remains) [34].
For example, the construction of city walls fitness the need to defend a settlement; the upgrade of this fortifications attest the permanence in time of this need and the evolution of obsidional techniques. Thus the study of fortifications enables many considerations about the history of the populations [31]; the decision to make a important fortification testifies to the relevance of a settlement, for example as a control point of a line of communication and trade.
Ongoing investigations have already resulted in several information on the construction of the walls, however they are only partial and temporary results and only the continuation of excavations and researches will allow to draw more in-depth conclusions.

Bibliographical References

[1] Balatti, Silvia. Balza, Maria Elena. Kınık Höyük and Southern Cappadocia (Turkey): Geo-archaeological activities, landscapes and social spaces. In Hofmann R., Moetz F.K., and Müller J. (eds.), (eds), *Tells: Social and Environmental Space*, Bonn, 2012, vol. 3, p. 93-104.

[2] http://www.kinikhoyuk.org/progetto.html

[3] Matessi, Alvise. Capardoni, Marco. Lanaro, Anna. Excavations at Kinik Höyük: a preliminary report on the first season (aug. – oct. 2011). In *Proceedings of the 8th International Congress on the Archaeology of the Ancient Near East*, Warsaw, in press, p. 1-19.

[4] Cinieri, Valentina. D'Alfonso, Lorenzo. Morandotti, Marco. Building techniques of fortified structures inn Kinik Höyük archaeological excavation (Turkey). In Peña, Fernando, Chávez, Marcos (eds), *SAHC2014 - 9th International Conference on Structural Analysis of Historical Constructions*, Tlalpan: Sociedad Mexicana de Ingeniería Estructural AC., 2014, p. 1-12.

[5] D'Alfonso, Lorenzo. Mora, Clelia. "Viaggi anatolici" dell'Università di Pavia. Rapporto preliminare della prima campagna di ricognizione archeologica nella Tyanitide settentrionale (2006). In: *Atenhaeum*, 2007, n. 95, p. 819-836.

[6] D'Alfonso, Lorenzo. Mora, Clelia. Il progetto di Kınık Höyük. Missione archeologica e ricerche storiche in Cappadocia meridionale (Turchia). In *Atenhaeum*, 2012, n. 100, p. 529-538.

[7] http://it.wikipedia.org/wiki/Tell

[8] D'Alfonso, Lorenzo. Mora, Clelia. Missione archeologica in Cappadocia meridionale: campagna 2010. In *Atenhaeum*, 2010, n. 99, p. 549-564.

[9] D'Alfonso, Lorenzo. Mora, Clelia. Missione archeologica a Kınık Höyük. Uno sguardo d'insieme a conclusione della seconda campagna di scavo (2012). In *Atenhaeum*, 2013, n. 101, p. 693-708.

[10] Glatz, Claudia. Plourde, Aimée M. Landscape Monuments and Political Competition in Late Bronze Age Anatolia: An Investigation of Costly Signaling Theory. In *Bulletin of the American Schools of Oriental Research*, n. 361, 2011, p. 33-66.

[11] Trameri, Andrea. Preliminary investigations at Kınık Höyük (Southern Cappadocia): The Late Bronze-Early Iron Age Transition in Southern Anatolia. In *SAA Annual Meeting (Austin, Texas; April 27th 2014)*, in press.

[12] Glatz, Claudia. Bearing the marks of Control? Reassessing Pot Marks in Late Bronze Age Anatolia. In *American Journal of Archaeology*, vol. 116, n. 1, 2012, p. 5-38.

[13] Glatz, Claudia. Empire as a network: Spheres of material interaction in Late Bronze Age Anatolia. In *Jpurnal of Anthropological Archaeology*, n. 28, 2009, p. 127-141.

[14] Pucci, Marina. Enclosing Open Spaces: The Organisation of External Areas in Syro-Hittite Architecture. In Maran, Joseph. Juwig, Carsten. Schwengel, Hermann. Thaler, Ulrich (eds.). *Constructing Power-Architektur, Ideologie und soziales Handeln, Münster*, 2006, p. 169-180.

[15] Mora, Clelia. Sudies on Ancient Anatolia at Pavia University, and the Hittite Lower Land. In d'Alfonso, Lorenzo. Balza, Maria Elena. Mora, Clelia (eds.). *Geo-Archaeological Activities in Southern Cappadocia, Turkey*, Pavia: Italian University Press, 2010, p. 13-25.

[16] Pecchioli Daddi, Franca. Il vincolo per i governatori di provincia, Pavia: Italian University Press, 2003.

[17] Miller, Jared L. *Royal Hittite Instructions and Related Administrative Texts*, Atlanta: Society of biblical litetarure, 2013.

[18] Seeher, Jurgen. *A mudbrick City Wall at Hattuša*, Istanbul: Yayinlari, 2007.

[19] Schachner, Andrea. *Hattuscha. Auf der Suche nach dem sagenhaften Großreich der Hethiter*, München: C.H. Beck, 2011.

[20] Mielke, Dirk Paul, Alte Paradigme und neue Erkenntnisse zur hethitischen Holz-Lehmziegel-Architektur. In *Byzas*, n. 9, 2009, p. 81-106.

[21] Mielke, Dirk Paul. Key Sites of the Hittite Empire. In Steadman, S.R. McMahon, G.(eds.), Ancient Anatolia 10000-323 BCE, 1031-1054, Oxford: The Oxford Handbook of Ancient Anatolia., 2011.

[22] Naumann, Rudolf, *Architektur Kleinasiens*, Tübingen: Verlag Ernst Wasmuth Tübingen, 1955.

[23] Jean, Eric. The Hittites at Mersin-Yumuktepe: Old Problems and New Directions. In *Byzas*, n. 4, 2006, p. 311-332.

[24] Alvaro, Corrado. The Architectural Sequnce at Malatya during the Hittite and neo-Hittite Period: A Proposal. In *Proceedings of the 8th International Congress on the Archaeology of the Ancient Near East*, Warsaw, in press.

[25] Seeher, Jurgen. Die Techniken der Steinbearbeitung in der hethitischen Architektur des 2. Jahrtausend v. Chr. In *Byzas*, n. 9, 2009, p. 119-156.

[26] Pucci, Marina. *Functional Analysis of Space in Syro-Hittite Architecture*, Oxford: British Archaeology Reports Ltd., 2010.

[27] Beyer, Dominique. From the Bronze Age to the Iron Age at Zeyve Höyük/Porsuk: a Temporary Review. In d'Alfonso, Lorenzo. Balza, Maria Elena. Mora, Clelia (eds.). *Geo-Archaeological Activities in Southern Cappadocia, Turkey*, Pavia: Italian University Press, 2010, p. 97-109.

[28] Gürel, Ali. Lermi, A. Pleistocene-Holocene Fills of the Ereğli-Bor Plain (Central Anatolia): Recent Geo-Archaeological Contribution. In d'Alfonso, Lorenzo. Balza, Maria Elena. Mora, Clelia (eds.). *Geo-Archaeological Activities in Southern Cappadocia, Turkey*, Pavia: Italian University Press, 2010, p. 55-68.

[29] D'Alfonso, Lorenzo. Mora, Clelia. Missione archeologica in Cappadocia meridionale: campagna 2010. In *Atenhaeum*, 2010, n. 99, p. 549-564.

[30] D'Alfonso, Lorenzo. Gorrini, Marilena. Mora, Clelia. Archaeological Excavations at Kınık Höyük. Preliminary Report of the third Campaign (2013). In *Athenaeum*, n. 102, 2014, p. 565-285.

[31] Spreafico, Gilberta. I sistemi difensivi di Bronzo Antico in Palestina: tecniche architettoniche e sviluppo tipologico. In Di Ludovico, Alessandro. Nadali, Davide. *Contributi e materiali di archeologia orientale X. Studi in onore di Paolo Matthie presentati in occasione del suo sessantacinquesimo compleanno*, 2005, p. 303-329.

[32] Cinieri, Valentina. Zamperini, Emanuele. Arquitectura vernácula: memoria y protección. El caso italiano desde el abandono hasta el reconocimiento de un nuevo patrimonio. In Vieira de Andrade, Nivaldo. Huapaya Espinoza, José Carlos (eds.). *Encontro Internacional Arquimemoria 4. Sobre Preservação do Patrimônio Edificado. A dimensão urbana do patrimônio*, Salvador - Bahia, Brasil: IAB-BA, 2013.

[33] Cinieri, Valentina. Zamperini, Emanuele. Il recupero di un patrimonio intangibile: la cultura tecnica delle maestranze edili. In D'Agostino, Salvatore. Fabbricatore, Giulio (eds.). History of Engineering. Proceedings of the International Conference. Vol. 1. Napoli: Cuzzolin, 2014, p. 475-486.

[34] Dezzi Bardeschi, Chiara. Materiali da costruzione e tecniche edilizie nel Vicino Oriente antico: problemi, metodi ed obiettivi. In Marino, Luigi. Pietramellara, Carla (eds). Tecniche edili tradizionali, Firenze: Alinea, 1999, p. 81-84.

HERITAGE and TECHNOLOGY
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Surveying and Restoration of St. Basilio Monastery in L'Aquila

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Abstract
The monastery of St. Basilio is in the northern of the historic center of L'Aquila, near the town walls. The complex has a medieval origin, and the church and the buildings have a system dating from the fifteenth century. In the eighteen century an expansion was realized, made by a long building on the homonymous square; at the same time the church was reconfigured in late baroque style.
This intervention – attributed to Cipriani – has significant importance according to typological experimentation and architectural quality, with particular reference to the solution of the facade. The earthquake of 2009 caused significant damage. The eighteenth century building, together with a part of the medieval cloister, homes the convention center of the L'Aquila University.
The paper, after an overview of the monastic complex, deals with the issue of the restoration and re-use of the portion owned by the University. The topics are: integrated surveying; 3D modeling; metrical and proportional study; the historical-critical analysis with the expression of the aesthetical and historical value's judgment; the analysis of the constructive system and of degradation; the project of reparation and mitigation of seismic vulnerability; the architectural restoration project according to the guidelines of the critical conservative restoration; the theme of urban restoration that necessarily involves the square, seriously compromised in its perception of space-square by the interventions of the twentieth century.

Keywords: architectural heritage; surveying; modeling; historical critical analysis; restoration.

1. The urban context
The St. Basilio nunnery is located in the northern part of Aquila's historic centre, within and partly against the perimeter of the medieval walls.
The complex is composed of the original 15th century church and cloister plus the expansion built after the 1703 earthquake, which includes a long "sleeve" onto the square that makes up the fifth building in the large urban open space.
The St. Basilio nunnery is nestled in a network of intramural urban gardens along with the St. Agnes nunnery (which is now partially incorporated into the former San Salvatore hospital), and both butt against the city walls.
The area changed in the 1930s, most notably with the construction of the hospital and its adjacent buildings, such as the Antituberculosis Dispensary – Ex ONMI (1935) and the Hygiene Dispensary (1939). The interventions listed, particularly those connected with the opening of the Viale Duca Degli Abruzzi in 1933, resulted in a substantial transformation of the area [6]: from an open area facing the town to a space concentrated in the square in front of the nunnery. The overall perception of the complex of St. Basilio also changed: today the square forces an axial vision of the 18th century "sleeve" – and a partly demeaning one for the church façade which is almost hidden – but until the 19th century the complex was defined by a broad perception created by the wide space between the two nunneries facing each other ("clogged" and altered during the 1930s, as already mentioned), and above all by the absence of the current trees. In particular, the main route giving access to the area was the Via Cascina, which offered a glimpse of the St. Basilio nunnery [8]. This "point of view" is shown in a photo from the early 1930s, depicting the area prior to the clearing being clogged with buildings built in the first half of the twentieth century.



Fig. 1: St. Basilio Monastery in L'Aquila. Aerial view and facade.



Fig. 2: Internal views of the halls at the ground floor and at the first floor.

This figurative significance is fully justified in the accurate architectural definition of the short façade of the 18th century section, which the adjacent new building made inaccessible.
The tree planting of the 1930s and 1940s also negatively influenced the current overall structure of the piazza, as they cover the façade of the 18th-century sleeve, denying it the role of being the fifth stage [22]. In addition, the trees contribute to surface degradation because they stand near the building and there is illegal parking on the garden paths.
In the overall restoration project, which necessarily falls within the urban context, one would therefore need to think of an environmental restoration, transferring the tall, healthy trees somewhere else, removing the asphalt and parking, as well as the incongruous buildings, and let the whole area in front of the main façade turn to grass again, in order to give back the fundamental characteristic of urban space to the piazza and full perceived usability to the façade.

2. The history

The first records of a settlement of a female order, founded by St. Equizio and dedicated to St. Basilio, dates back to the end of the 5th century, but it was likely located at another site [19].
The next record is of a nunnery in 696 and the consecration of a church in 1112 [14]. Archaeological excavations conducted in 2003 unearthed a place of worship in the shape of a singular rectangular room flanked by contemporary tombs. The remains spread from the area next to the walls up to the piazza opposite, underneath the main 18th-century expansion, and are dated to between the 10th and 12th century at the most, thus at least a century and a half before the founding of the city [15].
The first certain date referring to the current nunnery is from 1320 [21], a few years after the 1315 construction of the city walls, against which St. Basilio leans.
There is mention of some works in the 15th century, and in particular the restructuring measures taken after the earthquake of 1461-1462, when the nunnery passed under the jurisdiction of the Collemaggio and Santa Maria dei Raccomandati abbesses. This was when the cloister was built [14]. The prestige of St. Basilio is testified by the record that towards the end of the 15th century the widowed Maria Pereyra Camponeschi, a member of Pope Paul IV's family, retreated to the nunnery (1489) and was subsequently visited by Giovanna d'Aragona in 1493.



Fig. 3: Historical maps of the area (the current buildings are red colored).



Fig. 4: Historical photographs of the monastery before the realization of the buildings in the Thirties.

An expansion of the nunnery possibly took place in the 17th century, and in developing the activities of the college, which was dedicated to the daughters of the nobility, the institute played a role in the city's social dynamics, even gaining significant prestige. Queen Joanna of Bourbon was also hosted at the nunnery [1, 16].

The 1703 earthquake damaged the complex. The new arm stretching onto the square was part of the rennovation initiatives after the earthquake, and is attributed to Sebastiano Cipriani [12] [17]. However, probably due to Cipriani's death (circa 1740) the new building was not finished. This is seen, for example, on the jamb of the ground floor portal, which is located between the halls next to the chapel, and inscribed with the date 174(2?). This date could lead one to imagine that the building may have been left incomplete exactly at this point, and this hypothesis is supported by two other observations: the different geometry of the ceilings of the adjacent rooms and the fact that the divisional wall, where the date is inscribed, partially conflicts with the rhythm of the windows of the main façade, ending at the edge of the void.

A 1729 notarial act tells how two altars were entrusted to Rocco Cicchi from Pescocostanzo by the church [10, p. 1397], which suggests that the complex could be linked to that date [1, p. 111], especially in view of the fact that in 1759 the Celestini appointed the maestro Donato Rocco Cicchi from Pescocostanzo to finish the works ([10, p. 1400, note 15]. Cicchi may have played a role in the definition of the first floor, in particular in the design of the architectural split, because, as Vicari observes, the "broken curvilinear gable so insistently used in St. Basilio" is not found in other works by Cipriani in Aquila [23, p. 205].

At the dissolution of the religious orders and the incorporation of their assets into state ownership following the Napoleonic laws (1866-87), the nunnery lost its juridical personality, even though the nuns themselves were not expelled so as to safeguard the activities of the thriving women's college.

In 1915-18 the nunnery was requisitioned for military purposes, and in 1932 the nuns returned, buying back a portion of the building from the city of Aquila.

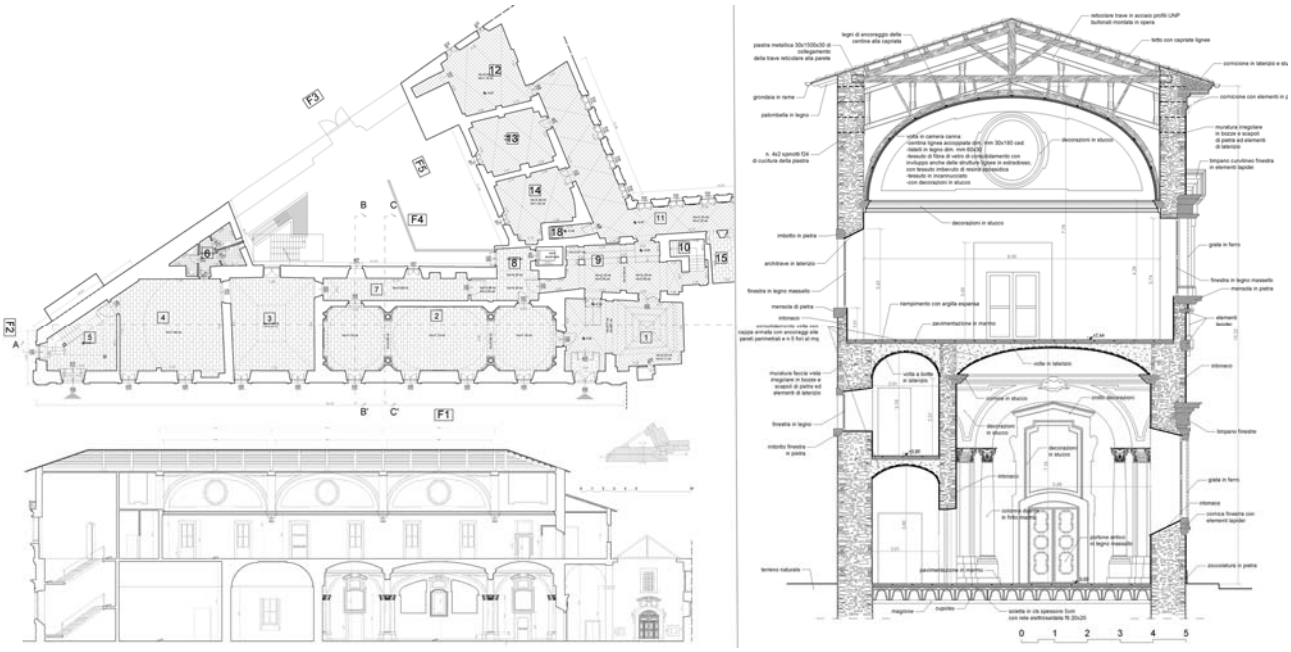

Fig. 5: Ground floor and longitudinal section of the eighteenth century expansion. Constructive system.

In 1948 the religious community's educational activities resumed with a boarding school called "Mater Domini." In 1975 the educational activities ceased and in 1988 a retirement home for women was opened [14].
A number of minor masonry interventions can be dated back to the time when the nunnery was used as a barracks, in particular those linked with the use of bricks. While the construction of the reinforced concrete staircase in the hall on the San Salvatore hospital side can be dated to the 1940s.
In the postwar period, the part of the building belonging to the city was used as a school, resulting in functional adaptations and in particular the partitioning of the room on the first floor to make classrooms.
In the 1990s, following an agreement between the city and the University of Aquila, the public part of the building was given on loan to the university, who restored it in the early 2000s as a Conference Centre named after Luigi Zordan (inaugurated in 2005-2006).
The 2009 earthquake damaged the masonry and arches – in particular triggering the rotation of the façades outwards – and the architectural apparatuses, causing cracks, a detachment, and the fall of stuccoes and part of the arches with supporting decorative trelliswork.

3. The 18th-century expansion

After the earthquake of 1703, the eighteenth-century addition gained particular prominence, extending into the nunnery and reconfiguring the urban space.
With the blind attic and bracketed cornice, the façade is in three tiers, and a string-course fascia runs up to the shutters of the first floor windows, where pilasters evoke faux balconies. The layout, bordered by angular pilasters, is divided into 10 pitches by the window spans. The 18th century building is also mentioned in Moretti and Dander's book for its architectural quality [13, p. 124-125].
The entrances are at the two extremes: the one near the St. Basilio church leads into a space, which was originally a heath but subsequently covered in glass during the 2003 restoration, and the other one into a hall with a staircase.
The 18th intervention assumes particular importance, both for its architectural quality and for its peculiar urban area solution: the façade represents a sort of convent-palace, expression of cultural vitality, social prestige and the economic success of the Celestino order, and in particular of this nunnery, in the 18th century. And the importance given to the construction of the new façade is shown by its inclusion despite the conflict it creates with the pre-existing church façade, which it subordinates. The desire to reconfigure the old clearing between St. Basilio and St. Agnes seems therefore obvious.
On the ground floor, the eighteenth century part of the building successively presents: an access courtyard, a single hall chapel with three bays, two rooms, and a hall with stairs at the top. On the first floor there is a large hall, which extends almost throughout the building. All rooms are vaulted, with arches that are "solid on the ground floor", and with supporting, decorative trelliswork on the first floor.
The city ownership extends to the 16th century part of the building, where the arcade of the cloister enclosed with windows serves as distribution spaces. Here, too, there are two levels. The architectural elements and

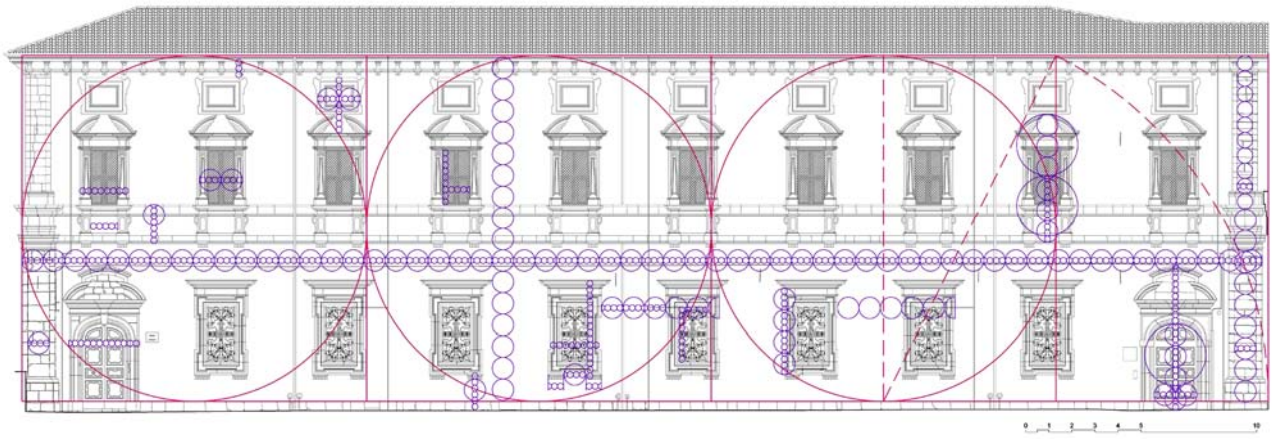

Fig. 6: Proportional and metrical analysis of the facade.

the fresco in the loggia on the first floor are evidence of the 16th century installation. The rooms on the ground floor are covered with solid brick vaults, on the top floor with a trussed roof and, in some rooms, with light vaults with supporting, decorative trelliswork.
From the distribution point of view there are two staircases, at the two extremes of the building and next to the two entrances from piazza.
The metrological and proportional analysis of main façade in particular allowed for an in-depth study of the design logic and realization phases. The main façade of the baroque St. Basilio palace has a precise compositional order. The proportioning layout is based on a dimension equal to the distance between the wainscoting and the corona. This module repeated several times, together with its golden section, determines the total length of the façade.
The compositional scheme is measured in Neapolitan spans (a span equals 26.45 cm). The pilasters of the lower row of the prospectus are measured on a 3.5 span module. The same module is used again in the measuring of the entire façade and of the two rows of the overlapping windows, and scans the distance between the window frames of the lower row. The second row pilasters have a 2.5 span module.
Despite the presence of a precise and accomplished compositional pattern, characterized by an alignment and the scanning of the openings according to the same format, there is not a perfect symmetry of the façade due to a pre-existing sixteenth-century façade on the right, which has an expansion of space between the penultimate and the last opening in the façade.

3.1 The 2003 restoration

The 2003 restoration was carried out on the part of the building belonging to the city, granted for use by the University of Aquila, and specifically on the 18th century part: on the ground floor there was the construction of a conference hall in the neoclassical room, small meeting rooms overlooking the cloisters, and service areas (wardrobe, catering, services); on the mezzanine floor (or the first floor of the cloister), offices for the Aquila university foundation, bathrooms and occasional storage spaces; on the first floor of the 18th century part, the great space that makes up almost all of the 18th century addition was appointed as the conference room, especially with the creation of light, removable staging that could be used to create steps, a small production booth and a projection screen.
In order to achieve this, the walls that subdivided the hall in classrooms were demolished. The restoration also provided for an elevator.
From the structural point of view, the main intervention consisted in the installation of metal lattice girders reconnecting the two façades, above the vaulted false ceiling of the first floor hall with its supporting trelliswork. The beam is connected with slabs “sewn” to the masonry with pins. The longitudinal walls were reinforced with Ø24 steel rods injected into the wall.
During the restoration, the vaulted false ceilings of the first floor hall with their supporting trelliswork were reinforced with a double lattice. In addition, the cloister at the entrance was covered with a skylight to create an atrium on the ground floor.

3.2 The integrated surveying

An integrated relief was made of the building using a laser scan, photogrammetry and direct relief. In order to get an "anatomical" relief that included the construction system, a critical reconstruction of the invisible structural elements was also created by integrating diagnostic data into the relief, in particular,

magnetometric, endoscopic and expert analysis. Of particular use for this were the project and building site documents (photos, reports, diagrams) from the 2003 restoration works.
As the relief was for restoration purposes, an analysis of the cracks and damage, as well as the pathologies of the macroscopical surface degradation, was carried out.
The act of restoring the architectural relief created a moment of cognitive and interpretative synthesis and interpretation, where the various contributions and interdisciplinary analysis found a shared medium of comparison, interpretation and systematisation. This complex restitution theoretically offers support for a conscious and scientific organisation of a comprehensive restoration project where the architectural, structural and installation engineering plans are developed in synergy with each other.
To this end, and as a complex restitutive model of architectural heritage, a 3D model was created as a shared interface for analysis and design.
It is hoped that it will also represent a useful interface even during construction, and after the restoration, for the maintenance and monitoring of the work.

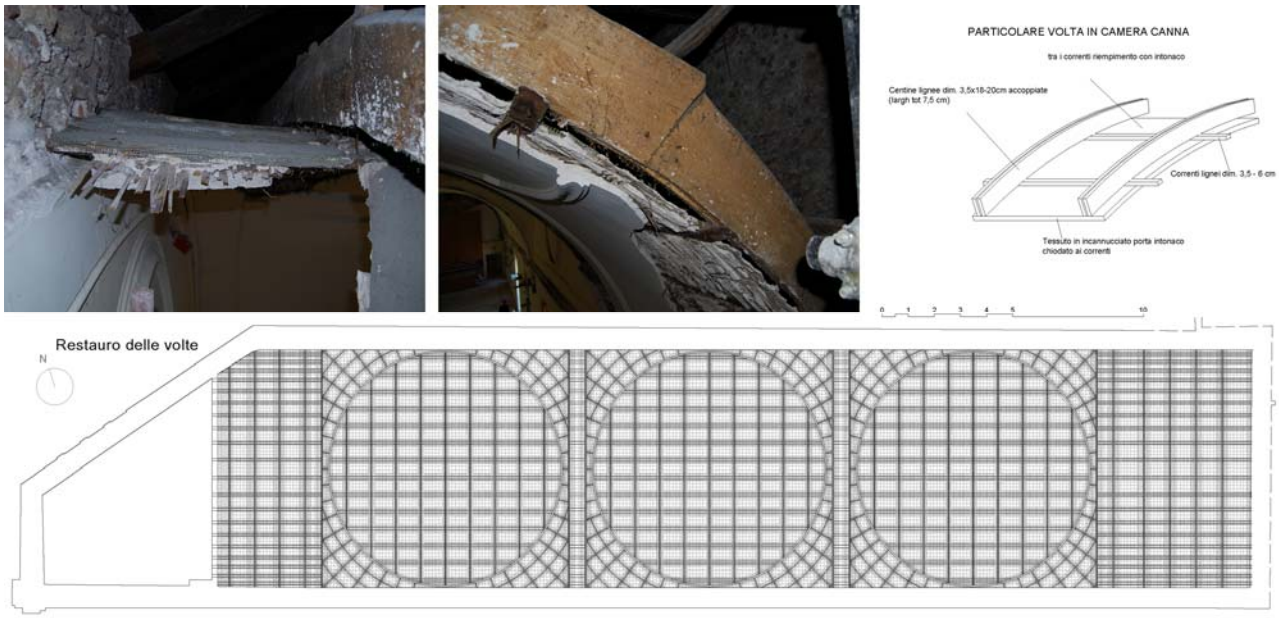

Fig. 7: The restoration of the trelliswork vaults.

4 The architectural restoration project

The architectural project envisages the renovation of existing buildings, without modification to their intended uses or of the distribution system.
The main restoration works relate to the internal spaces, external façades, the restoration of the wooden trusses and vaults with supporting trelliswork, and the restoration of important surfaces.

4.1 Intervention in the internal spaces

The main restoration work of the important surfaces includes: the architectural restoration of stuccoes (with the reinforcement, stuccoing and integration of the mould), stuccoing, as well as the integration of the supporting trelliswork and removal of surface deposits; the architectural restoration of the plaster (through the stuccoing and integration of the mould) and stuccoes, as well as the removal of surface deposits; the architectural restoration of the faux marble, with plaster reinforcement and a refreshment of the pictorial paint, as well as the removal of surface deposits.
The reinforcement of the foundations requires the dismantling of existing flooring and blocks of stone and the subsequent restoration of the flooring. In addition, to solve the problems of moisture present on façades, ventilated cavities along the perimeter of the building are built.
The reinforcement of masonry with injections, the closure of niches, and the creation of headers with helical steel bars, lead to detailed interventions on the existing plaster, which safeguards the material values of the surfaces. The rear façades with exposed brickwork made of irregular ashlars are kept the same and steel bars are inserted into the mortar equivalents.
The reinforcement of brick and stone vaults with fibre-reinforced plastic layers involves the dismantling of existing flooring and blocks of stone and their subsequent restoration.



Fig. 8: Use of the 3D digital model to correlate the architectural restoration of the facade with the study and the project of the square and of the context.

The construction of a new reinforced masonry spandral beam at the top requires the partial disassembly of the roofing and the lifting of the primary frame, which is then put back with the appropriate linking systems. The intervention is envisaged without any interference in the cornice of the main façade.

4.2 The surfaces

The external façades have the following degradation pathologies:- plaster pathologies: chromatic alteration, biological patina, accumulation of moisture and attacks by autotrophic organisms, leaching, surface deposits, acts of vandalism, defects and incongruous patched-up jobs; stone pathologies: scaling, pitting, erosion, defects, presence of vegetation; wood pathologies: fungus, attacks by xylophagous insects; iron pathologies: corrosion-oxidation.

The following restoration works are envisaged: the restoration of the plaster with the elimination of the macroscopic surface degradation and pressure washing; the restoration of the architectural elements in plaster or stucco (pilasters, cornices, etc.); the restoration of the exposed facing (cleaning, jointing, stuccoing); the restoration of metallic elements (gratings); the restoration of the wooden elements.

4.3 Restoration of the wooden structures

For the roofing, the maintenance of the major and minor frames and the reconstruction of the roof covering are envisaged. The interventions are: removal of inconsistent surface deposits; disassembly; disinfestation; cleaning; reinforcement; surface primer treatment; the overhauling and restoration of metallic parts.

4.4 Restoration of supporting, decorative trelliswork vaults with stucco decorations

The supporting, decorative trelliswork vaults are damaged due to partial collapse (collapse of the plaster and fabric – the latter from reinforcements installed in the 2003 restoration – as well as of the wooden substructure), to cracking and to the detachment of the layer of plaster and trelliswork from the wooden support structure. The centrings are still functioning, but they need suitable reinforcement.

It seems from the analysis underway, that the 2003 restoration work was carried out with a reinforcement of the web of cane and plaster through traditional techniques, based on the installation of extrados 'hoods' in jute cloth and plaster. The damage caused by the 2009 earthquake shows how the existing issues are to a large extent ascribable to the installation procedure of such reinforcements, using consistent materials on the extrados of the vault, but without considering an appropriate link to the centrings. Observation of the

collapsed material shows that one of the main causes of the collapse was the loss of anchorage between the wooden substructure and the centrings.
In relation to the state of degradation and the damage to the supporting trelliswork vaults, the following interventions are envisaged:
- Woven roving: restoration of the defects with new woven-roving fabric, made from cane woven in the same manner as the existing fabric, pinned to the wooden structure, and overlapping and made integral to the old woven roving through a network of flax fibre and suitable mortar.
- Intrados plastering: new plaster made with materials that have mechanical and thermo-hygrometric characteristics similar to the existing plaster. Reinforcement of plaster coat continuity / staked with flax fibre capillaries (f3.5-6 mm, 20-40 mm long), anchored with hydraulic mortar made of lime with added polymer to be used in particular in the parts of the decorative apparatus with the greatest overhang.
- Restoration of the coupling between the wooden substructure and the flax fibre woven roving installed with resin anchorage.
- Realization of the anchorage between the substructure and the centring lines, with flax fibres embracing the centrings and turning back onto the substructure, installed with resin anchorage.



Fig. 9: Render of the digital model to visualize the restoration project.

Bibliographical References

[1] ANTONINI, Orlando. Architettura religiosa aquilana. L'Aquila: Edizioni del Gallo Cedrone, 1993, vol. 2, p. 102-111.

[2] BARTOLOMUCCI, Carla. *Attività di Sebastiano Cipriani all'Aquila dopo il terremoto del 1703. Il complesso di S. Basilio*. Tesi Scuola di Specializzazione in Restauro dei Monumenti, Corso di istituzioni di storiografia architettonica, Prof. Sandro Benedetti a.a. 1995-1996. Roma: Università degli Studi "La Sapienza", 1996.

[3] BENEDETTI, Sandro. L'architettura dell'epoca barocca in Abruzzo. In *L'architettura in Abruzzo e nel Molise, Atti del XIX Congresso di Storia dell'Architettura*. L'Aquila: Ferri 1980, p. 275-312.

[4] EQUIZI, Giuseppe. *Storia de L'Aquila e della sua diocesi*. Torino: SAIE,1957.

[5] CENTOFANTI, Mario. Il tema del palazzo: aspetti della cultura architettonica tra XV e XVIII secolo. In *L'Aquila, i Palazzi*. L'Aquila: Ediarte, 1997, p. 53-95.

[6] CENTOFANTI, Mario*. L'Aquila 1753-1983: il restauro della citta*. L'Aquila: Colacchi, 1984.

[7] CENTOFANTI, Mario. La villa Dragonetti e l'architettura barocca all'Aquila. In STROLLO, Rodolfo Maria. *Architettura e ambiente, casi di studio*. Roma: Aracne,2004, p. 81-98.

[8] CENTOFANTI, Mario. BRUSAPORCI, Stefano. Il disegno della città e le sue trasformazioni. *Città e Storia*, IV, 1, 2011, p. 151-187.

[9] CIOFFARELLI Sara. D'AMICO, Nicolas., D'OVIDIO, Dario. TANFONI, Arianna. *Restauro del complesso monumentale di S. Basilio*. Tesina del Corso di Restauro Architettonico a.a. 2012-2013, Proff. Mario Centofanti, Stefano Brusaporci, Corso di Laurea in Ingegneria Edile-Architettura U.E., Università degli Studi dell'Aquila. L'Aquila, 2013.

[10] COLAPIETRA, Raffaele. *L'Aquila dell'Antinori : strutture sociali ed urbane della città nel sei e settecento*. L'Aquila: Colacchi, 2002 (1978).

[11] COLAPIETRA, Raffaele. Prospettiva di ricerca interdisciplinare in Abruzzo: Storici dell'architettura e storici puri. *Bollettino della Deputazione Abruzzese di Storia Patria*, LXXXI, 1981, p. 179-229.

[12] DI PIETRO, Piero. ANNIBALI, Sandro. *Architetti romani attivi a L'Aquila nella prima metà del settecento. Il problema delle attribuzioni di tre edifici nel centro storico*. L'Aquila: Terranostra Abruzzo, 1990.

[13] MORETTI, M. DANDER, M. *Architettura civile aquilana*. L'Aquila: Japadre, 1974.

[14] MURRI, Filippo. *Monasteri, conventi, case e istituti religiosi dell'arcidiocesi aquilana*. L'Aquila: ISSRA, 1996.

[15] PANTALEO, M. REDI Fabio. Il Monastero di S. Basilio in L'Aquila: la campagne di scavo 2003. *Archeologia medievale: cultura materiale, insediamenti, territorio*, XXXI, 2004, p. 1-17.

[16] PIETRANTONIO, Ugo. *Il monachesimo benedettino nell'Abruzzo e nel Molise*. Lanciano: Carabba, 1988.

[17] SERRA, Luigi. *Aquila monumentale*. Aquila: Unione Arti Grafiche, 1912.

[18] SERRA, Luigi. *Il Barocco in Aquila*. Bergamo: Istituto italiano d'arti grafiche, 1929, p. 119-127.

[19] SIGNORINI, Angelo. *La Diocesi di Aquila descritta ed illustrata*. Aquila: Tip. Grossi, 1868.

[20] SPAGNESI, Gianfranco. L'Architettura barocca all'Aquila. In *L'architettura in Abruzzo e nel Molise, Atti del XIX Congresso di Storia dell'Architettura*. L'Aquila: Ferri1980, p. 495-518.

[21] SPERANZA, Ugo. (Ed.). *Il regesto e la storia del monastero di S. Basilio in Aquila compilati dall'Antinori*. Aquila: Off. graf. Vecchioni, 1935.

[22] STOCKEL, Giorgio. *La città dell'Aquila: il centro storico tra il 1860 e il 1960*. L'Aquila: Edizioni del Gallo Cedrone, 1981.

[23] VICARI, Luigi. Due architetti romani operanti ad Aquila nei primi anni del sec.XVIII: Sebastiano Cipriani e Giovanni Battista Contini. *Bollettino della Deputazione Abruzzese di Storia Patria*, LVII-LIX, 1967-69.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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A system for dating changes in building fabric via nail spectra

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Abstract
Nail morphology and its change over time provide a valuable dating tool for heritage practitioners that has hitherto been an underused resource. Using historic changes in nail morphology it is possible to construct timelines for each of the five major zones of heritage buildings. Each building zone presents its own spectrum of data manifested through nail, screw, and timber changes. By combining the five zone timelines a dating mechanism, either for the building as a whole or for subsequent alterations, can be constructed to create a national or area database. The procedure may take some months of effort and dedication in order to acquire the necessary data, carry out the processing, and organise the charting.

The paper concentrates on the possibilities presented by technological changes in nail production, both physical and metallurgical, and how to exploit the morphological changes.

Keywords: heritage, nails, analysis, methodology, timelines.

1. Backgound to nail morphology

> *These are a Material so well known, that... they need no description.* Richard Neve, 1703.
> *Nails in Building are small Mettaline Members, well known....* William Salmon, 1738.
> *Les clous sont trop connu pour que j'en donne aucan détail....* André Jacob Roubo, 1769.

Despite the epigraphs, there are some basic observations to be made about the principles of nail design. European nails essentially conform to a pattern set by the Romans that has filtered down to modern times. In the medieval period and later, the practice of designing the nail shank to suit the type of wood into which they would be driven was already established. In 1703 Neve makes reference to nails in two basic grades:

> 'Strong, suitable for oak, and other Hard woods', and 'Long, proper for any fine building with Firr, or other soft wood'. [1]

A third nail type is mentioned in medieval documents as 'dubells', sometimes in reference to masonry nails or those driven through stone tiles. A document of 1292 refers to 'grospykyngs and middlespykyngs', implying that three grades were then already in use. [2] Nails described in a Dutch document also include one termed '*Dubbelde'*. This suggests that a similar nomenclature was used in the Lowlands, since the nails are referred to as coming from Luik (Liège). [3]

In visual terms the three grades of nail shank translate into stout, medium and slender shanks, best expressed in terms of the shank's aspect ratio: its length divided by its width. Similarly the type of wood into which the nail is driven reflects nail design and particularly the nail shank aspect ratio. Shorter, stubbier nails could be driven into hardwoods, whereas long thin nails are suitable only for softwoods (see fig 1).



Fig. 1. Four wrought roof nails: 1795, Provence; 1861, Latvia; 1760, England; and 1851, Victoria, Australia.

The aspect ratios of the nails shown in Figure 1 are: 1:30, 1:26, 1:17, and 1:10, used in maritime pine, Scots pine, elm and eucalypt (white gum), with timber crushing strengths of 4, 7, 10, and 14 Mega-Pascals, respectively. Nail design across Europe is simplified in areas that traditionally used only softwoods, such as the Baltic States, parts of southern Germany, Norway, and Sweden.These areas traditionally used mainly high aspect ratio nails in timber.

2. Progress and change

During ancient times and in the medieval period, nailsmiths had to make do with iron in bar form. The end of the bar had to be forged down to rough out a shank and to leave a bulb, from which the head would later be forged before the roughly formed proto-nail was separated from the remaining bar, which involved holding the hot iron piece with tongs. The nail-making scene in the Holkham Bible shows the nailsmith's wife in 1327 doing just that. [4] She has re-heated the shank end of the rough-out and is seen holding the bulbous end in the tongs while shaping the red-hot shank. Her next task would be to re-heat the bulb in order to forge the nail head. All of this would change and much of the work and the re-heating would become obsolete with the advent of sliced iron filaments (or 'wands'), for the manufacture of which two separate machines became available.

2.1. The *Reckhammer*

The device used in the German States to prepare the iron filaments was the *Reckhammer* (rake hammer), which may have appeared in the 1480s. Its invention was almost certainly stimulated by the requirements set by the advent of power drawing in the wire industry, in which the German States led Europe. [5] The rake hammer appears in a woodcut by Christoph Weigel in Nuremberg, dated 1698. [6] This is well after the more efficient slitting engine became available, and the Weigel woodcut demonstrates how the German States preferred their own system. The face of the rake hammer was probably raised in a series of ridges to score pre-set grooves with an edge overhanging the anvil below in order to sever the outside wand.

2.2. The slitting 'engyn'

This machine has entered the realm of mythology and so it is prudent to examine carefully the known facts in order to arrive at the probable dates of changes affecting nail design. In England a 21-year special licence was granted in August 1567 to Peter Anthony van Ghemen and his company that involved 'the cutting and tempering of iron'. [7] The description and apparent strategic timing suggest that this was to resolve problems with the newly established Tintern wire mill, the first in England. References to Van Ghemen and his company then cease and the Saxon mining engineer Christopher Schütz took over the project with his English counterpart, Bevis Bulmer. [8]

It seems Van Ghemen had been considering a new form of cutting device that might have consisted of a set of sharp-edged discs on an upper axis, bearing against a plain roller below. Cast iron rollers had entered England around 1560. [9] A single row of sharp-edged discs would have been capable of grooving a hot iron ribbon, simplifying the manual slitting process and thereby reproducing the effect of the *Reckhammer*. It is possible that Schütz and Bulmer, in the absence of Van Ghemen, adapted the original concept and arrived at a more elegant solution by placing contra-rotating discs both as top and bottom rollers. The hot iron ribbon passing through the discs would be sliced into thin elements entirely by machine, producing narrow wands of iron. These have subsequently become known as 'nail rod'.

A lawyer at the Inns of Court provided the first reliable evidence of a slitting mill at Dartford, Kent in 1576. [10] It seems certain that one other slitting engine was already in use supporting the Tintern wire mill. [11] With no further reference to Van Ghemen or his company, it is probable that he had returned to the Low Countries.

On 4th December 1588, three months after the expiration of Van Ghemen's 21-year licence, Schütz's partner, Bevis Bulmer, was granted a patent for a slitting engine that would cut ribbons of iron into 'roddes'. [12] The wording of the patent demonstrates both the existence and inefficiencies of a former machine, and the coincidence of the 21-year gap makes it clear this would have been Van Ghemen's prototype. Before the end of the century slitting mills had been established in other parts of England and Ireland, and four were built in the Liège State:

> C'est entre 1583 et 1587 que sont construites, sur la Vesdre et la Hoëgne, les quatre plus anciennes «fenderies» connues du pays wallon. Huit autres sont aménagées sur l'Ourthe et la Vesdre au cours du XVIIe siècle. [13]

3. Simplifications in nail making

Nail rod greatly simplified the nail maker's task and was more fuel efficient. For common nails, one heating would usually suffice. More significantly, changes and subtle differences in nail morphology make it possible to identify nails made from rod with reasonable accuracy. Whereas Roman and medieval nails tended to taper to a point on both axes, after the introduction of nail rod a part of the shank was left untouched by the nail maker and remained square or rectangular for part of the shank length.

It seems likely that some vernacular nails were locally made in medieval times as many display little regard to shank strength, whereas those from prestige buildings display proper proportion and ruggedness in their design, fig. 2. The larger shown, being from a prestige building, is undoubtedly the product of a nailer belonging to a guild. Although apparently straight-sided, examination shows variation from hammer blows by it being wrought from a larger mass. A woodcut in Caxton's publication of Chaucer shows that nails were also made by blacksmiths in the 1480s, [14]. The weak, extenuated points often found demonstrate that some medieval nails were definitely not made by professional nailers.



Fig. 2. Roof nail: Muniment Room, Salisbury, 1260; Wells Diocese house, 1434; two from Chichester circa 1495.

After nail rod came into use, three salient features appear:

- Parts of the shanks are straight-sided, and full-length tapers essentially disappear.
- Minute shear burrs show on two edges of the shank, and two edges are rounded.
- Sharp or 'bodkin' points tend to occur in nails used only in softwood areas (with certain exemptions such as clasp nails, etc.).

These effects are not so marked when examining German nails, but changes occurred there earlier than elsewhere, and it seems that surplus rod may have been available from the early 1500s. The rapid adoption of the slitting engine in England and in the nail producing areas of Belgium meant that nail characteristics changed rapidly between 1590 and 1620. Should there be a mixed spectrum of nails (characteristic bar-iron and rod-based nails occurring together), this would suggest a date closer to the nominal change date. A presentation of this type of mixed evidence arose in a dendro-dated *Bauhaus* at Beutelsbach near Stuttgart, 1500–1510, where nails suggesting both origins were concurrent.

A ceiling dropper nail (fig. 3) found at Hampton Court Palace demonstrates some of the morphological changes attributable to nail rod: parallel sides for half the shank length, regular square edges, and the development of a spoon point.



Fig. 3. Coffering nail, south front, Hampton Court, 1690, courtesy Historic Royal Palaces.

The burred and opposed rounded edges effect can be seen in the following two examples (fig. 4). To date, the same burring on one side due to cutting shear has shown up more markedly in nails from the Baltic States and in those from Denmark and France.



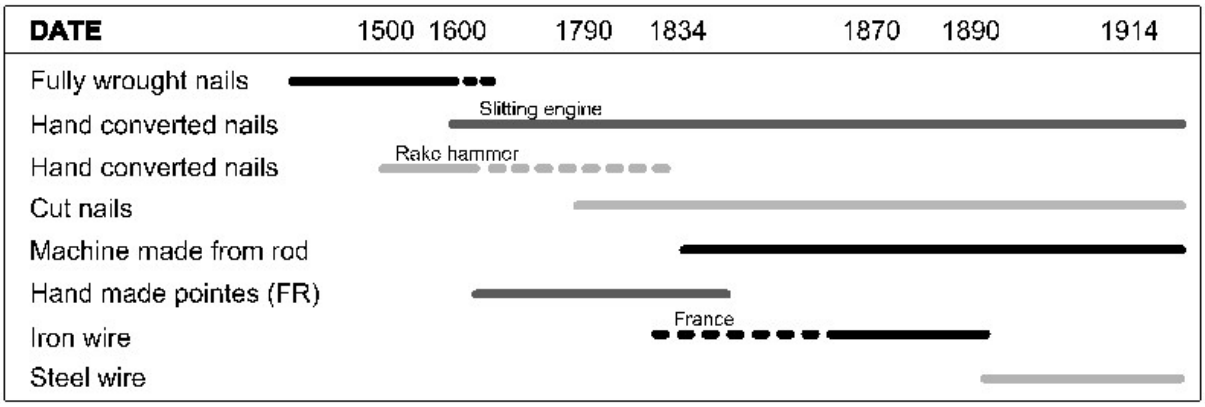
Fig. 4. Clasp nail, the Pantheon, Stourhead 1752 and shingle nail, Headcorn, Kent, 1801.

4. Chronology

By the late 1600s a sophisticated range of wrought nails had developed that is most marked in England, but that is seen in other European nations according to their specific building practices. Curiously, many hand-wrought nails continued to be made well after 1790 when the first mechanically made nails were produced. Some wrought nails were still being forged in Britain in 1940. [15] In spite of large numbers of patents, very few mechanically made nails impacted on the practice of those nations still reliant on hardwoods. In Australia, for example, a few wrought nails are still found in buildings of 1855, although 1850 might be taken as an effective cut-off date for wrought nails. [16]

With the exception of France, which used handmade wire nails (*pointes*) prior to 1700, [17] the advent of machine-made iron wire nails between 1845 and 1865 provides a way of estimating a threshold date. Close examination of the small differences between machine-made and handmade wire nails allow a dating possibility. The handmade ones comprise ground conical points and either domed or roughly flattened heads cold-formed with a punch. Machine made iron wire nails, however, have cut points, fig. 7, and regular heads.Steel wire nails, recognised by their relative brightness, appeared first around 1885 and by 1890 had a significant impact resulting in most cut nail production becoming redundant. [18]

Table 1: Basic nail morphology change.



Changes in mechanically made nails are an invaluable aid to establishing dates in buildings generally. Although the spectrum varies somewhat from nation to nation, a simple, technology-based time-line can be used to construct more detailed timelines (Table 1).

Multiple changes occurred within each group, and some explanation of these groups is appropriate:

4.1. Cut nails

Both the British and the Americans first patented in 1790 methods of making cut nails by machine. [19] Of two patents granted to Thomas Clifford of Bristol, [20] one used the principle of rolling iron ribbon to a tapered cross-section. This particular concept continued to develop through several variations and had a long production history to WW II. Simple cut floor and joiner's brads were cut from flat iron ribbon and show in a British specification of 1812. [21] These have been found in an earlier dated context of 1806 (fig. 5).



Fig. 5. Profiled-sheet cut roof nail, 1884. Headless and spur-head floor brads, Newcommen St, Dartmouth, 1806.

The American machines used only flat iron ribbon, but by 1811 their machines were sufficiently advanced to be sold to the British. At least two American inventors relocated to Britain to take advantage of its superior technology at that time. [22] Similar nails using the same American principles have been found in France and Latvia.

Arising from this mixed history, three different types of cut nail are identifiable in Britain and these are repeated in Australia and New Zealand:

- The pre-profiled sheet that enabled parallel cutting of iron ribbon from 1790.
- Tapered slivers, cut from flat ribbon as used in the American system, continued to be side pressed in Britain in various discernable forms of clasp nail. Several stages of their classic design give clues to four subsequent dating thresholds, and the basic type continues until WWII. [23] These have also been found in France.
- The transition to face pressing of the American versions, 1815–1832. [24]

American cut nails have been well described by the works of Mercer, Nelson, Loveday, and others. [25, 26, 27] A manually operated device became available in 1790, but rapid changes soon saw full mechanisation. The principle remained essentially the same, namely that tapering slivers were cut from

a heated iron ribbon by a guillotine, leaving behind burr traces to two edges. These were initially headed separately and to do this the element was side clamped below the head, which left some head weakness. After 1828 there was a slow change to face pressing, which is easily discernable and which provides another useful threshold date. [28]

Inerent weakness in the sheet resulting from the narrow rollers then used in America saw these more elegant nails rejected in Australia, where tough eucalypt timbers predominated, until 1870 or so, after which large volumes of North American timber were imported. [29] In New Zealand there was an earlier reception of the American-made cut nail since a far larger range of native softwood was available in that country. Historical changes like these also set useful threshold dates.



Fig. 6. The The classic form of the British side-pressed cut nail and the face-pressed American ‘fine’ cut nail.

4.2. Cut tacks

These were made by a modified process which probably originated from an American source. They are easily identified by distinctive shear burrs. They have been found in Latvia and most Western European nations. The national characteristics vary slightly, so small changes in the head can set different dates for different countries. They were in wide use by 1830, initially with a domed head as found in Australia, Britain, and Italy. The square to hexagonal head that followed is the predominant lath nail type found across Europe. A small blister on the flat head surface appears to be an American innnovation.

4.3. Machine-made nails using nail rod

The most succesful nail of this type was the remarkably tough ‘Ewbank’ nail made by Cordes & Co at Newport, Monmouthshire, from 1836. [30] This is found in four distinctive forms, each setting its own threshold date. A useful identifying date is 1869, when a four-pointed star, similar to a NATO star, was adopted on the head as a trademark. The ‘Ewbank’ became ubiquitous in Australia and, due to its toughness, was the preferred nail of most Australian carpenters. [31] Several French types that suggest the use of nail rod feedstock have been found, but until now these have remained unidentified.

4.4. Iron wire nails

Several French patents from around 1825 saw the gradual introduction of machine-made wire nails that gained ground by 1840 in France and some 15 years later in Britain. French iron wire nails appeared in New Zealand in 1842, but very few iron wire nails appear in Australia prior to 1870. [32] Iron wire nails did not prove popular in America, where iron cut nails were preferred. This changed after 1888 when steel wire nails effectively displaced both cut nails and iron wire nails in North America. [33]

Useful dating clues relate to the points and the gripping method prior to heading: [34]

- Until 1900 or so nearly all points were cut to give a point angle of approximately 30°, and early wire nails display a degree of slip by the cutters that often resulted in fouled points (fig. 7). After some practice it is easy to visually identify the change in the point to the new angle of around 46°, occurring around 1895, which was then used for most steel wire nails and retained to the present day.

- Until 1886 all iron wire nails were held with a four-square grip that can be seen pressed into the neck metal below the head. A two-sided clamping then appeared that forced the neck into a quasi-oval shape. This was an advanced form of grip that became nearly universal in steel wire nails and which continues in use to this day. Some of the very earliest steel wire nails also displayed a square neck (fig. 8).
- Early iron wire nails from the 1860s often have a number of grip marks from the jaw teeth, with as many as eleven in the 1860s, reducing to seven by 1880.



Fig. 7. Iron wire nail c.1864. Three iron wire types of 1888 and a side-clamped iron wire nail, c. 1886.

4.5. Steel wire nails

These rapidly displaced most other types of nails from 1890 onwards and the pattern seems to be the same across Europe and America. The threshold date is not absolute, however, as British steel bullet-head wire nails have shown up in 1883 in Australia in a datable context. Round steel wire nails are unfortunately difficult to date; however, changes to the head provide some useful clues: [35]

- Non-slip patterns appeared with bullet-heads in the 1880s (fig. 8).
- Flat heads appear in the 1890s with non-slip patterned heads (fig. 8).
- Steel wire nails display indentations from the teeth of the clamps in place of clamp marks, and only a few early ones have clamped necks like the iron wire nails, fig 8, nails 2 & 3.



Fig. 8. Steel wire nails, 1892 and 1900, with varied grip marks. Patterned heads of 1893–1913.

4.6. Other datable factors

Coated nails were available from the early Middle Ages using a covering of tin and these were the preferred nail for hanging tapestries and other fabric. [36] Several tinned square pin- nails, as described by Diderot and Panckoucke, have been recovered in Provence from French doors and from interior cupboards, where this nail type was the preferred type for securing hinges in the period of the *Grande Siecle*. [37]

Zinc-covered forged nails have appeared in Australia in an 1840s context and thereafter various other types. Early zinc covering appears gritty, whereas after 1860 the covering is comparitively smooth.

Zinc alloy slate nails of British origin were widely used in Australia in the 1840s and initially had a spindly profile. This changed to a type of cut form around 1850 in a datable context, and continues through to the 1900s.

Square-sectioned copper wire nails appear in buildings around 1880, often used in flashings and later, in round section, for slate nails. Round copper slate nails date from the 1840s.

Iron pipe nails, used to secure downpipes to masonry, have been found in an 1830s context and the shank marks clearly show that these round 'rod' nails were made from rod produced by a rolling a mill, which has then been hot wrought to make points and heads. Machine-made pipe nails of smaller diameter are common by the 1880s and have a regular appearance thereafter.

Tempered cast iron lath nails have been found in Britian, America, and Australia, the earliest datable context being 1784 and the latest datable context 1840. These apparently relate back to a patent grant to Joseph Ashton in 1769. [38] Diderot notes circa 1769, that in France iron nails were forged and others were cast. [39] A range of cast tile 'pegs' have been found in large numbers in different lengths in Britain, but in a non-datable context. Cast steel wall nails date from a patent of 1891 and relate to cabling and to topiary work. [40]

5. Past changes

The Australian experience, and to some extent the British experience, suggests that nail profile and type changes can often be related to the import of a particular range of softwood. Australian nail types change in relation first to the increasing dependence on North American softwoods, with a second change reflecting the import of the ultra-soft 'redwood' (sequoia). Effective nail changes for these two phenomena are 1870, when the American cut nail began to replace the British forms, then in 1895 or so when small American cut tacks become the favoured fixing nail for redwood quads and so on.

6. The five spectra of building nails

Attempts should be made to investigate a range of selected datable buildings in depth and to aquire a sample of nails from each of the following zones:

- Roof claddings. These include not just the tiles, slates or patent iron sheets, but also the chimney flashings, eaves, launders and so on.
- Roof construction. Depending on the period, these should include batten nails, principal and lesser rafters, hangers or droppers and ceiling fixings.
- Walls. In the case of masonry walls it can be expected that very few nails wil show up. Partitions, stairwells, reveals, and cupboards will often supply clear clues as to which nails were used and when. Lath repairs and straps can reveal changes and there are nearly always traces which relate back to the original period in samples found.
- Floors and underfloor joists and bearers. Significant decay can be expected in these samples.
- Linings, door frames, architraves, window reveals and casements. These are often the easiest nails to obtain and hence are used to construct a timeline based on a spectrum of use in each decade.

7. Methodology for constructing regional time-lines

There is no easy way to construct local time-lines for each of the building zones without obtaining samples and cleaning them for detailed identification. It is necessary to locate suitable buildings representative of each decade from 1790 through to WWI. After this time there is an explosion of different nail types and the dating task is approached more easily by other means. At least four samples from each zone, and covering each decade, are needed, but this may include some from buildings that already have datable extensions or renovations, and so the task is somewhat simplified.

In searching for samples a surprising amount of discarded material is found abandonned during house repairs and renovations, particularly in roof spaces and below floors. A close search often reveals useful samples without the need to disturb fabric. Buildings of known date falling into ruin, or in process of renovation, are a major source of local information and usually provide a spectrum of nails from each of the five main zones. Local repairs to linings and architraves can also produce a few critical samples with minimal disturbance to fabric, and anecdotal history is often available to provide context dates.

Each nation will have experienced similar changes to those outlined above, but these changes will reflect a different set of parameters. Thus, it is up to heritage practitioners to make themselves aware of the background of construction pertaining to the particular area. In a large country such as France, several zones of influence were present during any one particular period. Conversely, tightly grouped regions such as the Baltic States, the Balkans and Austro-Hungary would present similar time-lines throughout.

References

[1] NEVE, R. *The City and Countrey Purchaser, and Builder's Dictionary*. London: Rising Sun, 1703, p. 211. (1st edn, published under pseudonym T.N. Philomath).

[2] SALZMAN, L.F. *Building in England Down to 1540.* Midsomer Norton: OUP, 1997, p. 304–316.

[3] JANSE, H. *Spijkers en draadnagels*. Leiden: Primavera Pers, 2004, p. 28.

[4] *The Holkham Bible*, manuscript in British Library, nail making scene, 1327.

[5] DIDEROT, D. (ed.), *L'Encyclopédie: ou, Dictionnaire raisonné des sciences, des arts et des métiers par une société de gens de lettres* (35 vols). Paris : Briasson et al., 1769, vol. 3, p. 550–551.

[6] WEIGEL, C. Woodcut: *Abbildung der Gemein-Nützlichen Haupt Staende*. Regensburg, 1698.

[7] Calendar of Patent Rolls, Elizabeth I, 1566–1569. London: HMSO, 1939, p. 72.

[8] JENKINS, R. *Links in the History of Technology and Engineering from Tudor Times*. Cambridge: CUP, 1971.

[9] KING, P. The development of the iron industry in south Staffordshire in the early 17th century. *Transactions of Staffordshire Archaeological and Historical Society* 38 (1996–97), 1999, p. 56–76.

[10] LAMBARD, W. *A Perambulation of Kent.* London: Ralphe Newberrie, 1576, p. 453. (Cambridge Library ed.)

[11] HOW, C. Early steps in nail industrialisation. In CAMPBELL, James (ed.), *Proceedings of 2nd Conference of the Construction History Society*. Cambridge: CUP, 2015, p. 81-90.

[12] WYNDHAM HULME, E. On the early English patent system. *Law Quarterly Review* 46 (April), 1896.

[13] HANSOTTE, G. *La Clouterie Liégeoise et la Question Ouvrière au XVIIIe Siècle.* Brussels: Editions de la Libraire Encyclopédique, 1972, p. 4.

[14] CHAUCER, G. Woodcut: *The Game and Play of Chess*. London: Caxton, 1483.

[15] Box 1 papers, Naish Collection. Salisbury Museum. Handwritten letter from C.V. Kelly of McArthur & Co. Ironmongers, Bristol, March 16, 1940.

[16] HOW, Chris. The American cut nail. In LEWIS, M. (ed.). *The Pacific Connection Seminar,* Melbourne, 2009, p. 82.

[17] HOW, C. Just how old are cabinet pins. *Furniture History Society of Australasia Newsletter* 1, 2015, January, p. 13–16.

[18] LOVEDAY, A.J. *The Rise and Decline of the American Cut Nail Industry.* Westport, CT: Greenwood, 1983, p. 13.

[19] HOW, C. The American cut nail, p. 77.

[20] Patent nos. 1762 & 1785, Patentee Thomas Clifford of Bristol. Enrolled 31 July & 30 December 1790. British Patent Office.

[21] BUGGEY, S. Supplying building materials to the British Army in the colonies. *APT Bulletin* 8(3), 1976.

[22] Patent no. 3365, Patentee J. C. Dyer, enrolled January 1811. British Patent Office.

[23] HOW, C. The British cut clasp nail. In CAMPBELL, James (ed.). *Proceedings of the First Conference of the Construction History Society*. Cambridge: CUP, 2014, p. 231–238.

[24] HOW, C. The American cut nail, p. 81–82.

[25] MERCER, H. *Ancient Carpenters Tools.* Mineola, NY: Dover, 2000, p. 242–243.

[26] NELSON, L. Nail chronology as an aid to dating old buildings. *History News* 23(11), 1968.

[27] LOVEDAY, A.J. *The Rise and Decline of the American Cut Nail Industry,* p. 18, fig. 8.

[28] EDWARDS, J.D. and WELLS, T. *Historic Louisiana Nails, Aids to Dating of Old Buildings.* Baton Rouge, LA: Geoscience, 1993, p. 17–18.

[29] POTTS, E.A. & A. eds, in TRAIN, G.F. *A Yankee Merchant in Gold Rush Australia: Letters of* 1853–1855. Melbourne: William Heinemann, 1970, p. 25.

[30] HOW, C. and LEWIS, M. The Ewbank nail. In KURRER, Karl-Urgen et al. (eds). *Proceedings of 3rd International Congress on Construction History,* vol. 2. Germany: Cottbus, 2009, p. 836.

[31] LEWIS, M. www.mileslewis.net/australian–building/#eight

[32] MIDDLETON, A. Nail chronology: The case of Te Puna mission station*. Australasian Historical Archaeology,* 2005, *23*, p. 57.

[33] LOVEDAY, A.J. *The Rise and Decline of the American Cut Nail Industry,* p. 18.

[34] WOOD, C. & HENRY, A. eds. Special Topic: Dating from nails. English Heritage Practical Conservation Series, *Roofing*. Ashgate. Farnham, 2013.

[35] WOOD & HENRY. *Dating from Nails*.

[36] SALZMAN, L.F. *Building in England Down to 1540*, p. 260.

[37] HOW, C. *Just how old are cabinet pins*, p. 13–16.

[38] LENIK, E.J. A study of cast iron nails. *Historical Archaeology*. Vol. 11 (1977). p. 45-47.

[39] DIDEROT, D. (ed.), *L'Encyclopédie. 1769*. Vol 3, p. 548.

[40] Patent no. 8020, Patentee A. Chandler, enrolled 9 May 1891. British Patent Office.

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The aesthetic vision of the landscape in nineteenth century Piedmontese painting

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Abstract
The word "aesthetics" derives from the Greek "*αἰσθάνομαι*" meaning "I perceive, feel, sense". In fact it relates to feeling and, in particular, to the emotional perception of beauty in Art. At the end of the nineteenth-century there were two fundamental theories about landscape painting. The first one aimed at "sentimentalising" the landscape while the second one was concerned with providing a truthful and honest depiction of it. Until 1825 Piedmontese painters were well respected only for their painting technique because their landscape paintings were still much influenced by a solemn and regionalistic academic art. This provincialism was surpassed just by the painter Edoardo Perotti, who laid the foundations for a new era in landscape painting, more open to his contemporary experiences in Geneva and Paris. Vittorio Avondo, from Turin, was one of the painters who symbolised the new concept of modern landscape in Piedmont, characterized by an emotional vision and interpretation. Giacinto Corsi thought that a true and unidealised representation of nature, deprived of an artistic and emotional perception, was barren and sterile and unable to move us emotionally. In the meantime, a new leading figure in Piedmontese painting, Carlo Pittara, came to the fore. He was renowned for his bucolic and bourgeois scenes. In his works, and especially in the painting *Landscapes with Animals* (*Paesaggi con animali*)", he tried to achieve a truthful representation of the landscape, even if it was imbued with his poetic sensibility. The Rivara school (1866-1876) was one of the best results of this modern concept of landscape in visual Arts.

Keywords: Landascape, aesthetics, colour.

1. Introduction
Up until the mid-eighteenth century it was common practice to paint in the studio away from nature. However, landscape painting was not regarded as a subject in its own right, remaining mainly a private theme in the activity of an artist.
Later, the rise of the English landscape garden (1720) together with a growing interest in travelling for travelling's sake, which inspired artists to depict the places most admired along the journey, encouraged a different approach to nature, a change of attitude in the way man related to it. In fact, the way nature was perceived had changed, becoming now a source of pleasure. At the heart of the aesthetics of the landscape lies, in fact, the pleasure of vision, the delight of seeing, its function had changed too: landscape was no longer part of an artist's training process or a decorative backdrop, but merely the expression of an emotional state[1].
As a result in the nineteenth century the theme of landscape underwent a major transformation, going from being a merely decorative background at eighteenth centuries banquets, namely a subject of minor importance in the economy of the painting, to becoming a main character, often the dominant motif, at times even the only one. Therefore, as was said at the time, landscapes went from being frames to being paintings in their own right.
Above all, the perception of landscape and its relationship with the artist had changed and there was a new belief: all that exists in nature is beautiful and has a clear purpose. Man is part of it, in fact, he himself is an element of nature, in the same way as is a tree, a river or a flower. The basis of modern landscape painting lies in this syllogism: man is part of nature, man is its heart, therefore man's heart is in nature. In Italy, as in

the rest of Europe, landscape painting, following the early works by the Flemish painters and the great English and French landscape artists, became the most popular genre in the nineteenth and early twentieth centuries developing into the central focus of new pictorial techniques and experiences.
In the eighteenth century English artists contributed more than anyone else to defining the concept of topographical landscape, an accurate and detailed depiction of nature. In Italy modern landscape painting would take longer to spread due to unfavourable social and political conditions which slowed down the artists' reaction to the established conventions of the Academy which imposed that the landscape should serve only as a background or frame to the composition. The artists behind the movement which revolutionised the idealised landscape painting of neoclassical origin were the Macchiaioli and the Piedmontese landscapists. However, credit for its development was mainly given to the Resina and Posillipo Schools and only to a lesser extent to the Macchiaioli and the Scapigliatura lombarda. Very little credit was given instead to the Piedmontese painters. This seems deeply unfair, because both Antonio Fontanesi and the painters from the «Rivara school», assimilated the ground-breaking ideas which were already part of the French and English painting tradition, and adapted them to their artistic temperament, responding in different ways and thus giving life to those artistic expressions which characterised Piedmontese painting in the second half of the nineteenth century.
During these years Piedmont experienced a period of intense fervour in all the arts. Furthermore, a circle of painters, musicians and sculptors had come together. They shared common interests and constantly exchanged ideas, information and news, which they had acquired during their trips abroad either for studying or pleasure. As a matter of fact, their frequent journeys to France and Germany helped strengthening their artistic education which could be defined, to use a modern term, as European since it extended country borders, avoiding a too narrow minded and regionalistic approach. In Piedmont, however, a school of landscape painters was never established, neither by Fontanesi, leader of a group of painters who recognized his charismatic authority to such a degree as to manifest in their paintings what later came to be known as the "style of Fontanesi", nor by Carlo Pittara who was nonetheless a key figure of the Rivara artistic coterie.

2. The aesthetics of modern landscape painting in nineteenth century Piedmont

The process which led to the recognition of landscape as a subject matter in its own right, raising this type of painting to new heights, was so slow and tedious that, still in the early nineteenth century, potential collectors would consider buying landscapes only if they included their estates. It was not until the second half of the nineteenth century that in Piedmont, as in the rest of Europe, landscape became the dominant theme in the artists' work. The Piedmontese painter who more than anyone else succeeded in conveying on canvas the aesthetic transformation of the modern landscape was Vittorio Avondo, whilst Massimo D'Azeglio is credited for his ability to document the transition from a mannerist landscape to a naturalistic one. As Antonio Stella put it, the aesthetics of the landscape in the second half of the nineteenth century revolves around this double perspective: if it is more effective a depiction of an emotional landscape or one which is true to life, almost as if it was a photographic reproduction – modern landscape is the result of the combination of these two ways of looking at things [2]. As Stella explains, the aesthetic manifesto of modern landscape artists declares that art should be sincere, true to life, whilst at the same time capable of conveying on canvas the emotions experienced by the artists.
This was the ideal that Piedmontese landscape painters aspired to, even though to achieve it, they had to fight the prejudices of the eclecticism of historical painting and the stillness typical of local landscape. This is true of those painters whom the author defines "revolutionaries", namely Avondo, Fontanesi, Ernesto Bertea and Gaspare Bugnone, as opposed to those he describes as the "evolutionists" painters of the movement, Alberto Pasini, Pittara and Giacinto Corsi. The latter met with less opposition, were even praised, or at the very least, were warmly received by art committees as well as by critics and the public, whose tastes and preferences they sought to please even if it meant compromising their own art [3].

3. XIX century Piedmontese landscape painters and their trends

Giovanni Migliara (1785-1837) founded in Milan a new genre of painting in which clear signs of modernity can already be seen: the painting *Landscape with Figures* (*Paesaggio con figure*) is among those which best represent landscape painting whilst highlighting his aesthetic vision of the landscape. He was an etcher and had originally devoted himself to historical subjects which he imbued with a romantic interpretation [4].
D'Azeglio wanted to explore new paths, new ideas, rather than painting according to a Mannerist style. However, he then ignored the new artistic trends and criticised the realist school whom he regarded as "the clever legitimation of those lacking artistic flare", he didn't perceive the sense of colour, he didn't feel like working [5]. Nevertheless, he had been sketching from life for ten years and, even though in his paintings one can detect genuine inspiration, there is no lyricism. And if, on the one hand they display a sincere interest in nature, on the other they lack any realism. Some of his paintings, especially the *Sagra di San*

Michele, represent a valuable record of the transition of the Piedmontese landscape painting in which the concept of Mannerist landscape replaces that of a more naturalistic one [6].
Unlike D'Azeglio, Angelo Beccaria's landscapes (1820-1897) free themselves from mannerism, from the taste of the period and from tradition. In some of his paintings such as *Collecting Hay in Piedmont* (*La raccolta del fieno in Piemonte*) the presence of figures give the composition a rather contrived and incoherent quality. They do not seem to be there in order to complement the landscape, on the contrary, they appear to be something else, placed there deliberately in a rather artificial and unnatural way. *Mealtime* (*L'ora del pasto*) echoes the old tradition of the Piedmontese landscape painters. The scenographic effect is achieved through a not too dense woodland which serves as a backdrop to the painting "[…] I firmly believe that landscape painting should be true to life[…], wrote Carlo Piacenza (1814-1887) and this belief of his is clearly expressed in the paintings *Farmers at Rest* (*Il riposo di contadini*), "*Misty Effect*" (*Effetto di nebbia*), "*Towards the Evening*" (*Verso sera*). In the works of Giuseppe Camino (1818-1890), who is noted for his fantasy landscapes, Stella detects a sense of the place rather than an emotional perception of the landscape [7]. The painter who never managed to rid himself of mannerism as well as a rather dull palette was Francesco Gamba (1818-1887). A follower of Alexandre Calame, Edoardo Perotti (1824-1870) was the first Piedmontese painter to show artistic personality. He travelled extensively in France, Switzerland and also Italy and studied with Calame, whose influence he was never able to fully free himself from, if not later on, after a period spent in Paris during which he came into contact with new techniques. From that moment onward, his landscapes became more poetic and the lines of the drawing less "rigid", loosing the ticker strokes of the early period [8].
A similar landscape, characterised by lines so sharp that not even the colour can lighten, distinguishes the works of Luigi Cantù (1847-1887). An epic vision of the landscape is typical of the paintings of Felice Cerruti Bauduc (1818-1896). In them the scenery naturally frames his battle and hunting scenes. Of note from this point of view are some of his preliminary sketches. Although the influence of Camino is still very much noticeable as well as the stillness of the scenery, a typical feature of his Piedmontese predecessors, the landscapes of Giuseppe Falchetti (1843-1918) are nonetheless rather dynamic. In the paintings of Corsi (1829-1909) one can detect a certain harmony between tradition and the new teachings of the movement, which he had joined, even though as an "evolutionist". His aesthetic ideal of the landscape coincided with his notion of Art: "There is no art if you can just perceive the technique, but the canvas does not move you, which is the most important goal" he used to say [9]; at the same time the need to be true to life should not suffocate the most sacred qualities an artist possesses: imagination and creativity. His paintings, especially *Coastal Scene* (*Marina*), reveal his artistic beliefs and his emotional response to nature.
A great colourist as well as an excellent landscape artist and animalist was Pasini. The poetry with which he imbued his works is enhanced by the polished technique of a draughtsman. Another outstanding landscapist is Bertea (1836-1904), whose works reveal his enthusiasm for modernity. His vision of reality is plastic: he sees nature more in depth than in the outline, a quality which puts him ahead of his time [10].
Piedmontese painters, particularly those from the middle of the nineteenth century, were always seeking new ways and techniques to address the landscape, or better still, what in the landscape had struck them most. Fontanesi (1818-1882) was the only artist who managed to rise above the several artistic trends of the time, partly assimilating their ideas and partly reinterpreting them through his poetic sensibility. He was indeed a master of the modern landscape and as his disciple Marco Calderini wrote: "the reason for his greatness lies in his being first of all a poet" [11].
In a letter to Riccardo Pasquini he stated: "landscape must go beyond appearance[…]; and addressing his disciples he said: "beauty lies more on the inside than on the outside" [12]. His paintings trace the history of modern landscape from the great Dutch and English landscape artists to the various expressions of modern landscape painting. In fact, as Klaus Lankheit wrote, he was the greatest landscape painter of Italian Romanticism [13]. In a letter sent from London on the 7th February 1866 and addressed to his dear friend Alfredo D'Andrade, Fontanesi claimed that who had not seen John Constable and Joseph Mallord William Turner had not seen the founders of landscape art, whom, at the time, had been labelled as eccentric by the foolish, but declared the first modern painters by the experts [14]. Everything in his paintings is imbued with a sense of life which does not translate into a heartless imitation but rather in an emotional outpouring which reflects more his aesthetics than his technical skill. He absorbed the trends of the European landscape artists of the nineteenth century, whilst staying true to himself. He was drawn to light and wanted to capture it on canvas, as can be seen in the remarkable painting *The Small Church* (*La chiesetta*), where the small size of the church contrasts with the monumentality of the composition, whose rigor though is softened by the use of chiaroscuro which does not detract from the effect of a radiant brightness [15]. He was not interested in giving an accurate representation of nature, down to the smallest detail. As a result, some malicious colleagues found grounds to say that Fontanesi was not able to paint one tree different from the next.
"[…]Start again tomorrow and work with passion[…]", used to say to his disciples gathered at Cascina Vanchiglia, where they painted from life. Just before sunset he would walk among them giving a piece of advice, correcting a mistake, showing them how much he cared. They were his family as he said on several occasions [16].

He was fascinated with nature and firmly believed that an artist should turn to it for inspiration. However, he saw it as a nearly impossible challenge to record on canvas the intensity of the emotions experienced in front of nature (especially on such large canvases). He was afraid the strong feeling would have faded away when, back in the studio, he would attempt to put brush to canvas. This fear, this constant worry was to torment him for the rest of his life: he felt he could not achieve such a transposition of feelings, and for this he suffered greatly. He aspired towards infinity, he wanted to depict the sky and the vast plain [17]. His anguish can be compared to that felt by the Romantic artists, particularly Caspar David Friedrich, who in his painting "Monk by the Sea" expresses the tragedy which lies in the awareness of knowing that, as Friedrich Schlegel wrote: "[…]man has been destined to mould the finite with the infinite; a union which is however impossible" [18].
In the painting which best epitomises his human and artistic temperament *Solitude* (*La solitudine*),, he depicts a pastoral scene with a young shepherdess and three lambs lying at her feet and an immense, clear sky stretching above them. The young girl is portrayed in a pensive mood and despite the beauty of the surrounding landscape, the artist cannot suppress the sense of melancholy and bewilderment which from the young shepherdess goes straight to the heart of the viewer and which represents the poetry of the scene. In the painting *November* (*Novembre*) instead, the broad blue brushstrokes of the sky manage somehow to ease the sadness of the figure in the foreground, allowing through a glimmer of hope "pale as a lamp which is about to go out" as the painter said himself [19].
Among Fontanesi's disciples, Clemente Pugliese Levi (1855-1939) was the one who managed to capture on canvas the most delicate and innermost features of nature. The painting *Snow in Piazza Solferino* (*La nevicata in piazza Solferino*) reflects his visionary aesthetic of landscape. Enrico Reycend's style, described by Emmanuel Bénézit, as one of the greatest Italian landscape painters, stands out for its evident horizontality achieved through different devices, such as a low boundary wall or a small bridge over a stream. His landscape is characterised by carefully drawn lines thanks to a masterly use of a palette made up mainly of pale and delicate colours.
Avondo (1836-1910) was regarded as the greatest landscape painter of the XIX century. Just like Fontanesi, he wanted to depict the sky, which symbolises for both a constant aspiration towards infinity. His landscape scenes are full of passion: along with the theme, the painter's emotions and feelings are easily detectable.
As a matter of fact, in the painting *Morning in Maremma* (*Ora mattinale in Maremma*) the landscape is paid a much lesser importance to, it seems to serve almost exclusively as a background to the sky: vast, radiant, lightened by broad strokes of paint which nevertheless do not manage to brighten the surrounding landscape which is shrouded in mist.

4. The Rivara school

Together with Fontanesi, the «Rivara school» [20] represents the other key institution Piedmontese landscape painting revolved around in the second half of the nineteenth century. It was not a school in the strict sense of the word, but more of an artistic coterie, or better still a "unique artistic coterie" [21], the only one in Piedmont [22]. His members, mainly young painters, used to meet up during the summer months in Rivara, a delightful village in the Canavese area, where they would discuss art and exchange opinions. They shared the same ideas as regards to painting, both in terms of technique and subject matter. Their originality lies in the painting technique they adopted and their treatment of paint and colour [23]. It was a rather varied group, since, besides Piedmontese painters such as Bertea, Avondo, Federico Pastoris, it included Alberto Issel and Ernesto Rayper from Liguria, Serafín De Avendaño from Spain and D'Andrade from Portugal.
In their work one can detect an emotional interpretation of nature and a leaning towards romantic landscapes [24]. Their country scenes, mostly depicting Rivara and the surrounding area with its meadows, woods and even castles, evoke a sense of *pathos*. It is, however, a rural pathos which has got nothing to do with the torment associated with Fontanesi, but it gives voice instead to a calm, melancholic tenderness which only nature can convey when it is peaceful.
Pittara, disciple of Camino, was the key figure of the group of artists belonging to the «Rivara school», the man they would constantly turn to for inspiration. The group, although made up of people from different places and with varying educational backgrounds [25], contributed nevertheless to produce one of the most memorable periods in the history of local art [26]. Pittara regarded the landscape as a large natural backdrop on which to place his subjects which were nearly always cows or flocks of sheep and which seem to be an integral part of it. They blend in with the surrounding scenery just as does the grass they graze or the field where they rest. At times they dominate the entire composition to such an extent as to appear oversized in comparison to the other elements in the painting. The detail and accuracy with which the animals are depicted strikes the observer. The painting however, does not appear to share the coldness of a photographic reproduction.
The Portuguese painter D'Andrade (1839-1915) wanted to bring out the plastic qualities encompassing the beauty and poetry of the landscape. He was particularly fond of the scenery around Rivara, which he reproduced in most of his oil paintings such as *Rivara Lanscape* (*Il paesaggio di Rivara*), *Rivara Canavese* (*A Rivara Canavese*) and *Under the Walnut-trees* (*Sotto i noci*). *By the River Bormida* (*Motivo sulla Bormida*)

is the canvas which best epitomises his aesthetic vision of the landascape. This scene from everyday life characterised by the slow gait of a man on a horse and a figure walking by his side shows the level of realism the painter could achieve. The group is depicted from behind so as to make the landscape stand out. This is also achieved through the contrast between dark, dusky tones and the bright green of the meadows and the foliage of the trees, partially lit by the brightness of the clouds and the sky above them. In the picturesque painting *Landscape* (*Paesaggio*) the artist captures the stillness enveloping the landscape at a particular time of the day, when it is usual to go for a stroll or have a rest. It portrays two women, one sited and the other walking down a road, where the pattern created by lights and shadows on the ground helps create a play on perspective thus giving the painting a sense of depth which the modest size of the actual canvas would not have made possible.
A seascape is the subject of the painting *Petrels* (*Procellarie*) by Pastoris (1837-1884) whose dexterity justifies the high praise afforded him by Stella who rated him among the best artists from the «Rivara school» [27].
The painting *Piedmontese Landscapes* (*Paesaggi piemontesi*), by De Avendaño, a Spaniard who spent thirty years of his life in Liguria, expresses the aesthetic ideal of the landscape of the artist. In his opinion a painter should represent reality as it is; trees, stones or any other object should be faithfully reproduced. In the painting *Genoa Riviera. Rock at Quarto* (*Riviera di Genova*. *Lo scoglio di Quarto* (Fig. 1) the splendour of the sea is rendered through a range of different shades of blue and the contrast with the whiteness of the small boat'sail and the darkness of the rock of Quarto.
The Ligurian painter Issel [28] (1848-1926) executed many landscape paintings but the one he was most attached to was "Rivara".
Rayper (1840-1873) travelled all over Italy in search of inspiration. He chose his subjects based on their outline, but more importantly because of their gaiety [29]. Flowers, meadows, in other words the joy of nature, is portrayed on his canvas. He never ceased looking for new ways of expression. In *Il Gombo* (Fig. 2) the landscape takes the form of a vast and bare glade in which the sense of space is achieved through the matching of chromatic strips going from green to yellow to brown and running diagonally, whilst the sky which takes up some of the tones of the glade seems to blend with it. In the painting *The painters* (*I pittori*) (Fig. 3) the emotional perception of the landscape is enhanced by the use of bright shades of green for the foliage and the beach umbrella under which two painters work whilst taking shelter. The theme anticipates that of Èdouard Manet in the work "Monet Painting in his Studio Boat" where the painter Claude Monet is portrayed while painting "en plein air" on his floating studio, just like Rayper's *The painters* (*I pittori*) who are depicted while painting outdoors surrounded by an idyllic country scenery.
The most naturalistic tendency among the Piedmontese landscape artists is represented by Lorenzo Delleani (1840-1908). His numerous landscapes depicting mountain scenes stand out thanks to the use of bright colours.
Much has already been said about the fact that he was influenced by Pittara and Fontanesi. Although this is true, he managed to develop his own original style.
This overview representative, but not certainly extensive, of the aesthetics of the landscape in the nineteenth century Piedmontese landscape painters allows us a final comment. Thanks to Fontanesi and Delleani a poetic, emotional landscape was born in Italy. While Avondo invested the landscape with passion and feeling, for Pittara the landscape represented a vast natural scenery. If all this is true, it is also true that in all the painters taken into consideration is detectable at least an echo of that "[…] deep and poetic feeling which any sensitive and artistic man experiences when contemplating the vastness of a landscape […]" and which Ferdinando Fontana attributes to Fontanesi, but that can be attributed to all of the painters of the «Rivara school» [30].

5. Piedmontese landscape painters between the late nineteenth and the early twentieth centuries

Towards the end of the nineteenth century landscape was no longer the subject matter of choice, even though in Italy it could never really fulfill its potential [31], and the pure landscape artists, those who put landscape scenes at the centre of their pictorial exploration, or at least regarded them as an interesting theme, had nearly all died. There were still painters who depicted natural scenery like Luigi Calderini, however his reasons for doing it were to make his figures stand out or capture a memory of one of his several journeys, just as Eugenio Gays had done.
We can therefore conclude that by the late nineteenth century, landscape had lost his *allure* and no longer represented a window to the painter's feelings nor the dominant theme of his work.
A season had come to a close: landscape in contemporary art won't be a genre in its own right again.



Fig. 1: DE AVENDAÑO, Serafín, *Genoa Cost. Rock at Quarto* (*Riviera di Genova. Lo scoglio di Quarto),* 1881, [oil on canvas], 85 x 130,5 cm. Signed and dated. Galleria d'Arte Moderna, Genova (copyright immagine: Doc SAI - Archivio Fotografico del Comune di Genova).



Fig. 2: RAYPER*,* Ernesto, *Il Gombo*, 1864, [oil on canvas], 58,5 x 140 cm. Signed twice and dated. Galleria d'Arte Moderna, Genova (copyright immagine: Doc SAI - Archivio Fotografico del Comune di Genova).



Fig. 3: RAYPER, Ernesto, *The Painters (I pittori)*, 1867, [oil on canvas], 58 x 85 cm. Galleria d'Arte Moderna, Genova (copyright immagine: Doc SAI - Archivio Fotografico del Comune di Genova).

Bibliographical References

[1] CLARK, Kenneth, *Il paesaggio nell'arte*. Milano: Garzanti, 1985; BÜTTNER, Nils, Il paesaggio nella storia dell'Arte. Milano: Jaka Book, 2006. ISBN 88-16-60356-9

[2] STELLA, Antonio, *Pittura e scultura in Piemonte*: 1842-1891: *catalogo cronografico illustrato della Esposizione retrospettiva del 1892*. Torino: G. B. Paravia e Comp, 1893, p. 261.

[3] *Ibid*., p. 268.

[4] MALLÉ, Luigi, *Pittori piemontesi dell'800*. Milano: Arti Grafiche Ricordi, 1967.

[5] DRAGONE, Angelo and DRAGONE CONTI, Jolanda, *I paesisti piemontesi dell'Ottocento*. Milano: Istituto Grafico Bertieri, 1947, p. 18.

[6] *Ibid*., p. 22.

[7] *Ibid*., p. 24.

[8] *Ibid*., p. 28.

[9] STELLA, Antonio: *op. cit.,* p. 283.

[10] *Ibid*., p. 293.

[11] CALDERINI, Marco, *Memorie postume di Francesco Mosso*. Torino: STEN, 1895, p. 258.

[12] *Idem*, *Antonio Fontanesi, Pittore Paesista*. 1° ed. Torino: Paravia, 1901, p. 7.

[13] LANKHEIT, Klaus, *Dal Romanticismo al realismo*. Milano: Il Saggiatore, 1966, p. 246.

[14] Typewritten letter, not signed, date 7th February 1866, sent by Antonio Fontanesi to Alfredo D'Andrade (Lettere di Fontanesi, CAA 559.2, 1861-1873, Archivio storico dei Musei Civici di Torino, from now on referred to as ASMCT).

[15] LANKHEIT, Klaus: *op. cit.,* p. 246.

[16] STRATTA, C., La Scuola del Vero. *Giornale d'Arte*, giugno, 1891, Torino.

[17] Antonio Fontanesi expressed his wish to paint the sky and the immensity of nature to his disciple Clemente Pugliese Levi. See: DRAGONE, Angelo and DRAGONE CONTI, Jolanda: *op. cit.*, p. 84.

[18] LANKHEIT, Klaus: *op. cit*, p. 180.

[19] CALDERINI, Marco: *op. cit*., p. 31-32.

[20] BERNARDI, Marziano (ed.), *Catalogo della Mostra dei pittori della Scuola di Rivara*. Torino: La Stampa, 1942; POLA FALLETTI VILLAFALLETTO, Giuseppe Cesare, *La Scuola di Rivara*. Torino: Tip. Degli Artigianelli, 1950; PALUDETTO, Franz (ed.), *Paesaggi: la Scuola di Rivara*, Chieri: Arti Grafiche Giacone, 1991; *Da Daumier alla Scuola di Rivara: un percorso dell'arte nell'Europa del XIX secolo: 17 giugno al 9 luglio 2004*. Torino: Circolo degli artisti, Torino (Torino : Mar.co. graf).

[21] Typewritten letter signed by the editor of "La Stampa" and addressed to the director of the Civici Musei torinesi, dated 3rd November 1941, in which it was proposed the possibility to loan some works by the Rivara painters who most interested him, such as Carlo Pittara, Ernesto Rayper, Vittorio Avondo, Federico Pastoris, Alfredo D'Andrade, Ernesto Bertea, Casimiro Teja, Giulio Viotti, Giuseppe Monticelli, Adolfo Dalbesio, Antenore Soldi, Aberto Issel, Serafín De Avendaño and Eugenio Gignous, in order to put on and exhibition at "La Stampa", on the occasion of the fiftieth anniversary of Pittara's death, founder and promoter of the Rivara group (Esposizione Scuola Rivara, CAA 400, 1942, ASMCT). The exhibition "Mostra della Scuola di Rivara" was opened at the Salone of "La Stampa" in 1942 as testified in a typewritten letter signed by Marziano Bernardi to the director of the Civici Musei torinesi and dated 10th January 1942 (Esposizione Scuola Rivara, CAA 400, 1942, ASMCT). The event saw also the release of a specific publication, curated by Bernardi himself, art critic of "La Stampa", who presented the Rivara school and his painters. The catalogue was also accompanied by the biographical profile of each painter detailing the works on display and their provenance and by an appendix containing copies of the works themselves. Cf. BERNARDI, Marziano: *op. cit*.

[22] BERNARDI, Marziano, *Arte piemontese*. Torino: Lorenzo: Rattero, 1937, p. 36.

[23] DRAGONE, Piergiorgio, *Pittori dell'Ottocento in Piemonte, arte e cultura figurativa 1865-1895*. Torino: Banca CRT, 2000, p. 60.

[24] BERNARDI, Marziano: *op. cit.*, p. 42.

[25] It was a rather varied group of artists since, besides Piedmontese painters, there were also Ligurians such as Ernesto Rayper e Alberto Issel, the Spanish Serafín De Avendaño and the Portoguese Alfredo D'Andrade.

[26] STELLA, Antonio: op. cit., p. 272.

[27] *Ibid*., p.337.

[28] RUM, Piera (ed.), *Alberto Issel: l paesaggio nell'Ottocento tra Liguria e Piemonte*. Milano: Skira, 2006.

[29] STELLA, Antonio: *op. cit.*, p. 321.

[30] FONTANA, Ferdinando, *Scalpelli e Pennelli*. Torino: Roux e Favale, 1880, p. 115.

[31] MALTESE, Corrado, *Storia dell'arte in Italia, 1785-1943*. Torino: Giulio Einaudi editore, 1992, p. 230. ISBN 88-06-12989-9

HERITAGE and TECHNOLOGY
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Grotesque forms and representations in baroque balconies of eastern Sicily.

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Grotesque forms and representations in baroque balconies of eastern Sicily.

Eastern Sicily is characterized by late baroque buildings which have suggestive balconies supported by masks with grotesque and imaginative representations that alternate play and irony, and can disturb or cheer the way of passersby. The cities where we can find these elements are: Catania, Acireale, Noto, Ragusa, Siracusa, Scicli, Modica, Palazzolo. These cantilevers, keystones and historical portals are not only decorations, but real sculptures that become independent, from the architectural element of the mansion. We can analyze some of these cities; in the Palazzo Beneventano in Scicli, there are cantilevers that seems very expressive and grotesque masks with exasperated faces. In Ragusa, in Palazzo Zacco, there is a musician who is playing the maracas, a mask that appear to passers with its burlesque grimace and a mermaid with flute and trumpet. In Palazzo Nicolaci in Noto each of the six balconies has five cantilevers with different themes; sirens, ancient, winged horses, leonine forms, faces of cherubs. Maybe the most characteristic balcony is located in the Palazzo Cafici, in Palazzolo Acreide; it is the longest in the world with 27 representations. This kind of architectural element is important for the culture of the place; the Baroque period is predominant in this land of art, full of spirit and meaning in part still unknown. Elements that needs to be preserved because they are testimony of one of the most important periods that characterize the history of Sicily.

Keywords: baroque, balconies, masks, Sicily, history.

1 Some example of Sicilian Baroque masks and balconies

The ornaments that decorate the palaces in eastern Sicily are apparently far from the concept of art and architecture, but this point of view can be unequivocally refuted after visiting Val di Noto, the Baroque Valley. (Fig. 1)
Balconies, shelves and frames that enrich and decorate the palaces, become the emblem of the baroque decoration of many of these buildings.
In particular, façade balconies, that are supported by corbels made out of successive courses of stonework, or by large wooden or stone brackets, were ornate with apotropaic masks.
These architectural decorations are used to "mask" and "disguise" the technical elements, and then to transform an object with structural function in an ornamental artifact. Also, the masks had an anthropological and magical significance, from which the adjective apotropaic. The adjective apotropaic (from Greek αποτρέπειν) means "avert", "banish": monstrous faces, with horns and long tongues were used to ward off evil spirits. The use of this kind of masks to decorate portals and balconies belongs to the ancient culture. People from ancient times believed that the portals and windows were particularly vulnerable to the entry or passage of evil. Listed below, are some representative palaces, examples of the Sicilian Baroque style.



Fig. 1: John Senex, Map of the Island and Kingdom of Sicily, 1721.

1.1 Palazzo Beneventano (Scicli)

It is located on the slopes of the Colle di San Matteo, in Scicli, in a central position between the ancient city located on the hilltop, and the eighteenth-century modern city that lies in the valleys of Santa Maria La Nova and San Bartolomeo.
The charming Palazzo Beneventano, one of the 700 most important baroque monuments and most original baroque palace of the province of Ragusa, has been listed in 2002, as a UNESCO World Heritage Site.
Characteristic "irreverent" masks adorn the two monumental facades linked by a corner pilaster, which acts as a *trait d'union*.
Decorations consist of ashlars side pilasters, enriched on top by two mask representing two Moor's heads. In the bottom of the pilaster there is a statue representing St. Joseph (Fig. 2-3).


Fig. 2-3: Palazzo Beneventano and on the right, of the detail of one of the masks

The building is characterized by the balconies with curved cast iron railings supported by console brackets representing fantastic animals and masks. Among the masks, there are some representing black Africans. These sculptures were very rare in the Sicilian iconography because, until then, just Saracens and Moors were represented in the ornaments [1].

1.2 Palazzo Zacco (Ragusa)

The palace is part of the list of 18 monuments Ragusa included in UNESCO sites of Val Di Noto. It was built in the second half of the eighteenth century by Baron Melfi of St. Anthony and then bought by the Zacco family at the end of the nineteenth century [2].
Located on the border of the new Ragusa (built from scratch after the 1693 earthquake), the building has two façades with six large balconies. In the corner pilaster is the Melfi family crest outlined by a frame of acanthus leaves on which rests a cherub. On the main façade there are three balconies: the central one is supported by the two grand entrance pilaster with Corinthian capitals.
The side balconies are supported by stone brackets representing musicians with grotesque expressions.



Fig. 4-5: Palazzo Zacco and on the right, of the detail of one of the masks representing a musician playing maracas.

Very original is the middle stone bracket of the right side balcony. The bracket has two sculptures representing a musician playing maracas and a griming face (Fig.4-5).
In the side façade there are another three balconies. The one in the middle, leaning on five stone brackets, is the most charming; the stone bracket at the center, larger than the others, represents a mermaid, while the other four represent musicians playing flutes and trumpets.
Today the palace is owned by the municipality of Ragusa and it is a farmers' museum with a small exhibition of craft tools.

1.3 Palazzo Nicolaci (Noto)

Palazzo Nicolaci - Villadorata, Noto, is the urban residence of noble family Nicolaci. In 1701 the family Nicolaci acquired the title of "Barons of Gisira and Bonfalà" buying feudal lands with noble titles attached. Corradino Nicolaci led the construction of the first building. (Fig. 6) The coat of arms of the family is the rampant greyhound leaning on a column.
The Palace, in Baroque style has about 90 rooms and three Salons, is the result of the handiwork of several skilled architects, imitating the explosion of Baroque at that time, with its flamboyant world of the imagination.
The heraldic symbol shown on the family arms is a greyhound resting on a column, signifying trust, strength and loyalty.
The balconies resemble those of the Palace of Baron Trezzano, Noto Antica.

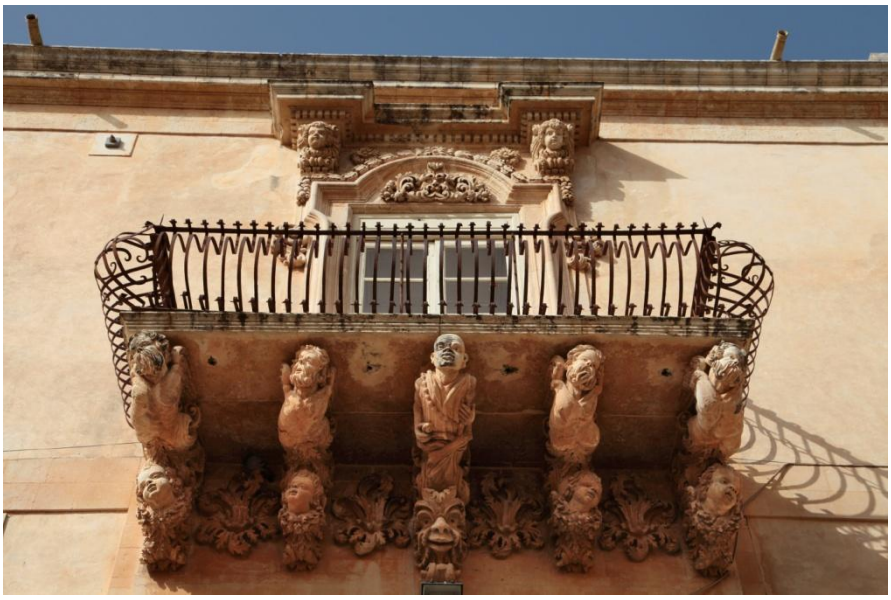

Fig. 6: Palazzo Nicolaci

The building is characterized by a sequence of cast iron balconies , with railings decorated "a petto d'oca". and supported by stone corbels with grotesque figures representing mermaids, sphinxes, lions, hippogriffs, winged horses and angels.(Fig.7)

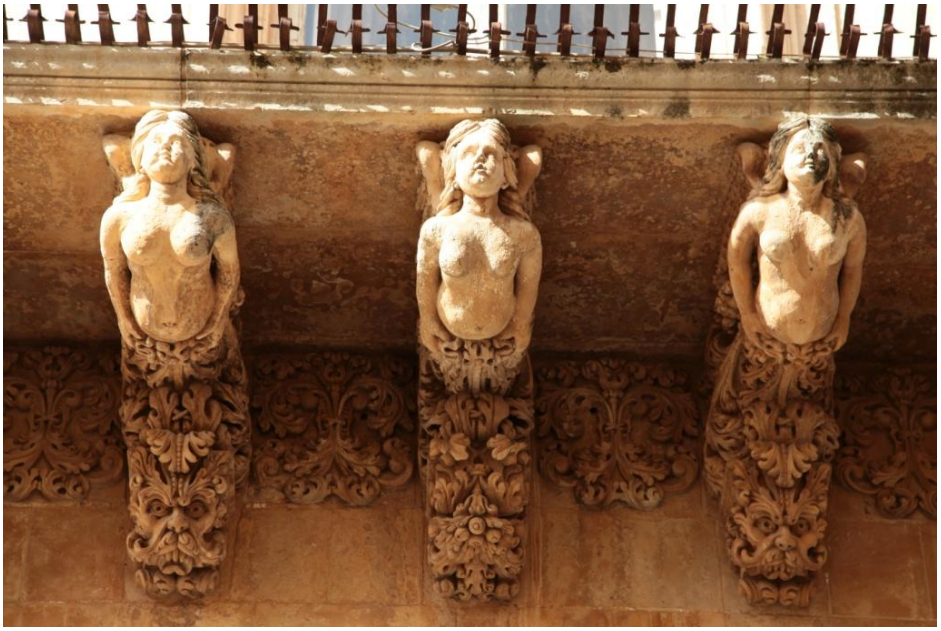

Fig. 7: Stone brackets representing the mermaids in Palazzo Nicolaci

The central mask of the balcony in the main façade, called "the Moors", resemble the figure of Giacomo Nicolaci holding a flute in his left hand, reminding us that in 17th century Europe human knowledge was represented by a man with a flute, not a musician but a wise man who did not allow himself to be enchanted by the beauty of the music [3]. Defined as the most beautiful balconies in the world, they have become the icon of the late baroque city of the Val di Noto and the cultural district of the south-eastern Sicily.

1.4 Palazzo Judica Caruso (Palazzolo Acreide)

Palazzo Judica Caruso, located in Palazzolo Acreide in the district of St. Anthony, was built just after the earthquake of 1693 by Don Pasquale Lombardo, first owner until his death in 1748.
On the cornice of the central window there is the Lombardo family crest representing the "family's weapons", also present in archival documents as a sigillum [4].

The palace is today called in different ways, according to the various owners: Palazzo Càfaci, Palazzo Judica, Palazzo Caruso.
The balcony is now the main attraction of the palace. Is the longest baroque balcony in the world, with 27 stone brackets, representing a combination of different masks and figures (Fig. 7-8).



Fig.2. The balcony of Palazzo Judica Caruso. The longest of its kind, supported by 27 finely sculptured brackets.



Fig.8. Particular masks of Palazzo Judica Caruso.

The building is the handiwork of the local architect Don Giuseppe Ferrara, a leading figure of Palazzolo post-seismic reconstruction. The cast iron balconies, with railings decorated "a petto d'oca" were made by the Syracusans Giovanni Fiore and Saverio Scatà, although after a restoration work carried out during the nineteenth century, the original design has been changed [5].

2 Memories of a stonecutter

The stonecutters played a fundamental role during the post-seismic reconstruction. During the construction of humble houses and noble palaces, the architect was often replaced by stonecutters. They usually followed architectural examples already tested. However, for the main façade design, they have managed to create original masterpieces that today, are considered unique examples of the constructive activity in the south-eastern Sicily.
The raw material for the production of shelves, capitals, and arches, was locally carved, thanks to the excellent quality of the Sicilian limestone and sandstone.

To better understand the methods of carving and creating stonemasonry in Val di Noto, and in particular in Palazzolo Acreide, it is helpful to read the statement of the craftsman Santo Calleri, a modern artisan following in his ancestors' footsteps, interviewed by Paolo Giansiracusa.

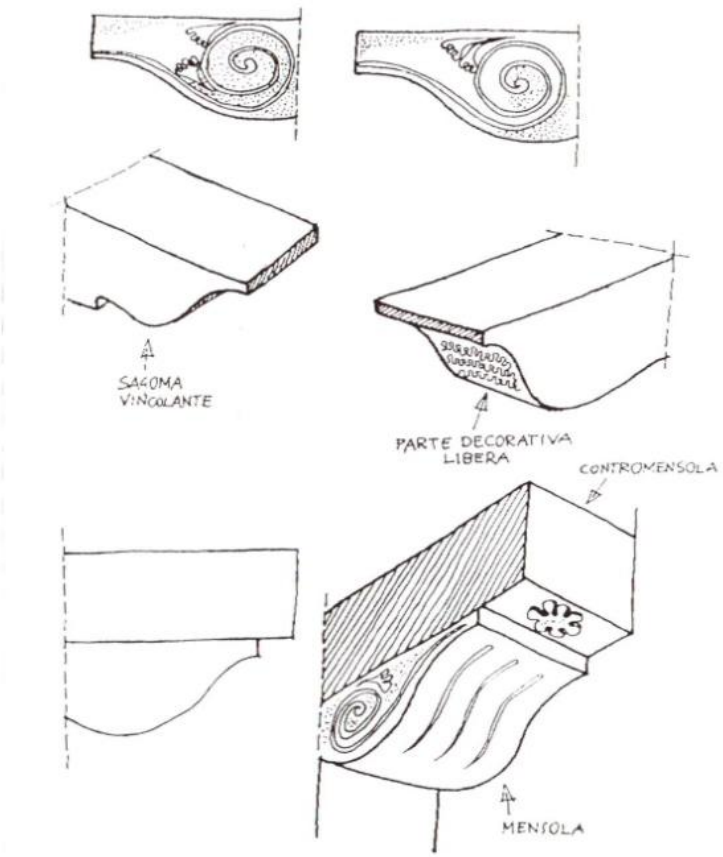

Fig.9. Stone bracket carved by Santo Calleri in a sketch made by Paolo Giansiracusa.

The craftsman is a member of one of the oldest families of Sicilians stonecutters. Among his ancestors there was Paolo Calleri, one of the most important craftsman during the nineteenth century.
Reading the interview is possible to understand the details that explain the work behind these great masterpieces, that can be seen along the streets of Val di Noto. The thickness of the blocks depends on the masonry in which the blocks (the brackets) are to be placed, and are all originally made of the same size, and then completed on the construction site. The designs of brackets and capitals were learned in schools, that the young stonecutters attended in the evening. During the day, however, they worked in the construction sites.
The shapes of these brackets were made on sheets of "carton-cuoio", that were laid against the raw stone before being carved [6].

3 Conclusions. Our past is our future

The Baroque style is predominant in this land full of art, and in great part still unknown and the masks, moreover, are the most representative elements of the Sicilian baroque architectures. Almost everywhere in the eastern Sicily, from Ragusa to Scicli, from Modica to Noto, from Catania to Syracuse, the mask represents figures linked with the magical and mystical world.
These elements must be preserved because they constitute the evidence of one of the most significant historical periods that characterize the history of Sicily and, all together, represent the cultural value that allows to maintain the identity and integrity of a whole region.
Our architectural heritage is a unique resource, an irreplaceable expression of the richness and diversity of a country and characterizes its past and the identity of its people. Is the soul of the people who make the places alive and unique, not as mere places, but as places in which the *genius loci* lives together with the souls of men and women.

Bibliographical

[1] Casamento, A., La qualità del progetto urbano in Sicilia tra Sei e Settecento. *Annali del Barocco in Sicilia Pompeo Picherali Architettura e città fra XVII e XVIII secolo.* Gangemi Editore: Siracusa, pp.47-52, 1997.

[2] Trigilia, L., *La valle del barocco: le città siciliane del Val di Noto*, *"Patrimonio dell'umanità",* Domenico Sanfilippo: Catania, 2002.

[3] Ide, J. J., Noto - the Perfect Baroque City. *Journal of the Royal Institute of British Architects*, 66, pp. 10-15, 1958.

[4] Antoci, G., *I monumenti del tardo barocco di Ragusa*, Nonsolografica:Ragusa, 2003.

[5] Lombardo, L., Don Pasquale Lombardo e il suo Palazzo. *Studi Acrensi (1984-1995)*, ed. Flaccavento: Siracusa, pp.175-182, 1999.

[6] Giansiracusa, P., *L'attività degli Scalpellini nella Sicilia Orientale* ed. Morrone *Editore*: Siracusa, pp.35-46, 2001.

HERITAGE and TECHNOLOGY
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The water and its monuments in Provence

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Abstract ID 176
One of the distinctive elements of Provence is the abundance of water in the area. We can say that it is at the top of the rankings of the factors that make up the heritage of the region and characterize it.
We want to investigate the process of transformation of the territory, which has been perpetuated over time, through the reading of surviving artefacts, related to the catchment of water sources. The use of sources, even in the days of the ancient Romans, has resulted in the construction of aqueducts to supply thermal baths, fountains and catchment basins. Afterwards in the Middle Ages we note the increasing distribution of cisterns and wells to supply. It is with the Renaissance that takes place the need to use water as a source of energy for each sort of mills; later, in the nineteenth century, are constructed navigable canals and for irrigation.
The image and the history of Provence, in times of change and development, is strongly marked by the use of the water, with the use of technology, has transformed the environment through time. Among the realizations of the past, originated from the need and characterized by clever technology works, are found architectural splendours, too often unknown that, far from the tourist trail, speak of harmonic integration of the built into the landscape.

Keywords: Provence, aqueducts, monuments, landscape, territory.

1. Water as the protagonist of the landscape of Provence

Provence is, on one hand, an area rich in history, architectural heritage and landscapes well preserved, and on the other, among its features there is the presence of copious amounts of water, which allows having a flora and fauna rich and diversified during the whole year. This abundance of water favoured urban settlements in the area, which are to organize, according to its presence and possibility of supply. The abundance of water is closely linked to climate factor that, in this region, is Mediterranean and expressed with arid and dry summers, and autumns and springs with significant rainfall. The rains in autumn and winter are extremely important for the recharge of groundwater aquifers and affects the type of precipitation: the violent downpours tend to flow on the ground without enriching the slopes, while a continuous rain or snowfall have effects very positive on the scope of the sources. In addition, it is round these that develop the first settlements called *oppida*. As for the collection and water supply, is not, however, have been made significant architectural works, and however, the testimonies we have received are still under investigation.

1.1 The aqueducts of antiquity in Provence

With the arrival of the Greeks, but especially of the Romans, with their culture and way of life, it is strongly modified territorial setting plan. The water has used for thermal baths, water games, for ornamental tanks, fountains and nurseries. Holding tanks soon become insufficient, hence the need to build aqueducts able to feed the growing city. Traces of ingenious works, and that often collect from distant sources, are still visible on the territory. The first operation for the construction of an aqueduct



Fig. 1: Roman aqueduct – Pont du Gard (Photo L. Blotto)

was to find a source, a stream, a source located at a height greater than that of the urban centre and having a regular flow and abundant. It was also necessary that there was a chance to build on the path a collecting basin. Through a gallery of drainage, the water was collected in a further tank, from which flowed by gravity through a conduit closed. Usually it was made of stone or brick, sealed joints with mortar made of lime. To be more waterproof, the inside of the conduit was made with a mixture of lime, sand and crushed brick. This bed with a thickness of a few centimetres, is finished off with a plaster elastic, consisting of lime and animal fats. To ensure a good transport of water, the slope must be constant of a cubic meter per second, i.e. a difference in height of one meter every thousand. If the speed is too fast the pipes will tend to wear out, on the contrary the mud settles on the bottom and over time reduces the flow rate. The height of the aqueducts are depending on the profile of the valleys and the ducts are laid on overlapped rows of arches, supported by pillars with square or rectangular base, generally composed of stone blocks. The highest bridges may be in two or three planes such as the Pont du Gard [fig. 1], but in general, in Provence vestiges in the area are few high. I will mention below the main aqueducts built in Roman times in Provence. In Arles, the most important is that of Barbegal, near Font Vieille. It conducts the waters of an abundant source located in Eygalieres up the thermal baths of Constantine in Arles [fig. 2]. The great interest in this monument is due to the presence of a waterfall, about twenty feet high, which allowed acting on a double set of wheels by operating grindstones and grinding wheels.



Fig. 2: Roman aqueduct - Barbegal

Aix-en-Provence has always known as the city of water. Its name comes from *Aquae Sextiae*, the waters of Sextius, name of the Roman general who sent his legionnaires to bathe in the springs born at the foot of the mountain of Sante-Victoire to heal their wounds; the Greeks already knew the sources of Aix. The geographer Strabon, in his work Geography, attributes to virtues of the water the great fertility of women in this area. For about a century, the waters are reserved to the militias and only under the reign of Augustus, the baths of *Aquae Sextiae* are open to the entire population and the notoriety of the beneficial properties expands throughout the Empire. Over the first four centuries of our era are made four aqueducts for provide for to the needs of the population of Aix who had greatly multiplied, drawing especially from the massive Sante-Victoire, real collection tank of water or as they say in France *chateau d'eaux*. The aqueduct of Frejus is among the best preserved in the region. With its length of 45 kilometres, carries the waters of the stream Siagne to the port area of the city. The height difference is about 490 meters, and then the slope is greater than 1%. The route winds often in underground tunnels, but also on high arches up to twenty meters. It is visible in different sections of its path, in particular in Cargalon. Even in the city appears on several occasions, near the *Porte des Gaules* and public gardens [fig. 3].



Fig. 3: Roman aqueduct – Frejus - Cargalon

1.2 From the middle Ages to the Renaissance

At the end of the Roman Empire, the Provence enters a historical period very nebulous. Its image is identified with the declining continuity of the previous age with rare architectural evidences of human activity dating accurately. The long and confusing period in which there was a gradual depopulation of cities, the Middle Ages affirms a new identity through a re-modelling of human and economic geography. The aqueduct of Marseilles is the only known in France of the medieval period, and practically it will remain a few traces on the territory. Only thanks to antique engravings can reconstruct the route. Indeed, the strategic needs of the city have given rise to construction of fortifications ring and big walls for the defense of the city and the water supply is entrusted to the realization of wells and cisterns. At this stage, most of the ancient aqueducts are dismantled or destroyed [fig. 4].

Among the emerging figures in the field of channelling of surface water, we find Adam de Craponne. While not the first to take an interest in these works, to him we owe the setup of innovative systems, such as models of reduced, construction of locks and deviations. To him we owe the diversification of



Fig. 4: View of Marseilles extracted by Civitates Orbis Terranum (1572 - G. Brown)

water use: power supply, irrigation, power for the mills, and flotation for wood, navigation. Especially draws up rules of law in order to solve the financial problems of the distribution, the allocation, and sale and allow the reclamation of a whole region.
Manufacturers of channels across Europe referred to this legislation. The most ambitious project of Craponne was to bring the water of the Durance to Aix-en-Provence and Salon, the Plain of Crau and Arles. The purpose of the project was to ensure domestic needs and the supply of hydraulic energy for crop irrigation and to facilitate the transport of heavy goods. From the technological point of view, his accomplishments have ingenious solutions, both as regards the uptake, both for the choice of the tracks and the realization of the channels. His works have radically changed land use planning changing their perceptiveness and use. Many of these canalizations are still in operation today [fig. 5].

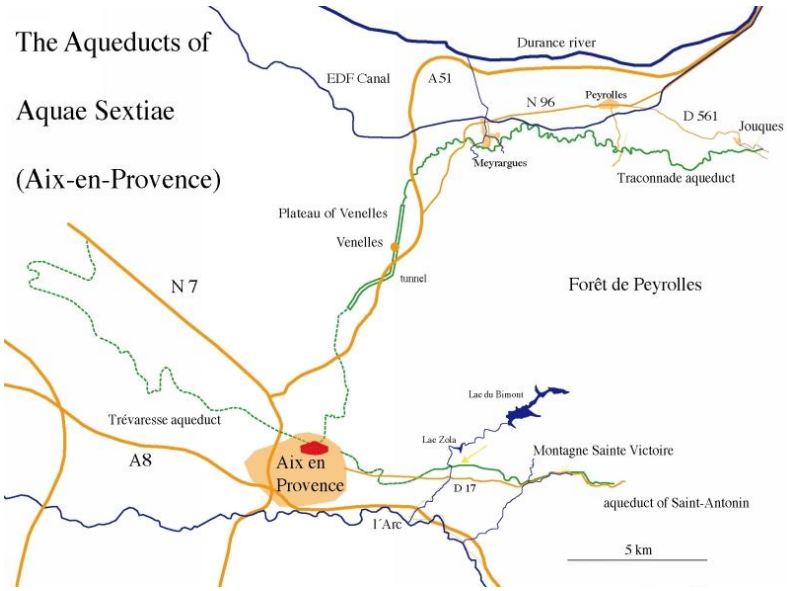

Fig. 5: Canalization in Aix-en-Provence area

The Canal Saint-Julien is among the oldest of Provence, was remodelled several times, expanded and improved. The first traces date back to the twelfth century, but its current form is the nineteenth century. Its construction is due to the initiative of the Benedictine monks who undertook the work to irrigate the lands of the Chartreuse de Bonpas. In the eighteenth century it was extended to the gates of Avignon and connected to the Rhone, currently is fed the river Durance Mallemort and irrigates the whole area of Cavaillon, making it the most fertile parts of France. The Channel of Carpentras dates back to the sixteenth century and was built to meet the needs of the city capturing the waters of the source of Caroube. In the eighteenth century, the track was lengthened to feed the Durance at the level of Pertuis. Currently the construction seems imposing with its 42 arches high 24 meters crossing the Valley of Auzon.

1.3 **The great works of the twentieth century**

Unlike large channels that cross visibly Provence, inspired by the technique of Adam de Craponne, with the Channel of Marseilles is adopted a new strategy. While the first do not tackle the difficulties posed by mountain reliefs and meander in valleys up to irrigate the countryside , the second uniquely designed to address the needs urban, is realized with the aid of culverts or closed, and then the shelter of pollutants. As we saw from the Renaissance onwards, the region has witnessed the realization of a multitude of projects and many others have been abandoned for lack of funds. The problem of water supply is always present and requires solutions compatible with the needs of users, but also with the duty to safeguard the natural heritage and landscape. With these objectives, the departments of Bouches du Rhône and the Var, and the city of Marseilles create the Company Canal of Provence. Over forty years, from 1963, the Company has made 260 kilometers of pipelines and tunnels, as well as 4,500 kilometres of canals with its reserves and retention basins. The numerous works are barely visible, to the point that does not seem to belong to the landscape that cross. Occasionally the channel is revealed in the vicinity a derivation or with the presence of basins. Instead of obtaining supplies the water of the Durance, as occurred in previous centuries, are collected those Verdon. The large catchment basin, located more than a thousand meters above sea level, is an important resource that can meet the needs of the entire region. Furthermore, the water is of excellent quality, less muddy Durance and free of impurities. [Fig. 6].

Of considerable environmental impact is instead the Channel EDF (the French electricity company) conceived for the production of electricity, which with its 120 kilometres of trail, through the whole of Provence. In fact, it appears as a kind of highway water, a blue ribbon from the deserted shores and without any kind of cultivation. Nothing to do with the old channelling, surrounded by lush vegetation. To keep the height of fall of water required for the production of electricity, the slope was reduced to the minimum useful. The bridges and tunnels that cross it are only at the service of the technical-functional



Fig. 6: Gorges du Verdon



Fig. 7: Channel EDF

equipment. The channel, in its linearity and severe geometry, sometimes, bad fit with the sweetness, the green of the surrounding landscape and alters perception [fig. 7].

1.4 **Minor works**

In addition to the great works that have allowed to supply water to large urban areas, increasing agricultural development and provide electricity, there are myriads of small plants scattered throughout the area directly connected to his presence. I refer to the mills, forges, in paper mills and industrial settlements requiring hydraulic power to actuate the various systems. All the villages of Provence adorned with fountains around which, at one time, the main events took place and still are social gathering places, as well as trade and cultural exchanges [fig. 8 - 9]. Water was used in handcrafted, for domestic use or collective to wash clothes.



Fig. 8: Fountain in Le Val (Var)

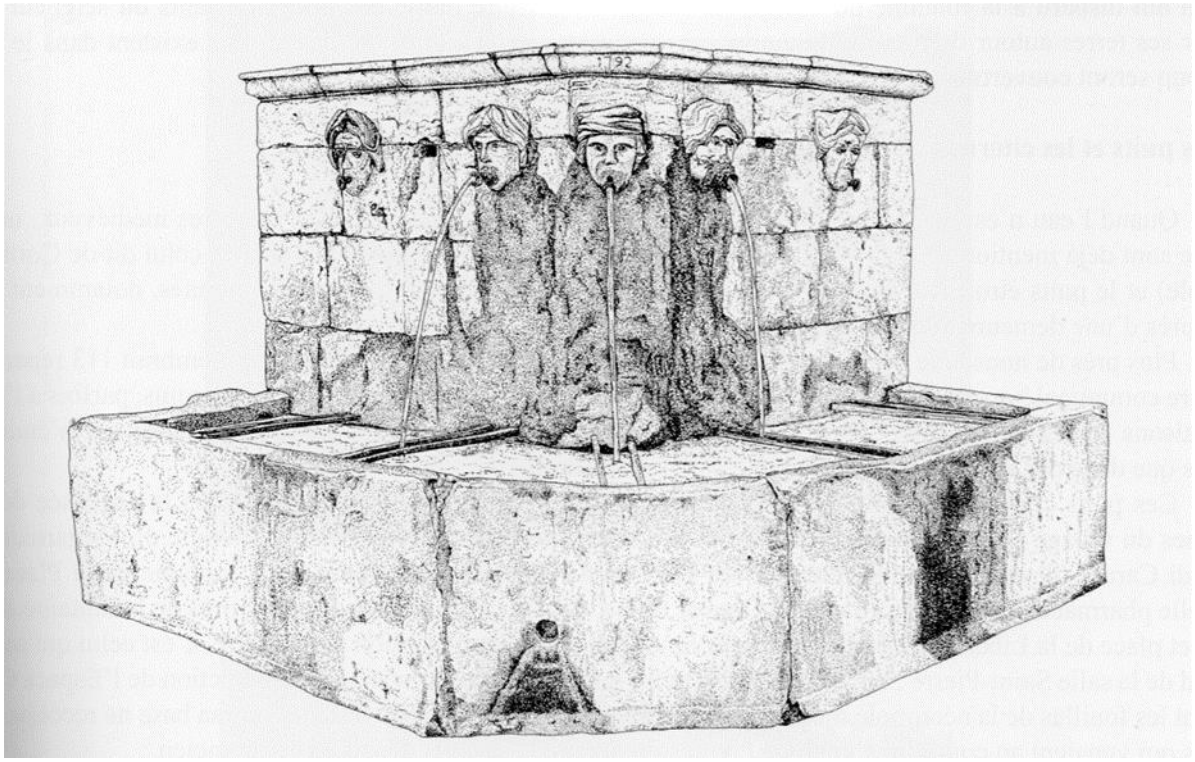

Fig. 9: The fountain in the Church of Tourves (drawing of C. Arnaud)

The wells in the countryside were used for watering and irrigation.
Therefore, there are many uses: for each of these categories of artefacts is associated with a particular construction technique, brainchild that translated into increasingly sophisticated technologies. It is these modest works that strongly characterize the landscape of Provence, of course, together with the large channelling already outlined above, to which it addresses the attention. The mills to grind wheat are common throughout the region since the Middle Ages. Their functioning was mostly horizontal wheel which allowed to obtain a rotary movement in a plane where, for rotation and crushing, were ground cereals. The milling technique used in the centuries, called *à la grosse*, consists in passing, under the grindstone, the wheat harvested at one time, the separation of the flour from the bran occurs in a second time with the use of appropriate sieves of different greatness. The use of vertical wheel takes place in the nineteenth century and it is in this period that takes place the re - adaptations of the old mills to new technologies. The hydraulic energy was also used for the production of woollen cloths, which, for their processing, needed for special and complex stages, connected, with the use of water. Testimonials of factories currently are found near rivers especially in Tourves and La Tour in *Provence Vert*.
Other small monuments present in almost every country of Provence are the Moulins à Huile: there are different size and shape, but all are united by the same technology for olive oil production, are often the subject of pathways to visit for tourists eager to learn the peculiar aspects that the region offers. Extraordinarily rich in water tables at the foot of the hills, the Provence has always been a land of wells. Surely, the great invasions of the Middle Ages contributed to their proliferation and urban development around them. In almost all districts of the medieval city like Marseilles, Aix-en-Provence, Avignon and Arles, there are still traces of wells in the cellars of the old buildings. In the villages are located in the squares and on street corners, and anyone can use them. In the castles were dug in the courtyards or inside the structure itself.
The most beautiful wells are undoubtedly those of the cloisters of the convents and cathedrals. The wells of the Cistercian Abbeys of Le Thoronet (Var) and Montmajour (Vaucluse) are small works of art [fig. 10]. The same is true for the great religious communities as Sant Maximin la Sainte-Baume and Saint-Trophime d'Arles. It should be emphasized that the wells mentioned above was useful not only for daily needs and for the purification of the monks before the religious offices, for them the source of water had a strong symbolic and mystical value. Indeed wells occupy an important role in the Old Testament but especially in the New. Several scenes of the life of Jesus taking place near a well for which over time it becomes the object of a particular attention being enriched with ornaments and decorations.



Fig. 10: The well in the Abbey of Montmajour

Outside of these contexts, in the Provence countryside, the wells for agricultural use are frequent: they are mostly small constructions made of dry stone, topped by domes. Here too we are facing a construction that, although small, are strongly characterizing the landscape of Provence with their forms often very elegant in the extreme simplicity [fig. 11].

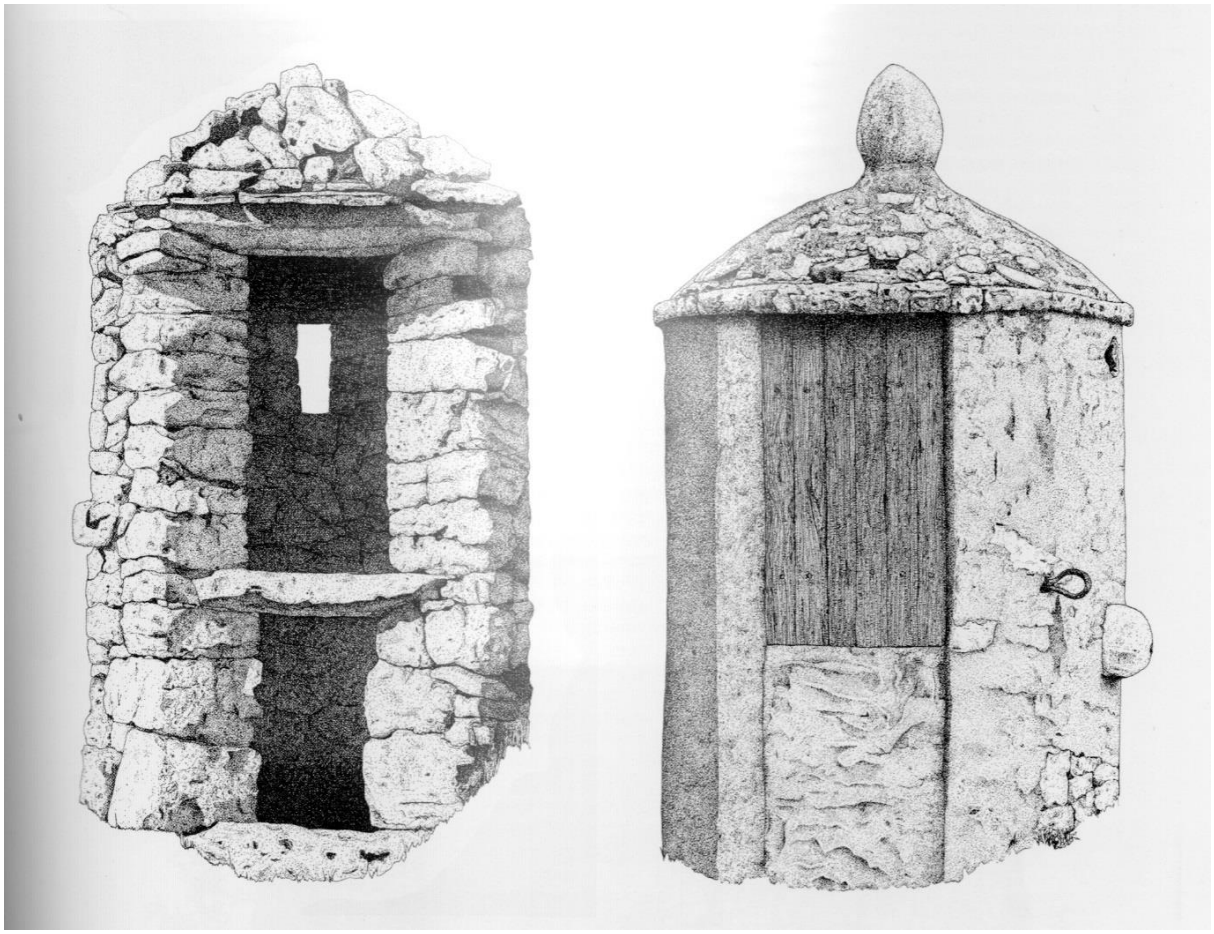

Fig. 11: Typologies of wells in the countryside (drawings of C. Arnaud)

The practice of using the ice for food preservation has ancient origins, since the time of the Romans. After the middle Ages, the consummation of ice resumes in the period of the Renaissance and especially in Provence that you may encounter significant examples of icehouses, built in nearby locations to population centers or placed in strategic locations. Their presence strongly characterizes the landscape of certain areas such as the Massif of Mont Ventoux and the Sante-Baume near Sant Maximin. In this last area can be counted today about twenty: some of them in ruinous state, others are used for habitation. The plant of these structures is cylindrical; the largest can reach 25 meters in height and 20 in diameter, while the thickness of the walls is about 2.5 meters. They lean the slope of the terrain for which there is the possibility of access on different floors, useful both for the filling of the tower and for the withdrawal of the ice. The presence of slits ensures a minimum of lighting and light ventilation inside. The roof is in tiles laid on a wooden support structure and particular attention is paid to the isolation made with earth, wood chips and straw. Outside, in the immediate vicinity of the tower, a network of channels allows to convey water in the basins where it will freeze in cold weather. An example of these artefacts is in Pivaut, located a few kilometres from Mazaugues adjacent to Plan d'Aups. The careful restoration has highlighted the beauty of the building, so been incorporated harmoniously into a natural framework of remarkable beauty. Surely the heritage of the icehouses is among the most original and interesting monuments of the water [fig. 12].



Fig. 12: The icehouse of Pivaut – Mazaugues

1.5 Conclusions

We have observed that, in the case of agricultural land area of low Provence, interventions of drainage of the Romans were helped by a favourable weather condition, characterized by a lower incidence of floods in the lowland. We can say that the works created in antiquity, and that over time have improved technically and involved increasingly wide areas, have outlined the particular characteristics of a country that bases its wealth on the valorization of a diversified rural areas, in which finds the usual association of arid lands with wetlands, characteristic of the Mediterranean area. The analysis conducted, at the global level, on the artefacts of particular interest historical - architectural and landscape, wanted to highlight the intrinsic peculiarities and characterize the area of the monuments of the water. The knowledge of these realities, in the area, allows us to reason not only in structural terms, construction technique and settlement strategies, but also in a future perspective, in terms of re-functionalization and enhancement of the same in relation to a plan more extensive, directly linked to the development of the contexts in which they are inserted.

Bibliographical References

[1] MASSOT, Jean-Luc. *Maisons rurales et vie paisanne en Provence.* Ivry sur Seine: ACTES Sud, 2004. ISBN 2-7427-5100-9

[2] MAYLE, Peter. *Provence.* London: LDT, 1994. ISBN 88-7063-236-9

[3] JOANNET, Henry. *An Provence l'eau est d'or.* Saint Cyr sur Loire: Alan Sutton, 1994. ISBN 978-2-8138-0052-7

[4] RIEGL, Aloïs. *Le culte moderne des monuments.* Parigi: Seuil, 1999. ISBN 9-782906-162495

[5] BECQUART, Henry Marc. *Les eaux d'Aix-en-Provence.* Gemenos: Jeanne Laffitte, 2004. ISBN 2-86276-413-2

[6] CHOL, Eduard. *Le fontainier d'Aix.* Candanne: Esmengiaud, 1998. ISBN 2-9512862-0-1

[7] BELLET, Michel-Edouard, ELLER, Marc. *Plans de villes - Aix-en-Provence.* Aix-en-Provence: BH, 2009. ISBN 2-9519954-0-7

[8] *Association d'histoire populaire tourvainne*. Arnaud Claude. Sanary sur mer, SIRA, 2012. ISSN 0996-5246

[9] HOMET, Jean-Marie. *Les monuments de l'eau en Provence.* Aix-en-Provence: EDISUD, 2007. ISBN 978-2-7449-0680-0

[10] DAUTIER, André-Yves. *Trus de mémoire.* Aix-en-Provence: EDISUD, 2007. ISBN 978-2-7449-0680-0

[11] COSTE. Pierre. MARTEL, Pierre. *Pierre seche en Provence.* Aix-en-Provence: EDISUD, 1986. ISBN 2-906162-00-0

[12] GUYON, Jean. HEIJMANS, Marc. *L'antiquité tardive en Provence (IV et V siecle).* Arles: Actes Sud, 2013. ISBN 978-2-330-01646-3

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HERITAGE and TECHNOLOGY
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Knowledge and Innovation in the Field of Cultural Heritage

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Abstract
Innovation is strongly linked to the knowledge system, particularly in the fields of research and cultural heritage where varied skills should be managed and coordinated. The acceleration of research processes, which has been recorded over the last few years, highlights the need for management systems that allow organizing and controlling complex situations by planning actions for the conservation, enhancement and promotion of cultural heritage. Advanced methods should be used to acquire knowledge, which occurs through processes of progressive working out and in relation to the capacity of managing and controlling the various components of the monuments to preserve.
Knowledge implies a specialized learning process, i.e. the use of skills to understand phenomena and situations and to suggest innovative solutions to specific problems by proposing management and control procedures that may be replicated and easily applied.
Therefore, there is a clear need for defining methodological procedures that enable to acquire and outline the knowledge framework of a monument as a necessary condition to identify its state of conservation and to detect the most suitable actions to take based on systematically collected information.
Within this process, special digital case sheets may be used for the examined assets in order not only to store information and further data, which may be collected over time, but also to specifically process them combining sciences, history and humanities (Fig. 1).

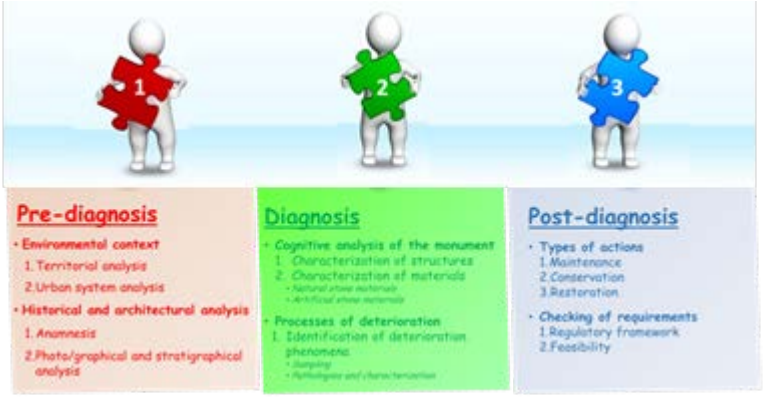

Fig. 1 - Outline of the knowledge plan

Keywords: Diagnostic plan, cultural heritage, Knowledge

1. Introduction
Cultural heritage is a strategic asset that can generate social and economic development and improve the quality of life. Therefore, it is important to develop actions to protect, preserve and enhance it through a comprehensive and coordinated research approach aimed at acquiring information on the components of an artefact, on its condition and on the mechanisms that led to its state of conservation, by integrating different spheres of knowledge, even seemingly distant research fields, in an intelligent manner.
Considering the complex and varied aspects that should be taken into account, it is clear that the study of historical, architectural and monumental assets requires methodological rigour. To this end, today, it is possible to use innovative knowledge tools enabling the synergistic integration of different competences and promoting their interrelations. Such a multidisciplinary approach will allow collecting varied information and data and highlighting the connections and relations useful to the interpretation of specific phenomena.

Hence, the study of cultural heritage must be based on the development of a rational technical process which starts from the context in which it is located, then defines accurate and effective interventions and, finally, proposes a project of enhancement.
As Art. 6 of the Code of Cultural Heritage and Landscape states, referring to heritage as a whole, enhancement means to perform the duties and regulate the activities aimed to promote the knowledge of the cultural heritage and to ensure the best conditions for its use and public fruition. With reference to the landscape, the same article states that enhancement also includes the renovation of damaged or degraded buildings and areas subject to protection, i.e. the creation of new coherent and integrated landscape values, thus reaffirming the value of protection and of the environmental and territorial context. Therefore, knowledge is an invariant constant necessary for protection, conservation and enhancement as well as an essential reference to plan proper restoration actions.

2. The methodological process

Any enhancement or conservation action must necessarily include the definition of the knowledge framework of an artefact that, due to its complexity, must be outlined in a systematic manner based on a rational and multidisciplinary procedure that integrates historical and architectural understanding and the definition of construction techniques and constituent materials.
The methodological procedure, referred to as CMK (Coordination, Management, Knowledge), provides a comprehensive approach that considers the artefact in its environmental context and, through an across-the-board investigation, defines its state of conservation whose elements can be detailed and collected in a user-friendly digital case sheet (1, 2).
In a system perspective, the whole process of knowledge acquisition can be divided into phases and sub-phases. This paper proposes a three-phase approach to knowledge. The preliminary phase of *pre-diagnosis* includes a first analysis of the artefact considered in time and space. The second phase of *diagnosis* is also analytical and is aimed at gathering information for the construction of the actual knowledge framework of the artefact considered in its material dimension, which is useful for the definition of its state of conservation.
The third and final phase, called *post-diagnosis*, is planned on the basis of the information gathered in the first two phases, which provide the assessment of the artefact. It is a pro-active phase that includes the identification of a range of possible and suitable solutions for restoration, conservation and enhancement, among which the definitive solution to be adopted will be selected in accordance with the most advanced cultural and regulatory policies (3, 4).
The methodological procedure aims to build a clear scientific knowledge framework within which different competences can naturally coordinate in order to find and develop knowledge about specific areas while respecting and taking into consideration their connections with other areas (5, 6).

3. Organization of the methodological procedure

The proposed procedure is meant as an integrated innovative approach to diagnostics on cultural heritage and is based on the rational search of specific propensities to deterioration in the environment where the artefact lies. The methodological procedure comprises: a) historical research and anamnesis; b) diagnosis, based on historical and critical information on the construction and development phases, which includes the assessment of the state of conservation. This phase will also include scientific investigations performed in the laboratory and designed to characterize the material dimension of the artefact as well as to identify existing pathologies and, therefore, understand deterioration processes; c) a conservation project deriving from the elaboration and interpretation of the gathered information (7, 8).
The complete process resulting from these concepts can be summarized in three key words: Anamnesis, Diagnosis and Therapy, terms borrowed from medical science that characterize the contents of such a process of knowledge acquisition organized in phases (9, 10).
In order to share and use the technical and scientific documents prepared and collected during the various phases, it is necessary to outline, construct and use a "digital case sheet". It will allow all the subjects involved in the process to establish a picture of the overall situation favouring correlations, comparisons and integrations with reference to the different investigation results and to gather and store all information in a unitary and integrated system, i.e. in a relational database.

The various phases leading to knowledge acquisition (Fig. 2) are intended as stages of a logical and critical path aimed at continuously monitoring the state of the system, providing directions and highlighting connections between its components (11, 12). To this end, it is necessary to focus on the contents of each phase:

First phase - pre-diagnosis:

- parameterization of the environmental characteristics;
- historical and archival research for reconstructing anamnesis;
- graphic and photographic analysis;

Second phase - diagnosis:

- characterization of structures and constituent materials;
- definition of the type and level of deterioration of materials and structures;

Third phase - post-diagnosis

- plan of actions;
- project of enhancement.

The advantage of such an integrated methodological process is the effective and multidisciplinary contribution from many different professionals not only to the preliminary acquisition of information and data, but also, and particularly, to the achievement of the preconditions to evaluate the overall situation through a correct global interpretation resulting from data intersection and overlapping (13, 14, 15). Ultimately, it will be possible to develop appropriate actions respectful of the artefact and of cultural instances (16).

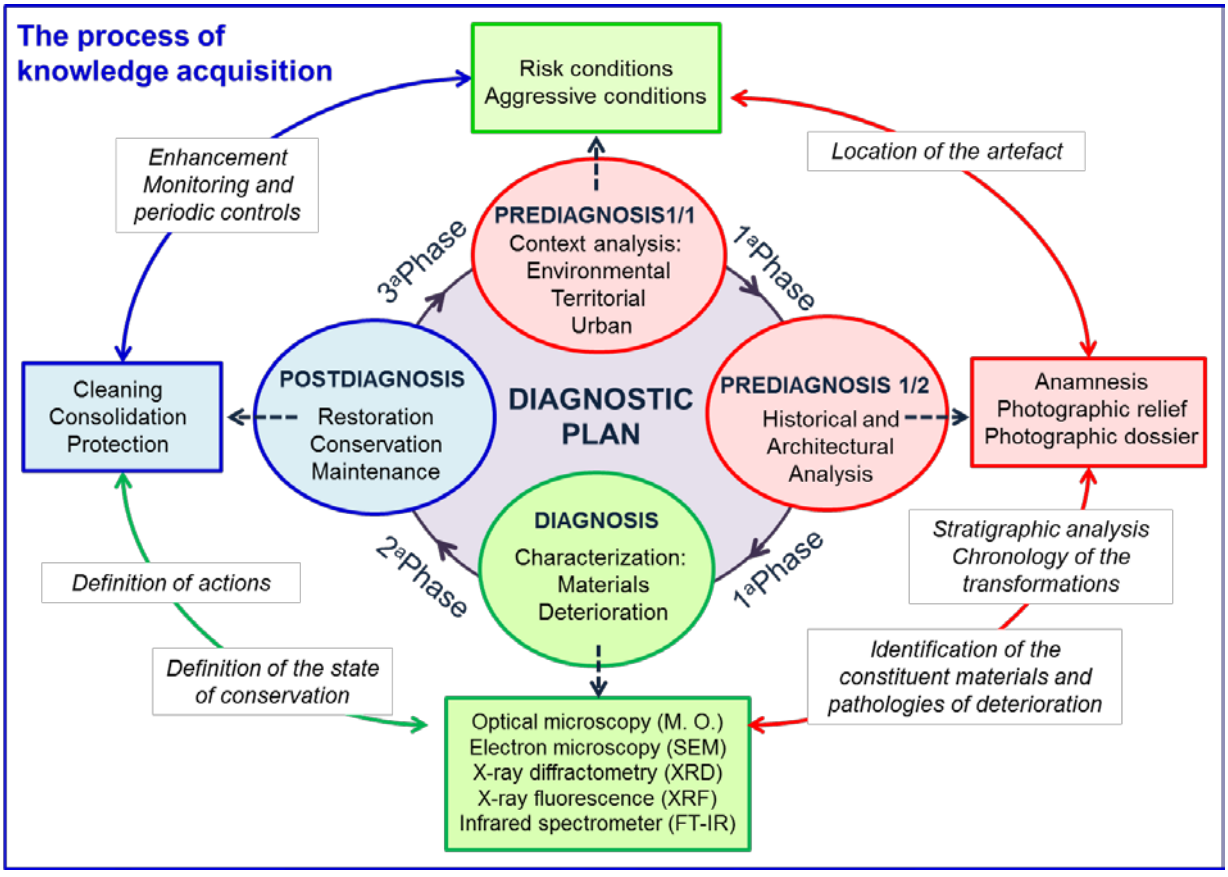

Fig.2 - Logical organization chart of the methodology

The knowledge acquired through the elaboration of the information gathered during the above-mentioned procedure should be developed by carrying out an assessment work in each phase and is preliminary to possible actions and strategies for improvement to be proposed (17, 18).

With reference to the most suitable actions on the artefact to be proposed, the logical criteria that led to the definition of the same procedure, which consists in a preliminary phase, in a phase of data development and organization and in a consequent phase aimed at outlining solutions to propose and implement (19, 20), should be adopted and applied.

Specifically, in order to manage appropriately the phase of actions, it seems useful to reapply these criteria identifying the whole process of knowledge acquisition in a phase of pre-intervention that leads to the elaboration of a digital case sheet. This phase should be followed by a phase of actual intervention including the definition and practical implementation of the intervention, which could be a project of restoration, conservation or maintenance, considering all the problems related to feasibility and compliance with existing regulations. Finally, the phase of post-intervention is devoted to the actions of enhancement and marketing of the cultural asset.

Conclusions

The considerable debate, which has developed in recent years through national and international research and studies, highlights the important role material and immaterial cultural heritage plays, since it does not only represent the cultural identity of a society, but it is increasingly considered as a resource that can lead to social development.

The deployment of advanced knowledge, represented by synergistically coordinated multidisciplinary competences aimed at achieving a common goal, favours the development of cognitive paths capable to guarantee the heritage protection, conservation and enhancement.

The definition of the method illustrated above becomes an opportunity to achieve coordinated convergence in the correct and complete management of the information about a historical and architectural artefact through a professional multidisciplinary dialogue which goes beyond mere technical aspects towards the protection and enhancement of cultural heritage by means of the latest multimedia tools made available by technological innovation.

Bibliographical References

1. Gattuso C., Conoscere per restaurare, Publiepa Edizioni, Cosenza, 2001.
2. Gattuso C. , An advanced model to represent and manage knowledgein Cultural Heritage, Atti del convegno "Best practices in heritage conservation and management. From the world to Pompeii. Le vie dei mercanti XII Forum Internazionale di Studi", Aversa | Capri, 2014.
3. Gattuso C., Approccio object oriented nell'opera di conservazione e/o restauro di beni di pregio storico-architettonico - IIIth Convegno Internazionale AIES - Conference "Diagnosis, Conservation and Valorization of Cultural Heritage, Ethos ed., Napoli, 2012.
4. Zevi L., Manuale del restauro architettonico, Mancosw editore, Roma, 2001.
5. Carbonara G., Trattato di Restauro Architettonico, vol. I, V, VI e VII, UTET, TO, 2001.
6. Gattuso C., Philomène Gattuso, Crisci G.M., Oliva A., Recchia B., Image Analysis for the study of working on stone surfaces - Science and Technology for Cultural Heritage, Issue no. 19, F. Serra ed., Pisa/Roma, 2009.
7. Gattuso C., "Per un approccio razionale al piano diagnostico". IIth Convegno Internazionale AIES-Diagnosi per la conservazione e valorizzazione del Patrimonio Culturale, Ethos ed., Napoli, 2011.
8. Gattuso C., Gattuso P., Crisci G.M., A numeric method for the quantitative evaluation of the deterioration of the surface of a monumental building - Science and Technology for Cultural Heritage, Issue no. 18, Pisa/Roma, F. Serra ed., 2009.
9. Gattuso C., "A coordinated and multi-step approach for conservation and enhancement of built heritage". Atti del convegno IIIth Convegno Internazionale AIES- Diagnosi per la conservazione e valorizzazione del Patrimonio Culturale, Ethos ed., Napoli, 2012.
10. Gattuso C., Cozza R., Gattuso P., Villella F., "La conoscenza per il restauro e la conservazione". Franco Angeli, Roma 2012.
11. Gattuso P., Gattuso C., Crisci G.M., La ricerca storico-architettonica nel contesto del piano diagnostico, in Archeomatica, n.1- A&C2000 editore, Roma, 2010.
12. Accardo, G.,Vigliano G., Strumenti e materiali del restauro. Metodi di analisi, misura e controllo. Roma, Edizioni Kappa, 1989.
13. Mordibelli L., "Le rocce e i loro costituenti", Bardi Editori, Roma, 2003.
14. Peccerillo A.,Perugini D., Introduzione alla Petrografia ottica, Morlacchi Editore, Perugia, 2007.
15. Gallone A., Analisi fisiche e conservazione, Franco Angeli, Milano1989.
16. Gattuso C., Momenti di riflessioni sul restauro: le opinioni degli operatori attuali, in "Recupero e Conservazione, n° 10, De Lettera ed., Giu-Lug. Milano, 1996.
17. Feiffer C., Il progetto di conservazione, Franco Angeli, Milano, 1989.
18. Marino L., Il progetto di restauro. Ricerche e studi preliminari, Alinea ed., Firenze, 1981.
19. Mattini M., Moles A., Scienze e restauro, Cardini Editore, Firenze, 2003.
20. Croci G., Conservazione e restauro strutturale dei beni architettonici, Utet, Torino 2001.

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Cultural Heritage 2.0. Toward innovative tools for the communication of cultural and historical asset

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Abstract

The cultural heritage is not only formed by the assets that survived through the centuries, but also by the cultural studies that have been collected through the years with the same heritage as subject. Often these studies and the following knowledge remain unknown or confined into the specialized world. A project that aims to valorise and promoted the architectural heritage, must take into account these historical studies and it must head up their communication.
The Eremitani church in Padua offered an important case study to experiment new methodologies to develop new communication tools. The research aims to create a link between the information collected by the historical researches and the chance offered by the new digital tools. The objective is making available the data about the building's historical evolution in a multidisciplinary and interoperable way.
The research attempted to link transversely the different information achieved by the historical studies, including those from the most recent history, and also by a deeper historical, dimensional and physical knowledge of the building. The objective was to merge and make available in a virtual model the collected data from different levels of a deepening analysis.
The expected impacts are: the knowledge deepening of the Eremitani church to a more efficient management of the cultural asset and a better educational and touristic divulgation; beside a development of digital tools that, even if advanced, are not always able to transfer the different levels of information about the cultural heritage.

Keywords: Digital Humanities; Communication for Cultural Heritage; Tangible and intangible dimensions; Documentation.

1. Historical Research and Digital Representation Tools [S.Z]

The research project presented he is part of a larger programme that involved other research units and that had as its object of study an architectural complex of great importance in the history of the city of Padua. In particular experimenting new systems to share all the historical knowledge gathered over time about the building studied to a wide audience was set as the goal of this work. In fact the cultural heritage is not only composed by the material traces transmitted from the past but also by documentary sources and historical studies that have accumulated over time. The contributions to common knowledge often remain unknown or are

only recognized in specialized fields. Making such content available is now possible through the use of new ICTs in the field of the Digital Humanities [1].
Indeed, the field of historical and cultural visualization has grown substantially in the recent years. There are many examples of this. Using every kind of information from ancient maps, paintings, photographs, archival documents and news accounts to geographic information systems and 3D modelling we produced a new rendering to illustrate how the building of interest has changed over time. Moreover the close interaction between the new display technologies and historical investigations enables to check and to test the hypotheses formulated in philological studies and are not just only a way of transmitting knowledge [2].
The case-study was the complex of the *Eremitani* in Padua and particularly the church. We can immediately say that the monument condenses the millennial history of the city because of the location within the city and wealth of cultural relics preserved. It is near the remains of the Roman amphitheatre, not far from the Scrovegni Chapel and close to what we might call the 'modern city' consisting of the twentieth century *rettifilo* that connects the centre of the city with the station. The church's current aspect is itself the outcome of the numerous evolutionary phases, of renewal and expansion but also of destruction like the damage it received during the Second World War.
The church was founded in 1218 and entitled to St. Phillip and James. It was flanked by the housing for the order of the friars of St. Augustine. The first core of the church was then expanded first in 1264, then in 1276 and its façade and roofing were further transformed in 1306 [3]. The structure of the church in that time is still conserved today: single nave developed in length (by approximately 80 x 19 meters) with chapels at the headboard. The convent was suppressed in the Napoleonic era and the church became a parish church, while the cloisters and convent were used for civil purposes. The most traumatic event dates back to 1944: when the church was destroyed by the bombings [4]. The reconstruction initiated in the post-war period has basically followed the earlier forms. The emblematic core of the church is the Ovetari Chapel that hosts the famous series of paintings by Mantegna realized in the early Renaissance. Heavily damaged by the happenings of the war, was subjected to specific studies in an attempt to virtually reconstruct its original consistency [5]. The fourteenth-century frescoes in the other chapels, are equally important though compromised by the destruction.
How to describe all these evolutions, then? The main problem was to organize a great complexity of data: on one hand the knowledge of the material state of the object of study, and on the other hand the possibility to graphically expose the evolution over time of the building. So the experimentation conducted has tried to take into account the multiplicity of the data, while dealing with the problem of their communication. In this sense the complex of the *Eremitani*, it is considered as a cultural and touristic center of attraction of the city, upon whom are still focused many interests. It should be remembered that the cloisters of the convent now house the Civic Museums of Padua and then normally included in touristic flows through the city. If from the historical point of view the close relationship between the church and the convent is finally severed, the presence of the two realities must somehow be corrected, and explained, through digital tools that facilitate the understanding by the public of the historic background.

2. Virtual models as collectors of historical and architectural analyses. [F.P.]
For the great amount of data the Eremitani case study has been emblematic for the elaboration of new systems of knowledge sharing, specially about the documentation of the historical building, that's very abundant. Above all for the documentation of the last century, concerning the various events that have characterized the most recent history [3]. It would be impossible to be able to condense al this information without fragmenting data "upfront", to be able to show "downstream" a result freed from errors, incoherencies, and, above all, clear and accessible for everybody.
The research project has started from the need to realize an informational tool able to be utilized by the greatest number of users. It started from the requirement that the audience of possible users may be particularly variegated, composed by person of different degrees of knowledge and competences, each one with his own needs and single capabilities of comprehension. The most important challenge therefore was making the historical information, as comprehensible as possible even by the common user.

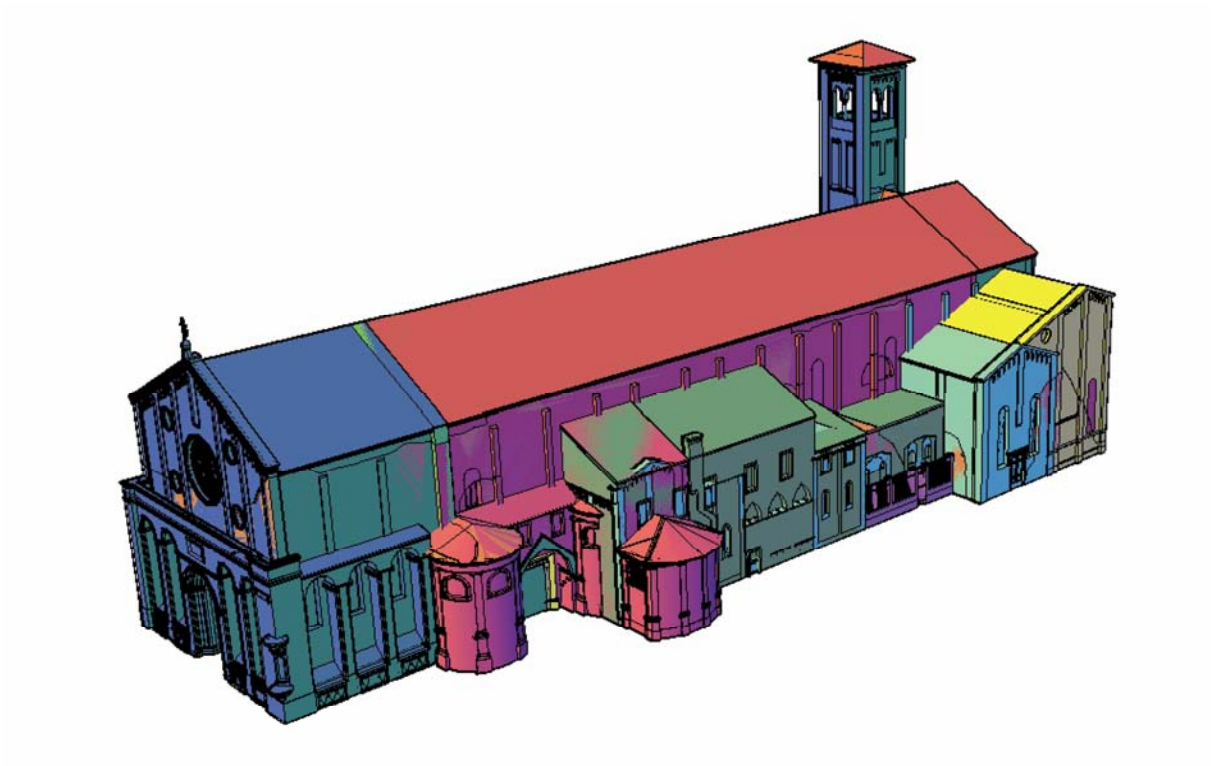

Fig. 1 3D model of the *Eremitani* Church: underlining the layers overlapping, as sum of the transformation during the time.

First of all the process begun with the collection of the historical data elaborated by historiography. After, the great quantity of data available have been divided by importance and partly simplified paying attention that they did not lose content. Furthermore, it is important to specify that the goal of this work has been that of realize a virtual model – based on the real building – that allows to develop thematic visualizations to comprehend the most important phases of the history of the building, obtained from the interpretations drawn from consolidated historical analysis, but that however in the future could be made more accurate or be modified: it is thus expected that the realized virtual model is able to be updated and adaptable to new discoveries.

Once determined the span of available historical information the focus was the understanding which was the most immediate and effective means that would allow to transmit such information to the great plurality of users that would have had access to it. The choice has been to utilize the support offered by disciplines of representation.

It has been studied a procedure that would allow to make readable the contents made available in particular from photographic and cartographic documentation. In this case it becomes useful the support from representation that for its intrinsic nature has the peculiarity of building a vehicle for the communication of information [6]. This type of visualization allows the user to understanding, intuitive and immediate, of the architectural changes and transformations not only from a geometrical, formal, dimensional or chromatic standpoint, but also from social, economical and territorial point of view, contributing to an accurate comprehension of the represented reality [7]. Specifically it has been treated tridimensional representations, where the 3D model does not constitute a mere representation (copy) of the reality, current or past, but is itself a valid tool of special investigation that permits to assess the geometrical coherence of the different parts, in order to confirm or retract, in some cases, the hypothesis bases on the study of the documents.

The utilization of the graphical representation than concurs to the development of the subsequent phases of the research: the morphological analysis of the building and the analysis that consist of recognizing the fundamental role of surfaces and mutual intersections for the space configurations. [8]. Before taking the graphical representation activity of the transformations that characterize the church, some steps have been performed to understand the linguistic analysis of the fundamental historical information that have characterized the

events of the church from the edification until today. The most important preliminary phases have been: the research and cataloging of the photographical and cartographical material; the establishment of a bibliography; the collection of geometrical and morphological data (both through both classic metrical methods as well as through more advanced systems such as photometric systems and in situ laser-scanning techniques. Subsequently it has been elaborated and compiled a chronological synthesis that spans the different building phases.
Through an *ex novo* evaluation with the most modern technologies and crossing with the existing data it has been possible to realize a virtual model that could represent the current state. However, since the model was the result of a sum of different transformations experienced throughout centuries, it has been decomposed in regions, linking each of them to a different layer and subsequently it has been followed by adding new architectural parts that have been developed during time.
The new technologies have become fundamental to this purpose, because crossing photos and historical documentation, have allowed to collect all the changes happened during time, simply by adding layers, connected to the same file (Fig, 1).
Briefly the different steps of the process have been:

- Creation of a virtual model that represents the current state;
- Decomposition of the current state in building parts (with different layers) realized in different eras;
- Realization of structure that do not exist anymore, elaborated from the historical documentation (historical evaluations, plants, sections, photos etc.)
- Evaluation of the geometrical coherences between the different parts. If there are some incongruences, the causes were investigated.
- Temporal allocation of the different physical models;
- Creation of a multimedia product, in which a time-lime is shown connecting the period of realization of the structures.
- Creation of the basis for a potential development of intraoperative products.

For what concerns the historical events difficult to interpret or dubious, that have not been able to certify an historical configuration, it has been decided to develop hypothesis and once a plausible form has been defined it has been inserted in the model, in a simple manner and without details, to signify a clear distinction.
Fortunately such cases were not too much: one in particular concerned the configuration of the façade before the interventions realized by Fra' Giovanni in 1306 (Fig.2), where it does not exist any document that could testify the actual aspect. It has been decided therefore to make the hypothesis a form that best could approximate the figure, based on the constructive typologies of the period treated, and obviously make explicit reference in the notes.
Another problematic aspect treated has been that of compare the metric surveys realized in different eras (Fig.3). As it could be expected, overlaying the charts it has been noted that they did not match perfectly with one another, and it has been required to realize a sort of scale of importance and fidelity, where it has been evaluated case by case several parameters such as the period where the metric survey had been realized, the scale, the techniques and the technologies applied etc.
A particular case has been the process of representation of the church in the state in which it appeared after the bombing experienced in 1944 (Fig.4). Since in this case it was not possible to use direct metric surveys and evaluations, it has been used historical images, where it has

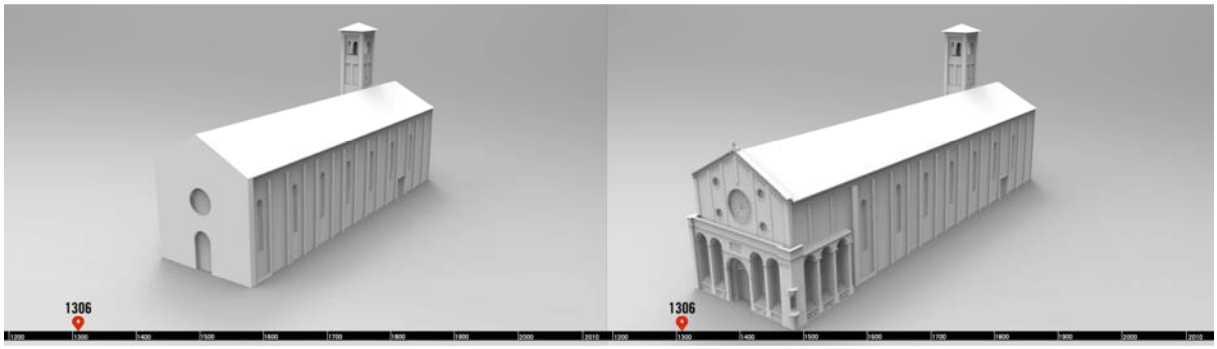

Fig. 2 Left, the church façade before the interventions by Fra' Giovanni (on the right).

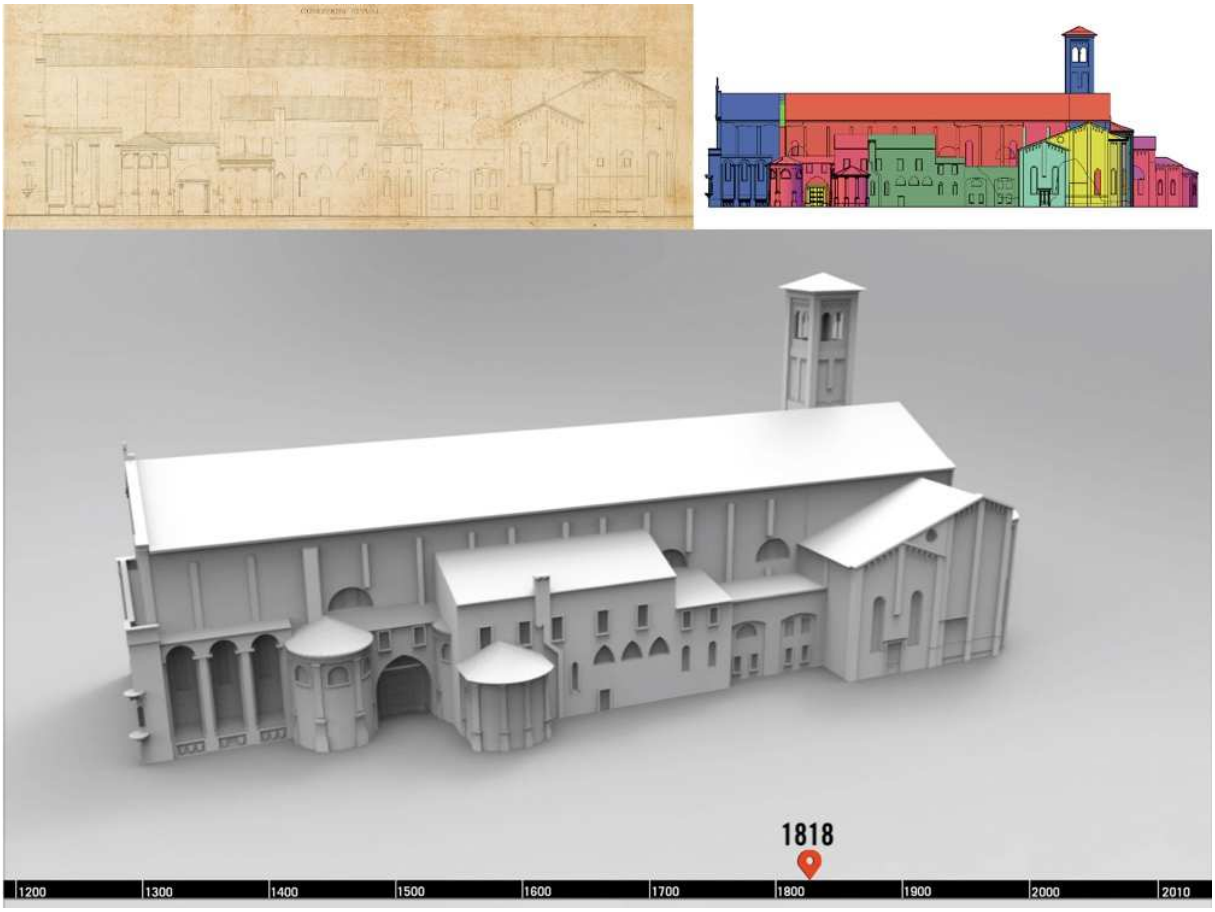

Fig. 3 Southern prospect of the Eremitani church in a chart dating back to beginning of the XX th century, the superstructures are visible. The solid model represents the structure in the same period. The frame collected by the digital video with the time-line that shows the period.

been proceeded tracing out the profiles of the remained semi-destroyed structures and subsequently they have been reported as counterparts of the model.
Furthermore a tridimensional reconstruction with mesh surfaces has been used, drawn from the process of photo modeling performed on a wood scale model, realized after the bombing, that represent the state at that time.

3. The church of *Eremitani* between past, present and future. [A.B.]

The research carried out with the aim of promoting the church of *Eremitani* in Padua has led to some general points to be considered when dealing with the concept of "promotion" itself, as well as to new experimental approaches to the way architectural items may be used.
When applied to cultural heritage, the term promotion involves various and complex commitments well beyond merely preserving and "showcasing" a work of art. From an historical point of view, Italy can boast of a peerless artistic heritage and of a well-grounded approach to its restoration and retrieval. Such wealth, however, sometimes is not matched by an adequate promotion capable of underlining relevant architectural and construction-related features, beyond historical-artistic factors. That is to say, little attention is being paid to the material, basic features that make the groundwork underlying the many monuments and historical cities constituting the wealth of our country. Such attention is sadly lacking even as far as our recent cultural heritage is concerned, with reference to those XX century events that have often led first to restoration and soon later rebuilding following First – and even more - Second World War bombing.
On the one hand such oversight has been mended by the world of academia through analyzing the various facets of the restoration works that have been carried out during the XX century , on the other the staggering amount of the data gathered has in no way been suitably conveyed to a large share of the public, thus remaining mostly within the precincts of specialist studies. For example, as far as Veneto is concerned, two volumes that collect images of Verona and Vicenza during World War II have been published. The images and the reports bear direct

witness of the protection and reconstruction work enacted by Soprintendenza [9] [10]. Conveying such wealth of high-ranking specialist research to a wider public would lead to greater awareness of the cultural import of the heritage itself. The lack of information may in a way be justified by the amount of the documents: the data referring to the building and alteration works of the church of *Eremitani* are in fact relatively scanty, whereas those concerning Ferdinando Forlati`s restoration works for the reconstruction of the building are sizably larger.

Access to such bulk of data is made possible by resorting to computerized instruments allowing the realization of inter-operating models. In the model, in fact, manifold information can be summarized and visualized adequately: rather than being stored in various files, it is gathered in a purposely-devised database. Here all information concerning the building is then recorded, either regarding materials employed, or construction techniques, or alterations; in this way the building can be analysed as a whole rather than approached in separate theme-related sections.

As far as the church of the *Eremitani* is concerned, the transformations it underwent during the XX century have been particularly focused on. At the beginning of the XX century the building evidenced various “layers” and restoration works that had deeply altered its spatial proportions and its overall visual impact. In 1527 the rood-screen separating the area of the church reserved for the clergy from the one for the worshippers had been pulled down, thus causing the choir to be moved to the main chapel.

During the XVII century the original Gothic windows had been substituted by semi-circular windows, and in 1690 the opening between the nave and the Ovetari ante-chapel was walled. When in 1806 the orders were suppressed and the church became a parish church, further changes were made: the floor was remade and raised.

In 1924 the then Soprintendente dei Monumenti di Venezia, Ferdinando Forlati began the first phase of restoration works, which ended in 1929. Such works, prompted by respectful architectural restoration [11] meant substituting the former windows with Gothic openings similar to the ones in the apses, removing the wattle and daub from the hull-shaped false ceiling, as well as pulling down the walling of the arch leading into the Ovetari chapel.

Forlati was to face a much harder job when appointed to rebuild the church, destroyed by an allied raid on March 11th 1944. Only the front external walls of the building – though dangerously slanting – and the bell-tower had been spared, whereas the apses, the Ovetari chapel with Mantegna`s frescoes, most of the roof and of the main front were completely destroyed. Works started immediately after the end of the war under Forlati`s guidance: he had to face difficult restoration choices, not to mention enormous problems related to organization, technical solutions and funding, as evidenced by the large number of estimates he drew. The solution Forlati suggested for the complex restoration problems of the damaged monuments was in keeping with the guidelines enacted by the Soprintendenze of his times, though at the same time he advanced original technical solutions. In those times bombed buildings were reconstructed by reassembling everything that could be retrieved from the heaps of ruins, together with unobtrusive – though visible – new materials. Such approach was embraced also by Pietro Gazzola when reconstructing buildings in Verona, or by Alfredo Barbacci in Bologna [12] [13] [14].

In order to avoid as far as possible the pulling down and alteration of the still standing – though damaged – ancient structures, Forlati devised an innovative approach (which was later to be resorted to in Palazzo dei Trecento in Treviso (1949-52): the slanting walls were to be harnessed and slowly pulled so as to bring them back in place, at the same time they were made stronger by means of applying concrete; brickwork, on the other hand, was rebuilt so that the eye could tell what was new from what was ancient by means of a rift, a reminder of the raid. The roof, instead, was rebuilt using new timber according to the original shape, both as regards the structure (trussed roof) and the hull-shaped false ceiling. Such solution was adopted after a first hypothesis of rebuilding the structural framework of the roof in aluminium, suggested by the firm Alluminio S.A. “Modern” materials for rebuilding historical roofs were employed even on other occasions, namely the reconstruction of Ile de France Gothic cathedrals in the twenties or the roof of Santa Chiara in Naples, after World War 2.

The large amount of data referring to XX century restoration and later reconstruction of the church of *Eremitani*, the embarrassingly scrappy information and the quick pace of

reconstruction make it difficult to involve a wider section of the public in what was actually done. However, being able to resort to a digital model – a sort of structured database – has allowed the visualization of a great amount of information, namely geometrical, construction-related information, together with the kinds of materials used and times taken. Furthermore, such model has made the whole body of information simultaneously available and recorded according to a chronological order, connecting it to the various subjects involved.
Twofold are the operational returns of this sort of virtual model: on the one hand in fact it is possible to obtain an orderly database recording the historical, geometrical, construction-and-material-related information about any building, which may turn out to be a useful tool of management for Soprintendenze. On the other, instead, the same suitably-simplified model may produce a virtual, connected-to-various-subjects (though basic) image of the building, capable of conveying information regarding its physical history to a wider section of the public, in this way overcoming time boundaries and involving even what has happened in the XX century.



Fig. 4 Section of the apsidal part, mesh reconstruction of the plastic of the destroyed church, photogram from the digital video with the timeline that certifies the period [15].

Bibliographical References

[1] There are now many international association about Digital Humanities: http://www.adho.org; http://eadh.org;

[2] GIORDANO A., *Rappresentare la consocenza,* in *In mezzo a un dialogo. La Piazza di Carpi dal Ronascimento ad oggi,* GIORDANO A., ROSSI M., SVALDUZ E. eds., Carpi, APM, 2012, pp. 80-85.

[3] BETTINI S., L. PUPPI, *La Chiesa degli Eremitani di Padova*, Vicenza, Neri Pozza, 1970.

[4] BANZATO D., PEZZETTA E., ANTONIAZZI E. *Gli Eremitani 70 anni fa le bombe e la ricostruzione*, eds., Padova, Comune di Padova, 2014.

[5] DE NICOLO SALMAZO A., SPIAZZI A. M., TONIOLO D. eds. *Andrea Mantegna e i Maestri della Cappella Ovetari,* Milano Skira, 2006.

[6] GIORDANO A, *Geometria e configurazione – Le chiese del centro storico di Padova*, Padova, Cortina, 2012, p.14.

[7] GIORDANO A, *La rappresentazione per la valorizzazione della città*, in AA. VV., Atti 16a Conferenza Nazionale ASITA, 2012, p. 753.

[8] GIORDANO A, *Geometria e configurazione – Le chiese del centro storico di Padova*, Padova, Cortina, 2012, p.4.

[9] VECCHIATO M. (edited by), *Verona, la Guerra e la ricostruzione*, Verona, 2006.

[10] BARBIERI F.; GAUDINI G., VECCHIATO M., *Documentare Vicenza. Strategie di salvaguardia durante la Seconda guerra mondiale e la ricostruzione*, Verona, 2014.

[11] DI LIETO A., *Ferdinando Forlati (1882-1975)*, in BRUGNOLI P. –SANDRINI A. (edited by) *L`architettura a Verona dal periodo napoleonico all`età contemporanea*, Verona 1994, pp. 438-441.

[12] DI LIETO A., MORGANTE M. (edited by), *Piero Gazzola: una strategia per I beni architettonici nel secondo Novecento*, Verona, 2009.

[13] TALÒ F., *Alfredo Barbacci e i soprintendenti a Bologna*, Bologna, 2009.

[14] PASCOLUTTI F., *Alfredo Barbacci: il soprintendente ed il restauratore; un artefice della ricostruzione postbellica*, Bologna, 2011.

[15] Hystoric Images: Concessione MIBACT, Archivio Fotografico Soprintendenza BB. AA. PP. per le Provincie di Venezia, Belluno, Padova e Treviso.

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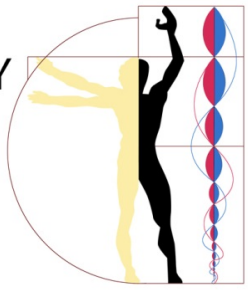

Self Explaining City

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Abstract

This paper presents a section of a wider research project [1], which deals with the enhancement of cultural heritage, also by means of Information and Communication Technologies. The focus is about the potential of architectural and urban design as a tool when pursuing this aim.
Since the layering of different elements and relationships has been producing a remarkable richness in the city, particularly in Italy, architectural design is meant as a lively part of this, slow though never ending, ongoing stratification. Architectural design adds a new layer to the pre-existing ones and, through the creation of urban spaces, aims to provide a larger awareness in the fruition of the city.
The case study, the area where the Eremitani Church lies in Padua, is heavily layered: around the Roman amphitheater the heritage of several centuries is found in the Scrovegni Chapel, the Eremitani Church, the city walls and the canals, which have been changing in terms of uses, meanings, spatial configurations and mutual relationships over the centuries.
The design of renewed spaces inherits its formal fundaments from the above-mentioned relationships, uses and meanings, the existing as well as the newly produced ones. The architectural project is conceived to produce a Self Explaining City, where educational and exhibition needs are merged, without transforming the city into a museum, and without subordinating architectural form and space to the smartness of technological exhibitionism.

Keywords: cultural heritage, urban space, exhibition, CLT timber, form/matter

1. Merging city and art, through thick and thin (L.S.)

When submitting just one portion of the thoughts that have been leading a wide research project [1] dealing with the historical complex of the Eremitani in Padua, as well as its multi-layered urban context, and involving a large team of professors, researchers and firms, it is not possible to isolate some topics and cut away the links of a thick network, without giving up most of the complexity of a trans-disciplinary, methodologically ground-breaking, and technologically advanced, programme, where several issues, such as scientific knowledge, data processing, modelling of reality, scientific communication and dissemination, cultural heritage preservation, as well as the relationships between historical and artistic works and the people who enjoy them, have been complementary and mutually fostering. Yet, at least three key issues, arising from the horizon of this project, dealing with the knowledge, representation, and enjoyment, of the complex of the Eremitani, can provide a chance to cast a new light onto some recurring topics in the speculation about city, architecture and art. These topics are tightly mutually interlaced and only for the sake of simplicity they are split into three different points.
The first one deals with the relationship between the city and the work of art, where the city is meant both as a large complex artefact – a collective work of art – undergoing a continuous, sometimes quickly changing, flow, and as a varied, liquid and multicultural community, which interacts through the space-time, while an author- or workshop created work of art is meant as an object bearing a peculiar, aesthetical and historical value, and undergoing an extremely slow flow, which wears out its matter and threatens its form and is often seen, for several reasons, as a phenomenon to be strenuously fought. The city and the work of art make

therefore an open system, whose elements, though simultaneous in space-time, are characterized by different, not uniform, and sometimes immeasurable, velocities. The difficulty to conceive and to manage such a complex system has often brought to adopt radical simplifications that have traced two possible main paths: the former lies in separating the system elements, subtracting, by means of different ways of isolation, or sometimes displacement, the work of art from the city flow; the latter is the attempt to slow down, in the direction of an asymptotic zeroing, the urban context velocity, with the aim to transform it into a crystal, with a duration that be uniform, if not coinciding, with the time of the work of art, i.e. virtually infinite. This attempt has often turned out into the hypothesis of transforming some whole urban districts into *en plein air* museums. In both cases, both the city and the work of art will pay their shares, since they are taken away from their own flow and deprived of their features, and finally choke, owing to the lack of mutual fostering. The dichotomy between transformation and preservation, which is unconceivable in other fields of thought, has harmfully marked the culture of city and architecture, inferring a wide detachment, if not an opposition, between the cultural approaches of design and of preservation, which have often ended up to delimitate their own exclusive, and possibly non overlapping, realms. These fields, which nowadays appear so naturally and unavoidably unrelated – among the scientific community, and especially in the legislative and bureaucratic management that rules the splitting of jurisdictions – were never so extraneous, although seriously discussed, up to the post Second World War period; just think about the reflections on art, architecture, and city, made by some fathers of Italian architectural culture, starting from the Italian unification, such as Camillo Boito [2], Gustavo Giovannoni [3] and afterwards Cesare Brandi [4, 5], yet a thorough list would be endless.

In view of a city flowing at differentiated speed, which is characterized by a complex space-time layering and by variable and unstable relationships, a dialectic re-composition of different points of view and scientific knowledge cannot rely solely on the identification of a greatest common factor – which cannot of course be found, except for states of ephemeral and feeble balance, owing to the immeasurability of non homogeneous magnitudes – nor on the aim to conquer again a unity where, as Viollet-le-Duc would say, *un état complet qui peut n'avoir jamais existé à un moment donné* could be established [6]. The loss of the unity and the growth of the multiplicity, the shift from homogeneity to variety, from a finite figure to the lack of any perimeter, from the whole to the fragment, from bijective and deterministic links to unstable, feeble, and probabilistic, formal structures, make an inescapable condition in our contemporary age.

As we consider the inalienability of the network of the possible relationships between the city and the work of art, as well as the need to find ways to intercept different trajectories and velocities, without being tempted to flatten the former's necessities to the latter's ones, the acknowledgment of the loss of the unity and the fragmentary nature of contemporary reality is the second main issue that arises from the research project on the complex of the Eremitani.

The fragmented state of Andrea Mantegna's frescoes (1448-1457) in the Ovetari Chapel – the focus of the

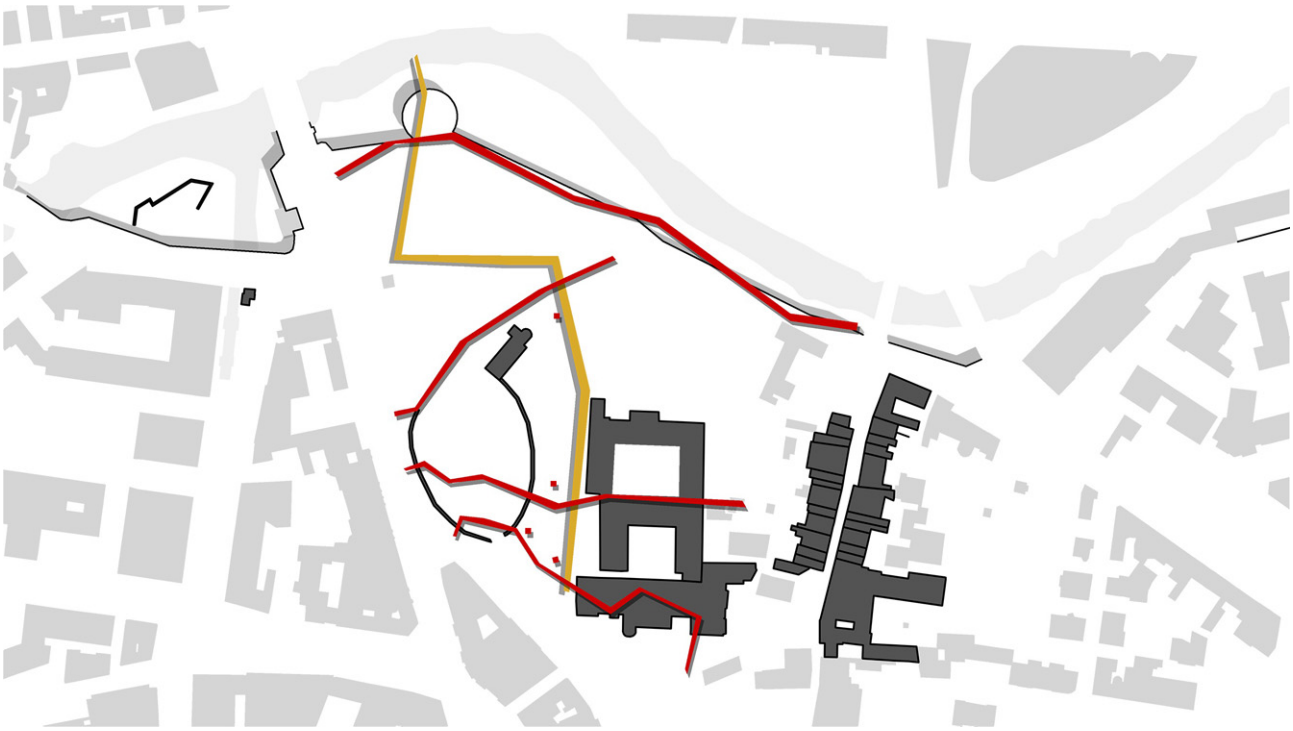

Fig. 1: Self Explaining City, concept. Architectural and urban design as a further layer across the multi-layered city.

research project – a consequence of the bombing on March 11th 1944, and the exhausting, as well as ineffective, attempts to re-compose the rescued fragments, are emblematic of the frustration of the ambition to reconquer not only the physical formal entirety, but even, definitely, that *potenziale unità originaria che ciascuno dei frammenti contiene proporzionalmente alla sopravvivenza formale ancora superstite in essi* [5]. This fragmentation dialogues with a heavily stratified urban context, a charming spatial and temporal continuum, which is marked by mutilations, differences, shifts, dissonances, and where the Roman arena's ruins live together with the traces of the medieval town, the Renaissance, and so on, up to the XX century architecture (Daniele Donghi, 1913-20; Giò Ponti, 1959-64; Franco Albini, 1966-79) and to the memorial for victims of the 9/11 attacks (Daniel Libeskind, 2005). Following the discourse that starts from the refusal to re-establish a hypothetical state of entirety, which have never existed [6], and then argues about the idea to re-compose the potential unity of the work of art [5], Mantegna's fragments appear as a warning not to idly linger on the view of a patchy pictorial surface and attempt to reconstruct its original outline, but to project an investigating gaze through it, along threads of thought, among material and immaterial lines, searching for imaginary spaces to walk through and explore, which, anchored to the material fresco fragments, be immersed in the space-time that continuously flows before and behind the painted wall. The fragments, the ruins, the interrupted architectures, the emerging traces, do invite to weave formal, spatial, and meaningful, relationships that intercept discontinuities, underline fractures, organize possible sequences of changeable stories. They invite us to vaporise point clouds, to trace virtual lines, to section the physical body of the city, so that the fragments can be observed, chosen, and collected, by the individual and collective narrative thought, so that each one can live, tell, recognize their own stories in a self explaining city, which exhibits its folds, its differences of potential energy, the curvatures and the cusps of space-time, without dictating a pre-established plot.

In this project, the space-time machine – conceived as a short-circuiting device, as a catalyst for semi-probabilistic reactions, as a mass capable to induce deformations or folds in space-time, interacting with the different material (ground, water, ruins, masses, volumes, surfaces, light) and immaterial (gazes, perceptions, ideas, thought, memories) layers that get in touch with it – is composed of hardware and software. It is form, space and mechanic or electronic device at the same time, and it is capable to generate forms, spaces and thoughts. It is capable to dissolve and to reveal itself only when interacting with something else. It dematerializes to appear again, it takes new different shapes and positions, expands, stretches, contracts, sinks beneath the soil, climbs a wall, excavates the ground, creeps along a groove, supports a ruin, peeps into a well, leaps over a void, bridges a gap, invites to sit, wraps a space, offers a shield, bears an inscription, hosts a room, exhibits an object, marks a pin point, stops before a tree, frames a

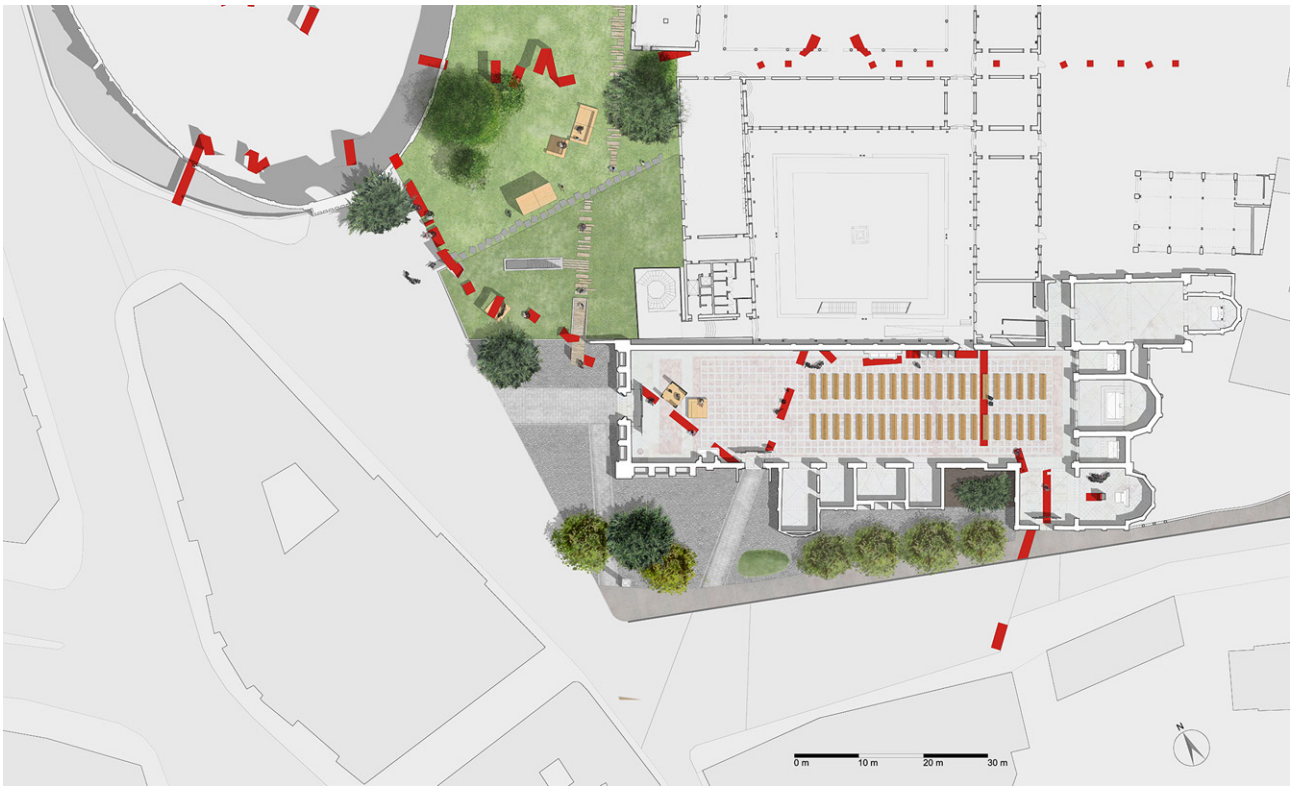

Fig. 2: Self Explaining City. The hypertext-paths across city, architecture, art.

view, directs a gaze, projects a vision, writes onto a wall, draws graffiti, recalls past images, opens a door, unveils a secret passage, lingers onto a fresco, underlines an absence, gives way to beauty. Along its discontinuous development, several rooms are deployed, as microcosms that allow delving into different dimensions and surfacing again to stare at the world from different points of view, onto different backgrounds, imaging alternative scenarios.

Each time *machine à habiter*, *machine à regarder*, *machine à émouvoir*, *machine à penser*, architecture takes different shapes, where form and matter dialogue, according to a rich array of variations. The research project about the Eremitani was based onto a thick twine of physical, virtual, augmented, and immersive, reality, by means of technologically advanced tools allowing the management of material and immaterial data and the making of visions that are capable to go through different segments of reality to draw highly interactive scenarios of knowledge, awareness and design, projected into the past, the present, and the future.

In this frame, onto the relationship between form and matter a third reflective issue is founded, since the formal thought that leads the project is developed through different stages of this relationship: immaterial forms, material forms, and matter that is not controlled by any alien form, interact and support each other, according to a complex relationship structure, which can no longer be described by means of a unique paradigm. In view of such a complex interaction between material reality and virtual forms and spaces, which are managed through Information and Communication Technology or projected onto the physical space by means of devices producing images or holograms, the different realities acquire manifold level of interdependence or autonomy, whose description requires an enlargement of the possibilities that can be found along a path starting from canonical paradigms – first of all the Alberti's one, which considers a formal thought that is dominated by the *lineamenta*, where a drawing-subordinated, and not immediately necessary, matter is inscribed [7] – and getting to less conventional ones – e.g. the reflections by Peter Eisenman about the formal potential of a matter that is not framed by the drawing, which lead to counterpose diagrammatic notations to conventional drawing, when describing space [8] – hybridizing different paradigms and accepting their weaknesses for the observation of an urban space that is structured by layers [9]. In the field



Fig. 3: The Eremitani's façade seen from the garden. Merging public space design and cultural heritage preservation.

of these probabilistic interactions between form and matter, each layer, each artefact, each touchable or virtual image, can intentionally or accidentally play the role of, and be valuable as, a support for other forms, each fragment is a potential speaker in many different dialogues.
Yet only those artefacts that, even when the functional relationship according to which they act as support for something else is ceased, keep their own formal value and can generate a space, capable to enlighten a thought on form, are actually architecture and are immune to obsolescence that, on the contrary, is going to struck the supports, the machines, the devices that, the highest might their technological value be, do not possess formal qualities. These are bound to become debris. Architecture, when matter is worn out, shall become ruins, i.e. still architecture [10].

2. Cultural heritage as urban space (R.S.)

The use of cultural heritage and its so-called enhancement involve the exhibition and the explaining of cultural objects to the public. While the massive flux of visitors in the cultural sites proves that the needs of physical accessibility are satisfied, it is not the same for the comprehension of the works of art. This situation is due to the gap existing between the code and the context of visitors and of works of art. Since the work of art is a sign finalized to communicate, it is necessary to bridge this gap to allow the communication [11]. For these purpose several communication techniques and technologies exist. In the wide discipline of Public Archaeology, for example, there are some activities finalized to generate a sense of belonging toward archaeological ruins, which are based on the recovery of cultural recognizable layers existing between the public and the exhibited objects. Some tools, like Information and Communications Technologies (I.C.T.), are potentially unlimited about communicative possibilities, although they can be inadequate if their communicative contents are not well designed or are not designed by an expert in this field [11]. Furthermore they do not always provide the cheapest solution for the same communicative result. Another important wat to use and communicate cultural heritage is the design of the spaces in which artworks are exhibited. In fact, in order to contribute to bridge the gap between the visitor and the artwork, the spaces must be enough wide to allow telling a story about the exhibited objects or to show the context in which the objects were generated. The issues about the use of cultural heritage, which are often dealt with according to a small scale design – the design of a museum or of its showrooms – concern also the urban scale. The layering of a great deal of elements occurred in the long run has produced a stratified city where the elements of several



Fig. 4: The space-time machine stops and stares at the fresco remains on the northern wall of the Eremitani church.

layers have interweaved relationships of shape, use and meaning, when they have not been obliterated by other natural or artificial layers and it often happens that several layers are excavated, unveiling new findings, which need to recover their relationships with the context. The frequency of similar cases and the width of the affected areas brings to think about the possibility of creating a sort of open scattered museum, where the city becomes the exhibited object and, when it is possible, the mobile findings can be preserved *in situ*.
The here presented architectural project, which is a part of a wider research project of University of Padova [1], shows the application of these concerns onto the case study of the Eremitani area in Padua with a focus on the Eremitani Church, where Andrea Mantegna's frescoes are kept in the Ovetari Chapel. The Eremitani Church, the Roman arena with its archaeological site, the Scrovegni Chapel, where Giotto's frescoes are kept, the walls of the city, and the canals, are a remarkable example of layering as a result of several events that affected and profoundly transformed the area [12] [13].
The Church, dedicated to the Saints Philip and James, was built by the Eremitani monks of St. Augustin, during the second half of XIII century. The building has only one very long nave and at the beginning it had a rectangular plan. In the long run many chapels were built along the south side of the church and, in 1306, a monk, Giovanni of the Eremitani, built the curved wooden roof and likely the stone cladding of the façade. The Ovetari Chapel, instead, was built in the middle of XIV century. Other buildings, which lay along the north-west side of the church, were a section of the religious complex that linked the church to the Roman arena. This, instead, was used as a garden of the Dalesmanini Palace, which was destroyed between XVIII and XIX centuries, and of the Scrovegni Chapel. Two cloisters lie beside the north side of the church and are currently the abode of the Musei Civici. After the bombing in March 1944 the church and the cloisters were interested by several works of demolition led by the *Genio Militare* and other ones of re-building in which Franco Albini's atelier was also involved [14]. All these changes have produced the present condition of the intervention area: a metallic fence separates the cloisters from the church and from the Eremitani square; a garden, where some archaeological findings and contemporary sculptures lie, separates the Roman arena from the cloisters. For the absence of the Dalesmanini Palace and for the presence of the archaeological site, the arena appears detached from the urban context.
As a preliminary action to the architectural project, the area was described as a combination of those layers that are considered fundamental or mostly significant: water, walls, green spaces, the historical buildings that



Fig. 5: The space-time machine through physical, virtual, immersive, and augmented, reality in the Ovetari Chapel.

shaped the urban space (Roman arena, Scrovegni Chapel, Eremitani complex, Medieval houses in *via Porciglia*). On this basis the project consists of a series of paths arranged as if they were the structure of a text in which the user can freely choose to proceed along the main thread of the narrative or to analyse a theme of interest for them. The main text of this "experiential tale", the north-south path, lies on the area between the religious complex and the arena, shows a section of the history of the place since it develops across the most representative elements of the different layers. A series of paths, which are roughly orthogonal to the main path, link together some other elements, highlighting the previously individuated relationships concerning shapes, materials, uses, and meanings, which can be existing, have existed in the past or be introduced by the project. These secondary paths work as hypertexts, which allows the visitor to explore some themes of interest. From north to south, the first hypertext takes place along the city walls paths, the second one links the archaeological site near the Roman arena to the Scrovegni Chapel (in the past they were parts of the same complex of buildings), the third one links the archaeological findings lying in the cloister to the wall of the Roman arena. Finally the fourth hypertext links the church to the Roman arena and to the Eremitani square. The hypertexts are composed by a set of fragments roughly aligned along a direction and are able to create urban spaces, while they allow the possibility to accommodate the exhibition needs. The design of renewed spaces inherits its formal fundamentals from the site rather than from exhibitive technologies, which remain only one of the possible uses of architectural artefacts. So the duration of the architectural project exceeds the exhibition technologies one and the project is set free from the so-called smart design which, on the contrary, hides the ghost of obsolescence and of debris [10]. The fragments of hypertexts become portals that frame sections of urban landscape, benches, or just units to measure the surrounding space. The new designed layer permeates the area like an interference [15] looking like the work of Armand Grüntuch and Almut Ernst at the German pavilion for the "Biennale" of architecture in 2006 or some artworks of Krijn de Koning, where some elements of the composition give new views of the architecture. In particular the path passing through the Eremitani Church, which is the focus of the present work, is shaped like a bending-warping stripe that pursues the above-mentioned aims. It becomes a mark on the floor outside Ovetari Chapel, and then it becomes the track of the former *tramezzo* in front of the presbytery, an opening of whose still survives in the north wall of the church. The stripe continues its path in the nave declaring his contemporary through its shape and its red surface and becomes a confessional, then a frame for the fresco traces (which are nowadays unnoticed) on the north wall, and it finally becomes a section of the entrance structure. Outside the church, the stripe becomes a portal framing the entrance of the church, on whose surface drawings and captions can be applied. Then it replaces the existing metal fences, becoming the entrance of *Musei Civici*, a bench, a tool to measure the height of the Roman arena and finally it leads into the arena gardens.
This design concept has got the potential to be replicated and reshaped indeterminately to absorb new sections of the city into the tale-paths. This type of design aiming to the self-expression of the city, without transforming the city into a museum, can be applied to other similar cases where the model of the park – physically limited and which is often the result of the failure of the territory protection policy [16] – is replaced by the model of Self Explaining City: the city which explains itself highlighting the relationships between its sections. This can be a design strategy that replaces the passive method of the restriction (of building, of uses, and so on) with the dynamic method of the use and of the transformation of the spaces considering an osmotic and never ending relationship between nowadays and the past.

3. Linking past and present: timber technology applied to cultural heritage (A.B.)

A feature of historical monumental architecture in the Veneto region is the resort to two materials: brick and timber. Out of the Venetian lagoons two construction approaches have spread overland; as centuries rolled on, they have produced extremely light buildings, in which the two materials have blended together, resulting in almost see-through brickwork and quite nimble roofing. Thanks to this exchange, static and construction-related norms got transformed into formal choices, determining rich and widely different spatial solutions. In the Veneto region the evolution of timber roofing has followed the evolution of styles, though constantly maintaining a first-rate, strictly- linked- to –shipbuilding- tradition technical quality. Such connection appears evident in the sort of roofing fitly named "keel shaped"; developing in late XIII century, it was used until late XV century, obvious proof of the relation between naval and civilian architecture. This particular type of roofing, used to cover wide-sized buildings such as churches and public palaces, can be found in an area more or less geographically overlapping the area over which the political and cultural sway of the Venetian Republic was dominant, namely Venice itself, Padua, Vicenza and Verona, and as far as Aquileia.
The origin of keel-shaped roofing, its formal implications, and construction techniques, have already been surveyed. A first analogy, born out of the suggestive association home-ship [17] [18] has traced the origin of such roofing in the shifting of the construction expertise acquired within the Arsenal of Venice to the construction of the town itself thanks to ship carpenters who could also find work in the town`s building yards. Later studies have thrown light both on the existence of "professional" limits between ship carpenters and house carpenters [19] and on the deep differences between timber building on dry land and ship

construction, [20] [21]: these findings make a simplified shifting of Arsenal construction expertise to civilian building yards quite impossible. Recent comparative studies have furthermore underlined the basic difference between the static behaviour of a ship`s timber hull and the one of a roof of the same material [22] [23].
The resort to timber in architecture in the Veneto area is born out of the need to make buildings lighter: brickwork had to be thin so as not to weigh overmuch on a soil that frequently tended to give way. Horizontal timber beams were essential in order to make vertical walls stable, since they would have been too thin to withstand the sagging of foundations; at the same time, timber roofing covered the top of the building. Resorting to a timber structure even allowed some flexibility of construction: several sections could be substituted, without jeopardizing the structure as a whole.
The variety of timber roofing witnesses how underlying the different choices there was a determination beyond mere technical aspects: resorting to keel-shaped roofing (i.e. to a non-structural false ceiling) was meant to lead the eye towards the apse, three-dimensionally enhancing the function of multi-lobate arches. This easily led to Renaissance roofing, where trussing is completely hidden by panelled, picture-embellished ceilings. In both cases the structural pattern did not undergo substantial changes.
There are, however, several points of contact between Venetian naval and civilian architecture, with reference to timber construction. Such points of contact witness an exchange of building expertise, with reference not so much to construction techniques, as to know-how, to skills applied to planning and making complex timber structures, rather than types of construction.
Therefore, even if formally and structurally different, the roofs of the Chiesa degli Eremitani e of the Palazzo della Ragione in Padua, of the Chiesa di Santo Stefano in Venice or of San Fermo in Verona can be compared, with reference to their formal quality and construction inventiveness, to the hulls of Mediterranean galleys in the XIV century or of early XVI century galleons. In the same way, the complex trussing in the Doge's Palace (which was renewed in the XVI century) seems to herald the structures of the vessels the Serenissima started building in early XVII century.
If we intend to interpret the resort to timber from a contemporary viewpoint, it is possible to assess its main features, translating them into an innovative technological system that may underlie projects boosting our cultural heritage.
The project of MODULO has been developed within the framework of the research project aiming to enhance the potential of the Eremitani complex in Padua [1].
On the basis of the project input, the objective has been to realize a flexible set up, capable of increasing or of dwindling according to exhibition needs, subject to the changes of time; a unit interacting with the town

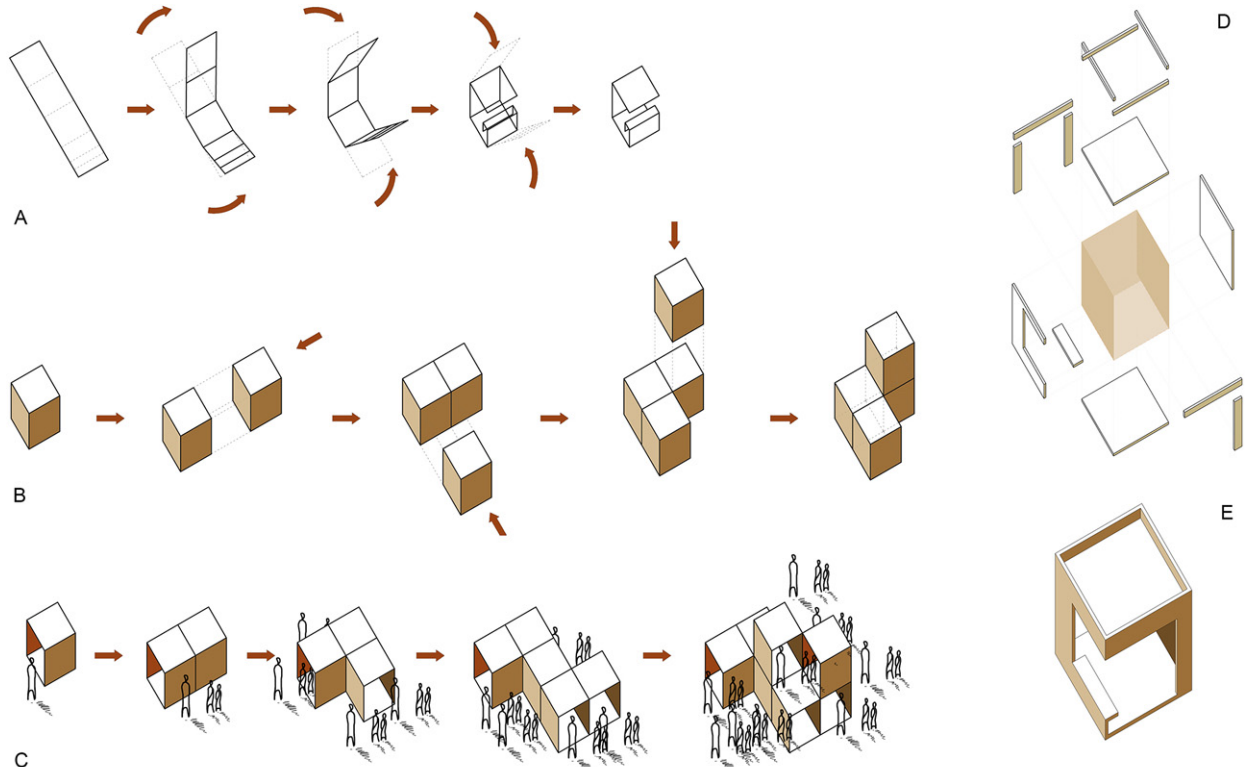

Fig. 6: Building scattered microcosms by means of the timber MODULO.

landscape, suitable for being used beyond its functional role of exhibition. The MODULO system has therefore been planned as the starting point for enjoying our cultural heritage, not only as an element designed for housing exhibitions but also as a building, thanks to which the town landscape may be used and enjoyed.
CLT (Cross Laminated Timber) has been used in this MODULO; it is an industry-produced material, based on wood. This choice is strictly connected to its features and potential, above all if we must take into account how little invasive it is, when for example our intervention might disturb a context that could prove to be multi-layered from a historical point of view.
The resort to timber (in our case CLT) is not widespread yet, even if there are examples of temporary set-ups in which elements can be easily assembled and removed, or modules placed differently, which allows the set up to be both flexible and changeable to its former pattern, even in the case in which timber panes are used alongside with other materials. On the subject, the experiences of Endless Stair (2013) are telling: they have surveyed the environmental potential of CLT resorting to hard timber. Another example is the Paracity (2014) set up, in which the 240x240x240 cm MODULO has been raised on top of a floor consisting of 4 structured 600 mm wide and 100 mm thick wooden boards, together with padding structures made up of aluminium frames, to which alveolar polycarbonate panes have been anchored.
CLT is the basic material of the MODULO: an industry-produced material, it consists of boards straight out of the saw-mill mainly obtained from the outer layers of trunks of Norway spruce, pine, larch and silver fir. Such boards are of scanty value, however they can safely be relied on as offering the best endurance and rigidity. The boards and panes are normally between 80 mm and 240 mm wide, between 10 mm and 35 mm thick. The ratio between width and thickness must be defined according to the equivalence W:T>4:1. The typical structure of a pane consists in layers of boards or single-layer panes one on top of another alternately oriented at 90°. It is also possible to orient the layers of the boards at a 45° angle. The almost rigid connection of single-layer panes is obtained by means of evenly gluing their surfaces thanks to properly applying the glue. Furthermore, the pressure the glue requires must be maintained constant throughout the cycle of pressing. The sizes and shapes of the elements of the panes are determined by the requirements of production, transport and assembly. Since the panes cannot be left at the mercy of bad weather (class of exposure 1 and 2), they are coated with suberite on the outside: such material can be sprayed on surfaces and acts like cork: surfaces are even and without joints, though at the same time resilient (Suberfloor system). Thanks to it, surfaces are capable of withstanding wear and tear and become slip-proof; it is even possible to add pigments to the mix in order to obtain surfaces of various colours.
The resort to CLT panes has allowed some important targets of the project to be reached, thanks to the modular nature of the material and of the elements. First of all, the elements have been made versatile thanks to the freedom the resort to CLT panes has allowed: once the 295 cm size has been chosen (which is the standard height of the panes) an abacus of Modules has been drawn up, capable of meeting the various requirements: showing exhibits, letting people walk through or sit. In this way each module may be employed independently, since their size, the features of the material and construction enable modules to be structurally efficient.
The standard height of CLT panels (295 cm) has also suggested the building of modular 295x295x295 cm elements: with such sizes it is in fact possible to have elements that may be joined so as to obtain even two-storied buildings by simply positioning the cubes one on top of the other. With a view to the latter hypothesis, a staircase module has been built, its size being 295x295x590 cm with landings either on the left or on the right.
The possibility of joining exhibition modules together, in order either to create a structured walking alley or a temporary building, makes the MODULO capable of suiting various requirements by adapting its set up. In the Eremitani case study, we have devised to resort to various modules tracing a walking path showing exhibits both inside and outside the church, capable of stringing together the main themes in a sequence through time and space. The modules have both been employed as structures supporting multi-media set ups, seat-provided areas, and information stalls in the open air.

Bibliographical References

[1] *Metodologie per l'acquisizione, l'elaborazione e la comunicazione di dati relativi ai beni culturali e per il progetto architettonico e tecnologico di interventi atti alla loro conservazione e al miglioramento della fruizione turistico-culturale*. Programma Operativo F.S.E. 2007-2013 Regione Veneto, D.G.R. n. 1148 del 05/07/2013, Project funded according to D.D.R. n. 456 del 17/12/2013. Project Leader: prof. L. Stendardo (UniPD); Scientific Responsible: prof. A. De Rosa (IUAV), prof. A. Giordano (UniPD), prof. L. Stendardo (UniPD), prof. S. Zaggia (UniPD); Fellow Researchers: dr A. Bertolazzi (UniPD), dr P. Borin (UniPD), dr M.R. Cundari (IUAV), dr F. Gasperuzzo (IUAV), dr F. Panarotto (UniPD), dr R. Spera (UniPD), dr S. Zoerle (IUAV); Partners: FòREMA s.r.l. - Confindustria Padova, DrawLight s.r.l., Ecomatt s.r.l., Impresa Costruzioni Giuseppe Maltauro S.p.A., Mentis s.r.l., NEOS s.r.l., Orienta+Trium s.r.l., Time2Marketing s.r.l.

[2] BOITO, Camillo. *Il nuovo e l'antico in architettura.* (Anthology [1860-1904] edited by CRIPPA, Maria Antonietta). Milano: Jaca Book, 1989. ISBN 8816402237.

[3] GIOVANNONI, Gustavo. *Vecchie città ed edilizia nuova*. Torino: UTET, 1931. (New Edition by VENTURA, Francesco). Milano: CittàStudiEdizioni, 1995. ISBN 8825171277.

[4] BRANDI, Cesare. *La materia dell'opera d'arte*. In ID. *Teoria del restauro*. (Lectures collected by VLAD BORRELLI, Licia. RASPI SERRA, Joselita. URBANI, Giovanni). Roma: Edizioni di Storia e Letteratura, 1963. New Edition, Torino: Einaudi, 19771, 2000. ISBN 9788806155650.

[5] BRANDI, Cesare. *L'unità potenziale dell'opera d'arte.* In ID. *Teoria* …, cit. First published as *Il ristabilimento dell'unità potenziale dell'opera d'arte*. In *Bollettino dell'Istituto Centrale del Restauro*, 1950, 2.

[6] VIOLLET-LE-DUC, Eugène. Restauration. Entry in ID. *Dictionnaire raisonné de l'architecture française du XIe au XVIe siècle*. Paris: Morel, 1868.

[7] ALBERTI, Leon Battista. *L'architettura*. (Translated by ORLANDI, Giovanni, Introduction and notes by PORTOGHESI, Paolo). Milano: Il Polifilo, 1989. Translation of *De re aedificatoria* [1485]. ISBN 8870504867.

[8] EISENMAN, Peter. *The diagram as a space of difference: The MAK exhibition* [2004]. In NOEVER, Peter (editor). Peter Eisenman*. Barefoot on white-hot walls.* (Catalogue of the Exhibition, MAK Vienna 15.12.2004-22.05.2005). Ostfildern: Hatje Cantz Verlag, 2005. ISBN 9783775715614.

[9] STENDARDO, Luigi. *Dalla città per parti alla città per layers.* In RISPOLI, Francesco (editor). *Forme a venire*. Roma: Gangemi Editore, 2013. ISBN 97888492741.

[10] STENDARDO, Luigi. *From construction to "machine", Pieces of engineering vs engineering into pieces.* In D'AGOSTINO, Salvatore. FABRICATORE, Giulio (editors). *History of Engineering. Proceedings of the International Conference History of Engineering*. Napoli: Cuzzolin, 2014. ISBN 9788887479805.

[11] ANTINUCCI, Francesco. *Comunicare nel museo*. Roma - Bari: Laterza, 2014. ISBN 9788858114681.

[11a]ANTINUCCI, Francesco. *Musei virtuali*. Roma - Bari: Laterza, 2007. ISBN 9788842082866.

[12] SPIAZZI, *Anna Maria. La chiesa degli Eremitani a Padova*. Milano: Electa, 1991. ISBN 8843535382.

[13] DE NICOLÒ SALMAZO, Alberta. SPIAZZI, Anna Maria. TONIOLO Domenico. *Andrea Mantegna e i maestri della Cappella Ovetari: la ricomposizione virtuale e il restauro*. Milano: Skira, 2006. ISBN 887624800.

[14] GAY, Fabrizio. *Il Museo Civico di Padova nel complesso degli Eremitani.* In *Rassegna di architettura e urbanistica.* 1997, n° 90.

[15] MARINI, Sara. *Architettura parassita, strategie di riciclaggio per la città.* Macerata: Quodlibet, 2008. ISBN 9788874622344.

[16] GULLINI, Giorgio. *Museologia per i parchi archeologici.* In AMENDOLEA, Bruna. *I siti archeologici: un problema di musealizzazione all'aperto.* Roma: Gruppo editoriale internazionale, 1995. ISBN 8880110659.

[17] BELLAVITIS, Giuseppe. *L'Arsenale di Venezia: storia di una grande struttura urbana*. Padova: Marsilio, 1983.

[18] LANER, Franco. *La chiglia rovesciata*. Milano: Franco Angeli, 1988.

[19] DAL BORGO, Michela. CANIATO, Giovanni. *Le arti edili a Venezia*. Roma: Edilstampa, 1990.

[20] BENEDETTI, Andrea. *I materiali e le tecniche costruttive della fabbrica veneziana. Compendio antologico*, in CRISTINELLI, Giuseppe (editor). *Restauro e tecniche. Saggi e ricerche sulla costruzione dell'architettura a Venezia*. Arsenale editrice: Venezia, 1992.

[21] PIANA, Mario. *La carpenteria lignea veneziana nei secoli XIV e XV*, in VALCANOVER, Francesco. WOLTERS, Wolfgang (editors). *L'Architettura gotica veneziana*. Venezia: IVSLA, 2000.

[22] NOWACKI, Hans. LEFÈVRE, William. *Creating Shapes in Civil and Naval Architecture: A Cross-Disciplinary Comparison*. Leiden: UPL, 2009.

[23] GERDING, Hans. *Roofs and Superstructure*. In BLACKMAN, David. RANKOV, Boris (editors). *Shipsheds of the Ancient Mediterranean*. London: Cambridge University Press, 2013.

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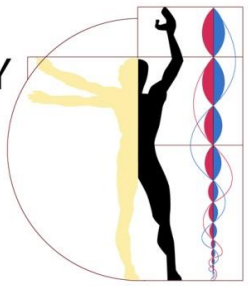

Protection of Cultural Heritage on the Example of Krakow Town Houses from the End of the 19th and the Beginning of the 20th Century

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Abstract
There is a good tradition of protecting monuments in Krakow (Poland), which sustains the cultural and collective identity for the future generations. Nowadays, however, a clear conflict can be observed between Krakow historical heritage vs. technological innovation, accelerated development and modernisation. Developing harmonious balance between the canons of their protection and laws of economics becomes a significant factor in maintaining their authentic form because what is important is both the city's sustainable development and the sustainable use of buildings. The paper highlights the need to document and maintain authentic precious details and decorations of historical Krakow town houses. Protection of original façades elements enables to perceive the differences and the similarities of architecture in various country manifesting national and local identity. Thanks to the individual shaping of forms, distinctive town houses from the turn of the 20th century provide the possibility for residents to identify themselves with the place and to create local tradition. The paper is a synthetic presentation of the results of researches conducted within the scope of projects financed by the Polish Ministry of Science and Higher Education (subsidies: *Decorations of Krakow Town Houses from the End of the 19th and the Beginning of the 20th Century: A Need for Protection of Cultural Assets of Architecture* and *Decorations of Krakow Modernist Town Houses*).

Keywords: town house, architectural detail, decoration, architectural heritage

1. Introduction
Nowadays, a clear conflict can be observed between historical heritage vs. technological innovation, accelerated development and modernisation. This problem especially concerns private town houses, their valuable elevations, details and decorations. Developing harmonious balance between the canons of their protection and laws of economics becomes a significant factor in maintaining their authentic form because what is important is both the city's sustainable development and the sustainable use of buildings.

Unfortunately, both regulations in legislation, as well as local law constituted by local government authorities in Poland fail to sufficiently protect valuable architectural details and decorations of town houses as an integral part of historical buildings. These provisions only protect a monument as a whole, its silhouette and mass. At the same time, the lack of area development plans for the whole area of Krakow poses a significant threat to the protection of historical sites not entered into the register of monuments. In order to better protect historical urban arrangement of town houses with valuable details, it is important to bring the theoretical principles of the protection to a common ground with the laws concerning organization and planning. It seems important to find the best ways to include maintenance and revitalization issues in a comprehensive programme of harmonious spatial and social development of Krakow.

The right way of funding renovations of town houses and their ongoing maintenance is a very important factor in effective protection of monuments. The state cannot charge the owners, who often have the need to be efficient and make a quick profit, with all costs. Indeed, there is a contradiction between the right of owners of historical buildings to order them freely and the limitation of this freedom, which stems from the desire to protect the monument. Thanks to the financial support from local authorities in Krakow and the work of the Social Committee for the Restoration of Monuments of Krakow, the number of renovated

buildings increased, and it is also possible to have a better control over the renovation work.

2. The role of details, decoration and ornamentation in maintaining collective identity

Ornaments, decorations and details can contribute to a better understanding of architectural form. They can also enhance its relevance and be useful in the identification process. They also have the communication and narrative functions, while referring to cultural context. They have an impact on the way of perception of architectural forms, as well as construing and understanding the space in which they are interpreted. They assist in achieving compositional and aesthetic unity of spatial structures from different periods, as well as unifying architectural form and visual arts used [3]. Thanks to ornamentation, bilateral mediation is achieved, which grabs observer's attention and also points beyond itself to the reality of the urban context by which it is accompanied. The diversity which details and decorations may introduce into architecture influences the space perception, whilst their artistic value and ability to affect on emotions may facilitate identification and memorization of forms, creating expressive and friendly character of a place.

The appearance of town houses in different countries is influenced by many factors including building regulations (for example characterizing the height of the house), shape and size of plots, climatic and local conditions (the character of landscape, watercourses), materials used and construction techniques, social stratification of the owners and users of town houses, designer's class, etc. Cultural traditions of different regions clearly differentiate architectural elements of town houses, creating characteristic and distinctive solutions: houses have different roof forms (an attic, a turret, a dormer window etc.) and are made from different, often local, materials. This way houses are linked with the history of cities and they are immersed in the rich tradition of local images, materials (colour and texture) and techniques.

Italian cities may serve as an example, with the characteristic colours of the elevation of houses and shutters and blinds on the windows matching them(e.g. in Bologna), all of which harmonizes with the natural landscape. Similarly recognizable are the Portuguese town houses with their distinctive *azulejos* and sophisticated metal balustrades and bars. Town houses are also different in Spanish cities with lacy ornamented textural elevations, using solar exposure conditions as in Salamanca, and at the same time shaded from the sun (*toldos*, shutters, *mushrabiye* – windows with openwork screens used in some traditional Arab houses).

Another example are Parisian town houses with uniform elevations made of similar material with bright colours, last storey withdrawn (an attic with big dormer windows), large French windows, balconies with steel or cast iron balustrades extending over the entire width of the elevation (usually on the first and last storey) and ornamental portals. Regionalism is also visible in Rennes, where houses often have window frames made of brick and stone or plastered walls. Materials found in the vicinity (stone: limestone and gray and brown granite, *kersantite*, wood) are used for elevations and construction. Also mansard roofs with tall chimneys (often covered with gray slate tiles) are typical for Brittany.

In contrast, irregular, chiaroscuro elevation surface, plastic, projected cornices and bay windows, as well as the abundance of uniformly distributed details and decorations, are typical of Viennese town from the end of the 19th and the beginning of the 20th century. White and gold colours are often combined on elevations.

The oil crisis in the early 80s and issuing relevant regulations concerning energy saving and the need for use of solar energy for heating houses resulted in characteristic rooftops in Jerusalem with photovoltaic solar panels and black water containers. Details and decorations are also different in the Nordic countries as they are rooted in the tradition of wooden forms e.g. in Stavanger (Norway).

Protection of original façades elements of private town houses enables to perceive the differences and the similarities of architecture in various country manifesting national and local identity.

3. Krakow Town Houses from the End of the 19th and the Beginning of the 20th Century

Despite many analogies, among others applying similar decorative motifs (foliage, zoomorphic, feminine heads), Krakow's town houses are largely of distinct character. Thanks to the individual shaping of forms and elevations, their own unique and clear expression in the landscape of Krakow has been created, forming a complex of buildings which is significant in terms of quality and quantity. Forms are integrally related to the nature and history of the place and its particular configuration of space, which is often a carrier of unconventional, innovative solutions. Of particular significance was the class of designers and the existence of distinctive social groups in the city, where among investors there were landowners, rich bourgeoisie, officials and the intelligentsia, for whom individualization of projects was very important. Town houses of Krakow retained some characteristic elements of tradition, e.g. typical features were crowning cornice associated with climate, attic hiding the roof structure, emphasizing the ground floor, ornamented portal, emblem and the material: brick, stone, and a relatively small scale. They were an expression of the connection of own traditions with new European currents, which resulted in maintaining a specific, native

form. In this way an own character and means of expression emerged. Historical heritage was used creatively in order to draw on the best works of past ages [2].

Town houses and their elevations contained references to the history of the place and far-reaching, recognizable roots. It was important for architects to define their own identity and preserve the identity of the place where they acted. It required new understanding of the essence of material, its properties, structure and colour effects. Designers referred to the tradition through material using signs on the level of “index”, defined in Charlesa S. Peirce’s terminology [6], transmitting the same sensory information (tactile and colour) which can be found in Krakow's historic architecture. On the one hand, architects, as creative entities, sought to mark their presence by designing innovative works of individual characteristics. On the other hand, they participated in the process of cultural continuation shaped by previous generations and periods. Artistic creation was understood not only as creating new products, but also exploring the forms and meanings or reinterpretation of traditional solutions. The new was a clear reference to the cultural background [4].

Originality was understood as a new clever juxtaposition of forms used many times before, as well as seeking new sources of inspiration and new decoration, the roots of which were related to the national tradition and local materials. Their quest was mostly about capturing what is original in the etymological sense of the word; capturing the roots of both people and things.

Decorations and details of facades of the distinctive town houses took into account the relation to the features of the historical architecture of Krakow (rhythms, lines and directions, saturation with details, materials, similarity of shapes, etc.), strengthened the relationship with the cultural context and had some importance in the creation of the aesthetic unity between contemporary and historical spatial structures.



Fig. 1-2: The decorations of Krakow town house (photo by author).

The facades of town houses in that period referred to the visual sensations (in the period of historicism to conceptual knowledge), the solutions are influenced by impressionist painting transplanted from Paris; elevations became more impressionistically flickering. Thanks to a variety of elevations and their painterliness, the architecture of the described periods was characterized by ambiguous nature that enriched its dialogue with the environment and audience, affecting their aesthetic sensitivity. In the design of the elevation of distinctive town houses a new value appeared as a result of architect’s creative freedom, who made synthesis resulting from the multiplication of sources of inspiration, which led to experiments and creating original works. Those synthetic trends, however, did not mean a simple compilation of ideas drawn from the leading architectural centres of Europe, but rather their original interpretation rooted in native architecture.

Employing prominent artists to decorate the elevation and using fine materials raised the social status of the owners and residents of town houses.

4. Technological details as a threat for historical heritage

The need for resident's comfort of life of and the economy, as well as infrastructure development made it necessary to introduce new elements on the elevations of historical town houses. It resulted in the diffusion of air conditioning and ventilation systems, which are often placed on elevations or roofs. Blinds and awnings were also introduced on the windows, changing the appearance of the elevation and introducing colours that are not always in harmony with the elevation [1]. The need for individualization of residents expressed in a variety of forms was not always consistent with the composition of the remaining elements of the elevation.

The progress of computerization and telephone services brings new technological details to the architecture such as satellite dishes, roof radio antennas, external cables, etc. New installations placed in the plaster destroy the wealth of textures and newly installed cameras and intercoms often compete with sophisticated details of portals. Sometimes the walls are additionally insulated with polystyrene foam and covered with plaster but not as sophisticated as the earlier one. Also cables related to communication (trams, trolleybuses) have become a necessary part of the urban landscape. Unfortunately, modernizations and new installations destroy details and three-dimensional effects of the texture. Although conducting such works contrary to the conditions of the permission for conservation works and construction works on the monument entered in the register is punishable, in practice, detail and decoration is not always protected.

Details and especially ground floors of town houses are also destroyed by vandal passers-by, who put inscriptions and graffiti on them, even though in a public place it is prohibited under penalty (as well as the placement of advertisements, posters and flyers). Only video surveillance and municipal police patrols can help in the enforcement of penalties, which is, of course, extremely difficult on such a scale.

Another important problem are advertisements, for which the architecture has recently become a kind of support frame. Town houses, in addition to their basic functions, have now become a medium of communication. Inscriptions, advertising, videos, etc. can be displayed on their elevations. Thanks to advertising, buildings earn for themselves. This practice is common in Krakow, where owners of town houses acquire funds for repairs, covering elevations with large ads that unfortunately change the image of the city for the worse. In the past, an advertisement was placed at eye level and referred to the place where it was located and the services offered there. That way of transmitting information was not contradictory with the architecture of facade, and often enriched it with additional symbols (excellent lettering, signage of workshops, family crests, etc.). Currently, in many cases it is necessary to correct signs and ads that do not harmonize in terms of size and colours of elevations, often covering important details and decorations, and even the entire facade. Unfortunately, in recent years numerous illegal "temporary" banners of poor quality have appeared. The reason for this is a complicated administrative procedure for their approval. The owners of town houses can appeal from the decision of the city's conservator and art consultant, making the enforcement of provisions very difficult for a very long time. In Krakow some people have tried to address this problem. The ranking of the ugliest advertising banners has been created and new projects have been funded for the ones selected as worst. Social pressure have proved to be a more effective weapon in the fight against advertising than regulations. Unfortunately, the scale of this phenomenon is huge. Ordinary and illuminated advertisements, usually placed on the ground floors of houses located at the shopping streets, are gradually becoming dominant, progressively covering and blurring the compositions of town houses' elevations.

Technological elements placed on the elevations of historical town houses pose a threat to the diversity of architectural forms, diverting attention away from them and causing their unification and destruction.

5. Conclusions

Artistic and formal values of Krakow's towns houses are more important now, in the time of homogenization of culture, when we can observe a return to facades in a different, contemporary form. Such "playing with the facade" is set to achieve short-term benefits (advertisements, banners), by which the audience loses their confidence and even interest [8]. Communication seems to dominate the visual and compositional values of architecture.

Thanks to the individual shaping of forms and elevations, distinctive town houses from the turn of the 20th century provide the possibility for residents to identify themselves with the place and to create local tradition. They have created their own unique and clear expression in the city landscape of Krakow's streets and squares, forming a complex of buildings significant in terms of quality and quantity.

Bibliographical References

[1] BARDZIŃSKA-BONENBERG, Teresa. On Unarchitectonic Genealogy of Contemporary Architectural Details. In *Technical Transactions*. Krakow: Cracow University of Technology, vol. 5-A, no 1, 2012, p. 14-20.

[2] MAKOWSKA, Beata. Krakow Town Houses from 1890-1939 with Particular Focus on Facade Decorations. In *The International Journal of Arts & Sciences*. ed. Joseph Bonnici. 2011, vol. 4, No 23, p. 283-289.

[3] MAKOWSKA, Beata. *The role of ornamentation in architecture until the modernism period*. Monograph no 360. Krakow: Cracow University of Technology, 2008. ISSN 0860-097.

[4] MAKOWSKA, Beata. *Krakow town houses from the turn of the 20th century and the interwar period (1918-1939) situated in the area between the first and second ring road. A description of the forms and their evolution*. Monograph no 468. Krakow: Cracow University of Technology, 2014. ISSN 0860097.

[5] OLSZEWSKI, Andrzej K. *The New Form in Polish Architecture 1900-1925*. Wrocław: Zakłady Narodowe im. Ossolińskich, 1967, p. 140-143, 199.

[6] PEIRCE, Charles S. *Selection of Semiotic Writings*. Warsaw: Polich Semiotic Society, 1997.

[7] PURCHLA, Jacek. *How Modern Krakow Came To Be*. ed. Krakow: Wydawnictwo Literackie, 1990, p 11, 21-23.

[8] REWERS, Ewa. National Fasade – Bricolage. In *Autoportret. A Magazine on Good Space*. Krakow: Małopolska Institute of Culture, no 4, 2007, p. 71-72.

[9] ŻYCHOWSKA, Maria J. *Between Tradition and Avan-garde. The Problem of The Style In Cracovian Architecture In The Interwar Period*. Monograph No 113. Krakow: Cracow University of Technology, 1991.

HERITAGE and TECHNOLOGY
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URBAN PRESENCE: THE FOUNTAIN

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Abstract
A fountain is a symbolic, social and physical place, captivating and communal and, like other urban objects, monuments, obelisks, newsvendors and triumphal arches gracing public spaces, represents the pleasant face of a city. Nodal points of an evocative cultural path looking at the future.
Anthropological symbols, recalling a high profile memory, figurative, complex and fundamental evocations creating a value both participatory and of re-composition of the relation between architecture and society within the frame of regeneration of the metropolitan city.

Keywords Fountain, emotion, aggregation, symbols, captivating

1. Section
The cities where we live and operate are places characterized by the dynamism of the settled communities generating innovative lifestyles. They are like magnets attracting people even from minor cities, forming metropolis which mark the global success of the urban living. The concept of living has, therefore, modified and widened in these last few years so as to consider a house as a place not only in which to find shelter, but a space to interlink relations with communities and the territory. In the future, in metropolitan areas there will be a higher concentration of people, many of whom are looking for employment and for a place for cultural interchange.
It will be necessary to re-organize the programming and to begin sustainable and participated planning involving all the stakeholders, in order to continue enjoying the advantages offered by the quality of life originating from the urban environment. The operation is just at the beginning and it foresees the use and experimentation of new technologies collectively called “smart”.
The journey in this new urban local reality enables us to start, through architecture, a dialogue between contemporaneity and the past, between communities and environment. In this context there are icons of single or complex elements in which communities recognize their cultural heritage which will be passed onto future generations.
It should be spoken about through images of certain urban facts, for example the fountains dotted around Turin; they are symbolic points, marking the city’s various historical zones. For their grace and joyfulness, they altogether create a more livable environment and they make its visibility more pleasant. In effect they are snatches of architecture that characterize the context of the urban scenery within the frame of the culture oriented toward the protection of environmental differences.
The attention is returning to iconic markers meant as strategic connection areas which will certainly be the object of reflection in the future redesigning of the metropolitan city.
In order to capture these emotional moments, it is necessary to move through the existing everyday urban fabric. You walk along a bit of road, you look at passersby’s colorful red and blue prisms moving on the hard stone and dotting the ground: small luminous spheres. You continue along your journey and a first rustle, different from the usual, calls your attention toward a space going beyond the screen of buildings, almost a faraway look. It seems a sound, you hear it clearly now, it bursts, your steps are faster, you recognize the whisper of the water which, dripping, speaks with the surrounding; the hidden place opens up to the brightness and the game of the spurts; it is the fountain. A fantastic glimpse. A polimateric imprint, discreet and important, which generated space is real and virtual if taken within the dialectic of the living.
The space defined by the moving water is “naked” because the shape is not marked by stone, it is a dynamic configuration, an entwined movement of light and shadow expressing a sense of contemporaneity;

simultaneously material and virtual. It is an unusual volume, with a lively and variable geometry, not concerned with being deprived of a container, and as soon as the temperature goes down the volumetric outline of the water solidifies, it changes into stereometry to return sparkling with sunlight.
The fountain is a fascinating witness able to create functional and psychological interrelations and a strong emotional impact with the spatial and physical environment it relates to. A city's interactive points.
It is an architectural organism, not only an embellishment, it does not appear as a superstructural contrast or antagonistic towards the built-up surroundings. On the contrary, it is added value to the aggregation of citizens and represents emotions, sensations, identifying of a living fabric, where to one finds and feels the atmosphere and the appreciation of use.
For Turin the fountains are a moment of sociality, important components of the artistic and cultural heritage of the citizen and added value to urban sustainability. They are located mainly in the squares of the historical center and have been created over three hundred years. They were thought out and executed according to allegoric subjects: time, memory; life and moving water.
In order to see them and immerse oneself in the communal space potentiated by the livelihood and joyfulness of the dynamic flow of the water, we open a window on the eighteenth-century fountain of the Naiads and Tritons enlivening the Royal Palace. From the white circular basin emerge the groups of sculptures of sea and river nymphs accompanying Poseidon's son. A joyful scene relating to the surrounding environment.
Now, a look at the nineteenth-century Carlo Felice Square framed by elegant buildings with porches and the spectacular façade of Porta Nuova Central Station; in its center the delightful garden developed around the vivid spurt stemming from the rocks immersed in the stretch of water.
In the garden of the measured and airy Statuto Square, open on one side, stands the austere Frejus Fountain (1879) commemorative to the creation of the homonymous rail tunnel. It is a pyramid of grey stone blocks, dotted by the expressive white marble sorrowful titans, defeated by the work of men; the flow of sound comes from the water spurting amongst rocks, sprinkling and cascading into the curious layer of floating leaves.
The delightful Balbo flowerbed, which in 1835 was called the Garden of the Ripari. The site is furnished with outdoor toys and is enlivened by the stretch of water, almost a "basin" from where vigorous jets and water spurts creates a natural microcosm atmosphere. An educational and privileged meeting place for the people.
At the end of the XIX century, in the wide Valentine Park, located along the Po River, surrounded by the hill and by the compact structure of buildings, the spectacular Monumental, or Mesi, Fountain was created, for the 1898 National Exhibition. Situated in the southern extremity of the Park and placed against the slope toward the Po River, it has a wide ovate basin, rich with statues and sculpture groups placed along the perimeter evocating the passing of time: months and seasons. The fruition itinerary harmonizes with the sound produced by the spillways and spurts, generating pleasant sensations connected to the rural site.
In the layout of the harmonious Solferino Square, strewn with trees and enfolded by eighteenth-century buildings, at one extremity of the garden is situated the suggestive Angelica Fountain built in 1930 by the sculptor Riva. In the wide sinuous blue dressed basin, the majestic groups of statues representing the seasons reverberate, enlivened by the vibrant musicality of the seventy gushes. The ornamental design is accompanied by water screens, altogether of great splendor; it is an urban salient. The tracks of liquid threads crossed by sunrays light up intense color vibrations all participating to create the ensemble. A symbolic urban and social context, unforgettable site of cultural reference.
In Via Roma, re-built according to Piacentini's project (1937), in the former fountain square, now CLN, on the new floors rearing the two churches overlooking Saint Charles' Square, two fountains were placed, recalling the two rivers lapping at the city: the Po and the Dora. They are two eurythmically homogenous compositions formed by a grey pedestal from which the spillway spurts abundant water fluctuatingly cascading into the arched basin. Overlooking the pedestal there are two white statues placed, a man with a fierce look, the Po, and a majestic woman, the Dora Riparia. Work by the sculptor Baglioni, winner of the competition. The reasoning of the judging Commission is stimulating:
"Baglioni's merit has mainly been that of understanding the architectural function the two statues should have played in the construction ensemble".
For the requalification of Castello Square in the year 2000, a "surprise" fountain was created, of the hidden flat kind without a basin for the collection of the flowing water.
The lack of a basin, and of the ornamental design, is a novelty, a surprise with respect to the expectations commonly acquired on the fountain type. The originality also resides in the technology accompanying it for the movement provided by groups of water jets with the possibility to also control them singularly so to form amusing dynamic figures.
It's formed by a square perimeter and by four squares marked by stones. Each square is formed by an overflowing and sparkling central spillway surrounded by eight spurts forming a crown.
It is an architectural composition which does not need ornaments, it uses the existing floor of the monuments amplifying the appreciable urban background. Overtaken the surprised state, now without barriers the water

is within reach, a chance for amusing games for children and of enjoyment of the structure. Sure opportunity for meeting relational exchanges on common values acknowledged and validated by the citizens.

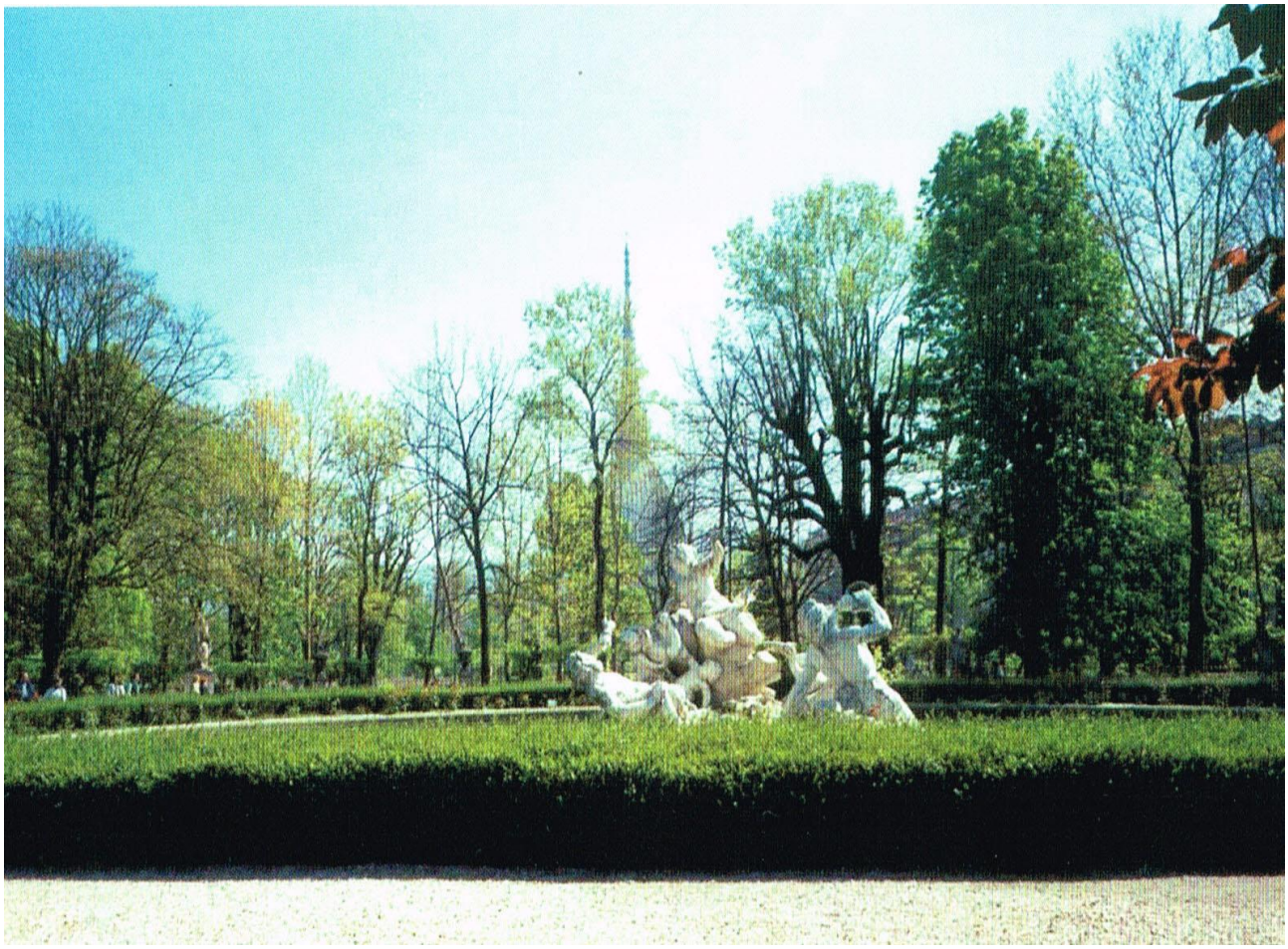

Fig. 1: Suggestion for a redesign of the city. Royal Gardens. Turin.



Fig. 2: Relational space and leisure. Fountain Garden of the Ripari. Turin.



Fig. 3: Spatiality accentuated by the reflection of the water. Fountain of Carlo Felice Square. Turin.



Fig. 4: Swirl of drops and colors that are intertwined with the green. Fountain Angelica. Turin.



Fig. 5: Water as an ornament of sumptuous built. Fountain of Piazza Castello. Turin.

Soucers

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BIBLIOTECA NAZIONALE UNIVERSITARIA DI TORINO, Torino.

Bibliographical References

[1] ROSATI, Ottorino. *Per una lettura percettiva dell'ambiente*. 1ª ed. Torino: Politecnico di Torino – Facoltà di Architettura, 1973.

[2] FEMORE, Piero. *Torino oggi. Guida alla Città. 2ª* ed. Torino: Alfa Editrice, 1982.

[3] COMOLI, Vera. *Le città nella storia d'Italia. 1ª* ed. Bari: Laterza, 1983.

[4] STARACE, Francesco. *L'acqua e l'architettura. Acquedotti e fontane del Regno di Napoli. 1ª* ed. Lecce: Edizioni del Grifo, 2002.

HERITAGE and TECHNOLOGY
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Structural analysis of finite element models of masonry balconies and overhangs obtained by B.I.M.

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Abstract
Recent news events are showing a widespread problem involving the structural safety of masonry balconies and overhangs. Not long ago it happened in Campania too: several pieces of balconies or overhangs broke away from the masonry walls and fell to the ground. The degradation phenomena, mostly due to weather, in addition to damage the surface layers of buildings facades, act, in fact, also on the balconies and overhangs structural stability.
The paper focuses on a thorough procedure aimed at evaluating the static and seismic safety of these components, based on structural analyses of refined finite elements models obtained by the building information modelling (B.I.M.) methodology. The analyses are performed creating a highly detailed numerical model: therefore, the structural B.I.M. model becomes the common basis on which to work for developing also, but not only, the structural analysis. This model, in fact, lets to achieve a perfect representation of geometry and structural consistency of each examined element, that is suitable for multiple purposes. As regards the static issues, the performed structural analysis allows to check how the behavior of masonry balconies and overhangs depends on the 3D behaviour and is linked to both the characteristics of the materials and the typology of the connection with the masonry walls.

Keywords: Structural analysis, Finite Element Method, Masonry balconies, Building Information Modeling.

1. Introduction
This paper analyzes the structural characteristics of a type of masonry balcony typical of Campania Region. The analyses are performed by using a refined three-dimensional finite element model: this model was developed and shaped starting from a detailed geometrical-architectural representation and by using the building information modelling (B.I.M.) methodology. The model breaks down itself into all the balcony components with precise morphological characteristics and mechanical properties, thus integrating and interfacing all the features of the structural engineering.
The analyzed balcony is one example of a broader scientific research that involves the protruding masonry balconies and is finalized to draw up an atlas concerning typological features and static and seismic safety of overhangs and balconies of Italian architecture and especially of Campania Region.
The structural function of balconies and overhangs of historic buildings mixes with their specific architectural configuration, creating an interesting element of architectural morphology that is useful to identify the building to which it belongs and to assess safety and enjoyment of the building itself.
The picturesque landscape of Sant'Agata dei Goti (BN) (Figure 1) was selected for choosing the balcony example to analyze. In this town there are both ancient local stone buildings and recent or retrofitted constructions: therefore there is a wide range of masonry balconies and overhangs.
The structural B.I.M. was drawn to make as faithful as possible the finite element structural model of the balcony, considering all the structural and non-structural elements. This means that representation and structure disciplines are strongly merged together. This approach also gives rise to a whole of assessments



Fig. 1: Sant'Agata dei Goti (BN) – Italy

concerning design choices for the heritage conservation which are suitable to preserve buildings and masonry balconies and overhangs for a better use of the surrounding spaces.
Few years ago, masonry balconies and overhangs (Figure2) were protagonists of news events that led to the need to evaluate their static and seismic safety for a correct use of the internal and external parts of buildings. This paper, starting from a historical and cultural knowledge phase, gets to characterize a representative type of historical balcony and to draw its three-dimensional model by using the B.I.M. method, which is a fundamental step to set up a refined structural model for assessing its safety.



Fig. 2: Masonry buildings typology in Sant'Agata dei Goti (BN) – Italy



Fig. 3: Sant'Agata dei Goti streets: balconies and overhangs

2. The selected balcony type

The balcony type examined in this paper was carefully selected in the architectural landscape of Sant'Agata dei Goti (BN). This ancient town is situated on a tuff knoll between two tributaries of the Isclero river. According to historic research studies it stands on the ancient Saticula site.

The actual name, Sant'Agata dei Goti, dates back to the sixth century A.D., when the Goths were defeated in the Vesuvius battle (553 A.D.) but were allowed to remain in their fortresses as subjects of the empire: in that occasion a Goth colony settled in Sant'Agata. There are several Roman remains scattered in the area, but the territory was characterized by several dominations such as Byzantine, Norman, Swabian and Angevin and this explains the architectonic richness of the town.

Every corner of the town has particular and interesting characteristics to be studied (Figure 3), and among the many historic architectural details, there are also diverse balcony and overhang types, sometimes with interesting and valuable elements, as decorated cornices or particular railings.

Until the Middle Ages, each overhang element of buildings was considered only from the functional point of view. In the Renaissance era, the prospective method spotted rules and proportions, and balconies, overhangs and cornices served to outline and highlight the mathematical rules of façades. In Sant'Agata dei Goti, the building façades become typological connotation of neighbourhoods and streets and this makes characteristic the town which is full of different types of overhang elements. Each element "tells" the history of the construction, the aesthetic aspect and is differentiated by a specific design and structure.

The protruding balconies are characterized by several technical supports and bearing structures, as well as by different types of parapet, varying both materials (brick, stone, marble, timber, iron) and designs (filled, "fretworked", hurdled, with balustrade, with railing, etc.). There are balconies with parapets in plastered masonry, frequent in modest homes and rustic towns of the Middle Ages, and balconies with parapets in marble or other stones, more frequent in mansions and important houses, and balconies with elegant wrought iron railing.

The selected balcony type (Figure 4) has materials and morphological characteristics representative of typical historic masonry buildings made by modest manufacturing. The balcony, slightly protruding from the façade, has both a decorative function and practical value. It belongs to the balcony type called "no protrusion" which is very common in the modest dwelling houses from the baroque period on. It was created to hide or grade the detachment from the building "body".

This type of balcony frequently has small size (the selected one is 1.80 x 0.40 m), which makes it not very usable. The stone slab has rather small thickness and is borne by wrought iron cantilever beams. The stone slab is also supported by iron flat beams, arranged in a cross, for reducing the span of the slab itself. The wrought iron railing has vertical rods with few decorations and connected by thin and flat iron handrail. Obviously, the materials are characterized by limited strength characteristics. Also the walls that bear the balcony are in mixed stones and bricks poor masonry, according to a typical course pattern of an era when buildings were built by using mainly local stones and few pieces of baked clay.

Finally, it has to be highlighted that the study of the chosen balcony type has an extensive interest because it is a typical Italian balcony, which is frequent and widespread in many areas, and especially in Campania.



Fig. 4: Analyzed balcony type

3. From B.I.M. to the structural model

The building information modelling methodology adopted for developing the finite element structural model was based on the three-dimensional re-design of the balcony, according to the measurements obtained by conventional digital survey. Starting from the 3D representation, the structural B.I.M. model was firstly built, that is a virtual model that has material and morphological consistency in each structural component, and finally the finite element model was developed for performing structural analyses.

Integrating principles of the descriptive geometry, and more generally of the architectural representation, with the structural engineering, the 3D model (Figure 5) was shaped as assemblage of: (i) main structure of the balcony formed by the iron cantilever beams; (ii) secondary structure of the balcony constituted by iron flat beams arranged as a frame rectangular structure with cross-diagonal elements; (iii) stone slab; (iv) iron railing and handrail.

Each element carries with itself the geometrical, material and mechanical characteristics needed for reproducing size, location and structural behavior, which are at the base of a refined and suitable structural analysis finalized to assess the static and seismic safety of this balcony type. In fact, the BIM model allowed achieving a refined structural model that lets to examine the behavior considering all elements and factors contributing both to ensure the structural safety and to represent possible elements of static or seismic risk.

This modelling approach is important for structures such as the one examined in this paper since it also allows considering the conservation status of each structural and non-structural elements and then assessing the consequent influence on safety. Only a careful knowledge and survey phase can give information about what may happen to balconies and overhangs that are constantly exposed to atmospheric agents and therefore spoil before than other building elements. In fact, it is now well established that their functionality and safety degenerates over time and increases more and more the risk of falling parts of the structure. Obviously, it is conceivable the damage that can cause such a situation to both the built heritage and users.

The structural analysis was performed using a finite element modelling, where a share of masonry is modelled together with all the balcony elements. Originating from the B.I.M. model, also the finite element structural model, in fact, contains in detail all the elements that make up the balcony: the supporting beams shaped according the actual ones, the stone slab, the iron railing and handrail. This allows to study in depth the structural role played by all the elements of the balcony.

Figure 6 shows two views of the finite element model, also showing the mesh used for discretizing all the balcony elements and the portion of the rear masonry wall. The model, only for the part relative to the balcony, is composed of 1230 nodes, 810 beam elements and 1234 plate elements. The iron beams supporting the balcony were considered anchored to a depth of 2/3 of the thickness of the masonry (assumed to be equal to 0.60 m).

The well-known and widely used yield criterion by Von Mises, based on distortional strain energy, was used for all the iron elements. An initial uniaxial yield stress of 120 MPa and a weight density of 75 kN/m^3 were assumed. The orthotropic material properties proposed by Pande et al. [7] were used to model the masonry structure as an equivalent homogenized material, based on a strain energy concept. Typical values of ashlar masonry with medium-low resistance were used in performing the analysis. Namely, the masonry units were supposed to have compression strength equal to 3 MPa, tensile strength of 0.3 MPa, Young's modulus equal



Fig. 5: Structural B.I.M. model

to 1800 MPa; the mortar was assumed to have compression strength of 1.5 MPa, tensile strength of 0.05 MPa, Young's modulus of 500 MPa. A weight density equal to 16 kN/m^3 was assumed for the masonry.

4. Structural analysis and results

The aim of structural analysis is to quantify and qualify the safety as well as to identify role and influence of each element in the structural response in order to focus all factors that could constitute elements of risk for the studied balcony type. The analyses were executed using the computer program MidasGen®.

The structural analysis was performed under both static loads (considering, in addition to the self-weight, a live load of 4 kN/m^2) and the action of the vertical earthquake. The latter was determined by referring to the municipality of Sant'Agata dei Goti (a_{gv}=0.128 g, F_V=1.518, S=1, T_B=0.05 sec, T_C=0.15 sec), but it has to be highlighted how the seismic parameters of this municipality are very similar to those that can be determined for many municipalities in Campania, including the city of Naples (a_{gv}=0.131 g, F_V=1.517, S=1, T_B=0.05 sec, T_C=0.15 sec). This provides an extended validity to the results obtained.

As already introduced, the achieved structural model allows examining the various features that characterize the structural response of the balconies, to a greater extent than the usual checks. In fact, the customary static verification of bearing structures is mainly performed carrying out the verification of individual iron cantilever beams that support the balcony. This involves the beams verification in simple (symmetrical) bending performed at its constraint section into the rear masonry (that is assuming that the beams behave as ordinary cantilevers), the stress verification in the masonry around the beams constraints, and the control of the maximum amount of the vertical displacement at the cantilever end. The detailed modelling used here enables instead of examining the actual 3D structural behaviour of the balcony in all of its components.

In the present case the customary checks are obviously fulfilled, being the beam stresses (the maximum one was equal to 22.6 MPa) notably smaller than the ones bearable by the metallic material, as well as the effective stresses on the masonry (maximum equal to 0.48 MPa) reasonably smaller than the limit ones

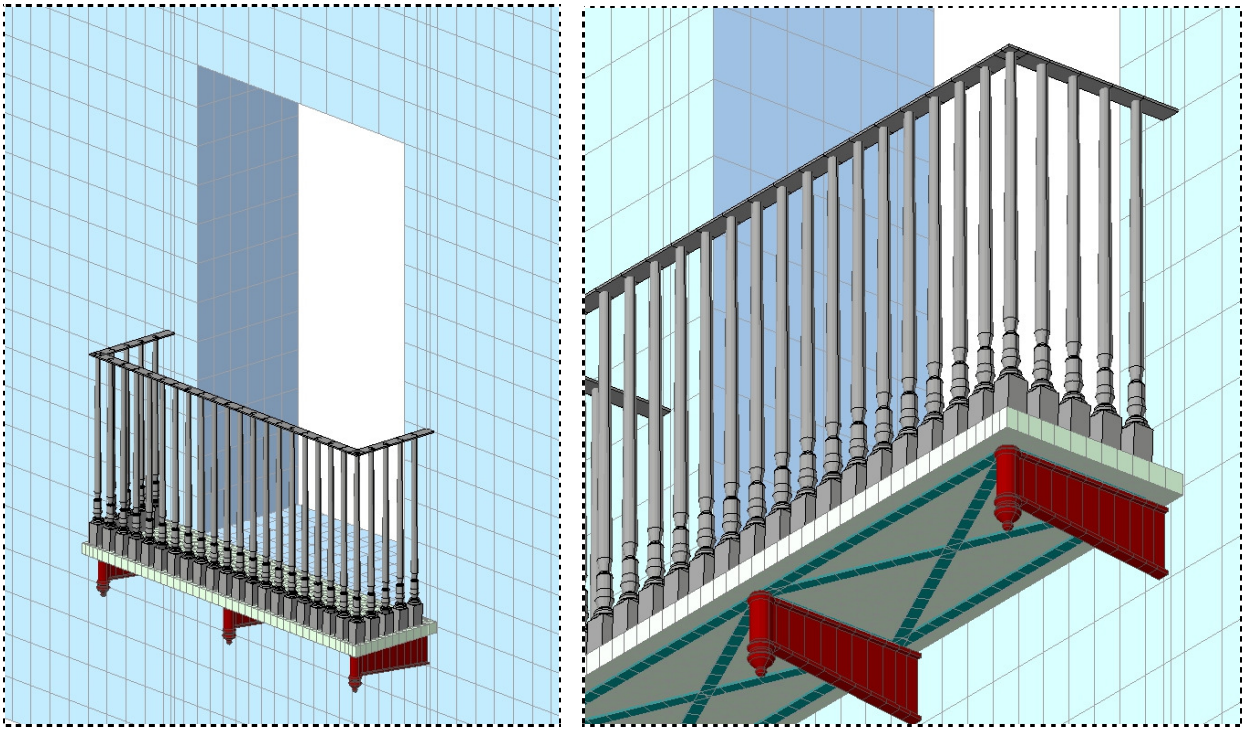

Fig. 6: Finite element model

(Figure 7). This happens also because the model reflects a balcony well made, without degradation and loaded by the loads required by building codes.
It has to be instead emphasized how the used structural model is capable of detecting two features of the structural behavior usually ignored in conventional (customary) tests.
The study of the balcony as a whole showed, in fact, that the outer support iron beams are subject also to bending actions and shear forces in the horizontal direction, due to the global deformation of the entire balcony. These member forces affect the beam also in its direction of lesser stiffness and strength (Figure 8), yielding asymmetric bending, and then reducing the safety index of the structure.
In addition, the FEM analysis showed that the presence of the stone slab does not play a significant role in the bearing mechanism, but significantly influences the balcony safety. In fact, although the maximum deflection of the balcony is very moderate (0.14 mm), the stone slab is locally subject to high stresses, as shown in Figure 8 where the effective stresses are plotted.
The above two features of the static and seismic response of the balcony foreshadow further possible mechanisms of collapse if the structures are not perfectly realized as that studied here, if possible and frequent degradation phenomena involve the bearing structures, or if external loads higher than those required by codes (and here assumed) as larger crowds or live loads or stronger earthquakes act. These can lead to the balcony collapse for loads lower than those usually estimated by the conventional checking usually performed ignoring these two features of the balcony response, which can be detected and investigated only through a detailed 3D model that contains all the components of the balcony.
The structural model used herein, achieved through the BIM methodology, allows this performance, but also allows to study further issues of the structural response of balconies, to be carried out varying other parameters, such as the influence of the anchor depth of the supporting beams, the type of metallic structure placed under the stone slab, the thickness of the stone slab, the constraint between handrail and masonry wall, etc.

5. Conclusions

A preliminary historical knowledge phase of places and architectures allowed to properly outline the balcony type to be studied, that is a structure is a typical Italian balcony, which is frequent and widespread in many areas, and especially in Campania. Subsequently, the study in depth of the historic materials and construction techniques let to define a detailed 3D digital model.
Today many graphic representations of structural elements are entrusted to the software capability to make virtual each component of actual architecture. But entrusting only to the graphic software for achieving three-

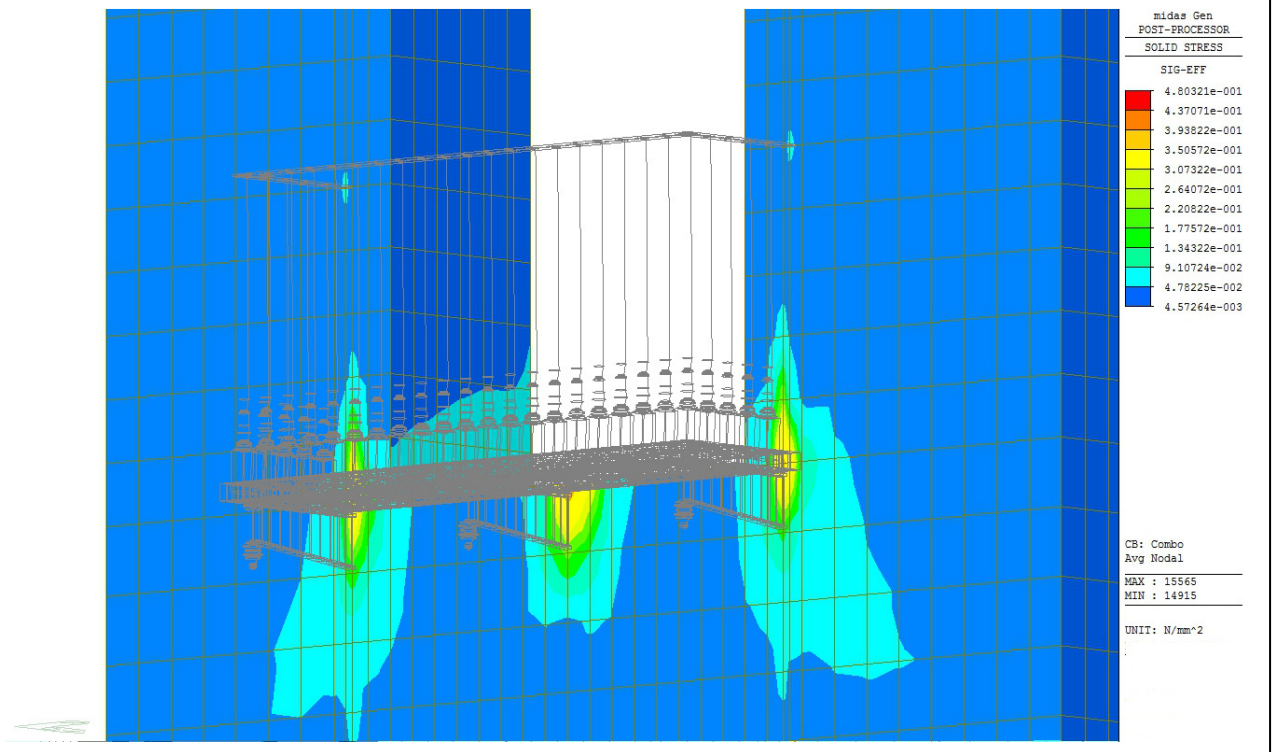

Fig. 7: Effective stresses in the masonry wall [MPa]

dimensional models is not always suitable since a superior knowledge of the traditional principles of designing and building as well as of the descriptive geometry for the representation strongly helps in attaining reliable models.
The "Computer Aided Design / Drafting" (CAD) has the objective to create 2D models of the technical drawing that describes the analysed artefact and supports the activity of the designer. Subsequently, once a

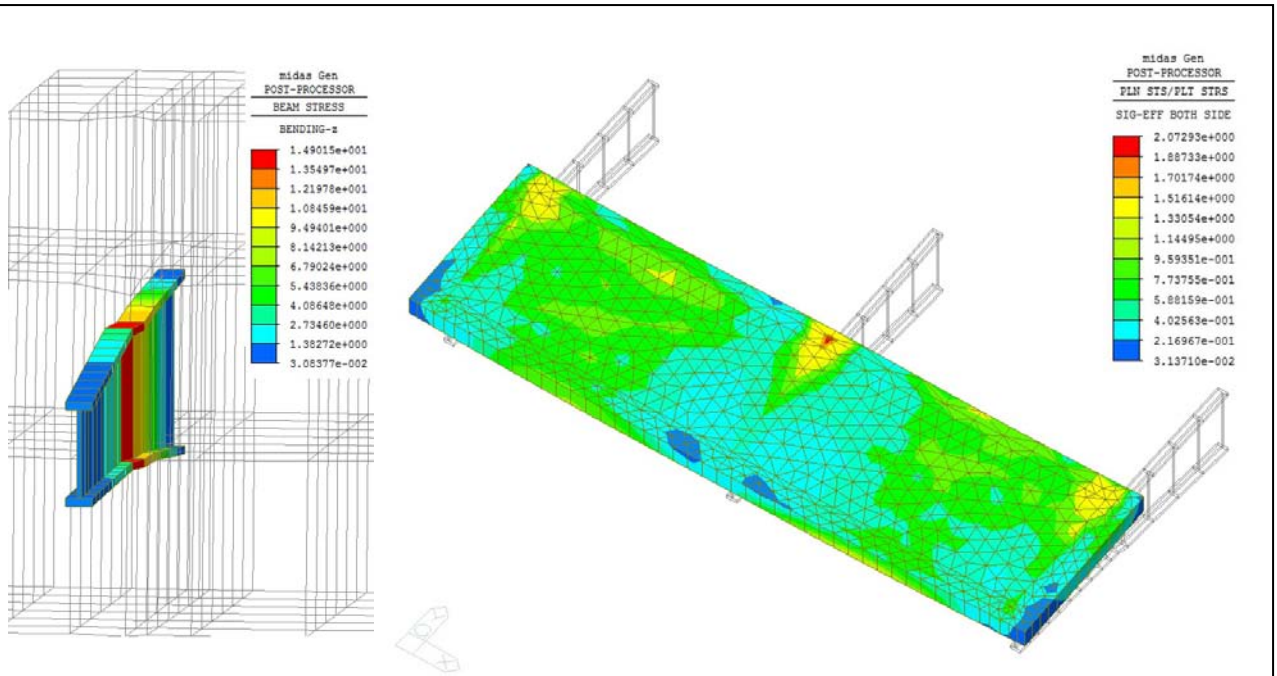

Fig. 8: Stresses in the outer iron cantilever beams and in the stone slab [MPa]

3D model is defined, this can be used to perform static and dynamic structural analyses. This is usually called "Computer Aided Engineering" (CAE), wider discipline of which CAD is the subset of actions and tools aimed at creating purely geometric models.
Drawing on these principles of representation, the morphological feature of buildings is linked to spatial issues: in the examined case, the balcony gets organic vision and becomes connecting element between the parties but also cutting and division element among each floor on the building façade. Furthermore, it is also a representative element of proportion and decoration which renews the importance of the sign and reveals outside the active function done within the building.
This paper reports a single step of a wider research that is developing on the static and seismic safety of balconies and overhangs. Inspired by news events that highlighted the need to critically and systematically evaluate the safety of protruding elements of existing buildings, especially the ones of masonry buildings and the ones in the historic areas of towns, it was developed a methodology that allows defining refined finite element models for structural analyses.
Merging traditional techniques of survey with the most powerful B.I.M. method, it has been achieved a 3D model that includes all the structural and non-structural elements characterizing the balcony type to be studied. Such a model allows both to quantify the safety and to identify role and influence of each balcony element in the structural response for focusing all factors that could constitute risk elements. Furthermore, it also allows considering degradation phenomena of each structural and non-structural elements and then their influence on structural safety.
The performed analyses confirmed the potentiality of the 3D model, showing how it allows going beyond the customary procedure for the static verification of the bearing structures of balconies, highlighting how the cantilever beams supporting the balcony are subjected to asymmetric bending (instead of the simple vertical bending usually assumed) and the failure risk of the stone slab which is locally yielded to high stresses. In specific cases these features can lead to collapses for loads lower than those usually estimated by the conventional checking and can be detected only through detailed 3D models including all the balcony components.
Finally, it has to be underlined that this modelling approach straightforwardly allows studying and foreshadowing all the possible collapse mechanisms by varying several parameters concerning construction faults, conservation status, loading condition, constraints of structural and nonstructural elements.

References

[1] Sacks, Rafael; Kaner, Israel; Eastman, Charls M.; Jeong, Yeon-Suk, The Rosewood Experiment – Building Information Modeling and Interoperability for Architectural Precast Facades, Automation in Construction, Volume 19, Issue 4, July 2010, Pages 419–432, Building information modeling and interoperability, ed. Elsevier, 2010.

[2] Techel, Florian, Future of Communicating Digital Design in Architecture / Overcoming the Divisive Power of Computer Aided, Computing in Architecture / Re-Thinking the Discourse: The Second International Conference of the Arab Society for Computer Aided Architectural Design (ASCAAD 2006), 25-27 April 2006, Sharjah, United Arab Emirates, Paper ascaad2006_paper14, Cumincad, 2006.

[3] Williams, Trefor, Information technology for construction managers, architects and engineers, ed. Thomson Delmar Learning, Pennsylvania State University, 2007.

[4] Azhar, Salman; Hein, Michael; Sketo, Blake, Building Information Modeling: Benefits, Risks and Challenges, Proceedings of the 44th ASC National Conference, Auburn, Alabama, USA, 2008. Available at: http://ascpro0.ascweb.org/archives/cd/2008/paper/CPGT182002008.pdf.

[5] Bachman, Robert, The ATC 58 Project: plan for nonstructural components. Performance-Based Seismic Design: Concepts and Implementation, Proc. International Workshop. Bled, Slovenia, 2004.

[6] Chaudhuri, Ray S. and Hutchinson, Tara C., Distribution of peak horizontal floor acceleration for estimating nonstructural element vulnerability. 13th World Conference on Earthquake Engineering, Vancouver, 2004.

[7] Pande G. N., Liang J. X., Middleton J., Equivalent elastic moduli for brick masonry, Comp. & Geotech.. 8, pp: 243-26, 1989.

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Building Information Modeling for the static and seismic safety of masonry balconies and overhangs

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Abstract
The key role of the digital representation during the preliminary phase of the structural analysis of whatever construction can be defined and integrated by using the Building Information Modeling (BIM) method which transforms the traditional drawing process from digital to virtual one.
Whether it's a new building made by modern materials or an existing masonry building or a product of the industrial design, each graphic process can be processed by BIM in order to become a unique platform, shared by the multi-disciplinary areas involved into the project.
Many existing buildings are characterized and recognizable thanks to the design of their masonry balconies and overhangs. These elements create particular shapes that add to the overall building design and characterize a particular type of enjoyment (the one dedicated to the exterior sight).
The masonry balconies and overhangs are perpetually exposed outside and for this reasons show wear traces due to the atmospheric agents and, therefore, their functionality can easily degenerate. Taking one of the most famous balcony models as a representative example, in this paper is explained the experienced procedure to create a structural B.I.M. Starting from a traditional geometric survey and elaborating it by different graphics software, it is possible to achieve a detailed and refined finite element structural model for performing nonlinear structural analyses aimed to assess the seismic and static safety of the element.

Keywords: B.I.M. building information modeling, structural representation, masonry balconies, modeling process

1. Introduction
This paper is a contribution to the knowledge and conservation of masonry balconies and overhangs through the evaluation of the structural characteristics of these factors.
Examining one of the most famous European architecture balconies it will be introduced the graphic representation procedure of the balcony structural model of Mila House designed by Antoni Gaudi.
The balcony is the central element of the research. It is an integration of the aesthetic-formal decoration [1] and the structural function (Figure 1).
Analyzing the Pedreira balconies and its history and symbolism, with a path of knowledge that starts from the origins of Art Noveau through the path of the author, it will implement a Structural BIM basis for the construction of a FEM model and for subsequent structural analysis for the determination of the level of static and seismic safety. This last phase will be thorough with the next paper.
The procedure used for the copy of the class will be examined by reference to studies much more directed to the preservation of cultural heritage understood as a safeguard of the overhangs masonry elements lining stylistic roles in Italian territory and that, recently, have been the protagonists of news events that led to the need to evaluate the safety of the overhangs elements for their correct use and without danger to those who use it.
It was chosen a construction of genius of the twentieth century, Antoni Gaudí. In his creative processes there were two creative phases. A kind of renewal of the modern architectural language that distinguished themselves in the structure, two independent moments: the "structure" and "formal", the skeleton by structural surfaces and by decorative components.

This paper briefly retrace the principles that led to the creation of the Catalan Gaudi Casa Mila where projecting elements in the work of the artist are a result of the articulation of the interior space. It get to redesign the balconies model in structural terms and prefigure the path of B.IM. applied to the element protruding its static and seismic safety evaluation.

2. Art Noveau and Antoni Gaudì

Antoni Gaudì belongs to the artistic movement of the early twentieth century called Art Nouveau that was closely linked to the elegance but hid the anxiety derived from a profound crisis of values. In Italy it was called Floral or Liberty and it was inspired by the nature shapes with an excessive decoration of buildings built with modern materials such as cement, iron and glass that gave brightness and lightness to the artefacts.

Gaudì, one of the great exponents of that art was called genius by someone but also a fool for his extravagant works.

Among the Sagrada Familia was the pipeline for more forty-three years and was buried there after the blessing and permission of the Pope on June 12, 1926. Gaudì was sad because a childhood plagued by rheumatic diseases who isolated it in the house and allowed him but to become a keen observer of nature, animals and their manifestations.

At the University he distinguished himself when during the examination of the design as a design theme led a funeral chapel starting to draw a hearse to the presence of the Director of the university who did not hesitate to promote a genius unregulated.

Its architecture developed in Barcelona in the period when Europe was open to research. The walls of the Spanish city were torn down in 1854 to make room conurbation widespread urban condition and this also influenced the artist thinking and the people inspired by the anticlerical ideas.

Initially, Gaudí was still looking for its own style and let herself be influenced by currents dominant, especially the Gothic Revival.

Despite being a European phenomenon the rediscovery of Gothic had assumed an additional charm in Catalonia and the artist was discovered nationalist, discoverer of the traditions and monuments of the past, especially those concerning the Arab past of southern Spain.

Its architecture was often called art because it was very imaginative and almost touched the idea that those designs so special could be real accomplishments.

The balconies of its architecture as well as fireplaces, windows, entry doors, roofs, were all very specific and articulated elements. Often the Casa Mila balconies were all in one facade (Figure 1).



Fig. 1: Casa Milà balconies in Barcelona by Antoni Gaudì [9]

3. The balconies and overhangs representation in Antoni Gaudì construction - Casa Milà

The Antoni Gaudì capability to realize admirable solutions especially in the critical points of a building such as for example the attachment between the facade and roof, makes him and its architecture especially interesting from the point of view of the formal technical.
The statements of the most famous Gaudi buildings are dynamic and in these is introduced transparency as in the case of the of the Casa Mila balconies said Pedreira.
In the latter, the cover is a corrugated ridge, forming the 'natural' conclusion of a stone mountain. From this vision comes the stone cladding of the house. Going through the details of the coverage, for example, it can possible admire the great creative capacity of the master at twisting the wavy eaves metal along the patios of Casa Mila, or in shaping wraps chimney ventilation turning them into sculptures exhibited outdoors (Figure 2).
Gaudí realized waterproof covers and elastic materials built with compact but divided and put into operates free to move under the effects of expansion and contraction of the wind. The structural part made very supple and reiterated the local tradition to build support structures cover made of thin diaphragms brick, but replacing them with parabolic arches. In Casa Mila was born from the idea of creating a mountain of stone, the architect has at close range a series of parabolic arcs of bricks that have the same profile but heights varied depending on the light blanket. The bases of the arcs are connected to each other with steel beams, embedded in the floor decking. It is obtained in this way a total elastic structure in which cracks are avoided in the arch brick (rigid part) by balancing the different coefficients of thermal expansion of steel and brick through the greater linear development of its parabolic profile of the arc.
Gaudi's magnificent solutions are made with games geometric representation of the construction elements. The light plays an important role in his work and this is filtered and is soft not to dazzle the visitor. Its architecture expresses a strong capacity for rational structural engineer and an interesting fantasy architect extravagant. Carriers and taken push Gaudí building shell composed of ruled surfaces, more valid by mechanical and easily achievable with traditional technologies.



Fig. 2: Casa Milà facade in Barcelona by Antoni Gaudì [9]

4. The Building Information Modeling and the Finite Element Method for balconies

Balconies are structural elements as well as decorative elements of buildings. They besides giving the possibility to let light in dwellings, damage that penetrates into the interior space on the outside of the building.Ultimately these elements as those of the overhanging eaves of buildings, are able to give character to the building, for the material with which they are built, for their design and for the function in the complex of the building [2].

The overhangs parts of a building is structurally accessory item but placed in the facade. It can be of different types:

- Jutting if sticking to the line of the facade, as if it were an extension of the building unit. Not included in the vertical structure of the building and it has only static range being hooked to the ceiling inside;
- Not projecting placed inside the perimeter of the building, structurally inserted into the bearing structure of this and not stretched in a vacuum;
- Balcony loggia forming a recess in the front of the building and does not protrude compared to the perimeter walls, remaining embedded in the body of the building;
- Loggia flush façade enclosed between two side walls intimately linked to the main unit;
- Landing that consists in a passage against the wall of the building on the outside with a railing, parapet or railings.

In the representation - structural study of architecture, the projecting balcony is interesting to point out which are the parts to be designed with the use of the methodology B.I.M.

Through the use of building information modeling (Figure 3) it can split the balcony in structural parts such as:

- The insole, which has a support and allows the usability and decking;
- The floor elements and accessories to it, as the structure that houses and any sheaths insulation;
- The gutters, that part of the floor that runs along the outer perimeter of the balcony;
- The parapet and railing, decking protection, without which the balcony would be impractical.
- The front panels;
- The under-balconies (or ceilings of the same, in the case of balconies or loggia collected).

Each element "speaks" about the history construction, the aesthetic appearance and they are characterized by a particular design and a structure.

The look like in the case of Antoni Gaudi architecture is essential the structural aspect. Until the Middle Ages, each cantilever construction was considered only from the functional point of view then with the Renaissance and the prospect is spotted rules and proportions, balconies and cornices served to outline and highlight the mathematical logic in the facade.

Comes the need to give depth to the paintings, to the quarters and squares with the creation of urban settings. The facade of the buildings becomes connotation typological neighborhoods and streets, referring to their destination (mercantile, residential, representation, etc.).

In Europe later developed the Art Noveau open to aesthetic and from that moment every building became the manifesto of the author's thought.

It highlights a strong anticlerical in the construction of Gaudi and a tendency to make the message impressive architecture in the urban landscape of Barcelona.

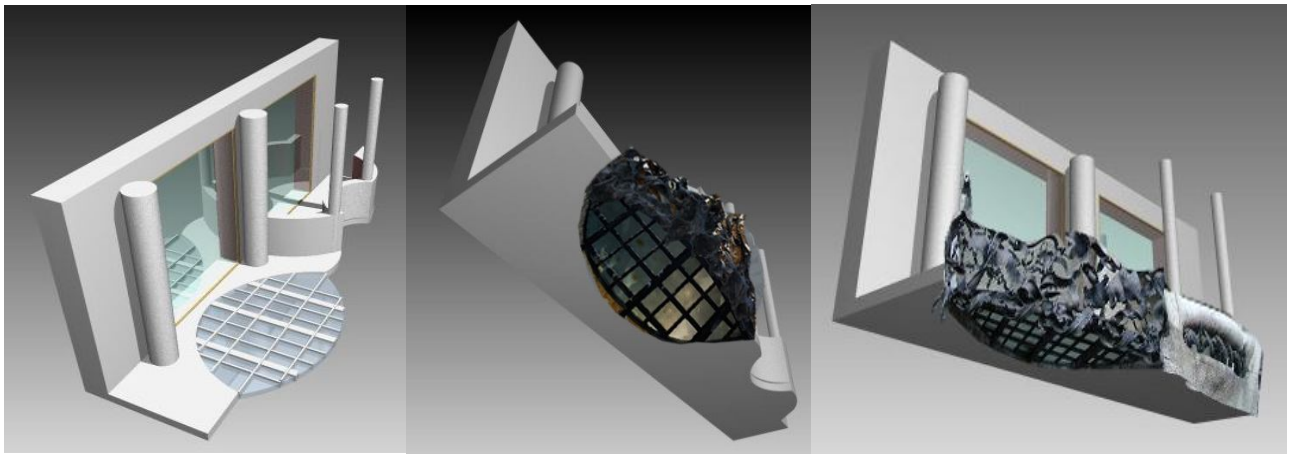
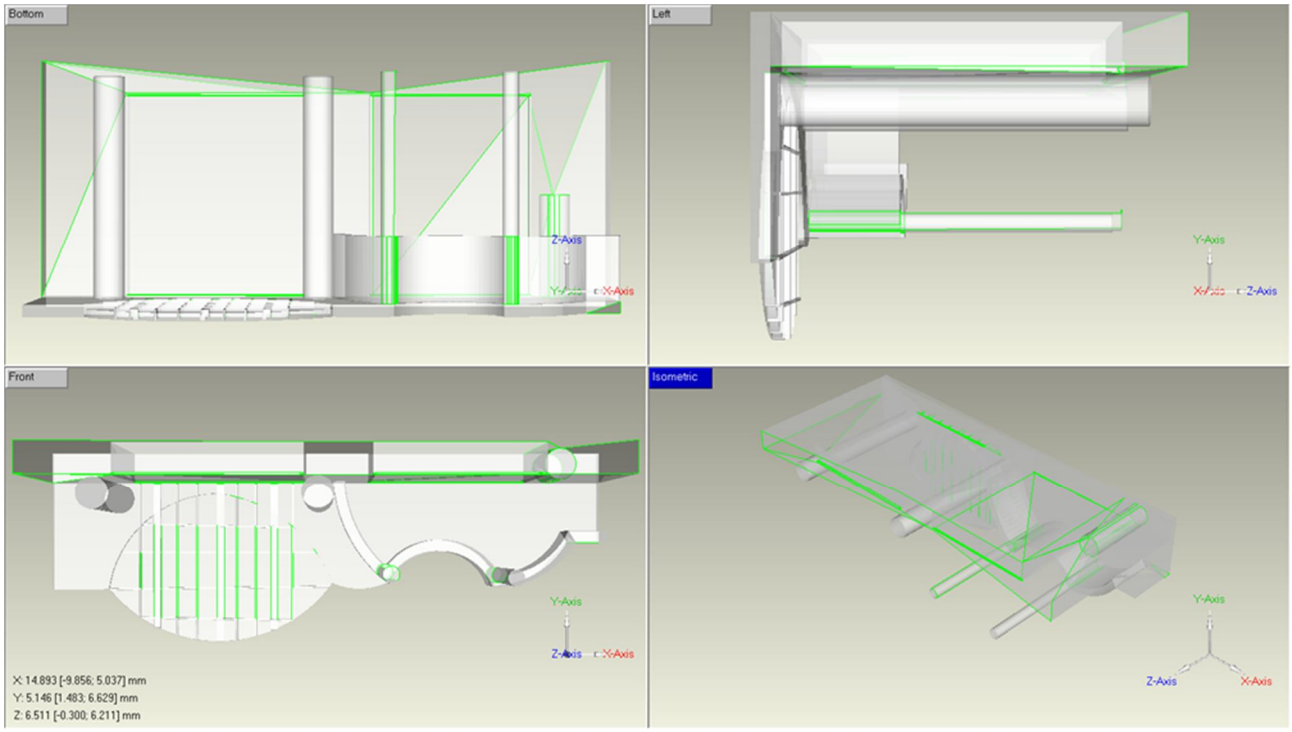


Fig. 3: Example of B.I.M. structural model and structural render of Casa Milà balcony in Barcellona by Antoni Gaudì.

As shown in Figure 3 it has been analyzed and summarized the Antoni Gaudi balcony and precisely part of the Casa Mila facade.
This building has the characteristic of having the lugs all connected materially and structurally to the facade.
Called La Pedrera this building was designed as a large boulder mountain. From this vision is coming off the necessity of stone cladding and the knowledge that every item even had an individuality structural and aesthetic independent, was part of a whole.
Selecting only part of the facade, it was possible to identify a projecting balcony slab with glass and iron and wrought iron railing completely and also an adjoining balcony jutting but with stone parapet and only top wrought iron. The insole of this balcony is the same type of the floor inside. The B.I.M. prepare the draft of the balcony for structural analysis and verification of static and seismic safety of the same.
Analyzed the features historical - structural and defined the size of the balcony with the geometric survey of the same, thanks to the use of digital graphics programs (Figures 4) you get to make the virtual element balcony.
Being very particular connection between the facade and the balcony was necessary to work on sketches in the first stage and then proceed with the procedure of BIM already experimented on Heritage Complex of architecture historical - cultural.
With this method you have the interpenetration of the discipline of the representation with that of the structures.
After creating the three-dimensional model of the object under investigation can proceed with the creation of horizontal sections at step 20 cm (Figure 5) to create a mesh based on what will be the next building with the software Midas / Gen finite element model [3,4].
The latter is characterized by having each point of the structure characterized by a solid that has physical characteristics, and mechanical behavior of materials.
Currently there are software like Midas FEA able to assess in the structural analysis also what happens at cracks. This motion is important for models such as the one examined in this paper because it is essential to assess the state of the protruding elements to evaluate their safety static and seismic.
Only one phase careful knowledge of the artifact can give information about what happens to the balconies and ledges that are constantly exposed to the elements and therefore spoiled ahead of time compared to the other elements of the building.
Their function degenerates over time and more and more increases the risk of falling parts of the structure from above. Obviously, it is conceivable that the damage may cause such a situation is that the built heritage to those users.



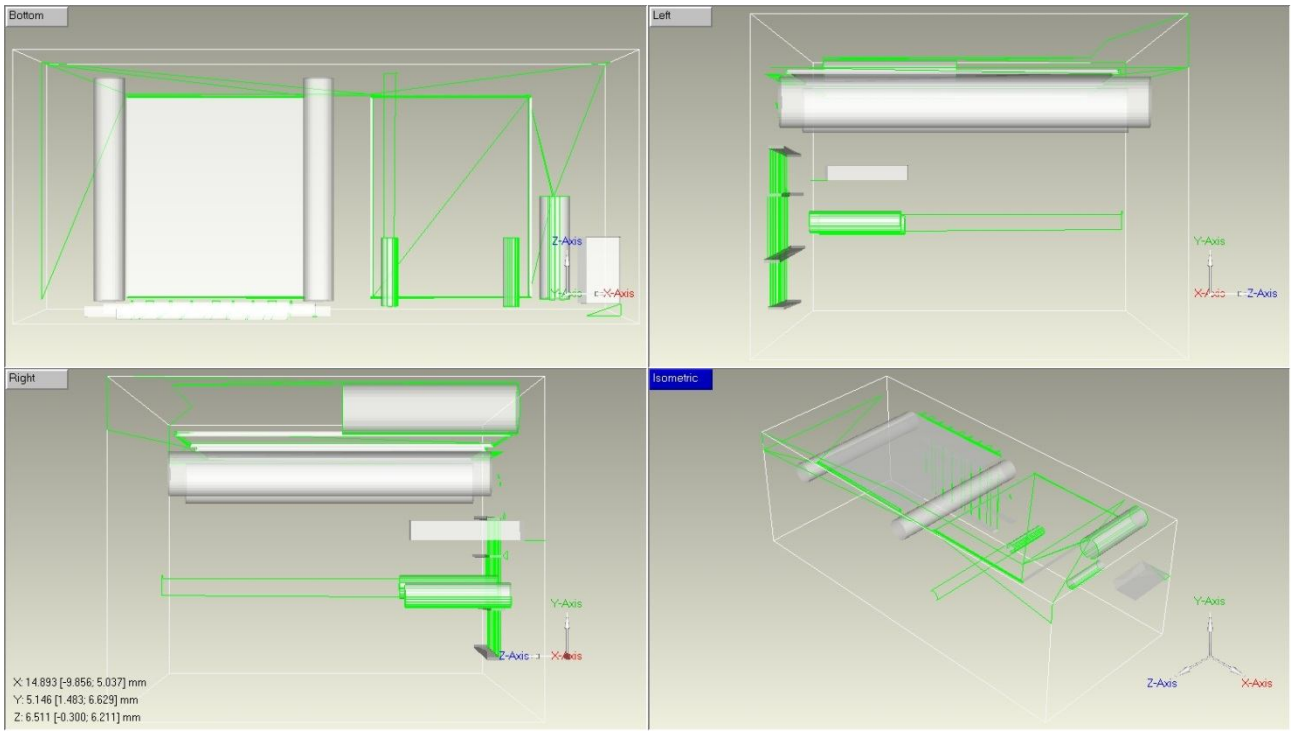


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Fig.: 4 Structural B.I.M. of Casa Milà balcony in Barcelona by Antoni Gaudì.

5. Interaction between representation and structural analysis of balconies

Today many of the graphical representations of the constructive elements of a building are entrusted to the ability of software to make a virtual element of real architecture. Entrusted exclusively to these graphics programs the realization of a three-dimensional model is not quite as good as what to be based on a good understanding of the traditional principles of geometric representation, helps in the phase of knowledge especially historical - functional object.

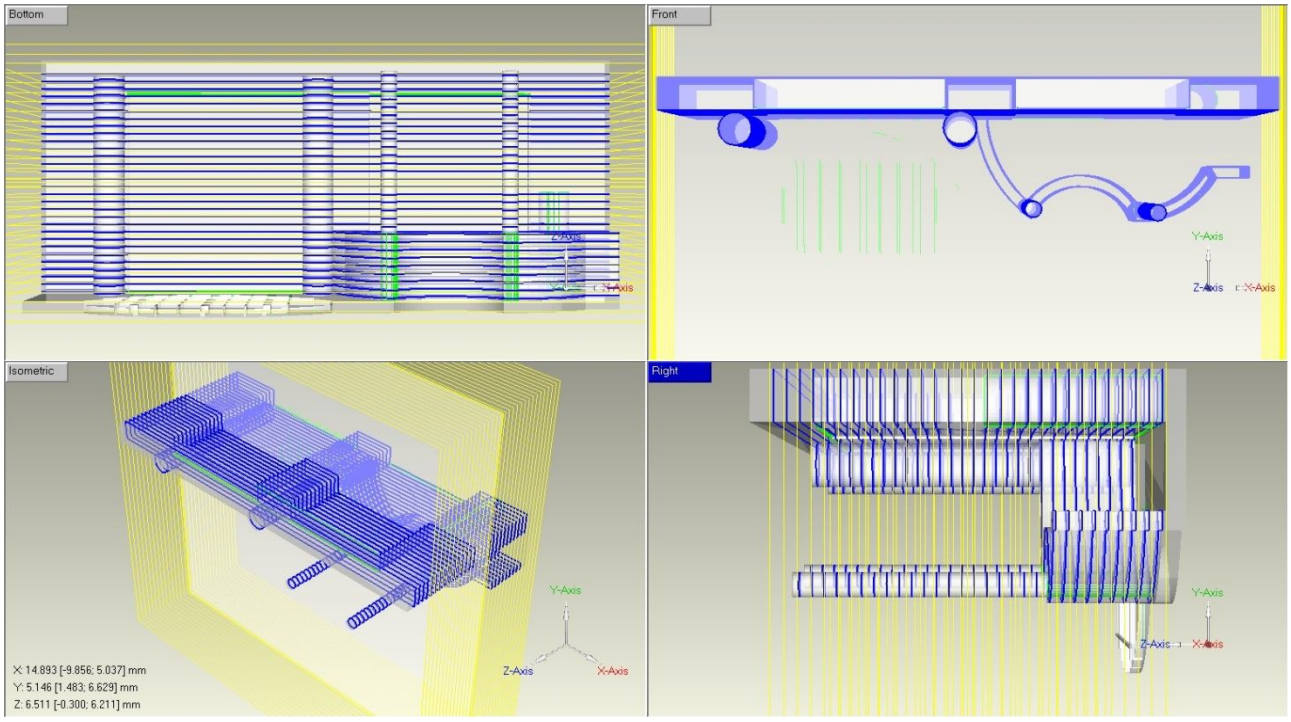

Fig. 5: Horizontal sections with step of 20 cm for the creation of the mesh for the FEM model

The graphic design is the production of floor plans, elevations, plans and sections of the artifacts to describe, through vivid designs and essential in an appropriate scale following the rules of descriptive geometry and the rules of technical drawing In case of La Pedrera seems difficult to frame geometries and symmetries of its basic design, but in fact these are masked and the basis is a project structural engineer so successful.
The family of graphics software (Computer-Aided Design / Drafting) aims to create a 2D model of the technical drawing that describes the artifact and supports the work of the designer.
Once defined a 3D model, this can be used to perform static analysis, dynamic and structural: in this case it is called Computer-Aided Engineering (CAE), discipline wider, of which CAD is the subset of actions and instruments aimed at creating purely geometric model.
The graphics editor of the architectural design must communicate the purpose of representation and can be enriched with the management of natural and artificial light, and with the addition of people to make true the virtual set.
The designer of a work of architecture should be based on the fundamental rule that every space must be received by man. Gaudí conceived as his works. He started from the concept already used by Vitruvius (great Roman architect of the first century BC.) For which the man - standing, legs closed and arms outstretched horizontally - can be inscribed in a circle (image represented in the famous drawing by Leonardo), whose center falls on navel. These measures are the dimensions of the human body and express regularity of mathematic laws. Recovering these principles of representation, the Catalan architect, described its balconies as elements of historical, formal but also structural representation. The morphological feature of the building is linked to spatial aspects. The balcony buys organic visual, becomes connecting element between the parties but also cutting element and division between a floor and the other facades. As a representative element of proportion and decoration, renews the importance of the sign and complaint outside the function active within the factory.
In Gaudi there is a different approach to the representation of the buildings and then the protruding elements, leaving the pure calculation and the ratio plant and raised, to enhance the baroque decoration, the importance of the sculptures on the parapets of decorum all strictly made with techniques traditional and realistic dimension of a three dimensional view of the element. Delivering to the present day the exciting three-dimensional representation of the architects, from 1500 onwards, you can see how it has developed an apparatus informed that another does not have at its base that the rules of the golden section, the construction mathematical and geometrical volumes late Renaissance . The balcony modeled with digital equipment, takes shape in itself, acquires an identity, a force. Element of external vision and separation units it finally exposes important structural and material.
The eaves and balconies still play an important role from a static point of view (Figure 5).
To develop a proper static scheme balconies for example with stone slab is necessary to consider the weight and load of exercise that are distributed loads and concentrated loads two ends that are due to the weight of the railing crosswise. The verification is carried out on the plate that is a schematic beam on two supports constituted by the shelves and two starts. you must check to rollover stability, tensions due to the shelf on the wall. These checks will be processed and described in the following paper.

6. The static and seismic safety of masonry balconies and overhangs

The news events have highlighted the need to assess critically and systematically static and seismic safety of the overhangs elements of existing buildings especially masonry and historic areas of the town.
This is to avoid the danger derived from the fall of protruding parts such as cornice and balconies. As is widely known, the seismic capacity of masonry also depends on the type and quality of the links between the masonry walls.



Fig. 6: Aquila and Napoli (Italy) – collapse unsafe balconies [9]

The guidelines regarding masonry buildings in seismic detection and structural deficiencies, in the chapter on the lack or ineffectiveness of connections between the walls, frequently say: "The connections between the walls and the walls are essential to ensure good behavior box together with the building, ie to prevent the detachment of the walls subject to actions perpendicular to their plane. " This is the basis of the success of a static building but do not underestimate the importance of this research gives protruding.
Moreover, on the occasion of numerous seismic events has often been noted that the collapses involving their daughters protruding elements due to the activation of mechanisms of rotation. The portion of the masonry that ribald depends on the quality of the masonry walls connected to the balcony, the type of this, as well as the position of the openings in the general framework of the facade.
Obviously, to assess properly the role of the balconies and cornices in the behavior of construction set, requires a thorough understanding of their structural characteristics. This is today acquirable both assays on the outside and on the inside, and through non-destructive instrumental investigations, with which it is possible to evaluate the construction technique of insoles.
There are different types of balconies that from the point of view of the evaluation of structural safety behave differently for both the different material characteristics and both for the different modes of assembly of the parts.
In Figure 6 it is clear that in the case of the balcony at the Eagle, there was an error in construction. The lack of connection between the wall and the slab has determined the absence of effective scarfing between perpendicular walls. And widespread view that can not be considered effective a balcony that has structural independence and therefore is not tied to the facade. In the second and third case Neapolitan instead detachment of the balconies is due to the lack of maintenance of the element, the elapsed time and in addition to the damage that the elements make [5,6,7,].

7. Conclusions

The balconies and overhangs elements are hallmarks of an era of art and have always marked and characterized the architectural styles, through the materials used, through the design of the parapets and construction techniques with which they are made.
They are related to both structural and aesthetic aspects that must unavoidably be safeguarded and preserved.
The Charter Italian Restoration of 1972 (now amended and supplemented by the Charter of the conservation and restoration of objects d 'art and culture of 1987), however, states that it is necessary "to preserve scrupulously the external forms and avoid sensitive to alterations' individuality typological organism constructive ". Unfortunately, most of the techniques of consolidation of the walls does not allow, at the time, safeguarding specific aesthetic and formal elements protruding.
From a structural point of view on the whole of the building, their role is important and the only modeling, including a simplified, using solid elements captures the salient aspects of their sharing the statics of the building.
In light of the above seems to need at least: to examine the behavior of the balconies and walls to which they are connected, find optimal solutions that simultaneously allow the seismic improvement of the construction and preservation of these elements, examining the role of the non-destructive diagnostics in deep knowledge of the protruding parts, perform an experiment in laboratory models to the reality [8].
The representation of the balcony is related to the importance structural element and this characteristic is united through history. Factors morphological-perceptual (factors of representation) are to exalt, joining those constructive-textural-building (structure factors), and together these aspects contemplate those socio-economic factors (history). Concluding with a statement of François de la Rochefoucauld writer, philosopher and French aphorist "charm disjoint beauty one can say that is a harmony of which you do not know the rules, is a secret report of the features between them and with features colors and with the attitude of the people ", it is stated that the balcony becomes an element of structural representation, featuring an artifact in its environmental features and technology.
It was chosen for this example one of the most beautiful balconies of Europe, the balcony of La Pedrera in Barcelona that together play an important formal and aesthetic, historic for its technology costruttivae structural for its interesting composition of elements and material composition . Only through the interrelation between the disciplines of representation and discipline structures has the opportunity to assess the completeness one of the richest traditions Catalan signed by a genius of architecture as Antoni Gaudi.
Assess the safety of these static and seismic factors prevents unpleasant events that may occur as those who in recent years have been described by the newspapers and also protects against damage to the structure produced by poor maintenance of the weathering aggression.

Bibliographical References

[1] MARTUSCIELLO, Sabina and GAMBARDELLA, Carmine (foreward), *Rilievo multicriteri@. L'elemento ordinatore della rappresentazione*, ed. ESI, Napoli, 2003.

[2] TITOMANLIO, Ingrid and FAELLA, Giuseppe, *Il cantonale come elemento strutturale e di rappresentazione storica*, in AA.VV. Proceedings of Aidmonuments, Perugia, 2012.

[3] PAULAY, Thomas and PRIESTLY, M.J.Nigel, *Seismic Design of Reinforced Concrete and Masonry Buildings*, ed. John Wiley & Sons, 2009.

[4] SPENCE, Robin, COBURN, Andrew*, Strengthening building of stone masonry to resist earthquake*, ed. Springer, 1992.

[5] COOKSEY, Jason, *The Integration of Building Information Modeling (B.I.M.) into Civil Engineering Curricula*, Masters thesis, Clemson University, 2011 .

[6] SACKS, Rafael, KANER, Israel, EASTMAN, Charls, JEONG, Yeon-Suk, *The Rosewood Experiment – Building Information Modeling and Interoperability for Architectural Precast Facades, Automation in Construction,* Volume 19, Issue 4, July 2010, Pages 419–432, Building information modeling and interoperability, ed. Elsevier, 2010

[7] ETTOUNEY, Mohammed, *Building Integration Solutions, in proceedings of the 2008 Architectural engineering national conference*, ed. American Society of Civil Engineers, 2006.

[8] DI EGIDIO, Angelo, CONTENTO, Alessandro and ZULLI, Daniele, *Dynamics of 3d monolithic objects of art subject to seismic excitation*, in A.A.V.V. Proceedings of 15 WCEE, Lisboa 2012

[9] Referring Web Pages: www.culturananopress.it; www.europaoggi.it; www.magazinevoiagando.it; www.chiaianapolitoday.it; www.lastampa.it; www.paesenews.it; www.mymagicplace.it;

HERITAGE and TECHNOLOGY
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Construction of the Museum of Fine Arts in Riga (1903-1905)

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Abstract
The Museum of Fine Arts building is integral part of the Riga historic centre. It is one of the public buildings commissioned and realized on the cost of the Municipality and forms one of the landmarks the city centre is known for. Its construction commenced in 1903. Being designed, supervised and later directed by architect and art historian Wilhelm Neumann (1849—1919), the Museum structure comprised all current technical and technological knowledge of the period. Neumann visited several museums in Europe before construction started, and several parallels between them and the Riga Museum can be identified. Original notes, scope-of-work descriptions, bidding letters and tender documentation, kept in the archive of the Museum, comprise a unique complex of historical materials allowing now to reconstruct the process of choosing solutions and structural approaches for the Museum building. The chosen planning principles and technical details allow to consider the Museum as a deliberately conceived, designed and realized structure incorporating the current cultural and planning ideas together with technological innovations used at the turn of the century.

Keywords: Built heritage, Architecture, Museum building, Conservation, Building technologies

Birth of the Museum

Idea to make a new building where to exhibit the collection of paintings gifted to the City of Riga by several donors dates back already to 1874. Yet the Museum building was constructed just in 1905.The location was found on the northern edge of the former military training ground - Esplanade, next to the also then intended Riga Stock exchange Commerce School building.

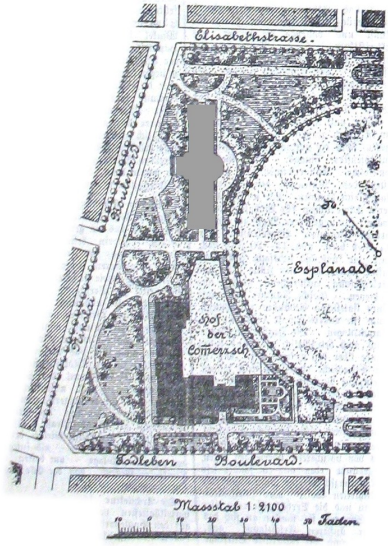

Fig. 1: Plan showing the location of the Museum building in 1906.

Turn of the the nineteenth and twentieth centuries in general marked an important step in the growth of Riga. Demolition of the city walls in 1863 promoted the development of the former suburbs during the second half of the nineteenth century. Besides the construction of rent houses, forming the majority of the current Riga centre, several public buildings as two theatres, the Riga Stock exchange, Houses of the Large and the Small Guilds etc. were constructed. Yet it was not until 1903 when, soon after the Riga Anniversary exhibition in 1901, the City council undertook the construction of the Museum of Fine Arts. Being designed, supervised and later directed by architect and art historian Wilhelm Neumann (1849—1919), the Museum structure comprised all current technical and technological knowledge of the period. Prior to the construction W. Neumann visited newly constructed museums of Europe, including Hamburg, Carlsruhe, Stuttgart, Berlin, Wien etc. The closest source of inspiration

is thought to be Bode Museum in Berlin (architect Ernst von Ihne, 1897—1904), with whom direct parallels can be traced in neobarocal facade, "flying" central staircase as well as in interior details and the manner the art objects were originally displayed.

In 2010 the international competition was organized for the reconstruction and restoration of the Museum. The winners - Lithuanian architectural bureau “Processoffice[1]” commissioned the report's author's office to help with the restoration part of the Project. Therefore besides the data uncovered during the pre-project works [2], it was possible to acquire the in-depth knowledge on the object, taking part in the conservation and reconstruction process. The reconstruction and restoration of the Museum shall be finished by the end of 2015.



Fig. 2: Modern view of the Museum building (architect W.Neumann, 1903—1905). On the right side Commerce School of the Riga Stock exchange (architect W.Bockslaff, 1902—1905), constructed in neogothic forms almost simultaneously with the Museum. Photo: Arturs Lapins, 2013.

The plan and the volume

The spatial structure of the Museum is rather simple - it is a prolonged, in NW - SE direction oriented symmetrical 3-storey building, with two avant-corps on both ends, and the central avant-corps, crowned with the cupola and the lantern. The central entrance to the Museum is accented with the expressive gable, rested on monumental Ionic columns. The composition of the volume and spatial organization of the plan is maintained in Baroque forms. The attic inside the cupola and Baroque-shaped end gables are lit by ornate dormers. The 2nd floor windows show the “jumping” imposts - as the sign of the then-modern Art-nouveau ideas. The original roof covering - black slate, laid in the so called German style cladding, was been replaced by the copper after the WWII.

The elevation details are made as a combination of cast Roman cement elements, combined with in-situ drawn profiles. The central sculptural group, depicting the allegory of architecture, painting and graphics, still bear the signs of the three-part casting moulds. The other elements such as columns are constructed of natural sandstone, with their surface dressed in the classical manner. Otherwise the Museum volume and façades have been preserved throughout the ages without significant alterations.

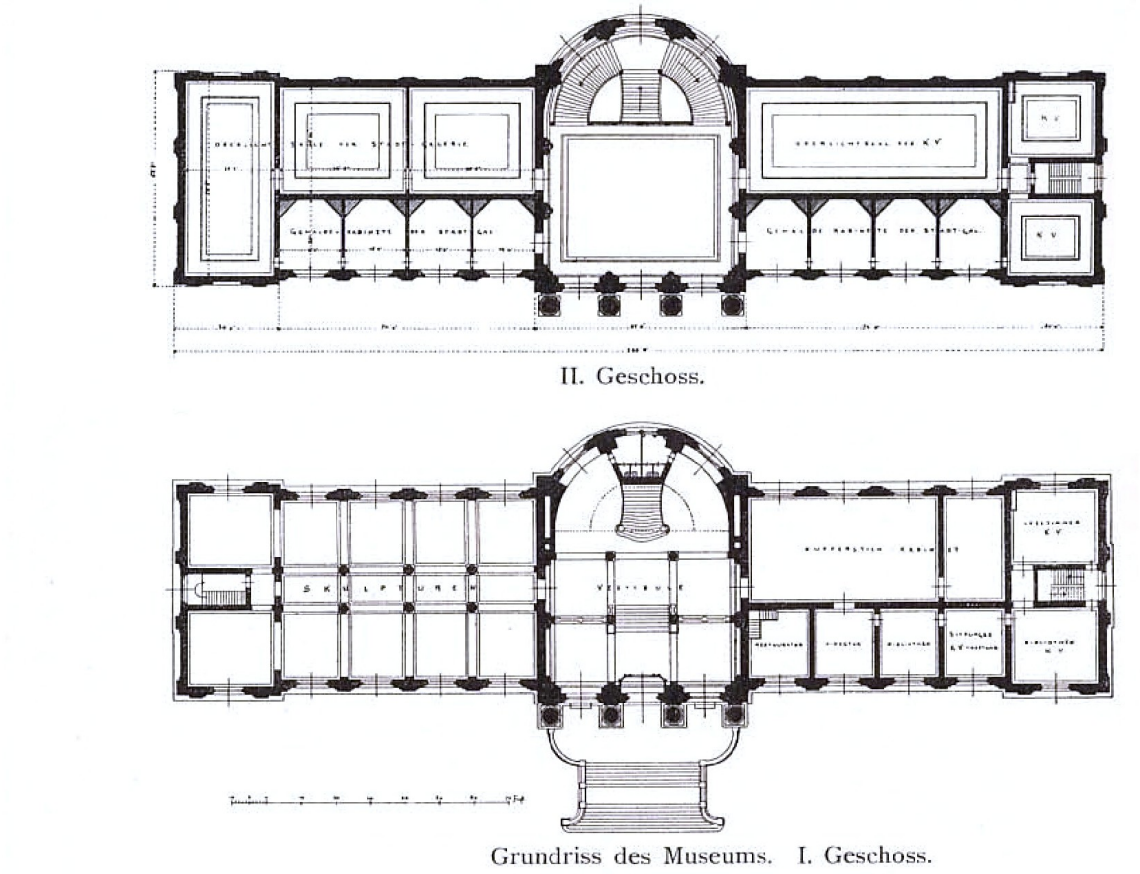

Fig. 3: Plans of the 2nd and the 3rd floor as published in 1905.

The 1st floor of the building contained premises for heating, workshops, Director's apartment and other subsidiary premises. The exhibition rooms were located on the 2nd and the 3rd floors. The 2nd or the main floor besides the larger exhibition hall also housed the Cabinet of the copper engravings, rooms for the local Art society *Kunstverein*, as well as the Director's office. On the 3rd floor the doors from the large stair-case led to the large exhibition halls, located on the south side and smaller exhibition halls or cabinets on the north side.

The main accent of the interior by no doubt is the Hall with the effective white marble stairs. Construction drawings show, that separate steps rest on rolled iron H-shaped beams, which allow the space below the stairs to be used for auxiliary premises and toilets. Rolled iron beams are also used as the structural core for the artificial-marble finished columns, supporting the ceiling of the 2nd floor.

Natural lighting

The Museum as a whole originally was planned to be visited during the light time of the day. The lighting of the 3rd floor exhibition halls has been solved in a manner, few years earlier applied in the Bode museum. Schematic drawings, made by the author, reveal, how the proportions of the premises have been analysed, setting that the height of the room shall be 5/7 of the width. Also by indicating the eye level, the optimal size for the roof lights has been searched for - to insure, that the paintings, hung on the walls would be optimally lit by the natural daylight. The smaller 3rd floor exhibition rooms are lit by side windows, located above the eye level - as author has pointed out in his 1906 publication, the method applied in *Pinakothek*. The large Hall on the 2nd floor is lit from both sides, as it was originally intended for the sculptures, so it was lit through the large windows, situated on the both longer façades.

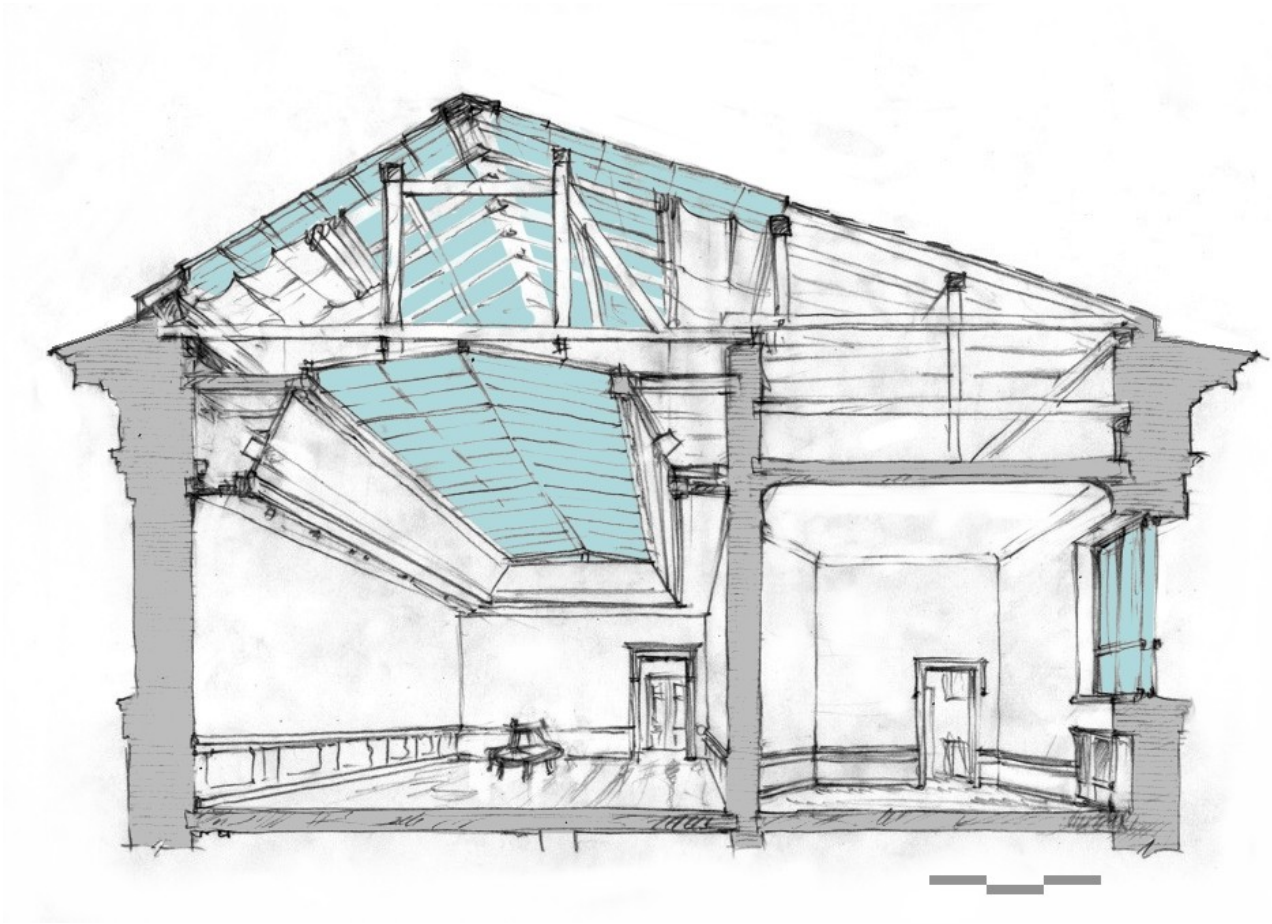

Fig. 4: Schematic perspective section of the 3rd floor and the attic, showing the glazed areas for natural lighting of the exhibitions. Arturs Lapins, 2015.

Ceilings

Original notes, scope-of-work descriptions, bidding letters and tender documentation, kept in the archive of the Museum, allow nowadays to follow the process of choosing the technical solutions and structural approaches [3]. As example, schematic drawing of the ceiling together with the description allow to identify, that the ceilings have been made according to *Koen*'s system [4] - a reinforced concrete slab with integrated steel beams. This construction is recorded to be used factory buildings in Berlin in 1897 and 1898 [5]. The sketch also shows "reversed" version - this variation is used for the ceiling between the ground floor and 1st floor, where sand infill ensures additional sound insulation.

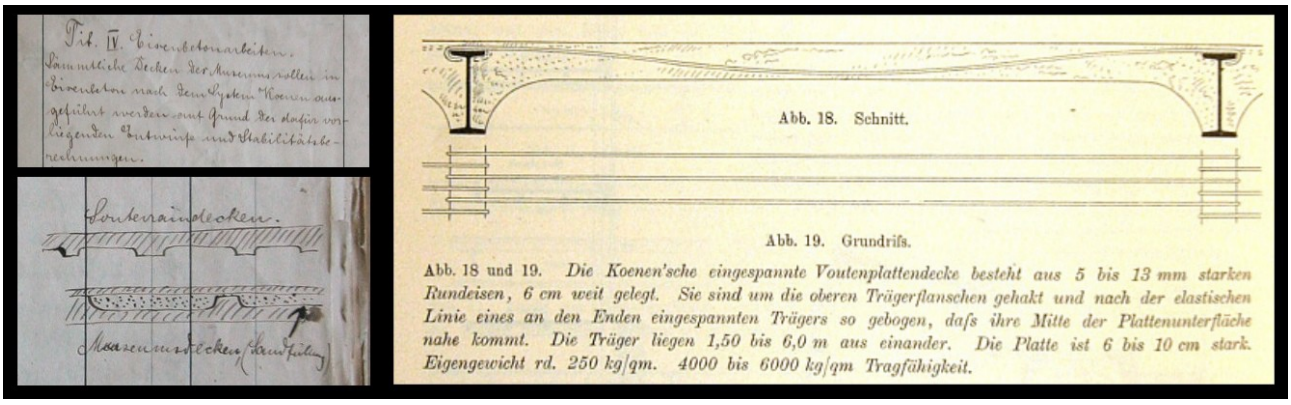

Fig. 5: Detail from the original listing of the works (on the left) and illustration from an early 20. century building lexikon.

The magnificent plastered ceiling of the 3rd floor hall was also investigated, and it turned out to be hung to the wooden truss construction, to witch metal ties were attached. The rest of the plaster plane, or one could say - ca. 8cm thick plate, together with the cove, profiles and relief details were fixed to the suspended steel grid. Surprisingly no cracks were observed in the construction, although the exterior walls showed several evidences of settlement.

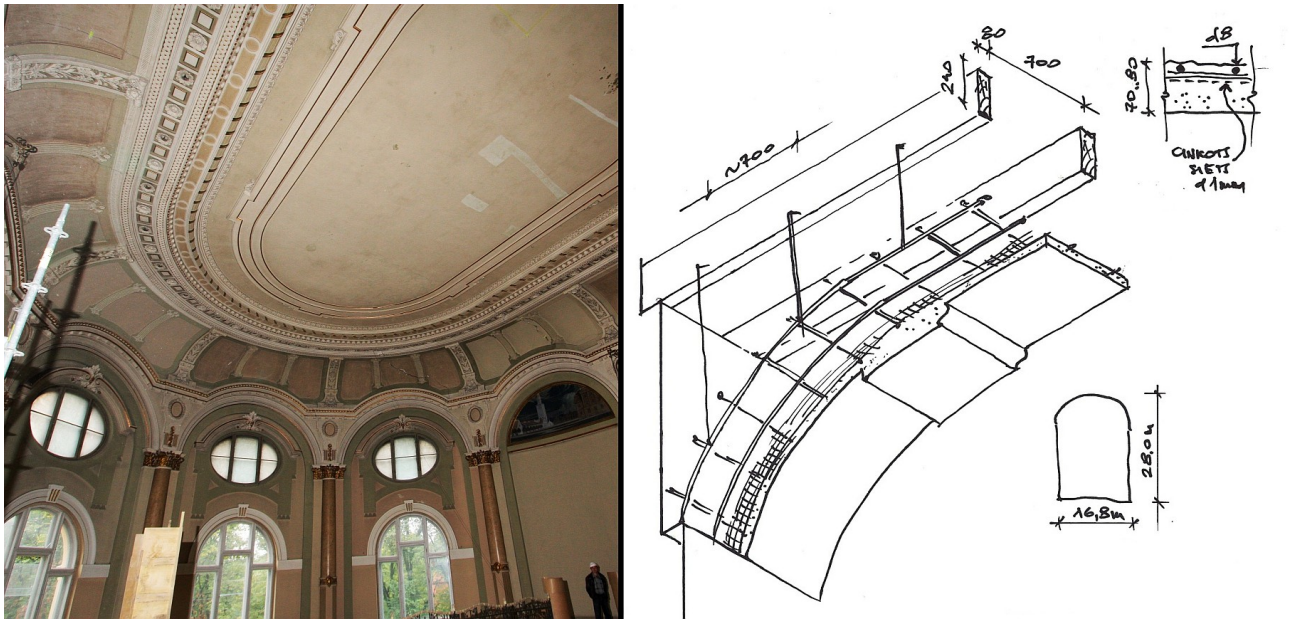

Fig. 6: The 3rd floor Hall - general view of the coved ceiling (to the left) and isometric cutout of the ceiling construction. Arturs Lapins, 2013.

On the floors Above the sand layer the floor covering has been laid. Within the Museum building several types of covering have been used. The Entrance hall has been covered with terrazzo, where small crushed stones are put into the mortar. The exhibition hall floors are covered with oak parquet, laid on bitumen - for which also references in turn-of-the-century literature can be found [6]. The subsidiary staircase landings still preserve the original pressed asbestos-and-oil mix floor covering, called "Dielol", which has been originally intended for bathrooms or kitchens.

Despite the carefully thought-out planning and structure, the current reconstruction also revealed several faults. The elaborated lime - gypsum plaster ceiling of the 2nd floor turned out to be fixed to the concrete panel just in several points, and the wooden wedges, to whom the reed sheafs were fixed, have been made as inside-narrowed cones. Accidentally it was also the place next to the chimney shaft, which the modern Builder neglected to cover during the rain. So part of the plaster next to the shaft went wet, got heavy and together with the profiles fell to the ground. So the plaster could be inspected and the necessary strengthening measures undertaken.

Artificial Lighting

From the original cost estimates and correspondence it also becomes clear, that in 1905 the Russian society "*Allgemeine Elektrizitäts-Gesellschaft*" or AEG has delivered *Nerns*t lamps, "Modell A [7] fur 1 Amp.", bronzed with brass [8]. This type of electrical incandescent lamps with ceramic rod was widely used at the World's Fair 1900 at Paris, where the pavilion of the AEG is recorded to be illuminated by 800 *Nernst* lamps. In the Museum 8 lamps have been used for the rooms of Art society, located on the ground floor of the building and 9 for the lighting of the Gallery itself. But in general the whole grandeur of the Museum was achieved by means of careful use of natural light effects, making the building energy-efficient.

These and other technical details allow to consider the museum structure as a deliberatively conceived, designed and realized structure incorporating the current cultural and planning ideas together with the available technological innovations of the turn of the century.

Bibliographical References

[1] http://www.processoffice.lt/ - accessed 2015-03-24
[2] architectural investigation was carried out by the specialists of the Architectural Investigation group in 2004 - LEVALDE, Daiga. *Architectural investigation.* Riga, Architectural investigation group, 2004.
[3] Archive of the Latvian National Museum of Art, F. 76.
[4] *Schönermark, Gustav / Stüber, Wilhelm (Hrsg.)* Hochbau-Lexikon. Wilhelm Ernst & Sohn , Berlin o. J., 1905. S. 334.
[5] *Mislin, M.* Iron Constructions for Factory Buildings in Berlin in the Nineteenth and Early Twentieth Century // Proceedings of the first international congress on Construction History, 2003. — Volume III, P. 1451.
[6] z.B., KRAUTH Theodor. *Die Gesamte Bauschreinerei*. Leipzig, 1899. - S.66.
http://www.nernst.de/lamp/nernstlamp_a/nernstlamp_a.htm (Last accessed: 2011.04.08)
[7] http://www.nernst.de/lamp/nernstlamp_a/nernstlamp_a.htm (Last accessed: 2011.04.08)
[8] Archive of the National Museum of Art, F. 76. Page 98.

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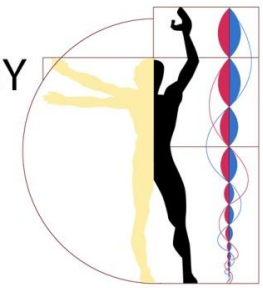

Critical Vision

The Impressionist Range Of Creativity And Technical Innovation Of The Heritage Cities Between Cosmic And Heritage Concept And Reformulation Of The Mental Image

"An Empirical Study of the Cairo in the Egypt's t environmental built"

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Abstract:

In the era of globalization, informational openness, knowledge, technical and technological revolutions. creativity and innovation became crucial to the progress of societies and underdevelopment. The world became a small village, where you can watch the event at the same moment it occurs. This as a result of scientific, technical and technological innovations in all fields of life in general, particularly the field of architecture and urbanism. These technical and technological innovations that have made it easy to the visitor able to visit the heritage city to recognize its characters and identity through the internet through the air images (upper view) that showing its features with different concepts and simulation models that embodied it. Until life can not be imagined without the vast amount of knowledge and information given by the creations and innovations to study the heritage cities through aerial photo and upper view for Urbanism rather than the naked eye perspective of the average person who goes where on his feet (general view). Which makes it incumbent on all creativity and innovation organizations when developing strategies to address the problems and the challenge of solving problems of urban heritage list.

The main objective of the research is trying to reach the impressionist range of the role of creativity and innovation, architectural and technological rework the mental image of the cities heritage by dealing with them, whether conservative or improvement or reformulation to revive the list and as a tool to document the current status of the image of mental perceived online and face and monitor the changes and developments that have affected them across different eras. Well acquainted with the features and dealing with the tribulations and problems existing creative and innovative look. Giving the new non-traditional solutions by activating the upper view for the aerial image to take advantage of drafting priorities and concerns of the order of Architecture and Urbanism of the cities heritage. As well as the possibility to convert the city into a global city. And implications for the extent of cosplay on the bases of the ruling theories formed to comply with the technological and technical development in our contemporary without compromising the value of heritage.

This reseach presents a modernist look to identify the impact of creativity and technological innovation in reshaping the mental image of the cities heritage and document its current status. facing and monitoring the changes and developments that have taken place them acquainted with the features and deal with the problems existing creative and innovative look. And how to formulate a new vision to draw a relationship between the blocks and spaces and activities incident, stressing revive its tracks heritage and the development of trails and services to meet the current needs and future upgrade them while maintaining the distinctive outlook metadata. With the introduction of new activities or re-activate its role to become a bright spot and a source radiation culturally economically ..... etc. As before turning it into a global city rather than just being a tourist heritage. Through the study of creative innovative concepts formulated in an era built, modernist concept of globalization to monitor change and development, to identify the fact that the conceptual conflict of cultures and the extent impressionist her architecture. And vulnerability as a result of the incident in which Western ideas coming, technological development and technical across different eras. Stressing the importance of maintaining or reconstruct the lost identity through a contemporary perspective.

To draw the importance of theoretical and critical studies of creativity and innovation architect and software architectural technical simulation of the face and monitor changes in the mental image of the cities heritage residential and architecturally. (From exotic designs them and construction techniques used by now), the importance of creativity and innovation to create a new vision perspective to solve the existing problems of the cities heritage architecture and urban. And the development of architectural and urban thought the ruling and theories to be reformulated with modernist confirm her identity to meet our current needs and future cities to

become a global heritage and a source of cultural and economic radiation .... etc. in addition to being a tourist cities. Relying on technological programs and aerial photographs of cities heritage satellite and simulation programs.

Keywords: Digital revolution, Virtual reality, Heritage-based cities, Digital cities, Imaginative spaces, Criticism of design & informatics.

1. Introduction:-

In fact, revolutions in knowledge, technology and digits have affected life in different aspects or fields. This remarkable effect has also extended to the field of architecture and structure generally and the heritage-based cities specifically. The progress and development in the information technologies and their varieties have actually lead to the emergence and appearance of the so called "knowledge or digital cities" with their smart buildings not only by the employment of computer technologies and knowledge means for increasing efficiency and achieving use rationalization, but also by the integral and interactive role of the various buildings in the distant and far cities through linking them with knowledge bases to be as media for exchanging experiences and to convert functional spaces for their activities into a transporter medium and a knowledge source for building knowledge. As a result, societies with electronic information have created and emerged, new activities have generated and existing activities have omitted, averages and services have been changed and their place relations have also changed. In addition, this concept has affected in facing the urban problematic issues for the existing areas in the heritage-based cities. It also resulted in mixed vacuums for the heritage-based cities. These vacuums are represented in material and realistic ones on one side and electronic, imaginative and virtual and hypothetical ones on the other.

2. Research Problematic Issues:-

The fertility of any concept is represented in its ability of generating the greatest amount of research problematic issues. The concept which we are discussing now is rich in a number of problematic issues that are summarized as follows:-

- What's the expected effect of the information technologies & digital revolution on the prevailing fundamentals in the architecture and structure of the heritage-based cities?
- Digital revolution opens new possibilities and capabilities for urban architectural and structural systems and types that arouse strong stresses to change our heritage-based cities architecturally as well as structurally. So, it's important to consider the similar digital places for our heritage-based cities beside the material places.
- The material virtual vacuums may weaken the vacuums of the material and traditional one.
- The information structure and the heritage-based digital cities as well as their development are considered the main axis for formulating and drawing the strategic perspective and the future structural and architectural agenda for the heritage-based cities in our contemporary fact.
- The essential nature of the intellectual concept of the information and digital revolution as well as the fictional virtual vacuum, and the effect of this concept on the architecture and structure of the heritage-based cities currently and in the future eras.
- The extent of clarity of the architectural and structural perspective in the heritage-based cities for dealing with the technologies and techniques of information as well as the digital revolution in different places and times.
- The architecture and structure of the heritage-based cities between unchangeability and changeability with time under the model of changeability and the increase of knowledge for the information revolution as well as the conversion into the fictional virtual vacuum, in addition to their relation with the conceptual thought of customs, traditions and values.
- Is it possible to expect and predict our future heritage-based cities through the cosmetic perspective of the two concepts of digital and information revolutions and their effect on shaping buildings architecturally?
- The extent of accepting information revolution in the heritage-based cities that resulted from the cultural, architectural and structural heritage in the previous eras.
- Is it possible to study the heritage cities depending on the previous perspective through the horizontal vision and perspective of the human's eye in the material vacuum only in the age of information communication as well as the virtual vacuum, that enable us to visit the heritage-based cities and recognize their features on the Internet?
- The development of the heritage city lead to the loss of its fundamental identity and it disappeared some of its items and distinguished activities as a result of the digital revolution and the techniques of the technology.

3. Research hypotheses:-

- The application of the information technologies and digital revolution in the heritage-based cities to be converted into heritage-based digital cities, this in turn increases their efficiency, promotes their creativity, increases their economy and their tourist as well as cultural movement.
- Through recognition and methodological understanding of the digital revolution, we can know the trends of the future conversions and developments for the heritage-based cities.
- Digital revolution will lead to changes in the functions, activities and material vacuums for our heritage-based cities, and this in turn may lead to the loss of their identity and their distinguished character. Also, this revolution will affect through modern concepts like virtual vacuum on the methodology of development and conservation of the heritage-based cities.
- Digital revolution will change the conceptual thought of tourism in the heritage-based cities and will affect these cities in an economic and tourist way; as tours and visits to its will be through their virtual not material vacuum.
- Digital revolution will lead to the secretion and creation of new methods for developing the societies in general and the heritage-based cities in particular. These methods will be different from the traditional ways of development that were associated with the material place and vacuum.
- The importance of innovation and creation's effect has become clear as a result of the information and digital revolutions for the formulation of the buildings in the heritage-based cities that are built structurally and architecturally in our contemporary age in order to be developed and to conserve their identity and distinguished character.
- The structure and architecture of the heritage-based cities is the mirror of the creation and digital innovations and the reflection of cultures, behaviors and social & economic aspects…. etc. that controls the extent of their conformity with the information and digital revolution.
- The importance of information and digital revolution in the structure and architecture of the heritage-based cities has become clear as well as the importance of interaction between architecture, structure, creation & innovation AND the technical & cognitive thoughts when adopting new or modern ideas for conserving or improving the heritage-based cities and formulating them as digital, cosmetic and heritage-based cities in the future.
- Clarity of the theory of the digital, cosmetic and heritage-based city as an applied theory and its pursuit in our contemporary fact for facing and observing changes and developments that took place with their negative and positive sides.
- As a result of the digital revolution and information technology, there has been a main role for the theory of the heritage-based cities between the heritage-based concept and the cosmetic and virtual one in order to be able to meet the contemporary needs for the reformulation of the mental vision or picture of the heritage-based city.
- Through the air photographs, there will be a new formulation for drawing the main relation between masses and vacuums of the heritage-based cities and for following up the activities in these cities.
- The importance of the architectural and structural critical perspective for the heritage-based cities for reaching intellectual interaction and communication as well as linking creation and innovation with the mental picture of the heritage-based city with both concepts; the digital cosmetic virtual and material, in addition to activating theories of formulating these cities in the future architecturally and structurally.
- The modern air photograph showed the shaping features of the heritage-based cities with different concepts from the horizontal view.

4. Research Objective:-

The main objective of the research is trying to reach the impressionist range of the role of creativity and innovation, architectural and technological rework the mental image of the cities heritage by dealing with them, whether conservative or improvement or reformulation to revive the list and as a tool to document the current status of the image of mental perceived online and face and monitor the changes and developments that have affected them across different eras. Well acquainted with the features and dealing with the tribulations and problems existing creative and innovative look. Giving the new non-traditional solutions by activating the upper view for the aerial image to take advantage of drafting priorities and concerns of the order of Architecture and Urbanism of the cities heritage. As well as the possibility to convert the city into a global city. And implications for the extent of co splay on the bases of the ruling theories formed to comply with the technological and technical development in our contemporary without compromising the value of heritage. There are subsidiary objectives for the main objective that help in achieving it. These are as follows:-

- Clarifying the concept of the digital cities and the digital heritage-based cities in light of the digital and information revolution, and this concept is different from the traditional heritage-based cities.
- A new shape formulation for the concept of the tourist journey in the heritage-based cities at the age of digital information; as this journey depends on information systems, communication technology, knowledge in the virtual vacuum on the Internet and artificial intelligence.
- Measuring the reality and the extent of the heritage-based cities' effect by the digital revolution and their information elements.

- The way of reformulating the architecture and structure of the heritage-based cities and the nature of their design fundamentals for overcoming problems and crises and for meeting the future needs at the age of information and digital revolution.
- Linking both digital revolution and information technology with the heritage-based cities and their associated architectural and structural applications that lead to the drawing and shaping the features of the digital, cosmetic and heritage-based cities as well as the effective extent of their conceptual change in our contemporary fact.
- The effect of the technological development and the digital & information revolution on the formulation of the architecture and structure of the heritage-based cities as well as an expected future perspective through the virtual and cosmetic concept of the vacuums.
- The way of progress, improvement and conservation of the upper perspective of the heritage-based cities (on the Internet), in addition to drawing a map showing their features and shapes and as a fundamental element to activate the economic and tourist movement.

5. Research Methodology:-

The research will adopt a theoretical inductive methodology with benefitting with all theoretical tools and the available applied evidences. The study is divided into two parts; the first part discusses the theoretical frame that is related to the digital revolution, information technologies, the associated computer technological programs, the concept and nature of the heritage-based cities and the fictional frames that emerge from the effect of the digital revolution on the activities of the heritage-based cities as well as the conversions in their activities and their prevailing concepts. The second part shows the problematic issues of the existing heritage-based cities like the historical Cairo and the way of converting it into digital heritage-based cities as well as activation of their tourist and economic movement by changing the style of its promotion to be electronic to benefit from the digital revolution.

6. Concept of Digital Revolution:-

Digital revolution means the development in the technology and methods of communication by omitting borders on the Internet to ensure that the information will reach at the time of its occurrence, whether it is in the form of words, pictures or voices. This revolution made it's possible to control, define or prevent information. This revolution is different in form and shape from the rest revolutions; as it's able to omit all borders and distances and its link with the societies that are represented in information. The expected future effects of this revolution on the heritage-based cities are represented in the conversion of these cities into an electronic, digital and heritage-based city in a way that contributes in solving all the problems in the different life, architectural and structural aspects. (15,19)

7. Architecture & Structure of the Digital Electronic City:-

There are a number of names that used for the cities in light of the digital revolution; such as smart city, information city, digital city and electronic city…. Etc. These cities with their communication links are like spider network for accomplishing the functions for their citizens in the different life fields. In these cities, there are education, trade and electronic government to overcome most problems of the existing services; as information is exchanged through their electronic, virtual and invisible vacuum. There are many levels; the first is the information level (that contains restaurants, banks, schools…etc.), the second level is a surface that shows the architectural two- or three- dimensional environment (by it we can define a spot inside the realistic city and reach it) and the third level is the level of social interactions amongst individuals (through cultural tours on the Internet) (15,19).

8. Nature of the Heritage-based Information City:-

It's the heritage-based city that uses the information technologies in controlling its parts and forming its functions, the results of which are life systems that are different in form, function and construction. It may contain many and new functions. It may omit some activities, vacuums and traditional knowledge that are built on them as they become unnecessary. The degree of information depends on the amount of electronic control in their performance, elements and administrative systems. They contain a foundation that consists of communication means and their interlocking networks "the Internet" as well as the social interaction of their individuals inside their virtual vacuum that is not limited to a place and can accommodate the all individuals without limits. The change of their land usages that happens in the electronic vacuum in distant have destroyed the concept of the centrality of the services site. Work and everything happen electronically (19).

9. Concept of Digital, Heritage-Based City:-

In order to recognize this concept, we put many questions: is this digital city an independent one or a part of the heritage-based city; could this city be seen through formats, diagrams and constructions related to the heritage-based city or it has an effect on the city whose location cannot be seen on it. So, the digital heritage – based city can be defined as real, imaginative city. It is a real for being material and heritage-based city; whereas it is invisible and imaginative for being a digital city. Its digital elements are intangible, cannot be represented materially. Its means of transportation are consisted of internet networks, its electronic communications are considered ‘city of ‘gathering between material spaces and universal, virtual and imaginary spaces with respect to

its electronic spaces. Its networks are gathering between automatic movement in the heritage-based city and electronic, traffic movement that permits communication and moving freely. We can walk in its paths and spaces; practice the different vital activities such as shopping, education, entertainment, bank transactions…etc. it is possible to enter it through its websites that represent entry points for internet users.

The digital, heritage-based city combines between the heritage-based, real space and the digital, imaginative space (place of residence, work…etc); where its function is transformed from being a real, material space to a virtual space supplementary to its real and factual space(12,13). Functions of the digital, heritage-based city are similar relatively to that of the material, heritage-based city; but it changed most of the material functions into electronic ones as a result of a digital, information revolution in order to cope with the modern age. However, these changes can affect on its urban and architectural feature as most of its activities and social life are related with its material feature; which is the secret behind its unique character.

10. Heritage-Based City with respect to Electronic, Information Life Cycle:-

Problem of the digital, information revolution and its application inside the heritage-based city is considered familiar and old one. It is the relationship between the present lifestyle and heritage-based cities; resulting from urban and architectural civilizations for constructing our heritage-based cities that are considered as a visible record of different communities leading to diversified urban and architectural lifestyles.

Information technology represents the electronic means for communication and information networks systems inside the heritage-based city currently. The electronic life represents a lifestyle, and its effect on the urbanization and architecture of heritage-based cities has become clear; modifying its urban and architectural features. Consequently, its spaces' functions have been changed, new functions have been innovated, existing functions have been cancelled, and buildings with several functions have appeared … etc, as above mentioned. This requires innovative solutions radically or additionally for maintaining the heritage-based city's effectiveness; consistent with the modern technology and digital revolution. Electronic life is considered a lifestyle, whereas information life is an urban and architectural lifestyle affected by the digital revolution as well as the transformation to imaginative and virtual space instead of the factual and material space; as above mentioned (5,19).

11. Technology's Effect on Development of Heritage-based City generally:-

With a long-term technological development, the heritage-based cities do not allow having large-scale changes; but these changes appeared in technological cities such as scientific city **"Sokoba".** However, expected effects of information systems can appear in our heritage-based cities through three points or changes starting from organizational transformations, urban changes or changes in its administrative measures. The organizational transformations depend on the software and electronic mail for coordination between persons and decision-making, urban changes represented in performance methods and concepts as there is a free exchange of high-speed information; expanding the concept of universal and virtual space instead of the material space for dealings, whereas the administrative changes are slow relatively with respect to the problems; particularly those related to the lands uses(3,19). As shown in Figure.-1.



Fig.1. Technolo _gy's Effect on Development of Heritage-based City. source:(internet)

12. Digital revolution and digital forms:-

The digital revolution excretes the digital forms which can be listed under the concept of formative

architecture theories that correspond with the age requirements. Their designs depend on digital and computer technology (which emerged as a result for creativity and innovation concerning software continuing progress) (7,21). In the digital environment, you can early see the form and make a movement in its inner and outer space before executing it in the actual environment. Therefore we follow the abstract thinking while designing the abstract form, getting inspiration from material components, solids which can be created through three-dimensional programs or imitating nature or traditional building in the historical cities… etc. The form is to be composed according to several sides, first from the level of abstraction, then modifications that describe its form and concepts and interpret it expressing its symbolism, then analyzing its structure according to relations to see distinctive forms which have unrealistic characteristics, expressions and formal changes, unexpected cross forms, closed structures, resembles force field, abstract or biological buildings…etc. Form structure is the thing that mostly addresses the architect and assessment planner to extract its characteristics (21).

Contemplating the architecture and construction of our historical cities, we find blending and mingling in shaping the modern buildings between the historical buildings with their distinctive feature and buildings of the digital revolution which leads to the loss of the distinctive identity and features of our historical cities concerning architecture and construction (*).

13. Techniques Accompanied to Digital, Information Revolution; As Well As Affected on Architecture and Urbanization of Heritage-Based Cities to be Changed into Digital Heritage-Based Ones:-

These techniques include drawing sketches programs "Cad", models design programs such as "Solid Modeling", "Auto Cad", "3D Max as well as three dimensional models programs. In addition to the programs that help the design thought such as "Archi Cad", "Scan 2 Cad", "Imag 2 Cad", "Archi Graf", and "Architectural Design". There are also digital tools in Geographical Information Systems such as "Magic Book", "GIS" and other programs resembling the heritage-based cities by changing the drawings into factual ones (14). As shown in Figure-2.

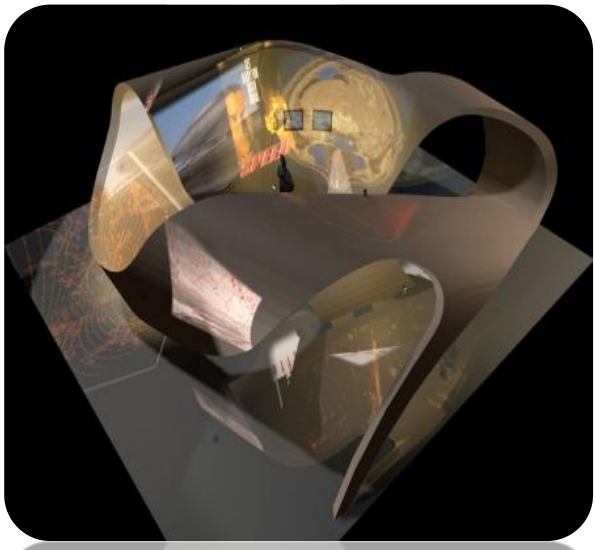

Fig.2. Techniques Accompanied to Digital, Information Revolution. source:(internet)

14. Cave system techniques in virtual reality applications of the historical digital city (When improved or reshaped:-

Virtual reality technology is one of the most important techniques of digital revolution in the field of architecture and construction of historical cities as it participates in cognition and demonstration of its materialistic production in its imaginative virtual reality to the visitor through the web as mentioned before. Cave system is considered a technique which affects cognitive characteristics of the realized space. To demonstrate the cognitive effect of the technological developments in virtual reality, Cave system surpasses the computer screen in cognition of vacancy and space. It changes the view of the concept of cognition and feeling of vacancy in our traditional historical cities. Depending on the view of virtual reality instead of the horizontal view of the person's eye walking towards it or the upper horizontal view of aerial photos of satellites. The cognitive view of space in the virtual reality became the core of studies. (As a result for information and digital revolution's techniques and software technology that accompanies it which helps to achieve that). Through this computer virtual world, we can visit it and wander through its ranges and spaces through connected safe environments. To give a view about these cities either their parts that are perished in the process of time or their current concrete reality or an imaginative view of what they will look like in the future and coexist with them through designs in their virtual reality(8,11,22).

We can watch ideas different from our past view of this historical cities as the formal characteristics are the connecting point between the mass and space as it grants it the value and soul and helps it to be realized and comprehended. This is what leads to difference of view and diversity of virtual space rather than the concrete space of the historical cities. The virtual characteristics of space turns the cognition into a dynamic channel for the viewer on the web. The perspective view of the channel's construction can be divided and provide the chance and

(*) Criticism by Researcher

time for observation and contemplation. To encourage the viewer to continue in the channel, the relation between mass and space and the dynamic view give altered types of interaction either by spatial containment or blending while maintaining the identity and feature asserting on the sensory characteristics such as suspense, excitement and grapping attention (11).

Conclusion: The usage of Cave System is considered an effective technique to study the historical cities specially when improved or reshaped or when resolving their current problems. As it gives a distinctive view to study their spatial form and their distinctive features. It presents a more complete picture of their visual image in their virtual reality. It's important to use it in the architectural educational process in our universities. (*)

15. Problems facing the Heritage-Based Cities to be transformed into Digital and Heritage-Based Ones:-

Several functions assisting the heritage-based city and emphasizing its unique feature, as well as the digital cities are considered one of the most important problems confronted as they change the daily life activities of the heritage-based city; losing its unique identity and feature (12). for example, Fatimid Cairo is characterized by its handicrafts and districts that are called with these handicrafts such as Al Khiyyamia, El Magharblin, El Nahaseen, Khan Al Khalili and other unique, heritage-based areas (12,17). In addition to different elements of infrastructure for both digital and heritage-based city; thus further attention and care must be directed to both material and universal, virtual structure for relating spaces of the factual city to virtual spaces of the universal city. There are also interferences between the activities affecting on the urban and architectural feature of heritage-based city.

Our belief that there is no need of information systems application inside the heritage-based cities because its application is characterized by sudden and quick changes, that the infrastructure of communications and information is incomplete in spite of great trials have been made by the heritage-based cities to cope with the latest developments, that there is no specialist technical personnel and that the administrative systems are insufficient. The heritage-based city characterized by its services anciently is the same present heritage-based city that must provide 21st century services uniquely in order to cope with the digital information revolution (4,13,20).

16. Information Digital Revolution and Innovative Problem in Reformulation and Recognition of Heritage-based Cities' Features:-

It is a future position vision reformulated according to assumptions and expectations of changes in urbanization and architecture of the heritage-based cities; depending on digital revolution's effect on it. In the 20th century, designers have formulated imaginative ideas for the anticipated new cities; and nothing of these ideas is accomplished. Due to digital revolution and information technology along with their changes in lifestyles, some of the buildings have become deficient and disappeared subsequently as an outcome of the information technology's effect on the essential reformulation of its architectural programs. Electronic life is dominating the residential buildings with its activities and spaces. Persons have met in the universal and virtual space instead of living and reception rooms that have been cancelled currently. Our buildings lose the social and family life between relatives, whereas electronic dealing inside the administrative building results in disappearance or shrinking of halls where dealings with audience in banks are conducted, while stores that distinguished our heritage-based cities with its shapes and passages have been transformed to warehouses as shopping has increased across the internet inside the virtual space; including all activities. This change results in consolidated buildings including all activities "Arch I gram". (It is a development of compounds that appeared in the Islamic architecture during The Mamluk Age when a group of Sultan Barquq, Sultan Qalawun and Sultan Al Ghuri. These complexes contain a mosque, hospital, (Bimaristan), Khan (hotel), and Al Wekalah (shopping center and warehouses), etc). It is expected that some schools shall be disappeared and there shall be distance education centers.

An important idea in respect of the heritage-based cities is emphasized concerning both the place of residence and work which are included in one building; the workshop is at the bottom of the craftsman's building, and persons are working from their homes nowadays. Thus, the function of residential place has been changed; as it includes an office where person can practice his daily activity (3,19).

Digital revolution has resulted in mechanisms and tools for designing in computer; entering architectural and intellectual trends reflected on the design maintenance and affected on the decision-making. There is no longer human meter and rations, or static shapes. Instead, digital genes and standard liberalization have appeared. Moreover, a molluskan architecture has started to be shaped without any limits, and used in all destinations. A machine has become similar to the place of residence; but not the vice versa (15).

17. Applied study of digital revolution's techniques on Cairo historical city:-

We review this through the concept of upper photo of historical cities in their virtual and actual worlds and information sent from their upper aerial photo through satellites and their effect on changing the idea taken by their viewer and visitor about them. As shown in Figure-3.

17.1 Concept of upper photo:-

It means the view which represent the way of visitor's cognition in its virtual reality on the web for the visual image of the historical city being represented in its environmental characteristics concerning architecture and construction and shows its texture and formations. In the past, it was studied through making an academic miniature model.

17.2 The upper concept of Cairo historical city:-

Through the usage of four-dimensional programs and studying of the city in its virtual and actual space, we find the concept is developed through different periods beginning from the period of Fat-h (victory) to its current state. The city has been governed in shape and form by a group of ruling legal regulations derived from The Holy **Quran and Sunnah** which shaped all the different aspects of life (political, social…etc.) and excreted a lot of habits, traditions and values. By the entrance of Islam in the city, new types of constructions has appeared which have not been there before such as mosques, schools, agencies and mental hospitals which had distinctive features which can be seen apparently in its horizontal photo in its virtual world.

This photo which is distinguished by its minarets, formations and direction to Quibla (Kaaba at Mecca) to achieve three architectural principles verticality, horizontality (All are directed horizontally to the Quibla), centralism (The Kaaba is the center of the universe, we see its courtyard as a center for the mosque and the yard as a center for the Kaaba).



Fig.3. Applied study of digital revolution's techniques on Cairo historical city source:(internet)

- In the past, The historical city extended horizontally (but now vertically) and is distinguished by its minarets which are located above the mosques to perform Azan (the call to prayer) to gather the Ummah (Islamic Nation) in every situation.
- The horizontal photo shows the historical city as one unit. It shows its organic striation and its compact textures, the lane as a sketchy module unit which is shaped accurately. The town is the main artery of movement for the city on which are located the essential buildings such as the mosque, the ruler's palace, areas…etc. it was the core of trade and social life. In the horizontal photo in the virtual space, appear the route of Moez and Gamaleya which shaped the two main routes of the Fatimid Cairo which connect its north to its west and what are the changes that happened to them through different periods.
- It also shows the compact texture of the city and its mass porosity that consists of masses gathered around yards. Its twisted routes and distinctive areas are diverse and different in shapes and functions.
- We find the diversity of the parts of the city. We see The Old Cairo, Fostat, and Al-Ketaa', Moez Street, Gamalia Street…etc, each of them has its own distinctive identity for its architectural formations and features.
- The visitor on the web can recognize the historical buildings' features. He can find that the buildings are depending on the yards as an essential component for internal directing. The city is distinguished by the defensive building and their gates and huge walls. We see El-Mtwalli Gate, Bab zewila where the gates are chosen to be put in strategic positions to provide monitoring and securing the city. As for the castles, we see

the castle of “Mohammed Ali” which occupies a location in a high place, overlooks Cairo, surrounded by a huge wall and towers and contains the essential buildings which needs to be secured

- It assures the position of the mosque and its importance and control over the old city. The choice of its position and its relation with the main towns of the city. The apparent great relation between the administrative and religious routes between the routes of Al-Gamaleya and Al-Moez le-Deen-Ellah, and how the administrative center has been transferred from Al-Moez to Al-Gamaleya (6,14,16).
- The lane as a neighborhood unit controlled and distinguished by one profession, such as “ Khayamiah, moezbileen, Attareen (spice dealers), Nahaseen (coppersmiths)…etc.”. The lanes with one profession have been named after the profession, where the chief of this profession lives next to the inferior worker in it, presenting a great model of executing social equality and the disappearing of class distinction.
- In our current state, we see the appearance of towers and the huge heights which make the historical city lose its most important distinctive features.
- Geographical and technological programs help you to realize the old city of Cairo with its special nature, development and extension, etc… you may even realize it within suburbia, as the prosperity of Cairo has extended to reach to the Tenth of Ramadan form side, and October 6th City from the other side, in order to solve the traffic jam and make it to be flowing.

17.3 the mental image of the heritage-base city "Cairo" during the era of the digital revolution technology, by a horizontal perspective from satellites:-

The mental image standards and characteristics are determined according to the clarity of the aerial horizontal provided image in the virtual void, as the more clarity it is, the more richness, diversity and revealed details it is. This image is realized by many standards, starting with the totalitarian standard and ending with the detailed standard, in which we can realize its borders and paths of the heritage-base city. We can see this image only by its aerial image in the virtual void. We may classify its vision to night vision or day vision, as Cairo at night differs from the daytime. So we care about the light and the night vision of the heritage-base city to highlight the distinctive heritage places.

Study of the mental image aims to recognize how to see the city over the internet in its virtual reality, and emphasizes the factors and intermediate stimulants, and works on avoiding confusion elements which is effected on the cognitive image and its lack of clarity to reach to a good cognitive process of the city components, starting from its separated elements then collect them in an integrate structure, which is effective on its culture and makes it ready to be moved from the traditional through the digital revolution technology, with keeping its Identity and its distinctive feature(16).

- Emphasizing on the Media Influence on the mental image of the city according to two forms: firstly: the effect of image stability and not to change it which means that there is no need to change the information and to keep it without any change in the current image, Secondly: change the mental image when it's proved that it's different from the image which will be possessed in the future, which indicates that the current mental image is incomplete and it is supposed to be remodeled or reordered.
- We may notice on the mental image of the heritage-base Cairo over the internet, that it's not able to highlight the heritage-base city with its basic elements, and that it misses some of its features, because of the change of its activities or its functions. It lost its distinctive features, as a result of the Skyscrapers which are built recently within its biosphere. According to that some of its mosques minarets have been disappeared after being noticeable from everywhere.
- The most important characteristic of the city of Cairo is its tight nature, its tortuous paths, and its squares "areas" especially in front of its mosques or Governor's Palace, and its different verges and Slicers. This leads to containment, suspense, harmony and interdependence between its facades and heritage corridors, playing a symphony which was produced by the traditions, habits, values and the ruling legitimacy controls. The design of roofs of the old building which was decorated by gardens and flowers and the connections between its paths, leads to creativity in its formation. We can see that clearly in the El Sultan Hassan Mosque, as the district shows as a unit within the main formation, squares and the distinctive night light of the heritage-base city.
- the aerial horizontal image in the virtual reality over the internet highlights the tourist attractions and heritage areas such as; mosques, features, and distinctive buildings, etc.... also it highlights tourist attractions to visit it a concurrent visit within its physical reality after visiting it a asynchronous visit in its virtual reality, to stimulate realism tourism.
- Disharmony between the heritage and contemporary characters is shown clearly. As the visit in the virtual reality in the Cairo suburbia shows the disinterest of the movement paths, floors or paths. The old asphalt street of Cairo disappears with its main features, as the main feature of the city. The spread of bridges leads to distort its view.
- The view of the skyscrapers next to its heritage building misses this building its importance.

Summary: we should use geographical three-dimensional and Four-dimensional programs, and other accompanied technological software to the digital revolution, as above mentioned, in order to interact and edit the mental image of the heritage-base Cairo. As it's a production of the old image stored in the memory, which is updated with the increase of knowledge and change model. This is necessary to focus on it, to provide the mental

image of the city according to two dimensions; the open image(in the imaginary virtual void, which makes the visitor over internet to watch it and to continue its watching), the complete image(which reveals the elements of the heritage-base city without stirring, describing its suspense elements).
the aerial image of the heritage-base city Cairo, gives indications of its identity, features, function and the incident activities. It's like a comprehensive translation of the feature elements of the city on its virtual void and physical void. Its contemporary realization, indicates the changes and developments of the positives and negatives, starting from the realization of traditional society then the readiness of scurrying, scurrying then the movement towards the maturity in the digital revolution with keeping its identity and distinctive features.

18. Maintenance of the heritage-based cities during the age of digital and information revolution:-

Information systems inside the heritage-based cities are not considered as information storage only; but also as information generator. The heritage-based cities keep its information documentation and registration "past, present, reconsidering how to be used currently". This can be achieved through steps including identification, documentation, and registration, classification, putting the priorities and regulations and implementation by using the aforementioned Geographical Information Systems (18). The basic phases of these information techniques focus on maintaining the heritage-based cities along with its historical areas by establishing a data base; starting from storage and recovery from different sources, then processing and analyzing these data. Subsequently, maps and movies shall be displayed; using the digital technology for documentation and observation, processing the aerial photographs to draw out the maps, establishing the specialist maps, recognizing advantages and disadvantages of activities and services provided, And determination of changes in the heritage-based cities over the ages; ignoring the negative effects on it. These cities are considered a reservoir of cultural value, and an explanatory lens for societies' civilization and history (17).

Technique of the virtual reality is one of the most important applications. The heritage-based cities can be studied from two aspects; potentials of the virtual reality (three dimensional embodiment, resemblance of the existing environment, movement and its effectiveness on improvement process, maintenance and reformulation of its concept for displaying an artificial, three dimensional form representing it). We can imagine the visitors as they were wandering in the virtual reality, exchanging the points of view and ideas through "Virtue Conference" inside the virtual universe having a unique technique; including an infinite video without a specified time, path or scenario displayed for the wishers from different aspects inside this virtual reality; analyzing its spaces and wandering through these spaces. Technique of three-dimensional resemblance tends to entry of the heritage-based data and ideas into programs interested in finding the shape; having movement techniques and taking its own information from the satellites. This technique can be analyzed, its advantages can be recognized and its diversified methods can be coordinated inside its system (22).

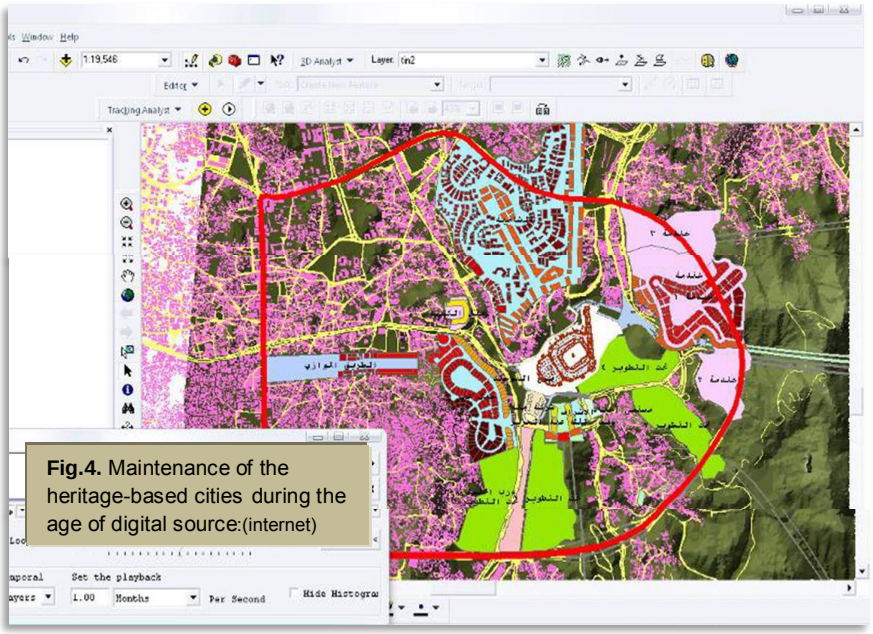

Fig.4. Maintenance of the heritage-based cities during the age of digital source:(internet)

Digital and heritage-based city is prepared by providing services and information of which persons are in need, embodying its environment with its different levels; starting from the information level depended on technological programs to Geographical Information Systems "GIS", drawing out three and four dimensional maps, architectural and urban level, resembling the built-in environment through three dimensional modeling programs such as "3D Max" and finally interaction level inside digital three or four dimensional space as a result of technological and information techniques. Touristic and digital trips to the heritage-based city have been organized through the websites. Tourist guide shall start the trip across the "WEB"; as above mentioned, explaining and exciting the virtual- space visitors to pay a visit in its material and realistic space as well (22). In order to revive marketing process, it may link its digital journey with visiting shops via internet to see trade workshops and their products, to buy from websites for activating the economic and commercial movement remotely. By doing this, every shop will have, on its heritage-based environment, a part on its virtual environment. Announcing the spread of the economic, touristic, commercial and heritage-based city either on its material fact or on its virtual environment to become a successful, informative, digital, heritage-based city at all its levels (12,22). As shown in Figure-4.

trying to reach at the touristic journey such as the idea of the book of “Magic Book” which have the same characteristics of the ordinary journey and contains colored photos that can be read. If we wear his special glasses, it makes characters of his pages move in a three-dimensional movement and by pressing on the glasses' button, we find ourselves enter in the story, standing before its heroes in actions place to help and warn them from dangers (13).



Fig.5. The digital and informative revolution and aerial photographs for keeping heritage-based source:(internet)

19. The digital and informative revolution and aerial photographs for keeping heritage-based and archeological cities:-

Registration, documentation, monitoring information and matters that face coastal and archeological places such as storms, streams and waves which may lead to rising sea level on the archeological places in the Egyptian North Coast. This problem faces coastal and archeological areas which are located under nearly a meter from the sea level. These archeological and heritage-based cities which are submerged under deep water along the shores which are opposite to the archeological cities. The best example for that is Bey Citadel in Alexandria as we see remains of minaret appear in the surface but ruins of the Ptolemaic Royal Quarter are submerged under the sea. As shown in Figure-5

Thus, we use the digital and informative technology for measuring the rate of sea level rising as it reflects and monitors the expected dangers and problems that may face our archeological cities located at our shores in order to take necessary procedures for maintaining the rest archeological sites in these cities. These places are considered creative and intellectual experiment which shall be maintained through a practical and creative vision for activating before the disaster struck.

20. A future vision for turning heritage-based city into informative, digital and heritage-based city without prejudice to its distinctive character:-

The design of the digital and heritage-based city on the basis of Compatibility and convergence between its physical and presumptive based on its physical and interstitial existence not on its imaginative existence within the cosmic space so the city can meet its contemporary needs and keeping its originality, style and distinctive character based on the latest technical developments for reviewers via internet through trilogy and bilateral and four-dimensional maps, as in "Digital Kyoto" City, encouraging the cultural interaction in its digital entity by providing digital means of transport for transferring its visitors during their touristic journeys via internet with a tourist guide through " chat" in the "web" as mentioned before in addition to embodying its physical space and it emulation in the virtual reality, classifying its informative and community service and chat rooms as well as reviewing its architectural and urban character, its historical and cultural heritage as available digital services (17).

The features and characteristics of heritage-based cities will change in the next years as a result of informative revolution and it may have a new face. The best example for that is the formative feature of Mecca city as we see developing projects in wide yards like Jabal Omar Project, Jabal Khandma, Jabal Al Shamia…, etc. As through technology and geographic informative technologies, they achieve innovative developments by studying urban expanding, deletion and addition to this heritage-based cities and by studying its superstructure image through applying the plan on city's aerial photo in order to know to some extent it appropriate with the urban and architectural feature of the heritage-based city as well as its compatibility and interaction with it. The geographic information system is considered a good tool for following up changing of heritage- based cities along years through documentation, linking change with the age which leads to this development (1).

21. A future vision for the essence of heritage- based city after digital revolution :-

The age of informative and digital revolution as well as technological techniques that came as a result for it are considered a central element for intellectual creativity and innovation. Thus, we have to pose a question what is the essence of heritage- based cities after digital revolution and whether it will be only heritage- based cities or digital heritage- based city or digital heritage- based city has a future vision. This heritage- based city reflects contemporary era possibilities as well as past possibilities to continue in interacting and to tell stories of the different eras.

Do these cities have innovative discussion in addition to its compatibility with imaginative designs in its virtual world asserting its physical and virtual world as a mixed and integrated world? Whether it became one formation made by the digital revolution or no, however; heritage- based cities keep its identity, culture and the distinctive character for it and its societies assuring value of heritage- based cities? This question may be a subject of another future research study.

For designing and analyzing digital environment, getting the structure and style of heritage- based cities out of its physical feature, supporting untraditional creative and innovative trends for developing and improving it, compatibility with our contemporary reality and future. So, we have to think about the essence of future heritage-based cities without dividing from learning revolution as it does not need years to reach to us in order to turn into a global village and whether its authentic constants and inherited behaviors will melt or will stop as a deterrent dam without interaction. The concept of "Utopia", today, in the imaginative utopia no longer exists as most of dreams and imaginations of factual and realistic cities. The virtual world became as "a world box", a reality embodied through networks. Transferring heritage-based cities to future digital cities to become "imaginative cities" without obliterating its identity.

There are some theories for resolving theoretical problems of theoretical cities represented in theory of isolation, incorporation, challenge, and adaptation, etc. We have introduced concepts for physical, symbolic and spare change whether in a broader range or deeper popular heritage by innovating and renewing urban and architectural formations of heritage-based cities whether by diligence in innovative architecture or depending on inheritance and architectural heritage with its pros and cons in our heritage-based cities like modernity, innovation, originality, contemporary, deconstruction and savagery (22). Currently, most of our heritage-based cities especially its old central region plagued by mixing heritage and modernity by a chaotic manner. There are many factors affect efficiency of its changes positively or negatively, its anticipation as following it became easy (with the geographic information systems which shows interest in studying fourth dimension in changes which is inserting time factor). Consequently, now there is no a clear perception for its future urban characteristics but by using geographic systems and following its analytic and practical approach, we can put a vision for its characteristics (1). After reviewing techniques and informative technology that accompanied the digital revolution, its architecture and its urbanization as a future critical vision for formulating architecture and urbanization of our heritage-based cities.

We found that, in our contemporary reality, we stood between two a two-fold for the Inevitability between subordination for trends and ideas resulting from this digital revolution without being deep or aware or returning to traditionalism, its characteristics in our heritage-based cities and using it effectively for reforming our lost identity architecturally and urbanely for our built heritage-based environment while preserving its graphical and dogmatic reference that are compatible with our customs, traditions, spirituality and its symbolism, exceeding its physical limits and discovering its lost relation between its physical and virtual emptiness without losing our identity in the age of digital revolution which is more deadly than political wars and revolutions for reaching at a future inception as a new formation of our heritage-based environment through our heritage-based, traditional, dogmatic reference(1).

Meanwhile, the West is creative in its intellectual frame, digital revolution is creative in its intellectual frame, and heritage-based traditionalism is creative in its intellectual frame that we have to abide by, as we cannot be creative in the physical frame or empty virtual frame or rational frame, etc. without our unified dogmatic reference that governs and assures wellness and safety of urban, architectural, innovative and creative work. This reference is important such as necessity of purification before prayers as it is a condition for prayer validity condition but its acceptance has other criteria that lead to creativity (16).

22. Lowering prices of visiting for activating touristic movement in the digital heritage-based cities:-

How and the manner of meeting with others face to face will be changed as whenever there is a communication with the other in the virtual emptiness, he can deal with it. Thus, patterns, regarding using spaces built for reception and meeting may fade away. Thus, in order to have a physical reality in the physical built environment, places shall be very desirable. (In the past, attendance was mean presence physically but in the age of digital revolution means that you are interacting and communicating in the virtual space). There is a suitable place for meeting whether at home or in the office, etc. Now, attendance became concurrent (person is going to visit other person) or asynchronous (by communicating with others via means of communication). As shown in Figure-6.

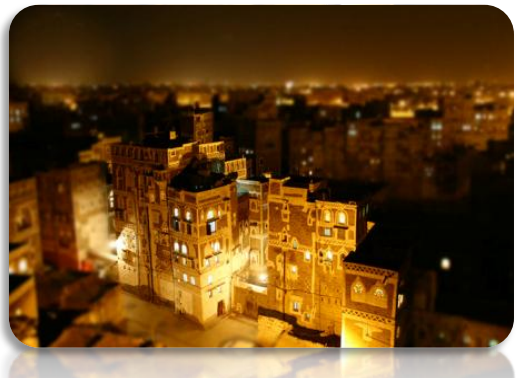

Fig.6. Lowering prices of visiting for activating touristic movement in the digital heritage- based cities
source:(internet)

In the past, in the heritage-based cities, presence was for tourism and for knowing it urbanely and architecturally then it changes and turns into asynchronous presence by visiting it through its virtual world. This leads us to change conceptual intellect of tourism and marketing in heritage-based cities and it has to become digital heritage-based cities for activating the economic and touristic movement. As rules and criteria that governing Convergence and cohesion in the old heritage-based cities like walking distances and means of transport, etc are not sufficient for achieving its future aspirations in the light of digital revolution and information technology and this is now the problem of heritage-based cities (9).

23. Summary:-

The architecture and urban formation of heritage-based cities along years has changed as a result of affecting by different techniques, information technology and digital revolution that reflected clearly in the formulation of structural product of heritage-based cities. The research study has showed the importance of studying the development and compatibility of digital revolution, its technical result and prevailing conceptual thought in our heritage-based cities urbanely and architecturally. Activities and usages of lands, rates, places of services, and reducing paths offers have changed; turning the physical emptiness into imaginative virtual emptiness. Every heritage-based city has its mixed physical and virtual emptiness and limits has been faded away, the matter that leads to changing architectural and urbanely features of these cities.

- Information are considered basic element for taking decisions, formulating strategies of the heritage-based cities and activating its touristic movement.
- Necessity of realizing the great impact of digital, technical and informative revolution, model of increasing knowledge along years and its effect on formation of these cities and its urban activities, changing its prevailing systems and adopting the concept of virtual and universal emptiness for exploiting its advantages.
- Using information technology contributes in improving performance efficiency of heritage- based cities, effectiveness of preparing its policies and strategies for stimulating process of development and improvement while keeping and taking advantage of them.
- the expected radical change which is expected to happen in activities of heritage-based cities and their functional spaces may lead to cancelling some of the current spaces or may require repurposing them, the matter which requires change in formulating urban, architectural and administrative programs of heritage-based cities thus it is important to solve this problem so our heritage-based cities do not lose its distinctive character and identity.
- Searching for untraditional solutions for the problem of architecture and urbanization of the heritage-based cities and its interaction with informative revolution and how to find methods help in its compatibility with electronic control systems.
- Necessity of having a clear vision for formulating the digital and informative heritage-based cities and its cultural, touristic and economic benefits for its environment.
- Achieving similarity between digital and heritage-based city through Convergence in its virtual and physical emptiness as a "Digital City" and "Physical City".
- Supporting heritage-based cities in order to become informative, digital and heritage-based cities with the necessity of preserving its identity.
- Technology of cave system gives perceptual performance efficiency for the space better than computer screen.
- The digital techniques have excreted for us, in heritage-based cities, virtual and nonphysical in addition to its tangible physical spaces.
- It will witness change in the urban structure of heritage-based cities and its humanitarian activities will be implemented as its implementation will lead to virtual interstitial space "Cyber City".
- Touristic journeys to heritage-based cities will be made via internet asynchronously.
- Heritage-based cities will remain the center of convergence of information and communities whether in the virtual and physical spaces.

24. Conclusion:-

- Emphasis on putting an urban and architecture future agenda for keeping our heritage-based cities and its distinctive character and identity.
- The effects of the informative and technical new revolution in our heritage-based cities supersede impacts of wars as news and its speed publishing makes the world a village in a hand grip even architecture and urbanization always converge in thought and concept, the matter that may make it lose its heritage-based features and identity.
- Urban and architectural of the heritage-based cities will subject to additional rules in the age of digital and informative revolution for liberation in stereotypes and functional matters to make the form follows technology.
- The digital model of heritage-based cities will lead to simulation heritage-based village and a new formulation for the concept of electronic touristic journey of the heritage-based cities in its imaginative and virtual space, differentiating from touristic journey in its real and physical space.

- Changing all requirements and service patterns as a result of developing digital and informative means.
- The importance of heritage and architectural inheritance and registering it as an introduction and a mirror for studying history.
- As a result of technical development and wandering in the virtual spaces of heritage-based cities, architects and planners can correct design mistakes before executing it in the process of developing and improving heritage-based cities and their architecture, the matter that was not available previously thus they have to interact positively with what useful knowledge technology introduces for them.
- In the age of digital revolution, standardization will be important in architectural design as it depends on formal diversity and multiplicity.
- Theories for which architects and planners struggle in the past not necessarily become an approach to be followed currently and in the future.
- Decentralization will prevail in spaces of heritage-based cities, production centers and at level of building or city.
- Traditional and physical spaces in heritage-based cities will remain as it is because of its unique quality characteristics, climatic and cultural specificity of the place that is not found via internet in spite of trials of the virtual theoretical places to weaken it, the matter which shall be kept and work to improve it continuously.
- Through techniques and four dimensional geographic information systems, it became possible to follow several different changes of heritage-based cities architecturally and urbanely throughout a certain period of time.
- Necessity of making more detailed simulation for urban places in heritage-based cities.
- Three dimensional analysis programs that help architects in for simulating and modeling real environment to a virtual imaginative environment and allow following change throughout years.
- The cave system is the best was to study heritage-base cities to improvement or to remodel it, as above mentioned, as it gives more clearly image of spaces and city buildings than the computer screen.

25. Recommendations:-

Through this study, a future predicative vision can be identified for architecture and urbanization of our digital heritage-based cities and publishing its modern ideas through contemporary concepts. the study also clarified that what has happened from changes and developments in our heritage-based cities as a result of techniques, information technology, digital revolution and communication in the virtual space; some of which reflect advantages and others reflect disadvantages as it affected by special concepts of other cultures, dialogues and clashes, the matter which contributes in changing cognitive model and preparing for pursuiting adultness, neglecting our customs, traditions and cultures which leads to the distinctive character of our heritage-based cities architecturally and urbanely.

- It is important to establish four dimensional information systems for heritage-based cities to know its architectural and urban changes within different periods of time.
- Necessity of knowing informative aspect and digital revolution that affects formulating of the current digital heritage-based cities.
- participation of informative techniques and strategies in dealing with heritage-based cities, their reformulation, improvement and keeping them as what has happened in the reformulation of many areas in Mecca.
- Providing the necessary techniques which are related with finding the virtual reality of heritage-based cities from technology of computer, communications and infrastructure.
- It is important to have informative infrastructure in heritage-based cities, represented in the internet and means of communication for making its virtual space in addition to taking care of its physical infrastructure in its real and physical space and for overcoming its problems and digital revolution becomes a part of its practical system.
- The necessity of using predictive informative techniques for digital revolution as it contributes in sensing hazards which threaten many of heritage-based cities and archaeological sites through its monitoring for climatic changes on the sea which leads to disappearing of cities and erasing them.
- Counting and documentation of heritage-based cities especially coastal areas, studying dangers that face it in order not to sink, and for keeping visual archeological register for coastal heritage-based cities.
- Interest in digital techniques as design tools not as a benefit approach. The necessity of adopting universities and architecture departments and planning of digital dimension upon developing curriculum as well as encouraging architects to take advantage of it in all fields.
- It is necessary to deal carefully with the idea of electronic, digital and heritage-based city and its appearance such as government, electronic marketing, etc for its pros and a lot of cons make us change the formulation of current rates architecturally and urbanely for studying its compatibility.
- Necessity of activating virtual and electronic space with keeping the concept of physical space and awareness of the importance of both of them. The appearance of electronic cities leads to developing activities and cancelling current traditional activities in our heritage-based cities stemming from our traditions, popular and cultural heritage and distinctive features of heritage-based cities character architecturally and urbanely.

- Asserting the importance the architectural critic who plays the role of gatekeeper who allows passing of suitable ideas with architecture and urbanization of our heritage-based cities in the age of digital revolution and preventing incompatible ideas with our societies, its distinctive identity and character.

26. Bibliographical References:-

1- Abdul Rahman Shehata,Ahmed Mohamed. Studying the Architecture Change by Using Four Dimensional Geographic Information Systems, Third International Conference of the Arabian Assembly for Designing with the Help of Computer, Embodying Imaginative Architecture, Alexandria, Egypt.
2- Agwah, Ali. general relations and , mental image, books world, Cairo, 1983.
3- Al Bana, Abd Elfattah. Confronting the Effects of the Expected Climatic Changes on the Coastal Heritage-Based Cities in Egypt.
4- Al- Jaafary, Abdel Rahman Ahmed. The Administrative Analysis is the Beginning of Developing the Arabian City", Seventh Conference for Arabian Cities Organization; Management Methods and Organizing for Serving Contemporary Arabian Cities, Algeria, 1983.
5- Al Moussawi, Hashim Aboud. Virtual Reality of Architecture and Urbanization, Engineering Faculty, Marqab University.
6- Al Sayyad, N.. "Streets of Islamic Cairo", Master Thesis, M.I.T, 1981.
7- Attaweel, Hatem Abd Elmonaim. The Digital Revolution and its impact on Developing Architectural Learning, article in the magazine of "Architectural Planning Journal, Vol. 16, April, 2005.
8- Campbell, Dace And Wells, Max Well. A Critique of Virtual Reality in the Architecture Design Process, University of Washington, USA, 1997.
9- Daif, Mohammed Ayman Abdul Majeed. Cities of the Twenty- First Century, Digital Revolution and Changing Basic Principles of Architectural Planning, Assuit.
10- El Desouky, Sherif Kamal. Reflection of the Digital Revolution in the Architecture And Urbanization in the Frame of Sustainable Development in Egypt, Sixth International Architectural Conference, Engineering Faculty, Assuit University, March 2005.
11- ElSaedy, Ola Mohamed Kareem. The Impact of Applying Virtual Reality in Realizing Characteristics of the Architectural Space- Applicable Study for the Technique of the Cave Method, Master Thesis, Department of Architectural Engineering, Technological University, 2010.
12- Habib, Tarek Galel & Mohamed, Hanan Refaat. Towards Policies and Strategies For Digital Cities Preparation, Assuit University, 2003.
13- Helal, Maysoun Mohamed Mohy, Ahmed Hussein Ahmed. Informatics and its Impact on Architectural Design, Technological Engineering Magazine, Vol. 28, No. 19, 2010.
14- Ibrahim, Lobna Mahmoud. Upper View for the Contemporary Egyptian City between Pros And Cons, Engineering Faculty, South Valley University, Architectural Engineering Department, Master Thesis, 2004.
15- Ibrahim, Wafeek Mohammed. A Critical Vision for the Architecture of Occasion And Time, Engineering Researches Magazine, Engineering Faculty- Al-Azhar University, October Volume, 2010.
16- Ibrahim, Wafeek Mohammed. a new vision of heritage-based cities through a View of Superstructure Architecture, Al Azhar Ninth International Engineering Conference, Engineering Faculty, Al Azhar University, April, 2007.
17- Ismail Mohy Eldin, Saad Soliman. Geographic Information Technique (GIS) as An Effective Tool for Keeping Historical and Value Places and Developing Them.
18- Mahgoub, Yasser Othman Muharam. a Conference for Keeping Architectural Heritage in Emirates, Dubai, June.
19- Nubbi, Mohammed Hasan. Informative Architecture, Vision for Problem of Innovative Creativity in the Twenty- First Century, Research Paper, Fourth International Architectural Conference, Architecture Department, Engineering Faculty, Assuit University, March 2000.
20- Revolution Magazine. Alwehda Association for Journalism and Publishing, Issue No. 11474, Damascus, May, 2001.
21- Yacoub, Lobna Ghanem. Digital Architecture, Studying Formal Characteristics of Digital Architecture. Studying Cairo University Case. Al Azhar Eleventh International Engineering Conference, December, 2010.
22- Youssef ,Abeer Sami. Architecture after Digital Revolution (Argumentative Vision of A New Aspect for Future of Architectural Building And Construction Technology, Third International Conference of the Arabian Assembly for Designing with the Help of Computer, Embodying Imaginative Architecture, Alexandria, Egypt, 201.

27. Internet Websites:-

http://alumni-www.cityu.edu.hk/empkehan/my-wwwboard/messages/24.html
http://eism.bus.utexas.edu/res/wp.html
http://www.arch-news.net
http://wehda.alwehda.gov.sy/_archive.asp
http://www.jeffrey-shaw.net/html_main/show_work.php3?record http://www.al-madina.com/node/581524
http://www.alyaum.com/article
http://arch-news.net/2013-11-01-22-50-55/2014-04-02-16-07-51/item/33364-3dgis



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HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
Aversa, Capri 11-12-13 June 2015

A tower for Shangai

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Abstract
The work is the result of the competition: A tower for Shangai. The object of the competition was the redevelopment of an area of the Chinese city. The area is located in Yangpu District in the north-east of Shanghai. The purpose of the contest is to give the opportunity to the professionals Neapolitans for discussion of a very topical issue in one of the capitals of world economic development. The project is expected to transmit the culture of Italian thought in the East exhibiting the knowledge and skills of the architects Neapolitans on architectural design and urban design. Currently the areas is the subject of several project initiatives, both at the urban level and at a level of innovation, both medium and long term. A tower that represents the elegance and the refinement of Italy is an exciting challenge and, at the same time, a difficult one, because it must indubitably embody, as far as regards its morphology and form, an object of top quality, while at the same time being an expression of Italy's history as protagonist in the field of fashion and of design. In fashion, Italy has always epitomised quality, elegance and refinement. Names such as Armani, Valentino and Missoni are only some of the most representative brands of our country. And so refinement, fashion, elegance and clean lines have been the leitmotiv of this project.

Keywords: Tower, Shangai, Yangpu, Missoni,

1. The project
Project attributes and aesthetic characteristics with respect to aspects and creative capacity at the base of the culture of Italian architecture.
A tower that represents the elegance and the refinement of Italy is an exciting challenge and, at the same time, a difficult one, because it must indubitably embody, as far as regards its morphology and form, an object of top quality, while at the same time being an expression of Italy's history as protagonist in the field of fashion and of design. In fashion, Italy has always epitomised quality, elegance and refinement. Names such as Armani, Valentino and Missoni are only some of the most representative brands of our country. And so refinement, fashion, elegance and clean lines have been the leitmotiv of this project.
The idea was to clothe a perfect female body, synonymous with beauty, highlighting its shape through an ideal dress recalling a Missoni's design, enhanced by the elegance and agility Armani style. That's the way how a 60 meter tall tower was born, raising on a 20 meters basement, where commercial areas have been placed in the lower part and offices in the upper one.

1.1 Innovative aspects
Innovative aspects of the project, from an architectural, as well as environmental and functional point of view (materials and technology, functional solutions)
The structure is made up of steel elements that are woven together, forming the 'M' of the Missoni pattern. Steel rods and joints define the morphology of the façade. The surface is closed by glass, with reflections of Armani grey, inserted into the steel framework.
This surface/outer skin is fixed to a slightly smaller internal structure, so as to form a cavity between the outer glass panes and the inner ones, in order to enable a good level of air conditioning, both independent and forced, for the whole tower.

The bus stop, in addition to being a waiting place for public transport, will be “smart” – it will not be just an ordinary bust stop, but also a place to “recharge” electric bicycles and an information point with multimedia totems. The panels located above the bus stop will be capable of generating energy to recharge the bicycles, illuminate the bus stop itself and the information totem.
Integration of the project within its urban system, recovering the essential relationship between the building and the public space, with attention to the ratio of the human scale of the project in drawing up the master plan
The buildings around the tower, which conform to the planimetric and volumetric plan of the district destined for “creativity”, are slightly rotated with respect to the grid at right angles of the lot. They are actually rotated 12° degrees clockwise and this rotation of the buildings directs the gaze towards the principal building – the tower.
The guidelines for the planimetric and volumetric plan, completely respecting the surface allocations of the master plan, were to avoid especially tall buildings and to create a harmonious balance between height and the surface area of the lot, which is also a symbol of Italian culture, with its roots in the proportions of the Renaissance town and of humanism… “everything on a human scale”. This proportion was also used in the public areas of the lots, spaces for meeting, strolling or enjoying the various activities found on the ground floors. The objective was also to avoid creating “cumbersome” volumes that might in any way detract attention from the “beautiful woman”. By enlarging the areas destined for commercial use, always on the ground floors, it has been possible to prevent the office buildings from becoming too high.

1.2 Project attributes with regard to aspects connected with issues of environmental sustainability and energy efficiency

The glass areas will be made up of “smart” glazing, or more precisely, photovoltaic panes able to generate a part of the electrical energy that the building will require.
These panes will be able to darken automatically during periods of strong sunshine and become transparent at other times.

1.3 Innovative aspects of the project from an environmental point of view

Green spaces are an important part of the project, which indeed is one of the prolongations of the city’s green lungs. The largest green space, located along the seafront, has been designed like a Missoni pattern, with soft and wavy lines that define coloured areas, each of which is characterised by its own function. These areas each have elements of design that recall products that have symbolised Italy in the past. This sea promenade will therefore be marked with elements of urban design that recall the glories of Italian creativity, elements such as the Vespa in the children’s play areas, the Brionvega radio in the music space, benches shaped like “mouths”, as well as the iconic Bialetti coffee-maker that becomes a fountain. The green spaces around the buildings of historical interest have been interpreted as flat, green “buffer zones”, plain lawns with pathways, which enhance elements of industrial archaeology.



Fig. 1: Project of the tower

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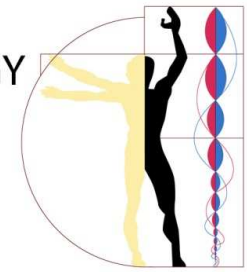

Protecting unpopular heritage. The difficulties of listing 1950s architecture and postwar planning in Plymouth, UK

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Abstract
The debate of listing postwar architecture and designating a Conservation Area covering Plymouth's rebuilt City Centre represents a relevant example of the tensions that arise when historic-artistic values do not fit with popular culture or economic interests. Plymouth's City Centre is considered to be the most complete plan of the kind in the UK. However, it has not achieved the same recognition as other parallel examples, such as Le Havre, designated as a World Heritage Site in 2005. Although including buildings designed by the most relevant British architects and artists of the time, they remain unpopular to a significant part of the residents, mostly due to their rigidity and austerity. In addition, the late classicism of the street pattern and its hierarchical grid do not fit in the national tradition, more used to the informal. Another argument is that further protection would discourage investment due to resulting building restrictions. The debate has achieved national importance, with English Heritage campaigning in favour of designating a Conservation Area for the whole area. The case of Plymouth's City Centre is an interesting example of the difficulty of preserving heritage when there is opposition between experts and local population, as well as between architectural, historic and artistic values on one side, and identity and sense of belonging on the other side.

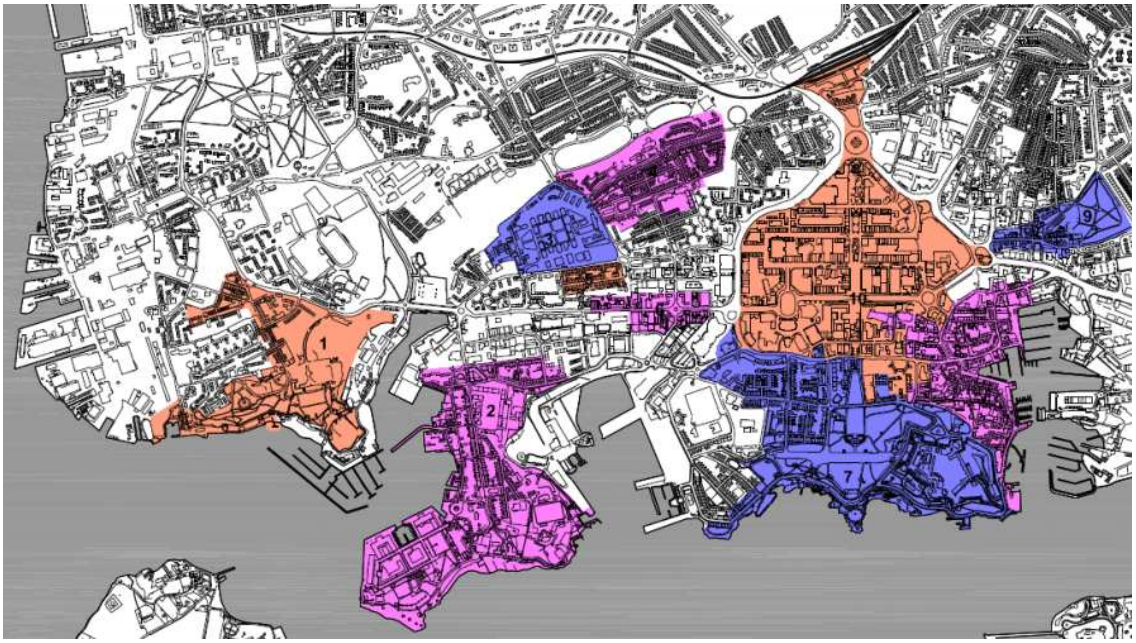
Keywords: reconstruction, heritage selection, dissonance, preservation, modern architecture

1. Introduction. The controversy around heritage selection
Most European cities have designated an area deemed to have heritage value. It normally includes the buildings and street patterns considered as representing the history and the symbolic identity of the whole city. The limits of the historic city and the designation of built assets are not exempt from controversy since a heritage selection is needed. Different criteria may be considered, such as age, authenticity, uniqueness or identity of different social groups. This selection always excludes communities that might feel unrepresented by the assets that have been designated by the authorities involved. In addition, authorities might consider the designation of assets basing on artistic or historic features that are not relevant to the community that is supposed to take part in their safeguard.
The extension of a protected historic city depends on the power of preservationists, the condition of the assets and the development pressures. Especially related to the latter, the introduction of preservation policies implies building restrictions and limits to street widening, which may difficult investment [1]. Heritage protection is always limited to certain assets, and only those that are considered as "the best" are listed, normally establishing priorities in relation to age, historic relevance or artistic quality, with the intrinsic difficulty to measure these aspects and omitting that in many cases assets are in fact listed thanks to urgent measures to face destruction or neglect. Furthermore, heritage protection serves to express the ideology of dominant elites or their opponents. Protection of a certain kind of heritage automatically excludes those who do not feel represented by its meaning, especially minority groups [2]. It also happens when cultural backgrounds from elites and the rest of the society differ significantly [3] or when there is a debate on listing assets relatively close to present [4]. The latter is the case that is analyzed in this paper.
In some cases, these exclusion processes might generate important conflicts, as in the case of heritage linked to war or totalitarian regimes [5]. That is the reason why heritage selection should be

based in the idea of representation. It implies putting the focus on subjects instead of on objects, and especially on the relation between current citizens and the preserved past. It also entails admitting that a consensus about the assets representing the whole society does not need to exist; instead different perceptions can coexist on the same type of heritage [1].
In societies where heritage preservation is very limited, heritage selection concentrates on reduced areas and it might entail the deterioration of excluded areas and assets, thus breaking the integrity of the historic city [6].
Heritage is a political tool that gives legitimacy to a specific social reality at the expense of other realities. Poria and Ashworth [7] differentiate "heritagization" from conservation. While conservation seeks to preserve the past in the most real and objective way, "heritagization" refers to the use and abuse of a past sometimes selected for the occasion. Agudo Torrico and Fernández de Paz [8] and Gunay [9] consider that heritage selection might serve to reinforce the own identity because of the projection that entails. However, when selection is too limited, designated assets lose their meaning as manifestation and testimony of a community's cultural features.

2. Definition of Plymouth's City Centre. The Plan for Plymouth

War destruction and reconstruction is a common pattern to many European cities which illustrates a key period in 20th century history. This importance has been recognised by the designation of Le Havre's city centre as a World Heritage Site in 2005, planned by Auguste Perret in 1945.
Plymouth was an important garrison and a city in ruins was unacceptable and perceived bad for public morale. Even before the end of the raids, there was a growing local mood that highlighted the city's strength and the wish to a quick recovery from the damage. This local mood was being actively spread at a national level [10]. There was a rejection of the past, which meant unemployment, poverty, disease and finally led to war, and a firm belief in the creation of a brand new future. This optimism influenced the bold design of the Plan for Plymouth, so radically different in scale and character to the prewar city [11]. This vision was followed at an early stage by many British cities such as Southampton, Portsmouth and Bristol. However, by 1947, many local authorities lost initial confidence and enthusiasm and retreated into a more conventional scheme due to lack of economic support or political will, local opposition, shortage of materials and workforce and bureaucratic restraints. Only Coventry and Plymouth maintained their faith in bold plans [12]. Finally, within the British most severely bombed cities, only Plymouth renewed the whole of its city centre and its institutions [13].
The plan prepared by Sir Patrick Abercrombie and James Paton Watson was finally completed by September 1943 and its basic principles were adopted by the Council in August 1944. According to Gould, the Plan for Plymouth was the last in a long tradition of humanistic city planning that had begun in the Renaissance and had been formalized in the 19th century. It represented the city of the Welfare State [13]. The Plan was influenced by Le Corbusier's Ville Radieuse and the concept diagram was very similar to Louis de Soissons's Welwyn Garden City [10]. It related to the international City Beautiful Movement, which influenced the planning of Chicago, New Delhi, Le Havre and Canberra [14]. It has also been associated with Albert Speer's mostly unrealised plan for Berlin [15]. The coherent architectural treatment was inspired by the style of Edward Lutyens and the neo-classicism of Bath and Cheltenham [12]. The grid was inspired by the Georgian plan of Edinburgh's New Town and its relationship to the older city [13].



1. Devonport
2. Stonehouse Pen.
3. Millfields
4. North Stonehouse
5. Adelaide St.
6. Union St.
7. The Hoe
8. The Barbican
9. Ebrington St.
10. City Centre (proposed)

Fig. 1: Designated Conservation Areas in central Plymouth and the City Centre. Source: the author.



Fig. 2 and 3: Dingles department store (currently House of Fraser), 1949-1951 and National Provincial Bank, 1955-1958. Source: the author.

Buildings in the new City Centre were cubic in form and influenced by classical models. Façades were composed following the strict lines of the new street pattern, creating continuity in heights, cornices and rhythm in windows, which gave place to a uniform street scene. Architects worked hand in hand with artists and sculptors, who created a variety of details such as murals, reliefs, mosaics, sculptures, railings or stained glass windows. Regarding building materials, Portland stone was widespread, while other buildings were in red-brick [13].

The new City Centre concentrates some of the best examples of British architecture of the fifties, hosting a number of works of some of the most recognised architects in the United Kingdom. Patrick Abercrombie was the best known planner of his time and won the Royal Gold Medal for Architecture in 1946. Other Gold Medalists who worked in Plymouth were Giles Scott, Curtis Green, John Murray Easton and Howard Robertson. Some of the RIBA prize winners who worked in the city were Thomas Tait, William Crabtree, Louis de Soissons, Easton & Robertson, Christopher Green and Geoffrey Jellicoe. Finally, other prestigious architects who participated in Plymouth's reconstruction were Colin Cakes, Lucas Roberts & Brown, Hector Stirling and Ian Ritchie [10].

3. The development of the Plan. The lose of the sense of belonging

The Plan for Plymouth entailed the complete reconstruction of the City Centre but the final layout differed from the Plan proposals in some key aspects, affecting the current low esteem of local citizens towards this neighbourhood. Armada Way, the main axis, should have had two magnificent ends at North Cross and the Hoe, which were never completed as expected. Pedestrians from North Cross have to walk under an enormous roundabout and the access to the railway station is hidden by a hill. As a result, the first image that a visitor has when arriving by train is that of a car park, feeling like entering the city through a back door.

The streets of the City Centre were designed for traffic. As a result, the City Centre is nowadays an island surrounded by a traffic ring, nowadays only partially mitigated in Royal Parade thanks to traffic speed reduction measures. When needs increased, car parks occupied the service courts that were intended for gardens and multi-storey car parks were built instead of other uses, detracting pedestrians to move around. It is especially visible at the northen side of the City Centre.

When many of the streets were pedestrianised in the 1980s they were too wide to offer a busy atmosphere. In addition, blocks are only two or three storeys high, contributing to the suburban image of the City Centre. Another major problem of the City Centre is the single use of the precincts. The result is a busy central area while shops are open but it turns deserted when they close.

The Plan's vision of a high quality City Centre with boulevards and exciting architecture was achieved only partially. One reason was the need to a quick reconstruction, where quality was often sacrificed. Differences in land values and the commercial appeal of some parts meant that only certain areas were able to bear the higher costs of high quality buildings. The Plan was implemented over a long time and when priorities and commercial requirements changed, the Plan was not flexible enough to adapt to these alterations [13]. When money started to run out, controls were relaxed and the variety of materials increased. As a result, quality decreased while reconstruction made progress north of Royal Parade.

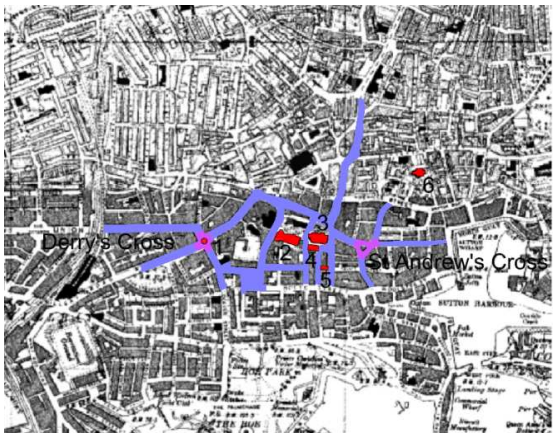
The development and implementation of the Plan lacked public participation. According to Willey, planners did not listen sufficiently to people's views; the Plan was too rigid and represented a top-down model of decision making. The lack of consultation resulted first by disenchantment, in the 1950s it led to disappointment when results were visible [16] and nowadays it has turned into a lack of civic pride and sense of belonging.

Regarding heritage preservation, there was no discussion in relation to the conservation of the two main churches, namely Charles Church and St Andrew's Parish Church, although only the shells remained. Charles Church was intended to be a prominent war memorial but it was left in the middle of an inaccessible roundabout. St Andrew's Church was successfully restored but it does not occupy the central position it had for centuries. Apart from these main monuments, caring about built heritage was not central. The Plan included a report stating that 39% of the buildings in the City Centre had been destroyed or severely damaged beyond repair [18]. It can be observed that although extensively ruined, there were still a large proportion of buildings that could have been repaired. 75% of damaged properties during the war were by fire, thus many buildings had their masonry walls still standing and could have been restored [11]. A provisional list including buildings of historic or architectural interest was prepared by the Ministry of Housing and Local Government [17]; the selected buildings had to be preserved unless there was a reason of public interest to make the contrary. Therefore, the 1952 Plan, which developed the Plan for Plymouth, stated that buildings coming into conflict with the reconstruction plans should be demolished. As a result, among the 262 buildings provisionally listed I or II, 43 were destroyed because they interfered with reconstructions plans [17]. Some of the prominent buildings that did not escape the reconstruction process were Prudential Building and St Catherine's Church. The Plan proposed to move to other places some of the buildings that were located on the site of new streets, but finally only Derry's Clock was moved from its original central position, standing nowadays at an insignificant site at the back of Theatre Royal and a multi-storey car park.

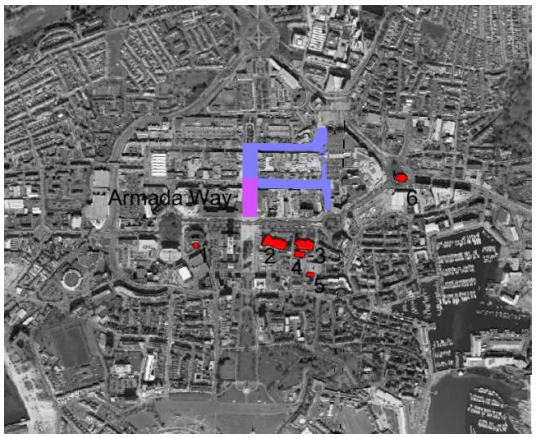
The reconstruction of the City Centre was not anchoraged enough in the former representative spaces and as a result, the City Centre is undervalued by many locals. The emotional image that many citizens had of their city was lost due to the demolition or displacement of landmarks and the alteration of their hierarchical position. Of special importance was the replacement of the historic commercial core formed by Whimple Street, Bedford Street, Old Town Street and St Andrew's Street by the newly created cross between Armada Way and Royal Parade and the main shopping area located to the North-East.



Fig. 4: Derry's Clock in its current location. Source: the author.



Pre-war main commercial streets
Pre-war main squares / crosses
Pre-war main buildings that still exist
1 Derry's Clock
2 Guildhall
3 St Andrew's Church
4 Prysten House
5 Merchant's House
6 Charles Church



Current main commercial streets
Current main squares / crosses
Pre-war main buildings that still exist
1 Derry's Clock
2 Guildhall
3 St Andrew's Church
4 Prysten House
5 Merchant's House
6 Charles Church

Fig. 5 and 6: Prewar and current main commercial streets. Source: the author.

4. Discussion about designating the City Centre as a Conservation Area

The possibility of designating the City Centre as a conservation area is being currently considered. Designating conservation areas is normally a matter of the local planning authority but the Secretary of State can also designate in some specific occasions [18]. English Heritage is the Secretary of State's advisory body on historic built environment and it supports the designation of the whole area inside the inner ring road. Other influential voices in the city supporting this designation are Professor Jeremy Gould, Alan Baxter & Associates and Chris Robinson, the local historian.

The campaign in favour of designating the whole City Centre as a conservation area has somehow achieved national importance since English Heritage started to lead a campaign together with Kevin McCloud, designer and presenter of the television programme Grand Designs.

On the other side stands the City Council, which defends the idea of designating only the blocks near Royal Parade, taking into account that they show the finest architecture and are the most respectful with the grandeur proposed by the Plan for Plymouth. In general terms, the building quality decreases northwards and the restrictions that a conservation area designation entail could prevent some businesses to locate in the area. It has to be noticed that the City Council owns the freehold of most of the City Centre [19] and its designation might limit its leasehold incomes in case building restrictions are implemented regarding density, height, uses or floor space.

As it has been explained, Plymouth's City Centre contains some postwar buildings of architectural significance, some of them Listed. Nowadays, Plymouth has the greatest number of postwar Listed buildings outside London and, according to the Plymouth 20th century city, the City Centre is the largest built example of postwar British planning and architecture [14]. However, it is at the bottom in number of listed buildings compared to other Conservation Areas.

Name	Type and grade	Date of listing	Listing legislation	Main author(s) and outstandig artist(s)
Charles Church	Listed grade I	25-1-1954	Planning (Listed Buildings and Conservation Areas) Act 1990	JH Ball (interior refitting 19th century)
Clock Tower	Listed grade II	1-5-1975	Planning (Listed Buildings and Conservation Areas) Act 1990	-
The Bank public house	Listed grade II	1-5-1975	Planning (Listed Buildings and Conservation Areas) Act 1990	-
Pannier Market	Listed grade II	25-3-2003	Planning (Listed Buildings and Conservation Areas) Act 1990	Paul Pearn and Ken Bingham (architects). Albin Chronowicz (concrete engineers). David Weeks (artist)
Former Barclay's Bank Building	Listed grade II	22-9-2003	Planning (Listed Buildings and Conservation Areas) Act 1990	Christopher Green (Curtis Green, Son and Lloyd). William McMillan (sculptor)
Civic Centre	Listed grade II	21-6-2007	Planning (Listed Buildings and Conservation Areas) Act 1990	Ballantyne and Coleridge (architects). John Hutton, Mary Adshead and Hans Tisdall (artists)
Unitarian Church	Listed grade II	17-9-2008	Planning (Listed Buildings and Conservation Areas) Act 1990	Richard Fraser (architect of the Louis de Soissons Partnership)
Baptist Church	Listed grade II	10-12-2008	Planning (Listed Buildings and Conservation Areas) Act 1990	Richar Fraser (architect of the Louis de Soissons Partnership). Hans Feibusch (mural)
Royal Bank of Scotland	Listed grade II	20-12-2009	Planning (Listed Buildings and Conservation Areas) Act 1990	BC Sherren (Chief Architect National Provincial Bank architects' department)
Civic Square	Reg. Park and Garden	9-4-1999	Ancient Monuments and Archaeological Areas Act 1979	Hector Stirling (architect, general layout and concept). Jellicoe, Ballantyne and Coleridge (architects)

Fig. 7: List of assets with statutory protection in the City Centre. Source: the author.



Fig. 8: Location of assets with statutory protection in the City Centre. Source: the author.

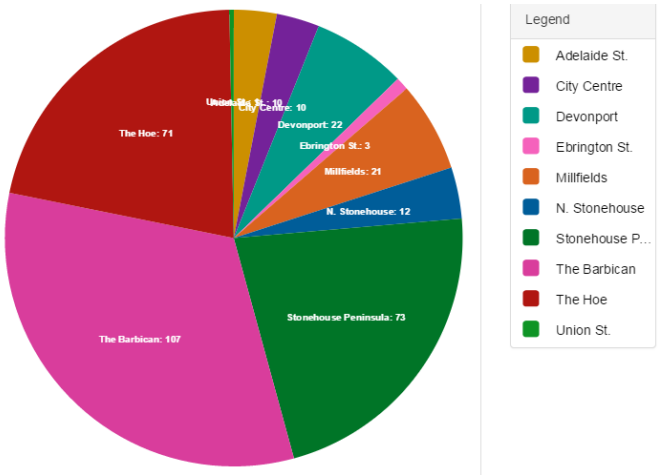


Fig. 9: Assets with statutory protection by Conservation Area, including the City Centre. Source: the author.

The importance of British postwar planning is increasingly being recognised and a number of conservation areas have been designated, including some housing estates and the New Towns of Easthampton, Stevenage and Landsbury. A parallel case to the one of Plymouth is Stevenage Town Square; it was the first pedestrianised town centre in the country and was designated in 1988.
In this debate underlies that the architecture and urban layout of the City Centre is subject of a significant reaction and has started to be recognised only recently. Especially, Plymouth's 1950s buildings started to be listed from 2003 onwards; the Civic Centre was listed in 2007 with a strong opposition, including that of the City Council.

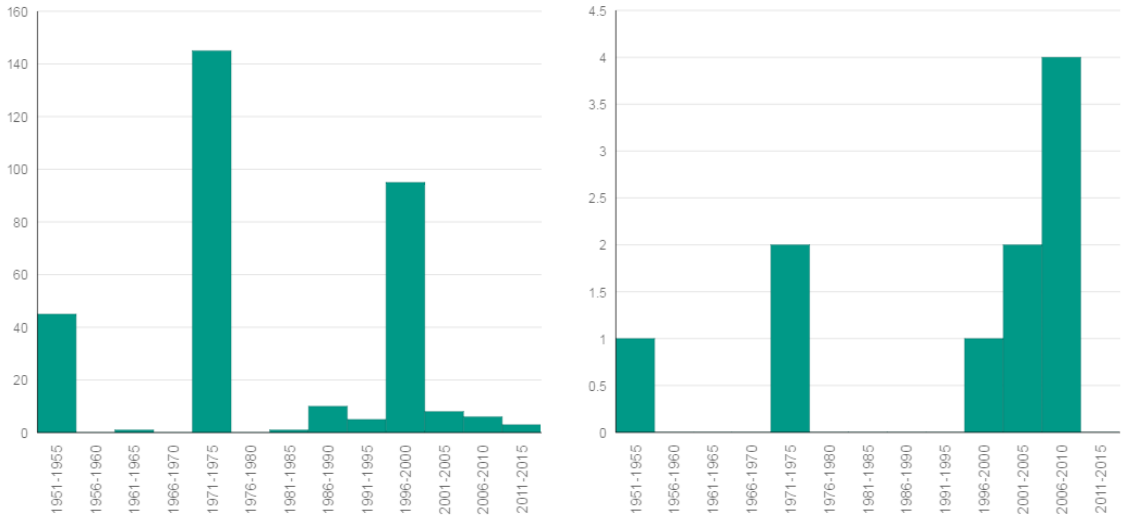


Fig. 10 and 11: Assets with statutory protection by five-year period in Plymouth and in the City Centre. Source: the author.

Regarding the architecture of the City Centre, its late classicism has been disliked for decades and it does not enjoy the popularity of other styles, the same way Victorian architecture was detested in the first half of the 20th century. According to Gould, the architectural press intended to link Modernism of the 1930s with New Brutalism of the 1950s, missing the "aberrations" created at the same time. Moreover, the urban design with its rigid and hierarchical grid does not fit in the national tradition, too used to the picturesque and the informal [13].
Nevertheless, designating a conservation area would discourage demolitions unless justified and would force the Council to make regular proposals for the preservation and enhancement of the built heritage, and to increase controls and publicity over permitted development rights. A Conservation

Area Appraisal and Management Plan would need to be prepared, including a compilation of elements worth preserving and detailed policies to increase the quality of the built environment. It would establish which changes can be made and where. Moreover, it would serve to promote the City Centre as an important part of the local and national history [20].
Conservation area designation needs to be followed by an efficient management ensuring that the intention is not to prevent change but rather to ensure that change is carried out properly and is sympathetic to the character of the area. Otherwise, investors could be detracted. In order to avoid the restrictions that designating a conservation area could involve, while maintaining the objective of preserving the built heritage, the City Council has suggested the use of other planning controls including landlord controls, statutory listing and local listing [21]. Nonetheless, the designation of a conservation area is the most useful tool to preserve the complete layout of the City Centre from the railway station to the Hoe and its definite character. The general architectural pattern such as heights, rhythms and materials could be maintained and only those elements making a negative contribution to the area should be subject to regeneration, discouraging piecemeal interventions which would dilute the harmony of the development.

5. Conclusions

The reconstruction of Plymouth's City Centre by the Plan of Plymouth is one of the most relevant examples of postwar planning in Europe. It is also unique thanks to its concentration of quality architecture of the 1950s. However, the number of listed buildings is significantly lower than in other neighbourhoods and postwar architecture has started to be officially considered only recently. The implementation of the plan was not as magnificent as expected; it removed the former symbolic core of the city and is not yet integrated in the local imaginary. As a result, voices mainly from outside the city have been needed to reconsider the value of this urban piece.
There is a gap between the vision of experts in built heritage and the local feeling towards this urban area. Its rigidity, monotony, lack of mixed uses and isolation are problems that need to be eased because otherwise the preservation of this outstanding neighbourhood is at risk. In addition, the debate about designating a Conservation Area evidences a tension between historic, artistic and architectonic values on one side, and identity and sense of belonging on the other side. If preservation policies were imposed strictly, probably the decadence of the City Centre would go further since restrictions on building or changing uses would be perceived as imposed and external to local needs. As a result, a more comprehensive approach would probably be more successful, preserving the architectural traces and street pattern, but allowing reconversion of the buildings of lower quality and an increase in density and heights in underused areas.

Bibliographical References

[1] ASHWORTH, Gregory, TUNBRIDGE, John. *The tourist-historic city. Retrospect and the prospect of managing the heritage city*. Oxford: Pergamon, 2000.

[2] WARD, Colleen. Probing identity, integration and adaptation: Big questions, little answers. *International Journal of Intercultural Relations*. 2013; 37: 391-404.

[3] TROITIÑO VINUESA, Miguel Ángel, TROITIÑO TORRALBA, Libertad (dir.). *Estudio sobre la funcionalidad turística del patrimonio cultural del municipio de Carmona y estrategias de actuación*. Grupo de Investigación Turismo, Patrimonio y Desarrollo, Instituto Andaluz de Patrimonio Histórico and Ayuntamiento de Carmona, 2011.

[4] ASHWORTH, Gregory, LARKHAM, Peter (eds.). *Building a new heritage. Tourism, culture and identity in the new Europe*. London and New York: Routledge, 1994.

[5] GRAHAM, Brian, HOWARD, Peter (eds.). *The Ashgate Research Companion to Heritage and Identity*. London: Ashgate, 2008.

[6] BATISTA DA COSTA, Everaldo. Patrimonio e territorio urbano em cartas patrimoniais do seculo XX. *Finisterra*. 2012; 93: 5-28.

[7] PORIA, Yaniv, ASHWORTH, Gregory. Heritage tourism - current resource for conflict. *Annals of Tourism Research*. 2009; 36 (3): 522-525.

[8] AGUDO TORRICO, Juan, FERNÁNDEZ DE PAZ, Esther. Viejos y nuevos retos para el patrimonio cultural de Andalucía. In HURTADO SÁNCHEZ, José, FERNANDEZ DE PAZ, Esther (eds.). *La cultura andaluza en el umbral del siglo XXI*. Sevilla: Ayuntamiento, 2001.

[9] GUNAY, Zeynep. Neoliberal urbanism and sustainability of cultural heritage. In AA.VV. *Proceedings of the 44th ISOCARP Congress*. Dalian, 2008.

[10] GOULD, Jeremy, GOULD, Caroline. *Plymouth planned: the architecture of the Plan for Plymouth 1943-1962*. Somerset: Jeremy and Caroline Gould Architects, 2000.

[11] PATERSON, Andrew. The price paid for Plymouth's new City Centre. Unpublished dissertation. Plymouth: Polytechnic School of Architecture, 1983.

[12] ESSEX, Stephen, BRAYSHAY, Mark. Boldness diminished? The postwar battle to replan a bomb-damaged provincial city. *Urban History*. 2008; 35 (3): 437-461.

[13] GOULD, Jeremy. *Plymouth: vision of a modern city*. Swindon: English Heritage, 2010.

[14] Plymouth: 20th century city [Internet]. Plymouth: Architecture Centre Devon and Cornwall. Available from: http://www.20thcenturycity.org.uk/about.html.

[15] ALAN BAXTER & ASSOCIATES. *Plymouth waterfront characterisation study*. Prepared for Plymouth City Council and English Heritage, 2006.

[16] WILLEY, David. Two tales of one city: alternative accounts for leisure and tourism in urban renewal in Plymouth, England, UK. *World Leisure & Recreation*. 1998; 40 (2): 22-29.

[17] PATON WATSON, James. *City of Plymouth Development Plan, 1952 submission*. Plymouth, 1952.

[18] Planning (Listed buildings and Conservation Areas) Act of 1990. Pub. 1990, reprinted 2002.

[19] PLYMOUTH CITY COUNCIL. Department of Development. City Centre and University Area Action Plan 2006-2021, 2010.

[20] PLYMOUTH CITY COUNCIL. Planning Services. Plymouth City Centre precinct, assessment of strategic options for the management of its heritage assets, 2008.

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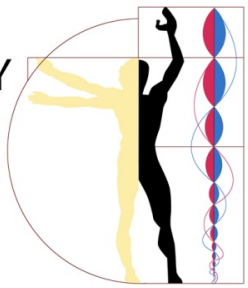

Sharing knowledge, grasping Cultural Heritage: a digital multidisciplinary approach to the historical process of architecture and urban changes

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Abstract
Digital tools are changing the way of Cultural Heritage is shared and understood in society. However, the key to improve truly the common knowledge about Cultural Heritage could be especially in a multidisciplinary approach in research and in the dissemination of its outcomes.
The paper focuses on a multidisciplinary approach by involving Urban and Architectural History, GIS and 3D modeling. It discusses how new technologies especially help in reconsidering the state of the art and in making understandable the historical process of architecture within the changes of the city.
The authors present this approach applied to a range of 19th and 20th Turin Cultural Heritage, at architectural and urban scale: the large range of buildings designed by Alessandro Antonelli and the destroying and rebuilding of a street with homogeneous front, via Roma, in the Thirties.
Research uses GIS, 3D models and digital platforms in order to visualize changes also making visible ideas and designs never realized. Digital platforms link buildings and urban areas to drawings and documents preserved in city museums and archives. The aim is to make truly accessible both historical information and different kind of Cultural Heritage.
The conclusion is that this approach to the historical research could improve a wider access to the Cultural Heritage by enhancing the perceptions and the understandings of the relationships between buildings within the cities, also revealing the Cultural Heritage in archives and museums.

Keywords: Digital History, 3D model, GIS, Multidisciplinary, Access Tangible Cultural Heritage

1. Introduction
Digital tools and web 2.0 have changed definitively the way to access the historical information, disseminating any kind of data about the worldwide cultural assets. The strict connection with cultural tourism and the UNESCO care in listing and explaining the motivation in classing world heritage also boosted a wide audience in checking information and learning about places, buildings, or intangible assets.
New directions in museums also contribute in changing the way to exhibit art and history in order to involve visitors by immersive spaces, exciting set up and digital displays. This approach of museums as a place “to preserve, to study and to communicate” (instead “to collect and to conserve” as priority) was among the early changes aimed for the inclusion of the larger community by using mass media.
Nowadays the potential of digital environments are pushing toward new challenges that are looking for the interaction with people. The community is asked to contribute personally in the sharing the Cultural Heritage for instance by supporting cultural activities, and above all in an individually experiencing stories and consciousness. By digital displays, everyone may put him/herself to the test about his/her skills and expertise, as well as they can choice what he/she is more interested in.
By this approach, people are engaged in building up their own attachments to the identities and cultural memories and in providing their collective evidence. On the other side digital environments documenting the cultural heritage also have the target to offer everybody the cultural tools to truly understand meanings. In this way the digital approach boosts in sharing the knowledge with society as well as in making understandable the heritage.

2. Architecture and urban contexts comprehension

Architecture is a relevant part of the tangible cultural assets. Buildings and built environment at large represent in a very strong incisive way values and meanings of the heritage. Siting within cities and historical landscapes they contribute to learn just moving in open-air museums, by creating immersive space.
This visible experience is very important but it is not enough to achieve a full knowledge about their history and its significance. Most of them also changed a lot in the centuries, and the relationships with the urban space could be very different in the present environment.
Studies and research refer about interpretations providing documentary evidence of different shapes, uses, and whatever. They are mostly addressed to select readers specially involved in the academic fields. Captions and figure of architectural drawings are asked to demonstrate the beginnings, the changes, the reasons. This process could be also more difficult to show and to documentary provide in the case of the urban space.
The general impression of the continuous change of cities is related to a wide range of phenomena and causes. The process of urban change mostly depends on the change in the topography, in the plan structure, in the open public spaces, in the buildings with their formal shape and their different functions (not necessarily but sometimes organized by orders and typologies), as well as in the social uses and in the architectural peculiarity of the space. Actors, patronage and creators play also a relevant task in the historical readings.
By traditional disciplinary approach, iconography is the instruments able to illustrate the stories. Nevertheless, architectural drawings, plans, cartography are not easily understandable by everybody. Special skills are needed “to read” through a dimensional representation system and especially 2D drawings (e.g. maps, plans, sections, and elevations) are quite difficult to interpret for not specialized people.

2.1 From tradition to digital solutions

No doubt, that 3D rendering opened a new access to architectural plans. That way they have started to be used also with an historical aim in order to visualize the Cultural Heritage. Therefore, a larger audience access information also encouraged to take an interest in cultural assets. Most among these 3D models reproduce the existing buildings by using the platform to explain. 3D images are conceived by a complementary connection with texts, not so far than the traditional approach does.
In a way, many digital environments for Cultural Heritage are acquired by translating in numeric data the usual written story. Nevertheless, this use of digital environment is very poor in front of its potential yet.
Digital tools (e.g. GIS, 3D modeling, and hypertexts) have to be used from the beginning of the research to ease the understanding of architectural and historical events by looking for a correct balance between technical solutions and conceptual contents. The “over exposition” of technical solutions without considering the real aim of the research can cause misunderstanding and incomplete or non-correct transmission of the real contents of the sources and of the interpretations made by historians. Therefore, “astonishing effects” have to be avoided if they are not able to transmit the real information useful to understand the origin of the analyzed data and the way they are used to reach the proposed interpretation.
The revolution created by digital age is much more permeating than that, and it allows rising to the occasion of a new open-mindedness. If “since its emergence as scholarly discourse”, history has been strictly related to the written texts as well as these ones were linked to the sources that are traditionally transmitted by written records, the ICT revolution also drifts historical approach toward the visual world [5]. The originality of this approach could be precisely in a different relationship between image and text, especially suitable for history of the architecture and cities conceived under the point of view of the physical space. By using images digitally produced, also the outcomes of research could be translated with the exit of a fully dissemination. In addition, images make more understandable complex historical process improving truly the common knowledge.
This sort of “freedom” transcending the linear structure of the written (or spoken) text could have very strong consequences if fully achieved [2]. However, it could not just be reach by introducing 3D models or other digital environment as figures. The new developments can be expected by changing mentality that is the gaining a stronger digital approach.
Historical processes of the architecture need to use smart digital environments since the research survey up to the outcomes, and their public uses for the Cultural Heritage.
In a way, the historical process is to be approached by a multidisciplinary team. The collaboration of different specialized skills in fact is essential in creating digital displays suited for historical meanings of architecture.
This approach forces the specialists to reach a common work process and the upgrade of the individual skills by considering the milestones of the different disciplines and by looking for possible solutions to obtain an acceptable scientific strategy.
A correct balancing of the expertizes is the only possible way to merge the different competencies: historians have to understand the limits and the possibilities offered by IT solutions while technical researchers have to adapt the instruments (e.g. acquisition and management digital tools) to the preservation of the original contents avoiding simplifications and/or incorrect management of the sources and of their interpretation.

The main goal of an interdisciplinary research is the preservation of the transmission of the research, which means a correct presentation of the original data, the correct "lineage" of the data processing by ensuring the possibility for the reader to replicate the complete research path.

2.2 Digital research and dissemination

The history of architecture is a process always based in a space and in a time. The organized information, by databases, has to link data to that space and that time. Nevertheless unlike the architecture has been presented by 3D modeling, the territorial data has been surveyed by GIS especially useful *to spatialize* historical information [1].

The design of the database is one of the most important steps and only a common effort by all the specialists involved in the research allows an efficient and effective planning of the basic activities: source collection, source analysis and interpretation, and visualization and transmission of the results.

The database is the IT instrument able to connect data of different origins and to localize them in a common reference system in order to connect each data in the specific spatial framework where each data can assume deeper meanings.

The organization of an historical research is not a new but the adoption of digital tools to record all the phases of the research force the specialists to modify the acquisition and elaboration strategies. At the same time the digital recording of the data from the beginning, open new possibilities of analysis and new possibilities to transmit the systematic procedures, which can describe how the data have been interpreted.

Usually the software used in this kind of applications require high levels of expertize which are different from the ones useful to interpret the data. Therefore, the historical research is transforming itself in a multidisciplinary activity where each specialist has to play his proper role at the maximum possible level to be able to manage the foreseeable adaptations of all the used techniques.

The main mistake to be avoided is the technical overpass over the historical requirements. It must be stated that IT technologies have to facilitate historical research and possibly enhance them and not the opposite.

The conclusion is that many different tools can be exploited. However, in the aim to achieve truly shared knowledge digital technologies have to be shaped as tools improving both research and understandings.

The ICT experts do not need to make cryptic their implementation or the readings of their application by showing all the detailed potential of technologies.

At the same time, historians need to believe in a public use of history also aimed to improve the common knowledge. That way the visual interpretations coming out from data go beyond the state of the art crossing disciplinary fields.

3. Turin in 19th Century

The first research presented applies the digital multidisciplinary approach at different scales of cultural assets in Turin, architectural and urban.

The study deals with the city after loosing the walls and growing up in the 19th century. The key of this reading is identified in the work of an architect, Alessandro Antonelli, as the city archives are very reach of his drawings. His personal archive of sketches, designs and details' studies, in fact, is also completely well preserved, as it was gift to the city government by his son Costanzo when Alessandro Antonelli died. Costanzo Antonelli would like by that to offer a philological completion of his father's masterpiece, the Mole (Fig. 1).

Although it is the symbol of Turin since it was built, this building actually is mostly the only one well known of the architect unlike he was very active within the city and in the region. His figure working as a professional for the middle class and making himself as an investor represents a period of the history, as well as his neoclassical style revised by using a mix technology that is the traditional masonry integrated with iron structure.

The strange dome was conceived to be the highest building in Europe but it was even only for few years until the Eiffel tower was up. Its shape with the classical order and its traditional techniques disappoints who believe the innovation came out from new materials and new techniques. It was just the monumental transposition of a conception of architecture that he practiced anywhere strongly believing in his idea of innovation through the continuity with the tradition. By this understanding, Antonelli deeply inspired many architects till the 20th century.

The range of information above mentioned could be for specialized people only or for somebody very interested in the architecture. They do not sound as relevant as a piece of common knowledge on Cultural Heritage that really needs to be shared.

Nevertheless a large part of the image of Turin is done by the inspiration of this architect as early controversial as shared now: the Mole first of all, but also many more common buildings typical of the 19th century districts of the city.



Fig. 1: The Mole Antonelliana in Turin

The Mole has had a lot of function as a monument or as a museum since the Jewish Community changed its mind to complete it as a synagogue. Now it is open to visitors with the setup of the national Cinema Museum siting there. No doubt, that it is still the symbol of Turin.
However, people take no notice that Antonelli signed more and more buildings too. Although in the nickname of the Turin symbol, nobody knows about Antonelli.
It sounds as a curiosity but it is about the identification of a large part of the 19th urban Cultural Heritage. Still existing buildings (mostly private housing spread in many districts) as well as many architectural drawings are the heritage. Drawings that are preserved in many different archives, museums and libraries form a Cultural Heritage just "invisible" to the most of people.
By this reflection, the digital tools can be the best way to make visible and understandable the Cultural Heritage originated by the Antonelli thinking.
The projects also light the city growth in the second part of the 19th century, when Turin ended to be a capital. Many buildings were constructed in the new areas, where he strongly contributed by plan proposals for the urban development too. He never realized many of these ideas. Nevertheless, all of them improve the interpretation of his relevant work as a whole.

3.1 Research strategies

Designs could tell a lot about very interesting stories for the collective memory and very effective ones for the understanding of the urban history. For instance through them it is possible to reflect about the resilience of this city at different times.
Nevertheless, architectural drawings need to be studied and shown for an immediate perception of their contents. They have to be related with the urban space and its changes. In this way they are linked to the space and the time. This approach allows people to recognize places of the present city.
Therefore, the research deals with the 3D modeling of designs of the buildings, both of the built ones and the unbuilt ones. The historical survey of the urban areas provides data about a wider portion of the space. The archive survey collects information about the building permissions of the plots.
The translation of 2D drawings into 3D models is not a task that can be automatized in some way because it needs intelligent interpretation of the data and intelligent organization of the digital data to respect the real content of the sources. The layer organization of the digitized model has to reflect the results of the interpretation of the original sources and the always-necessary integrations able to solve the lack of 3D information. Data coming from historical sources and data coming from personal interpretation have to be presented in a different way (e.g. recorded on different logical layers) to allow the final user to understand what is objective and what can be discussed or considered with a different level of importance.
Data are managed to realize a detailed 3D model of the entire block. Many more information have been collected such as information about owners, functions, transformations or, in certain case, about the project realized instead of the Antonelli's proposals. The aim is to gain understanding of the process of the architecture within the urban changes.
Franco Rosso specially consecrated many years to study and to catalogue all different projects, collecting records in more than a book [4]. The traditional approach is very important to carry on in-depth analysis by scholars. But it is not at all useful for grasping the significance of this work by everybody. Although these previous surveys are essential to broaden the research field to the whole

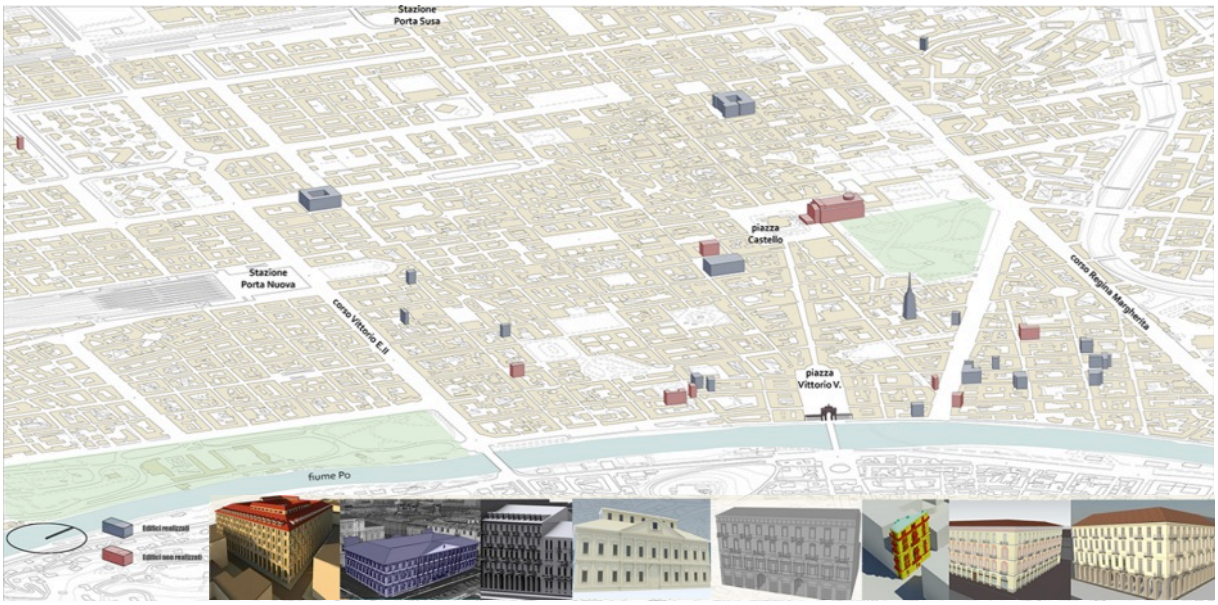


Fig. 2: Thematic map of the Antonelli's designs in the center of Turin

of his drawn work, the digital approach can create a new condition both for the research and for the common knowledge on the Cultural Heritage. The previous outcomes are used to create a GIS visualizing in a large territory all the projects.

The Turin GIS has been especially developed and is in progress now in order to link a database of all projects. The GIS is visualized by a synthetic overview of the nowadays Turin where each 3D models is placed (Fig.2).

The realized GIS uses different features: points for non-realized designs and polygons for existing Antonelli's buildings. For each of these features a specific set of attributes has been defined by translating existing classifications of the Antonell'is designs [4] and by adding the links to the existing digital archives of the original drawings or to the digitization performed of the material not yet transformed in a digital accessible way.

The drawings are the links to the 3D models realized for each existing or not existing building that can be accessed by the users. Finally the 3D model are linked to the GIS structure by realizing in that way a "logical circle" that allows the possibility to explore the historical sources and the basic results of the research in a unique platform.

The 3D modeling in the research is conceived to visualize different information. The architecture mainly is visualized as a process starting with a conception by drawings, sketches, variations and taking place within an urban area at a certain time, finally transformed later or under construction. The virtual architecture is mixed and compared with actual buildings in order to underline in one time the strong complexity of the process of architecture and its involving the everyday life (Fig.3). A grasping understanding of some projects never realized is obtained by visualizing them in the supposed area in order that everybody can fully estimate the range of the ideas (Fig.3). Some of these also disclosed fruitful comparisons with its greater inspiration of the Mole.

This is the case of the large scale of ephemeral triumphal arch he designed for the entry of the king Carlo Alberto, as well as his for the first academic project for the main square of the city (Fig.3).

In this case historical or recent photographic images can be used as a basic scenario: by knowing the coordinates in a specific coordinate system of some points, it is possible to recover the geometric parameters of the central perspective of the photographic image.

The 3D model of the design is than prospectively projected by using the above-mentioned parameters and inserted in the correct place inside the original image. The use of historical pictures allows one to understand what the architect imagined during his design while the use of recent picture allows one to see in which way the urban context could be modified in case of the realization of the design.

In the case of the housing 3D models also display the relevance of the structure and the disposition in order to achieve bright flats always realized by using in an innovative way the traditional reinforced masonry.



Fig. 3: A never realized triumphal arch modeled and inserted in the existing city landscape

To fit these purposes the layer organization follows the systematic subdivision of independent 3D elements (e.g. floor, stairs, windows, walls, etc.): the 3D visualization allows a better understanding of the design concept and of the adopted technical solutions.
Under this perspective, the designs of Antonelli become an interpretation key to understand the process of the architecture in the city growth, also checking as the quality of the design can contribute to the urban image and the urban everyday life.
The case study of the district of Vanchiglia is especially useful to understand this aspect. The story of the strange building, popular in the city under the name of “fetta di polenta” (*slice of cornmeal mush*) because of its thin depth, is very effective by the video showing the origins of the district and the plot, as well as the visualized chronology by 3D of the changes achieving the final construction. The story is as hard to describe by words as easily grasping by the digital environment.
3D models have to be integrated in an informatics structure, which allows the direct link to the historical sources (drawings, pictures, iconography, etc.) and/or to previous published research about the same topic.

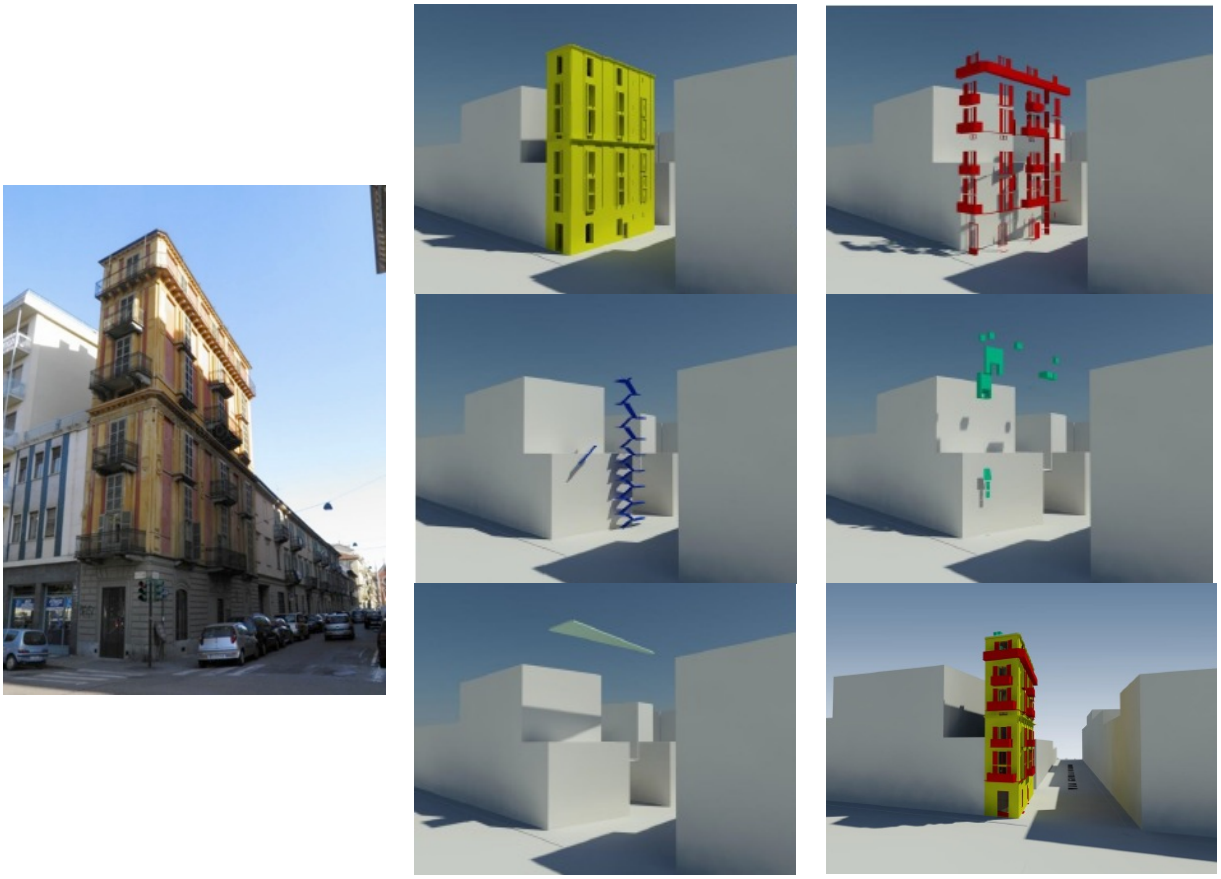


Fig. 4: The “fetta di polenta”. On the right the decomposition of the 3D model by considering different architectural components.

Because all the 3D models used in the historical research usually come from historical surveys or original design drawings. It is essential that each representation of 3D models (perspective or axonometric views, video, etc.) has to be documented in terms of metric system to allow the user to extract the metric information that are one of the historical data recorded on the used sources. Another important topic is the declaration of the level of detail of the produced 3D model to suggest the user the correct interpretation of the geometric models.

4. Turin in 20th century

The research on the 20th Cultural Heritage focuses on a street, via Roma, with its front rebuilt in the Thirties and it will discuss here mostly to mark the difference with the first study presented.
The difference is first in the identifying the historical urban landscape of the street as a Cultural Heritage by the definition of UNESCO.

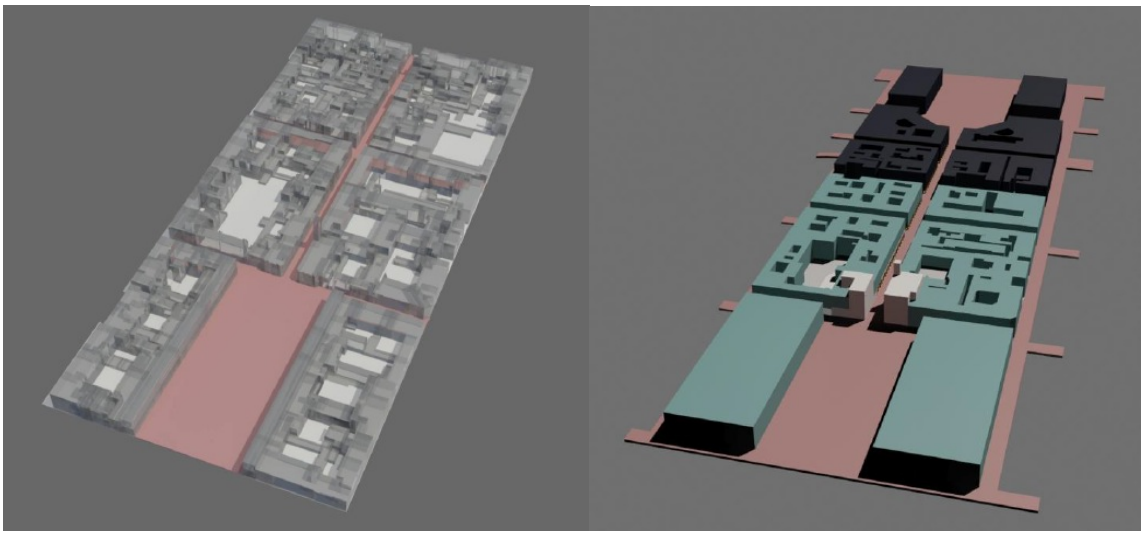


Fig. 5: The Via Roma (section from Porta Nuova up to Piazza San Carlo) in 1866 (on the left as extracted form the Rabbini's cadastral map) and in one of the designs realized for the reconstruction during the fascist period (on the right)

The digital approach is conceived in the aim of making more wider understandable this context, difficult to grasp because people is less familiar with modern architecture as an heritage as well as to read the urban open space.
Via Roma is still very important as central commercial area and it is a monumental way linking the main square with the monumental area of the Royal Palace and Palazzo Madama (both part of the UNESCO serial site of the **Residencies** of the Royal House of **Savoy**) with the 19th monumental building of the railway station through more monumental squares of different period.
The survey provide documentary evidence of a larger area around before the demolition. The change is visualized by 3D modeling the blocks before and after the demolition. The 3D models of the blocks related to the cartography make evidence of the structure of the street rebuilt with a larger area in order to rationalize the urban plan and its uses (Fig.5).
In addition the 3D modeling also aim to recreate other urban images demanding a more stressed idea of modernity in the context of the historical site.
These proposals created by the imagination of young architects were not successful. However, the large production of projects is essential to make understandable the relevance of the site originating many ideas and many discussions within the city now of the demolition (Fig.6).
The opposing visions also are as still visible in the two sectors as hardly understandable without an architectural guide. The digital environment also provides more information about the architects involved with these proposals.

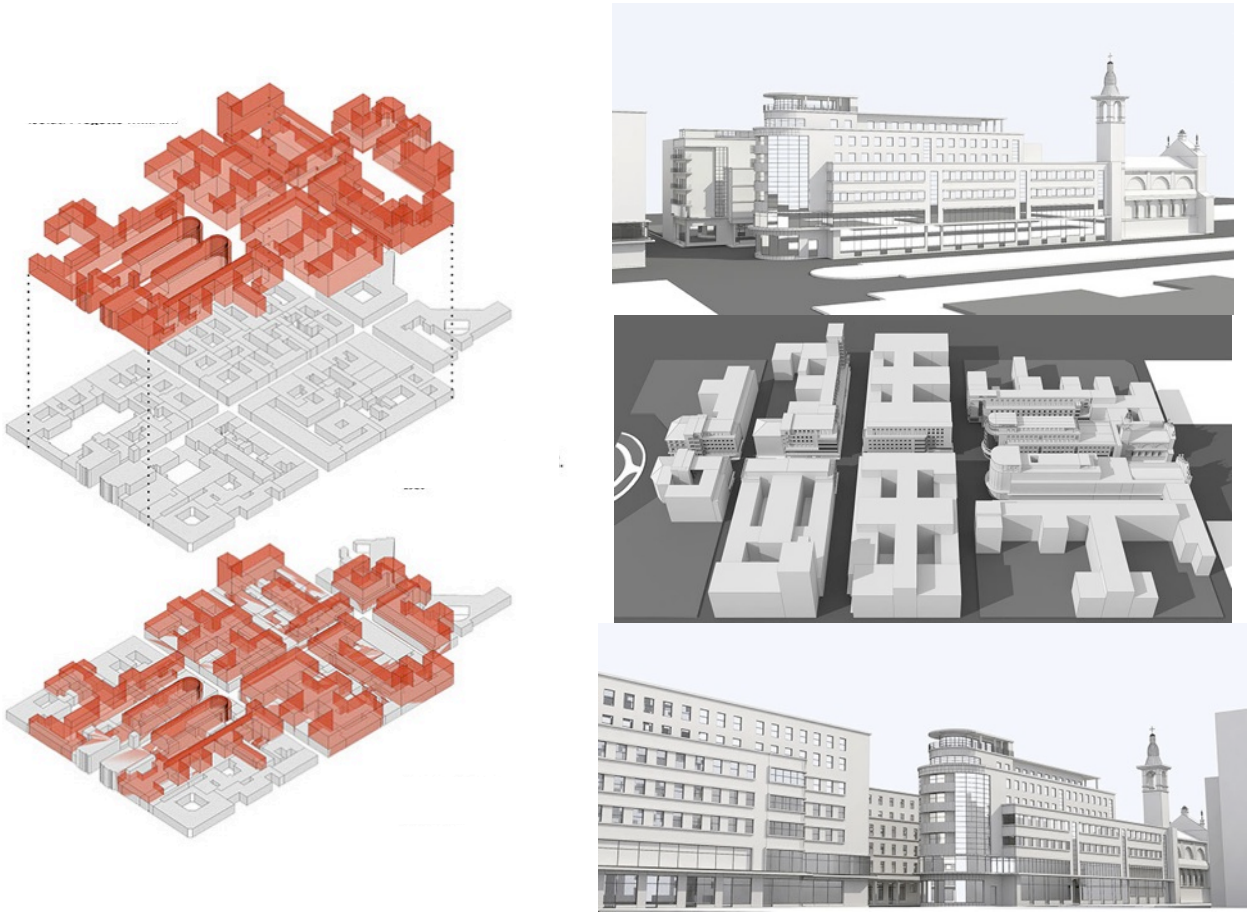
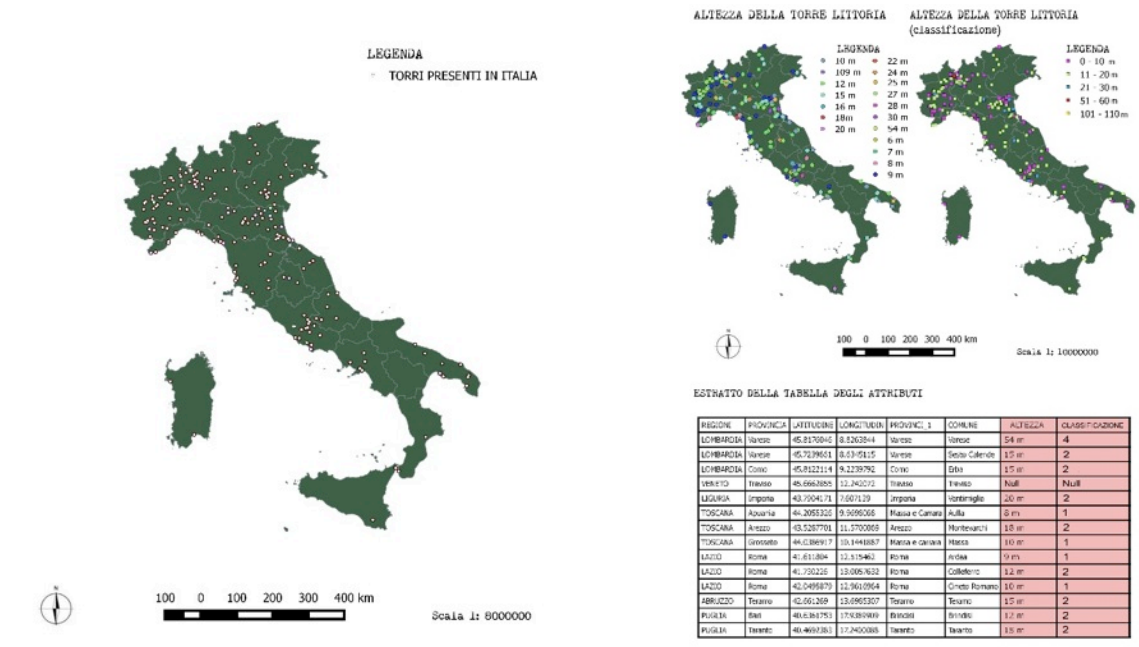


Fig. 6: 3D modeling of a portion of the design and of the buildings



REGIONE	PROVINCIA	LATITUDINE	LONGITUDINE	PROVINCI_1	COMUNE	ALTEZZA	CLASSIFICAZIONE
LOMBARDIA	Varese	45.8170845	8.8263844	Varese	Varese	54 m	4
LOMBARDIA	Varese	45.7239651	8.8345115	Varese	Sesto Calende	15 m	2
LOMBARDIA	Como	45.8122114	9.2238792	Como	Ebbi	15 m	2
VENETO	Treviso	45.6667855	12.240272	Treviso	Treviso	Null	Null
LIGURIA	Imperia	43.79041.71	7.607129	Imperia	Ventimiglia	20 m	2
TOSCANA	Apuania	44.2055328	9.9696066	Massa e Carrara	Aulla	8 m	1
TOSCANA	Arezzo	43.5287701	11.5700868	Arezzo	Montevarchi	18 m	2
TOSCANA	Grosseto	44.0386917	10.1441887	Massa e carrara	Massa	10 m	1
LAZIO	Roma	41.611804	12.515462	Roma	Ardea	9 m	1
LAZIO	Roma	41.750216	13.0057632	Roma	Colleferro	12 m	2
LAZIO	Roma	42.0495879	12.9610964	Roma	Civita Romano	10 m	1
ABRUZZO	Teramo	42.661269	13.6965307	Teramo	Teramo	15 m	2
PUGLIA	Bari	40.6364753	17.9389899	Brindisi	Brindisi	12 m	2
PUGLIA	Taranto	40.4697361	17.2400085	Taranto	Taranto	15 m	2

Fig. 7: Thematic maps generated on a GIS platform describing the diffusion of the “torri littoria” in Italy and their classification by considering the height

Moreover, peculiar urban stories are strongly related to the main history. As it is well known by the specialized studies, the modernization in this period was part of a larger government plan in Italy that is underlined by the tower, the *torre littoria*, in one of the blocks near the main square. This typology links to the fascist period with the range of the similar buildings realized in other sites in Italy and in the countries of a

larger territory under the Italian control at that time. A GIS is devote to collect and spatialize this information by using the copious studied published on the subject (Fig. 7).
The list of “torre littoria” buildings has been extracted from published cataloguing by considering different attributes (e.g. structural solutions, architectural models, physical dimensions, etc.) able to give to the users a complete view of this phenomenon and the today situation in all the Country

5. Conclusions

Despite the first studies presented above, this research aims to create digital environments for each block. They are conceived as databases collecting the documentation linkable also by the 3D models as sources. This approach also is asked by the complexity and quantity of records.
A careful design of the databases is the main step in digitization of historical research: the balanced mixing of different skills involved in the research is the starting point to select the correct set of feature types, the list of attributes and the connection with 3D models.
All the digital solutions pays attention to valorize the historical research results and are documented in such a way to allow a complete and effective use also for other possible researches. Open source format (e.g. shapefile for GIS layers and 3Dpdf for 3D models) are used to reach this last goal.
In the first case (Turin in the 19th century) the punctual buildings are used as a key telling about the city, in the second case (Turin in the 20th century) the urban area is the key to go through single stories of blocks, plots or uses.
In both examples, the result obtained has been to allow a wider access the rich heritage in the archives, museums and libraries. The aim has been to share the outcomes of the research and to produce a visualization of the data interpretations in order to achieve digital tools effective to grasp the Cultural Heritage.

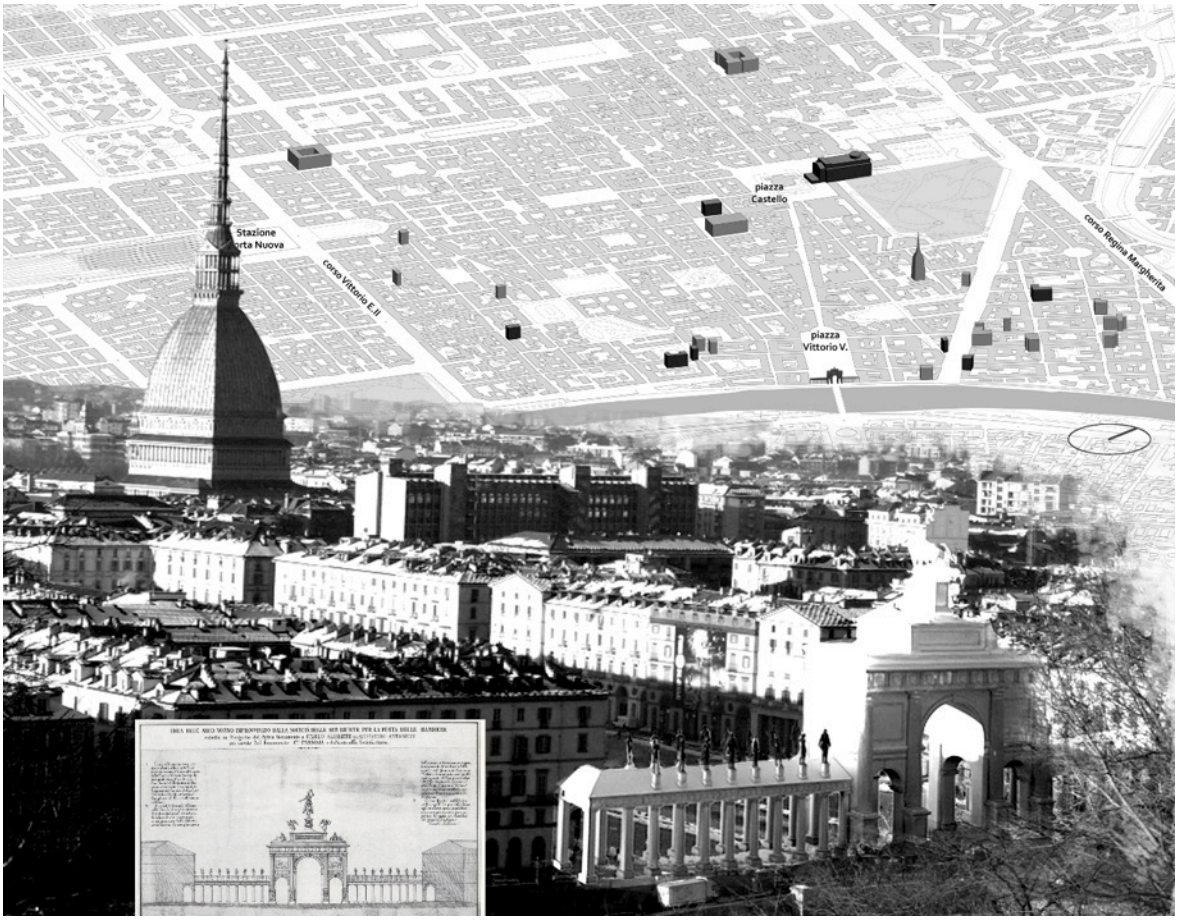


Fig.8: The digital tools linking the data visualization to the drawings in the archives

Bibliographical References

[1] BODENHAMER DAVID J., The Spatial humanities: space, time and place in the new digital age, in WELLER, Tony (ed.), *History in the digital age*, London - New York: Routledge, 2013, p. 23-38

[2] DAVIS Michael T., 'Ci poes vos veir': Technologies of Representation from Drawing to Digital, in BORK Robert, CLARK William W., MCGEHEE Abby (eds.), *New approaches to medieval architecture*, Farnham: Ashgate, 2011, p. 187-233.

[3] NOBLE, Joseph V. *Museum Manifesto*, in *Museum News*, Vol. 48, n. 8 April 1970, p. 16-20.

[4] ROSSO, Franco. *Alessandro Antonelli 1798-1888,* Milan*:* Electa, 1989

[5] TREDINNICK, Luke. The making of history. Remediating historized experience in WELLER, Tony (ed.). *History in the digital age*, London - New York: Routledge, 2013, p. 39-60.

[6] GUIDI, Gabriele; RUSSO, Michele. Reality-based and reconstructive models: digital media for cultural heritage valorization. *SCIRES-IT*, 2011,*1*(2): 71-86.

[7] PAVLIDIS, George, et al. Methods for 3D digitization of cultural heritage, in *Journal of cultural heritage*, 2007, 8.1: 93-98.

[8] YANG, Wun-Bin; CHENG, Hung-Ming; YEN, Ya-Ning. An Application of GIS on Integrative Management for Cultural Heritage-An Example for Digital Management on Taiwan Kinmen Cultural Heritage. In: AA.VV. *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection*. Springer International Publishing, 2014. p. 590-597.

[9] DURÁN-DOMÍNGUEZ, G.; FELICÍSIMO, A. M.; SÁNCHEZ-SOTO, P. J. The representation of Cultural Heritage: Methodologies for digital characterization, in ROGERIO CANDELERA, Miguel Angel *Science, Technology and Cultural Heritage*, London: Taylor& Francis Group, 2014, p. 363.

[10] MOURA, Ana Clara, et al. Parametric Modeling of Urban Landscape: Decoding the Brasilia of Lucio Costa from Modernism to Present Days. *Tema. Journal of Land Use, Mobility and Environment*, 2014.

[11] GOMES, Leonardo; BELLON, Olga Regina Pereira; SILVA, Luciano. 3D reconstruction methods for digital preservation of cultural heritage: A survey.*Pattern Recognition Letters*, 2014, 50: 3-14.

[12] POLETTO, Sandra. *Via Roma 1861-1937: dai progetti di abbellimento al piano di ricostruzione urbanistica*, Ph.D Dissertation, Turin: 2000.

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HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Algorithmic Transformation between Heritage and Design Innovation

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Abstract
The spread of digital modellers based on the scripting of algorithms helped the development of an alternative method of design and representation, which is able to shape innovative configurations, which generate from the "growth" of a beginning cell by repetition with continuous transformation. The applications to design triggered the formal research and the debate about the definitions of these new processes that underline a deep change from the experience of the past. The generation of form by the drawing up of algorithms promotes the importance of the code-procedure concept: if the solution to a problem can be described in a finite number of steps, in the same way the identity of a form is the consequence of a series of discreet rules that define it. In fact, the use in the design of computers and algorithmic processes, does not preclude a strong continuity with settled theories and practices from previous centuries. On a careful analysis, the heritage that led to this innovative approach ranges across the history of the mathematics, art and architecture design. Then it consolidated in some fields that seem to be unrelated to the world of design, such as cognitive science, biology, linguistics, musical composition and philosophy. The range of historical, geographical and cultural contexts reveals the use of geometry's laws as a matter in which art and science merge to create regulatory formulas. This paper reconstructs the ties with the history of procedural design, by the comparison of examples with similar methodologies.

Keywords: lattice, scripting, symmetry, tessellation, textile design

1. Introduction

In the introduction to Machining Architecture, L. Spuybroek states that: "The computer has reached a cultural stage, finally. The years that it was used for dreaming of perfect shape grammars and design automation (...) or, worse, used for dreaming disembodied dreams of an architecture floating in cyberspace – those tears are over. Also finally and especially important for the architectural profession, computers have outgrown their servile function in the digital drawing room, where the real design was still done far away from the machines, sketched by hand, guided by genius."[1] The last few years revealed the effect of the information revolution on the project. The new generation grow up together with digital technologies, developing a different approach, which is apparently free from the cultural conditioning of the past. The professional maturity of digital natives matches the transition to a new concept, in which the design is no longer an addition of parts and phases hierarchically ordered and/or subordinate each other, but it is the concept of a developing form. This is governed by rules that are implicit in the process itself, as well as in the organic model. Digital technology adapted to designers' needs: direct interaction systems facilitate the access to the scripting, which is the information code that define the shape. The easy interface with the computer reference facilitates the evolution of Computer Graphics in Digital Design, reconstructing the identity between Drawing and Design. The computing controls the complexity of the Design, by the application of dynamic systems that are inspired by the Mathematics. Actually this science developed its models in the attempt to find a recognizable to explain chaotic systems that govern natural phenomena.

[1] L. SPUYBROEK, 2004. Page 4

The tools of the digital representation encouraged the development of complex forms just by organic inspiration. They are characterized by the reference to movement and transformation. These concepts are extraneous to Architecture's mood. The dynamic articulation of Deconstructivist Architecture, which refers to the mathematical concepts algebra and to the relational geometry of graph, involves three different innovation levels: conceptual, geometric and material. The first two ones are directly related to the mathematical process that controls the design to the final form. The third is an indirect consequence of the research on geometric properties of shapes, in its creative application to the development of new materials and/or their innovative uses.
This paper aims to reconstruct the historical roots of the Generative Design. The goal is to identify its disciplinary matrices, as an essential contribution to the renewal of the Design teaching. Only the knowledge of the rules of the form allows the management of the digital project without falling into formalism. In fact, the awareness of scientific references and cultural roots of digital tools helps the definition of formal parameters and transformation codes that rule the digital Design.

2. Form and Design, the Pattern.

The application of digital technology to the project changed the shapes of the Architecture as a consequence of the easier representation of complex shapes, but above all it is changing the Design methodology. The focus shifted from the layout composition to the development process: from the additive tectonics of building elements, to the shape-process that rules the articulation of a dynamic and responsive body. The form is born from the combination of codes and factors working together. This synergy defines growing lines and tectonic features that are able to interact with the environment. Digital technology supports topological transformations that subvert the proverbial static of the Architecture. The computing manages the complexity of the Design process by dynamic systems that apply the concepts of the Mathematics, which developed its models in the attempt to find a rule in chaotic systems that govern natural phenomena. They refer to the Biology, finally. Thus Design is closer to the organic reference of nature patterns that inspired the arts in the past. It does not only imitate the visible articulation of exterior shape, or the structural design and distribution as in the past; it goes further and applies just the growth process and the adaptation to the environment of the organic forms in responsive architectures.
The two approaches could be called "constructive" and "evolutionary". They apply design patterns that are related to antithetical archetypes that follow the classical theory of proportions:
- the modular aggregation of smaller units,
- the harmonic decomposition of the whole.

Both of them define the form by the transformation of basic shapes through dimensional- and shape-parameters that refers to common categories; a great variety develops from simple form. The two alternative concepts get a respective feedback in the "pragmatic" reference to the building activity that characterizes BIM applications and in the "conceptual" identity of the form as the result of a growth or a transformation. This organic process is ruled by reiterative algorithms, which apply elements related to the basic concepts of the Design theory and to the definition of the movement, then of the growth from a "starting" cell:
- the laws that control forms, their additive aggregation and/or harmonic decomposition;
- the categories of orientation and space-time movement;
- references to organic growth and diachronic transformation.

The "Shape Grammar" refers to the basic rules that govern the primitive concepts of Design Theory. They derive directly from the application of primary concepts of the Arithmetic and basic Geometry to Design. They are in symmetrical structures of the ornament and in the in modular and hierarchical concept of the Architectural Order, as well they are are evident in the layout of the decoration design:
- the rigid movements of the four elementary symmetries,
- the concept of serial or cyclic repetition or decomposition, following Cartesian or polar grids.

They are possible all possible combination of previous patterns. The regular combination of equal or similar elements in a pattern allows innumerable designs with a limited number of basic elements, developing a great variability of shapes from a single theme. In 1707 Douat[2] shows the permutation up to a maximum of four elements, developing the design possibilities in black and white patterns, alike the combination of the amino acids in the DNA chain, whose configurations variety codes a huge number of properties, trough the permutation of a small number of elements.

[2] S. TRUCHET, *Méthode pour faire un'infinité de dessins dif¬ferens avec de carreaux mi-partis de deux coleur par une ligne diagonal ou observation di Pere Dominique Douat*. Paris, 1722.

The pattern is the basic concept. It holds and drives and drives the structure of the beginning unit than as well the rule of the design process. Depending on the context, the term *pattern* can mean “design”, “model”, “scheme” or “repetitive structure”. This word is not normally translated in Italian, where curiously it has lost its Latin etymon *Patronu(m)* “master”, “patron”, but also “model to follow”. The word derives from *Pater,* which can be traced to the Greek πατήρ*,* “father”, he who generates and gives structure to the family[3]. As such, according to its original meaning, *pattern* means the role of those who shape and regulate the behaviour of a series of people or objects.
Its contemporary use mainly refers to those cases where one or more entities are distributed in an organised way in space or time. With this meaning the concept is widely applied in the most diverse of fields, form computer science, to biology and meteorology.
In basic design the word *pattern* define the ordered repetition of a series of forms, i.e. portions of space determined by boundary lines or external surfaces. Virtually every line or form repeated with sufficient frequency produces some kind of pattern. However complex or complete it may be, a single trace is not a pattern but a unit that may eventually form part of a more structured pattern.[4]
The specificity of a pattern therefore derives from the presence of rules necessary for combining the various units. If we go beyond the graphical and ornamental use to which they are often relegated in the design field, we can regard patterns as abstract devices that are able to describe and organise the relations between the components of a system and determine their essential features. The repetitive and redundant nature allow for gradual variations that allow them to adapt to and respond to changing conditions.
In the production of artefacts, patterns have always been used in decorations as a useful tool for highlighting the regularity and specificity of the cultural world compared to the natural world. The ability of human beings to recognise patterns in the reality that surrounds us, such as cobblestones on a little road, in the bifurcations of tree or in the clouds dotted across the sky during the day for example, is proof of the fact that the creation of patterns is one of the oldest known human customs. Ernst Gombrich believes that it is both the specific and repetitive nature of patterns that enabled us to perceive the “sense of order”, i.e. that ability that allows us to find our bearings in space, establishing a relationship between an unchanging object and a changing background.
These concepts lead the twentieth century experimental experiences that accompany computer birth and success. In fact computer offers *the chance to program the creation of any type of order and to study the effects*. Thirty years ago Gombrich himself highlighted the computer's ability to follow any organization’s complex rule, but also to introduce a dose of randomness exactly calculated. The great innovation was the possibility of obtaining configurations that admit casualness, within a grid of predetermined movements. These last are elements of aesthetic interest that offer unparalleled understanding of the operations of “our sense of order in the perception of complex schemes.”[5]

3. Rule and transformation. The organic model

Many authors have highlighted the role of natural examples in the development of mathematical concepts through which man tries to explain physical phenomena, and it is interesting to note how the mathematical models of natural structures have been revised and adopted as a means to solve constructive or formal design problem.[6]
The earliest documentation belongs to Vitruvius, followed by all the treatises of the Renaissance, but only D'Arcy, at beginning of the last century, reveals the scientific reasons, proving that nature uses efficient forms that anticipate man’s imagination and genius.[7]
In nature “*all changes are small changes. Though a transformation can have a large effect, it is always a relatively small step, and the newness of the new can never be appreciated right away*.”[8]
The organic inspiration design forms are once again result of availability of adequate representation tools capable of integrating natural processes of construction of the form in the modelling. Processes such as genetic algorithms and cellular automata are instruments that take from living organisms fundamental principles such as growth or self-organisation and inject them into the formal process.
Computer dynamic tools are able to transfer at artefacts the capacity to capture and metabolize complex interactions with the environment and the user. Employing same principles used by nature to shape a leaf, a shell, or an ecosystem allows you to design artefacts and living spaces in the best suitable form to respond

[3] See Oxford English Dictionary
[4] D. K. WASHBURN, D. W. CROWE, 1988.
[5] E. GOMBRICH, op.cit, pag 114.
[6] R. PENROSE, op. cit.
[7] W. D’ARCY THOMPSON, 1917
[8] L. SPUYBROEK, 2004, p. 9

to human needs. Digital form generation proceeds in a similar way to growth of the organisms and evolutionary process. Step by step it determines an unstable equilibrium, which ensures maximum efficiency to shape and shows its *concinnitas* in *euritmia* of design[9].
The difference from the past is the shift from static equilibrium, which arises from the periodic symmetries elementary of nineteenth century ornamental grammars, to a search of dynamism through a recognizable change of base module pattern. "*Our language of patterning is based on similar principles of translation, reflection and rotation, though it can reach a higher level of complexity since there are no exact borders between figure and configuration. All figures have internal and external transformation that interact with effects like merging, hooking, crossing, sliding, opening, nesting*."[10]
According to Gombrich sense of order is a innate category and our perception captures the contrast between order and disorder, reading *regularity* as an index of *intentionality*. The design is configured in recognizable forms ordered according to rules related to the adoption of uniform repeating modular pattern, whose conception derives from the construction with minor elements, such as weaving and texture[11]. Pattern produce ordered drawings, generated by regular repetition of forms, according to preconceived but variable schemes, based on the laws of symmetry, which apply rigid elementary movements.
The module, repeated according to sequences, identifies a reference grid based on elementary forms who apply serial periodic combination serial with undifferentiated cyclic repetitions.
All periodic plane tilings adopt grids with equal quadrilateral or triangular/hexagonal mesh, which can be both regular or irregular.[12] The different systems provide a serial or polar organization, where the hierarchical arrangement of forms involves two distinct and related phases: *the framework*, namely the definition of the domain with an edge (frame) and *the filling*, or the organization of field defined from the domain.
Christopher Alexander was the first to introduce the term pattern in relation to a design process that deconstructs the design determinants and then recomposes them using language. In accordance with systemic theories, Alexander regarded pattern as a tool for interpreting and describing the organisation of the phenomenal realm. The academic conceived of the designed environment as a complex inanimate system, which, however, takes the form of a living system thanks to its continuous interaction with man. According to Alexander, contemporary design does not take sufficient account of the concrete experiences that derive from construction traditions and the peculiarity of the places, meaning that in the end the projects do not meet the real needs of the users. For eight years he studied the shared languages of different social groups in various nations, extrapolating patterns that could organise and produce the form of artefacts and buildings. These patterns were then reinserted in a hierarchical dependency context: every pattern is connected with a higher level and a lower level. The result is a language in which patterns are words and the designer can freely use or modify them, developing their own design syntax.
In his book *A Pattern Language* Alexander proposes 253 specific patterns, each one to solve a specific physical and social problem, which can be combined to offer infinite combinations and possibilities. These include patterns that organise the configuration of the roof, the ceiling, floors, pillars, the heating, ornaments and seating.
The distinctive feature of Alexander's studies is way he starts by looking at human behaviour and analysing the archetypes of various cultures before developing the design process, acknowledging that it has the ability to create ordered emerging structures that are the fruit of the interaction of the parties involved. His mathematical training contributed to reducing the design process to its invariants before extrapolating formal roots that can generate coherent morphologies.
Paradoxically, Alexander's studies have not been developed yet in the design field, enjoying notable success, rather, in the field of computer science. In fact, in 1995 his theories were taken and adapted to computer science by four researchers: Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, authors of the revolutionary book *Design Pattern: Elements of Reusable Object-Oriented Software* and universally known as the "Gang of Four". The method proposed in the book stems from Alexander's idea of generalising the relationship between the context and a set of conditions related to that context and a solution that solves the problem, which can later be applied to other situations. In any case, after forty years and thanks to computer science, Alexander's theories have sparked new interest in the field of Design. Computers allow us to manage increasing amounts of data and the use of algorithmic modelling software arranges the determinants necessary to define the relations between the parts.

[9] According to Gottfried Semper Man, in his creations, builds a miniature world that evokes the unreachable perfection of the wonders of nature. By the discovery of rules that generate forms of ornament mankind satisfies his cosmogonic instinct, frustrated by the inability to explain the deep essence of reality.
[10] L. SPUYBROEK, 2004, p. 272
[11] See E. GOMBRICH, 1979.
[12] The composition of quadrilaterals tile derived from the decomposition of the regular pentagon, with which it is not possible to cover plane without interstices. *Darts* and *kites* tiles instead produce aperiodic tilings such as those patented by Penrose, but also present in the Persian *girih* sixteenth century.

One of the key operations of procedural design is the choice of the parameters on which the design depends. This process of identification coincides with that of the recognition of the patterns proposed by Alexander. The language of patterns has finally returned in the world of design thanks to generative modelling tools.
Shape grammar is the name assigned to systems algorithms that generate geometries from Stiny and Gips[13] that in 1971 applied to computerized graphics the linguistic principles of Noam Chomsky.[14]
Digital grammar consists of a set of rules and a generative engine, which applies them to primitive element, repeating n times the same process. In this way the rule defines the transformations due to subsequent applications. A generative grammar consists of at least three rules:

- a starting rule that triggers the process,
- one or more transformation rules,
- the final rule that stops it.

The parametric structure of the rules allows the definition of the relative size of the parties and controls transformation process through mathematical functions, enabling the creation of a wide variety of possible variants of a single model.
Same mechanism can be applied to elements of increasing complexity, in which the final shape is the result of various parameters and algorithms. The application of the rule is thus a combination of factors in synergy with each other, acting repeatedly to produce more and more complex configurations, as in fractals.

4. Conclusion. Linguistic-mathematics legacy.

The same laws applied to digital generative form creation were center of interest for mathematician Andreas Speiser, founder of *Group Theory.* His research will be further developed by the experiences of Basic Design theorists at the School of Ulm, which was the real incubator of *Shape Grammar* and *Generative Design*[15].
The historicised definition of ornamental grammar anticipates the current concept of "formal grammar" in the exposition of design composition laws and emphasizes the reference to decoration as expressive language.
Nineteenth-century ornamental grammars have applied to design the rules of permutations theorized at the beginning of the previous century by Dominique Douat and published in 1722 by Sébastien Truchet, listed as the author of the first treaty explicitly dedicated to design theory.[16]
Reference concepts and designing results of digital innovation have renewed interest in principles and rules of classical treaties and historical theory of the project, focused on the concepts of form and proportion, repetition and variety, similarity and change.
Taken cyclically and updated, basic design concepts, which derive directly from mathematical rules of symmetries on which is built the design technique for ornament, have reacquired importance in primary methodological process of the digital project. The multiplication of studies on design pattern laws and on aggregative rule is reflected in the statement by Owen Jones[17], according to which the secret of ornamentation success derived from the production of a general complex motif with repetition of a few simple elements. Gottfried Semper[18] believes that these fundamental laws of form in which nature operates are: symmetry, proportionality, directionality.
Theoretical basis of design are then the first cultural reference for contemporary design culture, which has upgraded the concept of organism, evolving his interpretation of natural pattern, made of harmonious regularity, but also made of dynamic transformations, adaptations to the environment and movement. Thanks to technological innovation, the imitation of nature has shifted from formal similarity to resumption of growth process that characterizes life. Remain valid, however, the requirement of formal laws for design and project.
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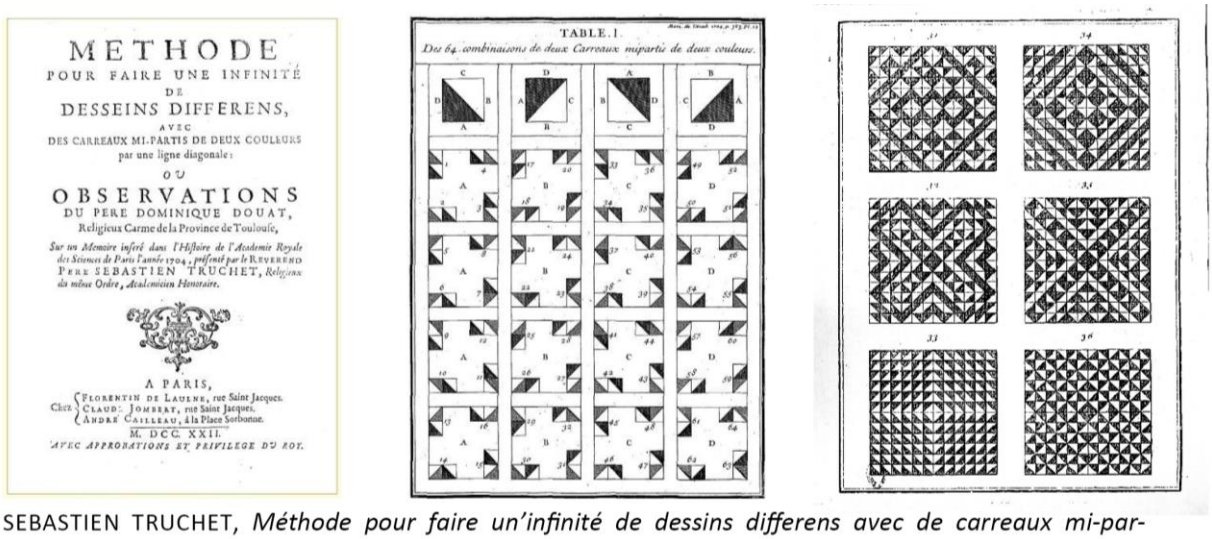
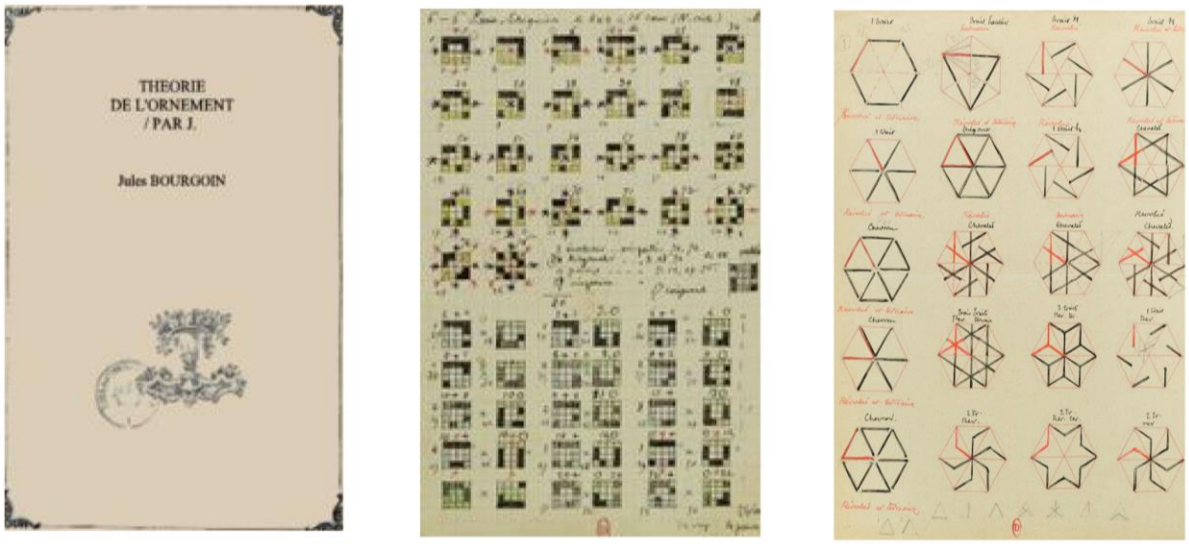
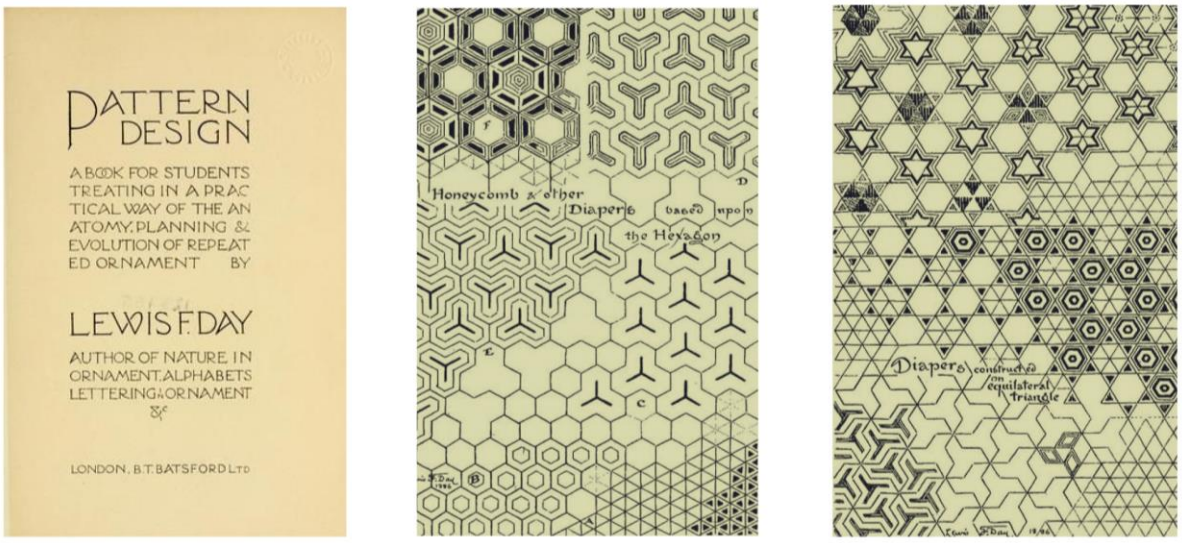
[13] STINY, G. E GIPS. 1972
[14] N. CHOMSKY, 1980.
[15] *"Generative Design is a morphogenetic process using algorithms structured as not-linear systems for endless unique and un-repeatable results performed by an idea-code, as in Nature*", www.celestinosoddu.com
[16] E. GOMBRICH, 1979, p. 90. Truchet is also the inventor of the system to measure in points the size of font.
[17] O. JONES, 1856.
[18] G. SEMPER, 1860.



SEBASTIEN TRUCHET, *Méthode pour faire un'infinité de dessins differens avec de carreaux mi-partis de deux coleur par une ligne diagonal ouobservation di Pere Dominique Douat*. Parigi, 1722.



JULES BOURGOIN, *Théorie de l'ornement*, Parigi,1873.



LEWIS FOREMAN DAY, *A Pattern design,* Londra, 1887.

Fig. 1: Some of the main historical treatises concerning the creation of pattern.

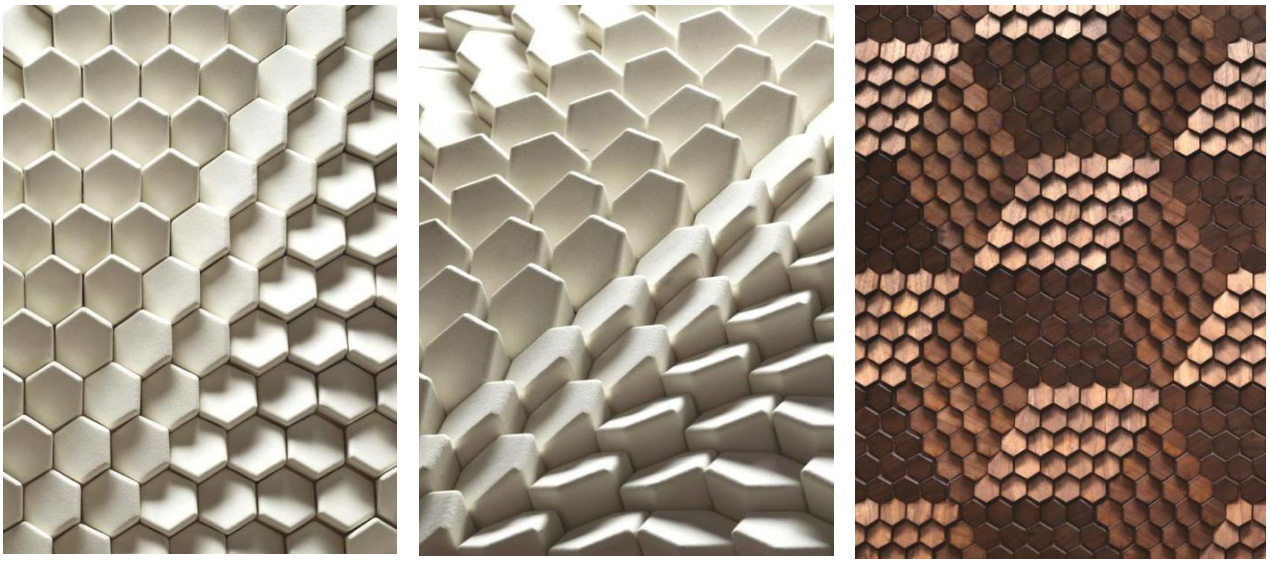


Fig. 2: Innovative surfaces for interior design created thanks to generative systems.

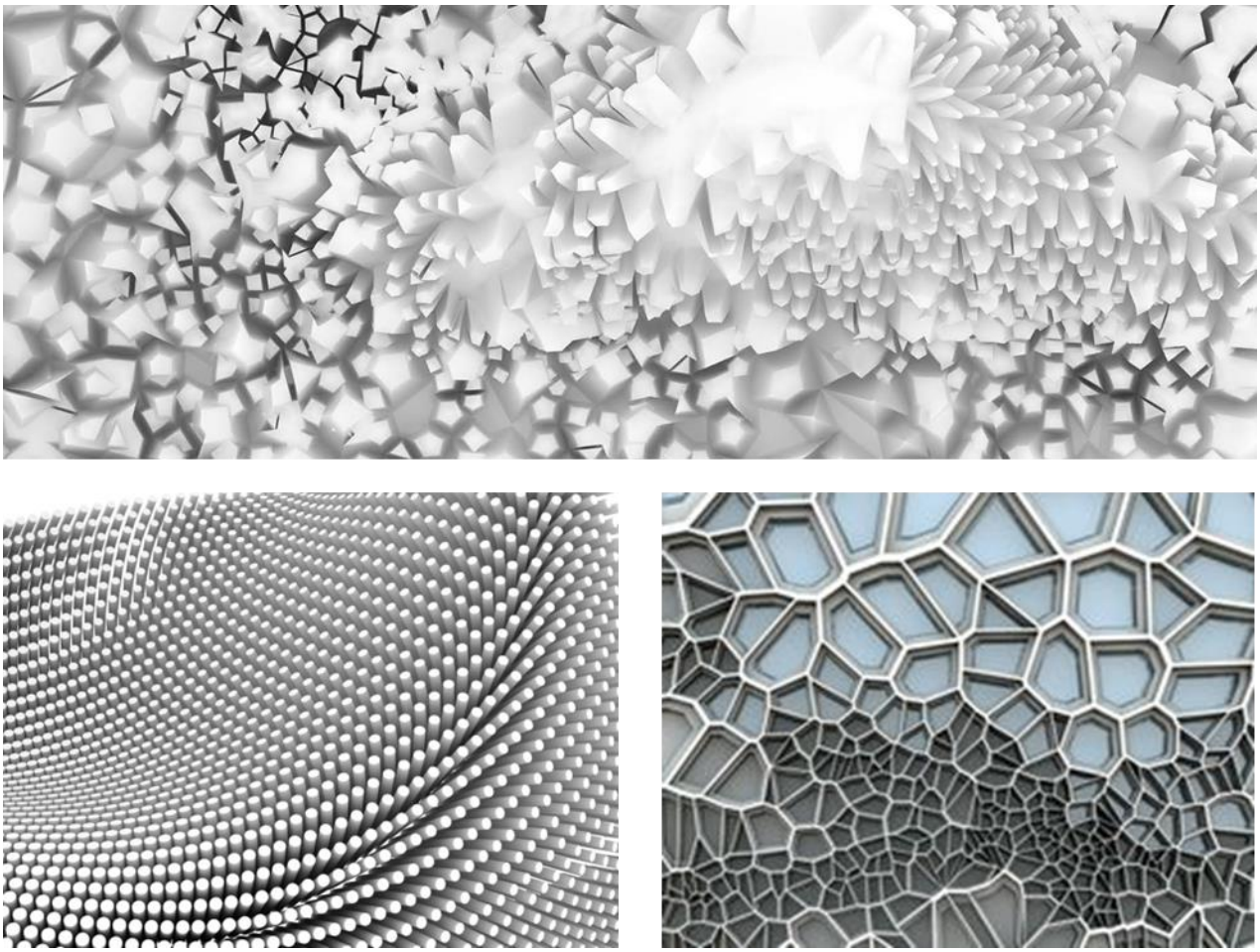


Fig. 3: Results of algorithmic modeling based on morphogenetic principles of nature.

Bibliographical References

[1] TRUCHET, S. *Méthode pour faire un'infinité de dessins differens avec de carreaux mi-partis de deux coleur par une ligne diagonal ou observation di Pere Dominique Douat*. Paris, 1722.

[2] JONES, O. *The Grammar of Ornament*. London, 1856.

[3] SEMPER, G. *Der Stil*, Munchen, 1860-63, trad. it. Parziale a cura di B. Gravagnuolo, Laterza, Bari, 1992.

[4] DAY, L.F. *The Anatomy of Pattern*. London, 1897.

[5] D'ARCY W. THOMPSON, *On growth and form*, 1917.

[6] SPEISER. A. *Die Theorie der Gruppen*. Zurich, 1937.

[7] CHOMSKY, N. *Studies on Semantics in Generative Grammar*, 1972

[8] STINY, G., GIPS, J. *Shape grammars and the generative specification of painting and sculpture*. In Information Processing 71, pp. 1460–1465. North-Holland Publishing Company. 1972

[9] STINY, G. *Algorithmic Aesthetics*. University of California Press. 1978

[10] GOMBRICH, E. *The Sense of Order. a Study in the Psychology of Decorative Art.* Oxford, Phaidon, 1979.

[11] CHOMSKY, N. *Rules and Representations*, New York: Columbia University Press. 1980.

[12] STINY, G. *Introduction to shape and shape grammars*. Environment and Planning B: Planning and Design 7(3), 343-351. 1980.

[13] D. K. WASHBURN, D. W. CROWE, Symmetries of Culture: Theory and Practice of Plane Pattern Analysis, Washington, University of Washington Press, 1988

[14] GAMMA, E.; HELM, R.; JOHNSON, R.; VLISSIDES, J. *Design Pattern: Elements of Reusable Object-Oriented Software.* 1995.

[15] SPUYBROEK, L. *Nox. Machining architecture*, Thames & Hudson, Londra, 2004.

[16] PENROSE, R. *The Road to Reality: A Complete guide to the Laws of the Universe*. Vintage Books.

[17] STINY, G. *Shape: Talking about Seeing and Doing*. MIT Press, Cambridge, MA. 2006

[18] LANGELLA, C. *Hybrid design. Progettare tra tecnologia e natura*, Franco Angeli, Milano, 2007.

[19] V.V. A.A. *Nature Design. From inspiration to innovation, Museum für Gestaltung*, Zurigo, Lars Müller Publishers. 2007.

[20] ALEXANDER, C. *Notes on the Synthesis of Form*, Cambridge, Massachusetts: Harvard University Press, 1966.

[21] ALEXANDER, C. *A Pattern Language: Towns Buildings Constructions*, Oxford University Press, Oxford, 1977.

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HERITAGE and TECHNOLOGY
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Structure and geometry

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Abstract
It is possible to characterize a family of architectural forms produced by affine transformations, or compositions of translations and linear transformations can characterize strongly three-dimensional space in which it takes place and develops human life. In this regard it prepares to present their configurational capabilities through descriptive analysis of some of the history of past and contemporary exempla. Narrowed has the scope of the analysis to some architecture and design of the two protagonists, the past and the present, the international architecture scene: the engineer Pier Luigi Nervi and the architect Christian Kerez, which is a great infrastructural protagonist of twentieth century and an interesting figure of the new structuralist European rationalism. In this perspective, it is evident the contiguity of research and formal affinity of related projects in the line of the use of geometries and complex structures for architectural configuration of their works, by comparing two projects figures distant in time and space: a comparison based on the use of reason identified as geometric matrix configuration of an architecture conceived as a work of reality and rationality.

Keywords: Drawing, Structure, Geometry, Pier Luigi Nervi, Christian Kerez.

1. Introduction
The importance of Euclidean geometry in the definition of typological structure of an architectural design, that of two-dimensional nature, is a cleared condition in the complex origin process and development that characterises architectural configuration, so that the projective geometry is fundamental in the determination of morphological and three-dimensional characteristics of its external shape and of its internal space.
Not only this.
Considering that in math, the affine geometry, that represent the science that studies the affine spaces, occupies a middle place between Euclidean geometry and projective geometry, it is possible to individuate a family of architectural shapes product by affine transformation, in other words between translation and linear transformation compositions able to characterise the three-dimensional space in that happens and develops the human life.
Originated by eighteenth century studies of differential geometry by Johann Carl Friederich Gauss and mathematical developed by Hermann Grassman in the nineteenth century, the affine geometry, debating those arguments of Euclidean and projective geometry, that can be developed without the concepts of measure angles, illustrates their configuration abilities across the descriptive analysis of a several exempla in the history of past and contemporary architecture.
Not wanting to debate a systematic study of the infinity and complex configurative potentiality of architecture - strictly connected to use of Euclidean geometry, affine and projective geometry, the analysis field is restricted to a several projects of two past and present protagonist, of the European architectural scene, that characterises the architectural research of a large group of young contemporary architects like Valerio Olgiati, Eric Lapierre and Peter Markli.
In this respect it would be enough to compare only two designs of Pier Luigi Nervi and Christian Kerez to highlight the research and formal affinity of their projects in the use of complex geometries for the

architectural configuration: the parabolic structures of roofing for the Torino exhibition in 1949 and the Gaussian shapes of different flanked pavilions for Warsaw Museum of Modern Art in 2007.
Obviously, in relation of Pier Luigi Nervi activity, the catalogue of his projects ascribable to complex structural geometries is more wide compared to the Swiss architect, is the methods compatibility which is at the centre of work of two personality far in time and space: a comparison based on the use of geometric reason detected like matrix of an thought architecture as work of reality and rationality.

2. Pier Luigi Nervi and his work

In his projects, Pier Luigi Nervi, has made extensive use of structures and dome lights turn capable of covering very large spaces; from the typological point of view is a clear reference to the basic shapes "square" and "rectangle" liaising, then, with prospects "central" and "accidental".
As for the figure rectangular base, then its matrix topological and typological, Pier Luigi Nervi, with the aid of parabolic arches, summarizes the spatial form extrapolating what is ribbed structure coverage with reference to the great architecture of conceptual ' antiquity based on the principles of unity and repetition as, for example, the vaulted roofs of the Baths of Caracalla in Rome.



Fig. 1: Pier Luigi Nervi e Annibale Vitellozzi, Palazzetto dello sport, 1956-1960 (detail)

In his work, the principle of repetition and translation facilities uses developable surfaces through the division into simple geometric shapes that are then to configure the overall shape, structural and space, its architecture.
"If the assembly of the loads will be evenly distributed the" solution-type ', will be an arc or a parabolic profile, in order to vary in time, places or will, may take another form."
As for the approach to the core schema is immediate reference to the sports hall (with a diameter of 60 m, in collaboration with the architect Annibale Vitellozzi) and the Sports Palace (now Palalottomatica, with a diameter of 130 meters , in collaboration with the architect Marcello Piacentini), designed in 1956 and built between 1958 and 1960 on the occasion of the Games of the XVII Olympiad in Rome.
In this case, the central plant, direct references to Nervi are architectures of the past as the time of the Pantheon or the macrostructures funeral turn, the mausoleums, the Roman emperors, both with similar characteristics with regard to thickness and structural ribs, as well as we are given to see in many of the engravings of Giovanni Battista Piranesi in his Roman Antiquities de 'time of the first republic and the first emperors.
In the case of plants with a rectangular base, we will examine the structures in time, focusing mostly on the construction of hangars Tuscan the first half of the '900.



Fig. 2: Pier Luigi Nervi e Annibale Vitellozzi, Palazzetto dello sport, 1956-1960 (During the time of construction)

The Tuscan hangars designed by Pier Luigi Nervi between 1935 and 1942, were a consequence of the historical period in which they were conceived in that he was obliged to use the materials instead of other problems of limited availability. The analysis refers exclusively to graphic and photographic sources as the hangars of Orvieto and Orbetello were destroyed in the last days of World War II as areas of interest war.
At the time the most common materials for the construction of hangars were wood and iron.
Nervi realized the hangars using beams ribbed precast reinforced concrete in order to avoid the use of timber formwork.
As regards the shape of the structure, we note once mixed barrel and pavilion with reticular structure in concrete or iron cemented. This structure, thus constituted, can distribute the loads according to the directions of the ribs was doing so that are downloaded directly in the few points of support.
The download time of a beam that runs along the entire perimeter of the same, which in turn discharge in a timely manner the weight of the structure through which recall pillars punctual tensions exhaust.
So we could summarize it all in the connection between the surface (time), line (beam), point (pillar).
The structure is apparently complex, but, in reality, is nothing more than the set of a series of arcs which are then braided to form a mesh of square shapes; the resulting impact is that of a homogeneous structure, however, and that distributes light in a harmonious loads creating a hybrid between static and aesthetics.

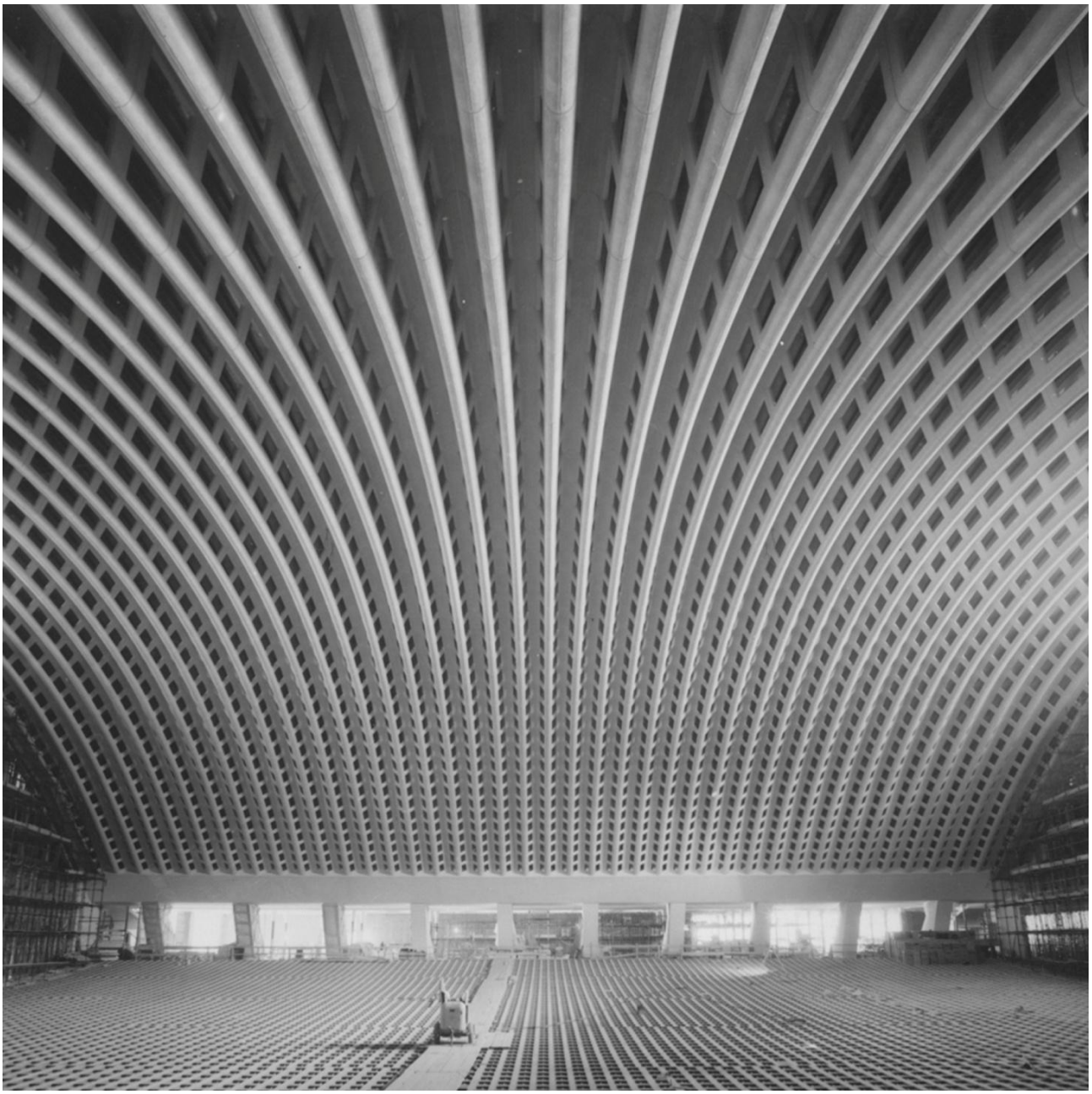

Fig. 3: Pier Luigi Nervi, Aula Paolo VI, Roma, 1966-1971 (Interior view)

"Once again the form and static are in perfect agreement also to deeper and less flashy root of static phenomena."
The hangars of Nervi we find in the two series: the first series in the period 1935-1938 to Orvieto and II series for the period 1939-1942 Orbetello. It is evident (also simply by the images shown here) which has been the evolution of the structure both as regards the materials used, both as regards the points of support on the ground of the same; in the second series the pillars and the decrease infill wall longitudinal disappears completely by making the whole structure more even light, all for the use of materials: ferrocement for drinking the first series and iron with regard to the second series.

3. Christian Kerez and his work

The analogy between design Pier Luigi Nervi and Christian Kerez is the result of the synthesis, structural and aesthetic geometric first and then, to which both have referred and, in this case, we are led to consider Pier Luigi Nervi as a precursor compared to what, only recently, has made Christian Kerez who, examining its design methodologies, considered as a guideline project during his studies.
Therefore, the review of selected projects is aimed at investigating the references design of the Swiss architect Christian Kerez, according to a digression involving projects of Pier Luigi Nervi who used purity, structural clarity and the absence of the decorations, as brought conceptual main for their accomplishments.



Fig. 4: Pier Luigi Nervi, Aviorimessa I serie, Orvieto, 1935-1938 (Interior view)

In 1980, after his studies, Kerez began to approach to architectural photography and started, then, working as a photographer getting passionate in infrastructure projects, dams, bunkers and starting to take account of the obstacles presented by particular structural conditions and so formal.
"The thing that is of interest in the architectural design of the building is Kerez house, as it is first manifesto of architecture and secondly you let it become a place inhabited.
Size does not disregard the quality of architectural design: a small house is no less interesting than a larger home.
The architecture for the idea and if this fails to be expressed in a small or a big house has little importance.
Kerez remains tied to the interest for large buildings, taking an interest in how to define spaces in a simple, concise, radical, with the repetition of a simple formula.
The ambivalence of his projects: on the one hand construction engineering that not only provide exclusively to solve economic problems and other buildings which eventually merge with the architecture.
The end result of his project is a symbiosis between engineering and architecture and is, at this point, clear how the issue of structural interest in the preparation of a project as a solution to find the essence of architecture."



Fig. 5: Christian Kerez, Museum of Modern Art, Warsaw, 2007-2014 (Detail of the model)

A very interesting project, especially after considering the review of projects of Nervi, is the Warsaw Museum of Modern Art in 2007, in which there are clear references to the modern architecture of the engineers.
The concrete structure conceived by Kerez is spread with a series of times thin barrel with parabolic profile, side by side to each other and supported by pillars; Again, at the peak, allow the passage of light through a cracking triangular meshes.
A synthetic form and unitary that succeeds in covering large spaces without forgetting to interface with the sensitivity of architecture despite the great outdoors jumping off the complicated relationship.
"After a long, tiring and controversial session, the jury chose the design of the Swiss architect Christian Kerez, author of the interior of the Kunstmuseum Liechtenstein in Vaduz. But the minimalism of the project was not liked by the responsible person in charge of the museum, Tadeusz Zieleniewicz, which asked the city administration to abandon the project because, according to him, 'the future building would not be able to become a new symbol of Warsaw, and therefore do not would have replicated the Bilbao effect', where the image of an anonymous Spanish city came completely transformed by the construction of the spectacular Guggenheim Museum. [...] Unfortunately, although extraordinary, the draft Kerez went in the opposite direction compared to the expectations of the general public. A strong movement of opinion in the press asking other conceptions 'in line with our aspirations' [...]



Fig. 6: Christian Kerez, Museum of Modern Art, Warsaw, 2007-2014 (Detail of the model)

Since then, the problems of realization of the project Kerez have multiplied. In 2009 the City forced the architect to alter the spatial distribution of the building, giving space to the future home of the theatre TR Warszawa. Consequently, the architect was asked to change the whole concept of the interior, and finally, to redesign the entire building.
The construction was postponed. [...] The administration has not only delayed the construction, but also dealt with the draft Kerez as waste paper. [...] One can only regret that this "anti-icon", building unsuited to our tastes and our mentality, we both passed under the nose. In short, if we are not old enough to appreciate contemporary art, certainly we cannot appreciate the avant-garde architecture of Kerez."

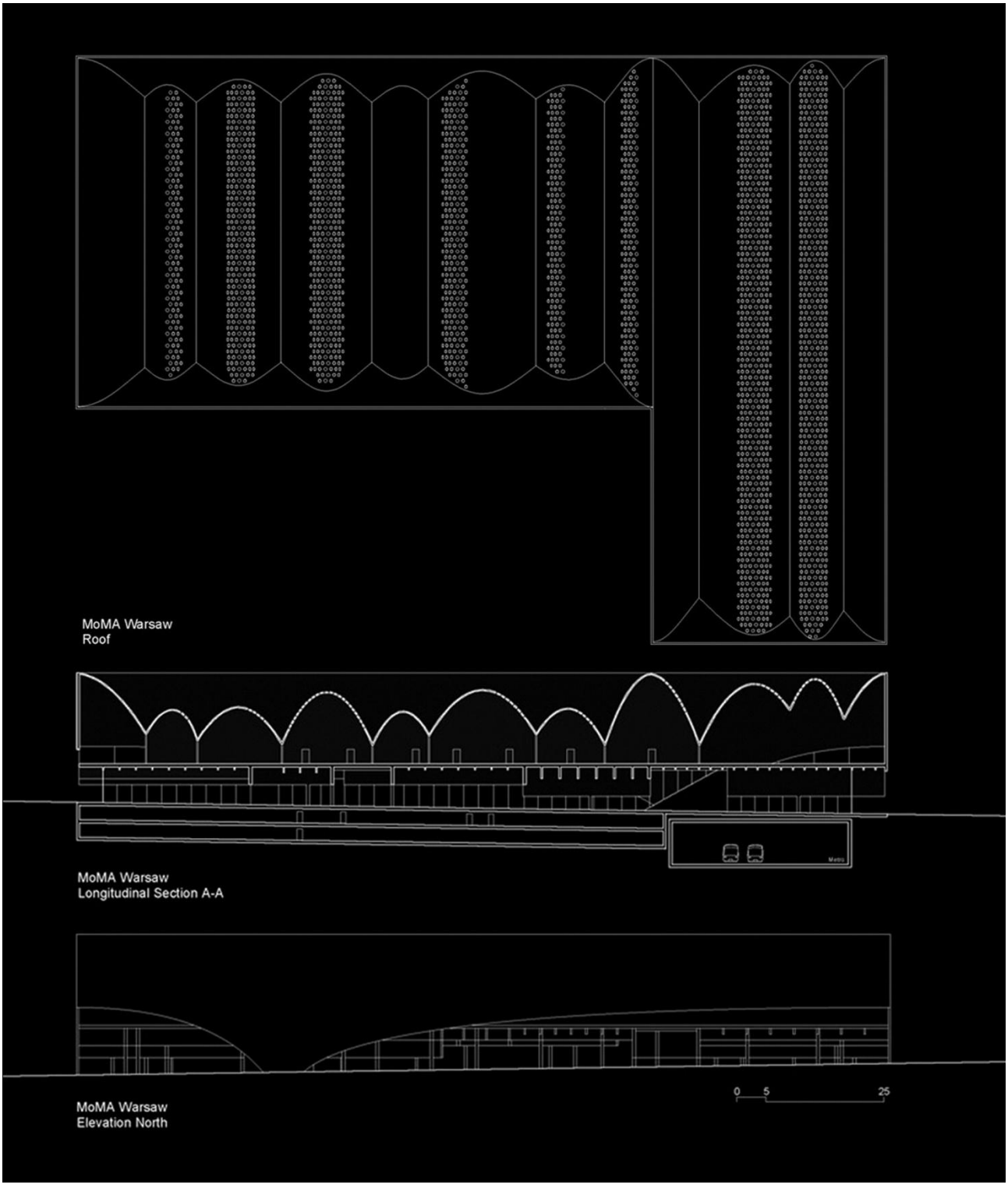

Fig. 7: Christian Kerez, Museum of Modern Art, Warsaw, 2007-2014 (Plan, Longitudinal Section and Elevation North)

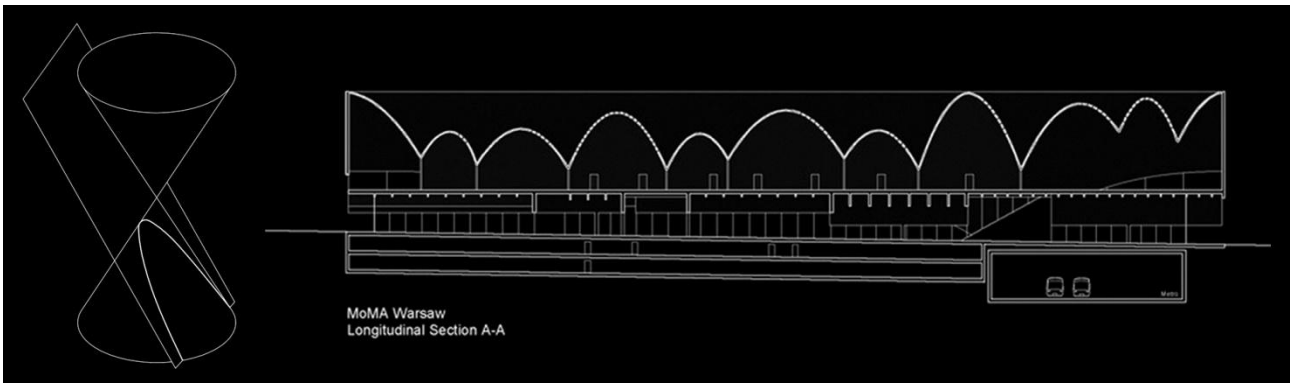

Fig. 8: Redesign of the Conical Section with Parabolic Arc applied to the Longitudinal Section of the Museum of Modern Art of Warsaw

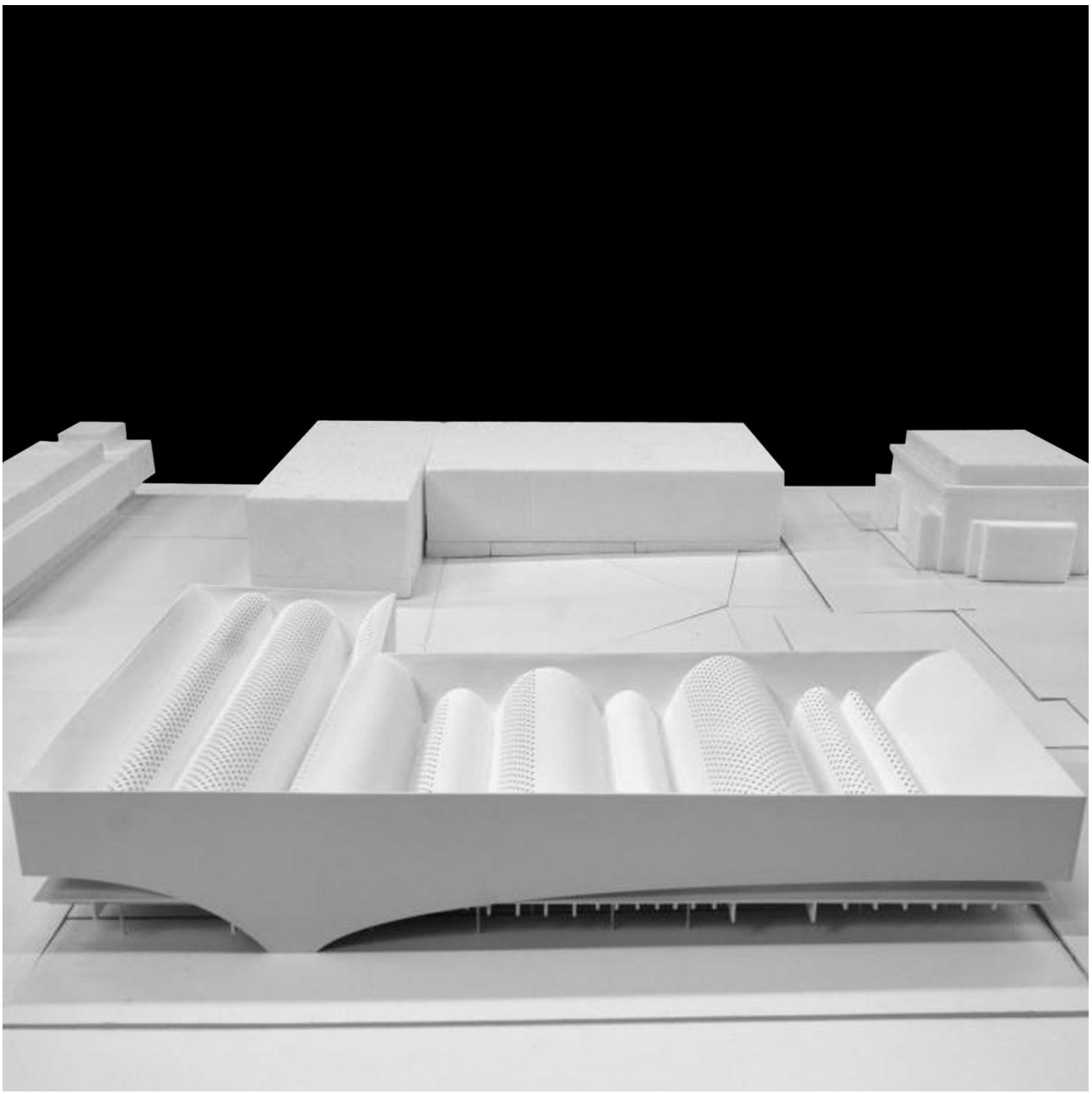

Fig. 9: Christian Kerez, Museum of Modern Art, Warsaw, 2007-2014 (Exterior of the model)

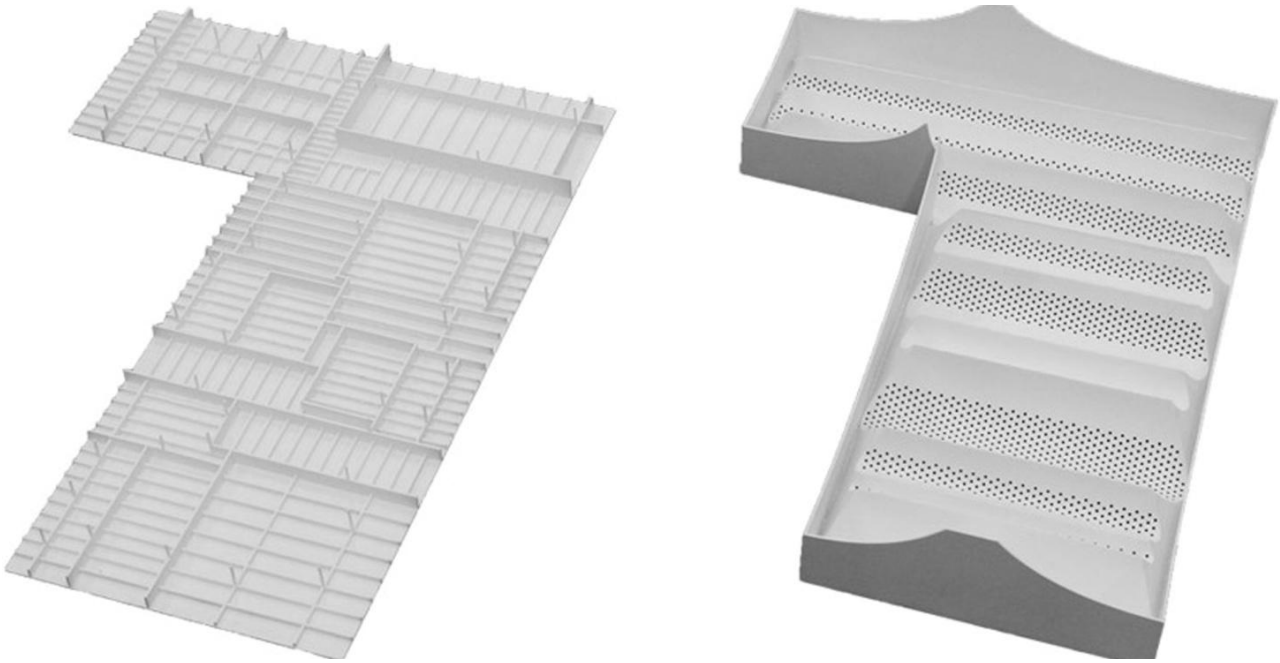

Fig. 10: Christian Kerez, Museum of Modern Art, Warsaw, 2007-2014 (Detail of the interior of the structure of the model)

Bibliographical References

[1] NERVI, Pier Luigi. *Le proporzioni della tecnica.* Milano. Domus 264-265, Decembre 1951;

[2] NERVI, Pier Luigi. *Costruire correttamente: caratteristiche e possibilità delle strutture cementizie armate.* Milano. Hoepli, 1955. (II ed. rivista e ampliata). ISBN 9788820346232;

[3] KEREZ, Christian. *Interwiev.* Studio Banana TV. Web Pages: http://www.studiobanana.com;

[4] SZCZELINA, Marcin. *Christian Kerez dice addio a Varsavia.* Domus Web. Web Pages: http://www.domusweb.it;

[5] GAMBARDELLA, Carmine. *Le Vie dei Mulini. Territorio e Impresa*. Napoli: Edizioni Scientifiche Italiane, 2003. ISBN 9788849506549;

[6] GAMBARDELLA, Carmine, *I layer della forma urbis*. Napoli: Edizioni Scientifiche Italiane, 2000;

[7] GIOVANNINI Massimo, *Spazi e culture del Mediterraneo*, Roma, 2006. ISBN 9788878909052;

[8] GAMBARDELLA Carmine, *Atlante del Cilento*, Napoli, 2009, ESI;

[9] GIORDANO Paolo, *Il disegno dell'architettura costiera. La costiera amalfitana_ il territorio, le città e le architetture*, Napoli, 2012, La scuola di Pitagora editrice;

[10] GIORDANO Paolo, CORNIELLO Luigi, *Atlante grafico e teorico amalfitano. La conoscenza e la modificazione del paesaggio costiero*. Napoli, 2012, La scuola di Pitagora editrice. ISBN 9788865421253.

HERITAGE and TECHNOLOGY
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The redraw of the architecture in the smart city

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Abstract
An abstract projection of a future city idea, recognisable by an applicative and conceptual perimeter that include many applications, like so different are the properties which belongs technologies that are indispensable for their realisation. The smart city is a result of the strategies that make competitive a city. More relief metric is deeper and we will have a perceptual experience rich; we will face a real process anastylosis virtual. The dimension that, for sure, surprises is the cultural one, because it has the necessity of animate to new creative forms for valorise the extraordinary urban heritage, architectonic and artistic of the country, trying to start, in the cities, a real rebirth. The system for which we can identify the patterns containing the identified issues, interpreting the paradigms of Smart City is certainly a three-dimensional representation of operational domain which includes complex areas, each of which, in turn, contains the problems analysed organised by layer.

Keywords: Drawing, Layer, Smart City, Survey, Representation.

1. Techniques and strategies (V. M. B. V.)
The smart city is the result of all the strategies that allow to make competitive a city, in matter of services and facilities, in comparison with the requests and necessities of entire community, up to the needs of single citizen. An abstract projection of a future city idea, recognisable by an applicative and conceptual perimeter that include many applications, like so different are the properties which belongs technologies that are indispensable for their realisation.
A full realisation need the construction of a new gender of common good, a big technological infrastructure that allow to communicate people and things,by integrating informations and generating cleverness, producing inclusion and improving our everyday lives.
The public service first, infrastructures then, have the necessity to be analysed along a criteria that goes in contemporary direction, in reflection of amount and especially of multiplicity of informative data transmitted.
The dimension that, for sure, surprises is the cultural one, because it has the necessity of animate to new creative forms for valorise the extraordinary urban heritage, architectonic and artistic of the country, trying to start, in the cities, a real rebirth. In this setting it’s inevitable to consider two important cause: “urban hacking” that is used to manipolate urban space to adapt itself to new people needs. the citizen, “living lab” that is used to change the area and the citizen in subareas of experimental aware.
To reach the result, the citizen has to be active part and perceptive part of his location, because all of us when meet other men, we reach informations first, and then we give answers; the big technological steps are the right start of this programatic genesis able to improve the conditions of social spaces in relation between the best ambient condition.
The data collected are no more than the complex infrastructure on a large scale, the "smart cities" become aware of itself and then require "intelligent citizens", playing a vital role in the collection and dissemination of data collected.

This methodology, to set a good project, it must be compatible with the "genius loci" of the area under study. The system for which we can identify the patterns containing the identified issues, interpreting the paradigms of Smart City is certainly a three-dimensional representation of operational domain which includes complex areas, each of which, in turn, contains the problems analysed organised by layer.
Each layer has its own efficiency and has the ability to find solutions in the regulatory, organisational, spatial, structural and infrastructural.
The design and performance are the basis of the transmission of virtual information, which later will be realized.



Fig. 1: Reconstruction by Davide Borra, The Valley of the Emperors, The Villa of Trajan.

An important result has come to us from the development of systems interposed between those exclusively real and purely virtual and it's called "mixed reality" that is a transition in stages: real environment, increased reality, increased virtuality and virtual environment, can facilitate the interface to the users through reference parameters which take account of the degree of immersion provided by the system, the composition method used, whether optical or digital and the final degree of realism made. In our case, a fundamental function plays the "increased reality" characterized by a set of predominant perceptions and data from the real world, increased computer-generated data, relative to their context of use, using real-time information in the form of text, graphics, audio and other enhancements integrated with virtual objects in the virtual world;



Fig. 2: Reconstruction by Davide Borra, The Valley of the Emperors, The Villa of Trajan.

all optimizing the use of other technologies can handle the technology of three-dimensional visualization of imaging for the recognition, especially in mobile environment as it increases the senses of the user with access to digital tools for faster responses or to accelerate the taking of decisions to be taken to accomplish the objectives. And it is the phase of the data from the real world then processed by the computer that we are interested in more depth.
Everything around us is detected, measured, in a single word "modified", considering the concept of change belonging to the etymology of its name from "Modus - change" directs us to the metric value of everything that surrounds us. More relief metric is deeper and we will have a perceptual experience rich.



Fig. 3: Reconstruction by Davide Borra, The Valley of the Emperors, The Villa of Trajan.

So much for the measurement of two-dimensional and three-dimensional tracker, indoor visualizations that can give us an important result precisely in the field of artistic and architectural, noting metrically in the first place than to have concrete and then by changing what we can provide for deficiencies of certain property now in ruins and through media technology such as three-dimensional glasses.
In summary we will face a real process anastylosis virtual. This technique is especially used in archaeological sites to reconstruct the destroyed buildings or structural parts of them, such as the columns, of which it was possible to recover a sufficient amount of remains.

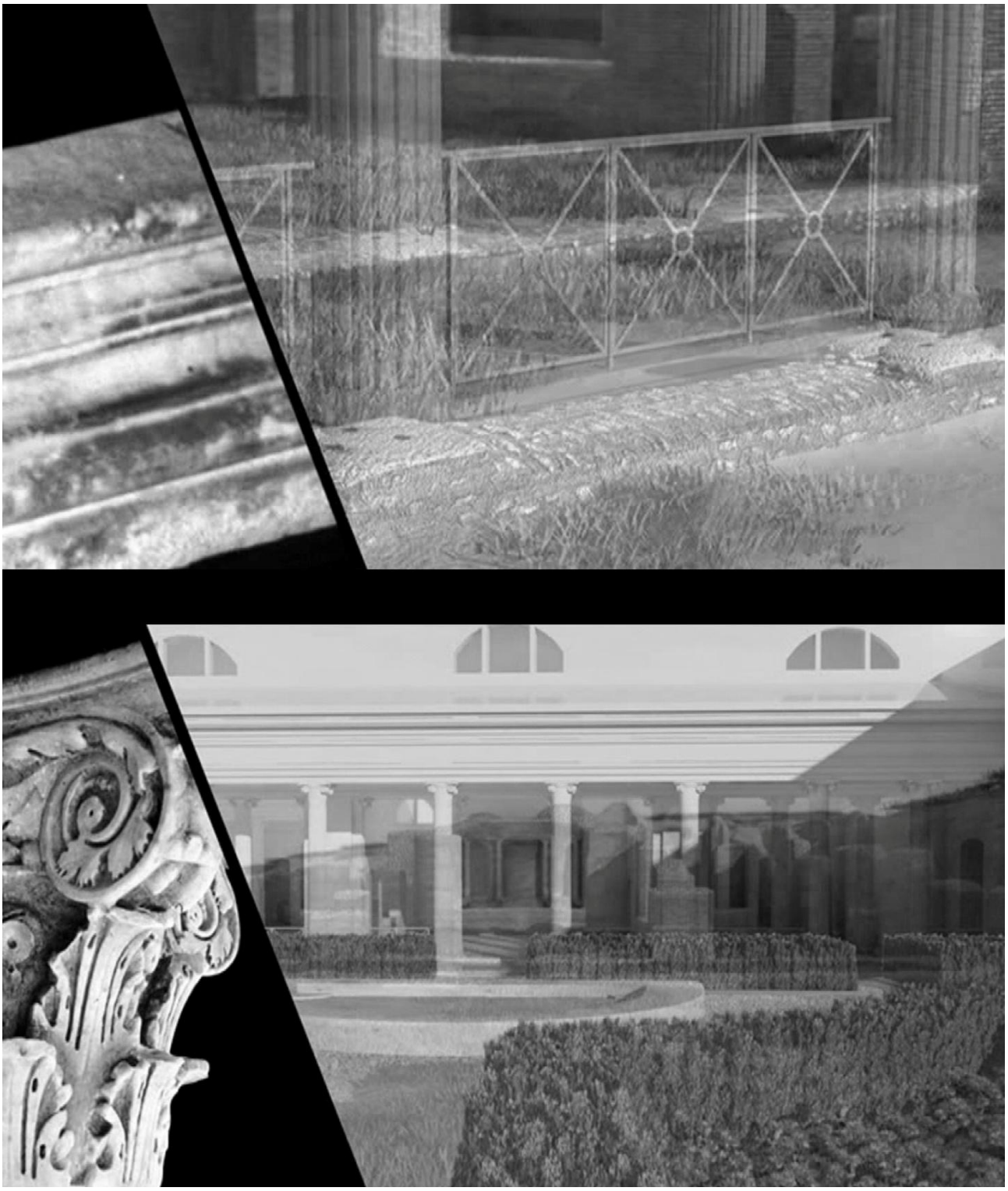

Fig. 4: Reconstruction by Davide Borra, The Valley of the Emperors, The Villa of Trajan.

2. Techniques and development (L. C.)

Very often, in fact, the remains of the temples which can be seen today in the most famous archaeological sites, are the result of reconstructions for anastylosis. In architecture and, above all, in archeology, anastylosis, from the greek "rebuilding", "rebuild" is the restoration technique with which you back together, piece by piece, the original pieces of a destroyed building, for example, after an earthquake.

The development had in time from the techniques of computer graphics and 3D scanning allows, in a scenario of virtual reality, what may be called "virtual anastylosis": in this case, the reconstruction is not only construction or structural parts of them, but goes even to artifacts and fragments, "through systems that incorporate digital and replicate virtually traditional modes of reconstruction and assembly" used in the past

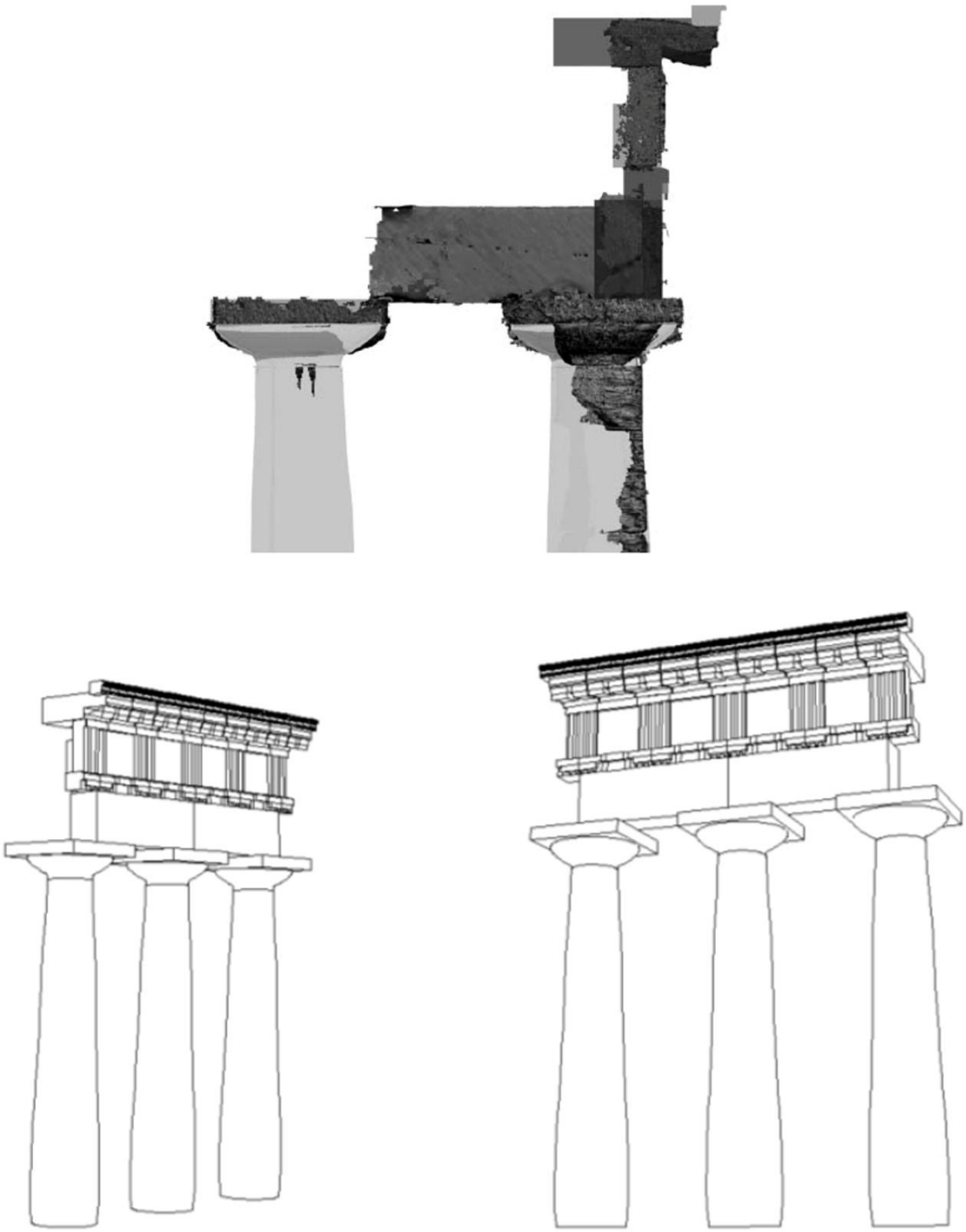

Fig. 5: Reconstruction by Marco Carella, The Temple of Selinute.

by manual. In this context, the representation and design are of fundamental importance because they are the means by which they are collected, cataloged and disseminated information.
Man has always measured his surroundings but, the first metric survey certificates as a discipline, taking place during the Renaissance, through the study by architects and other educated people, of all those monuments of earlier times, having just intended to the mere documentation.
The survey is divided into two basic methods: the direct relief and indirect survey. For direct relief operations mean those who are in close contact with the objects to be measured and which require the use of simple tools that are closer to the surface to measure lengths, alignments, extensions.
This method has advantages, such as the possibility of being able to know in an immediate way the measures of the object and, in case there was a need, to verify any detection errors.
For indirect survey we mean those operations that are carried out with the aid of optical, mechanical or computerized requiring particularly precise, by the operator, a series of more or less complex calculations.

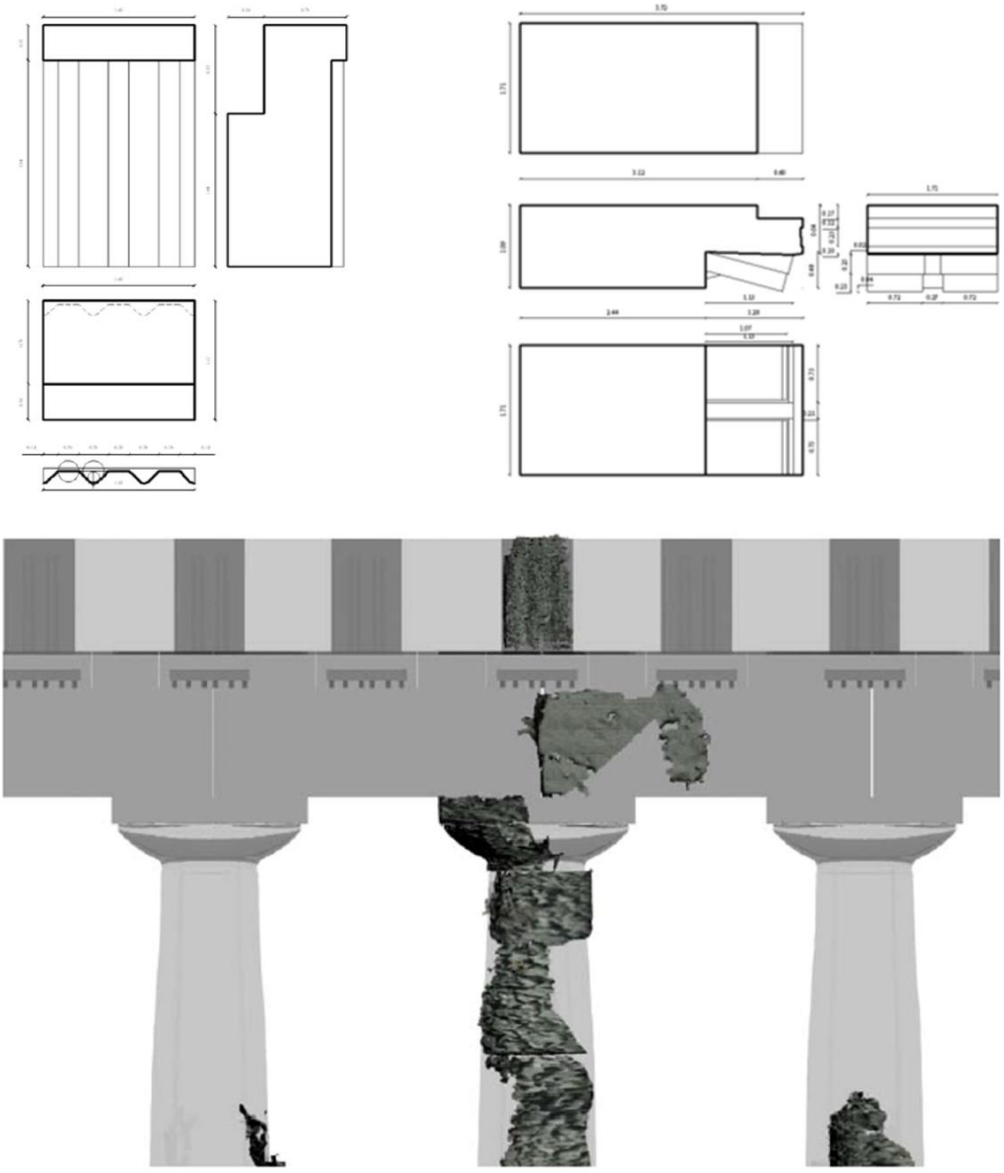

Fig. 6: Reconstruction by Marco Carella, The Temple of Selinute.

Recently, thanks to the development of new technologies, so it had the ability to accelerate and improve the processes of metric survey, through the use of instruments such as theodolites up to the laser scanner which, through the use of fixed points topographic, allow highly accurate positioning of the article detected in space, using point clouds processed through reverse orientation, isolation, extraction of profiles and research plans pose architectural elements scanned.
In the case in which we were faced with the need to make a virtual anastylosis, we could also use the technique of photoplane that, in practice, are no more than images obtained through the transformation of central projections in parallel projections orthogonal to the plane chosen.
The operation is done by software that, once identified a congruent number of parallel lines, detects points recognizable distribution as belonging to the same plan. Once assigned the straight lines with the direction and position of notes, will be made straightening using the correspondence between homographic projection from these lines and points and the plan projected orthogonally on the framework in natural shape and size.
Higher will be the number of points will be more precise the photoplan. Subsequently, should be identified and the vanishing points and lines, selecting the area that interests us straighten, you define the relationship between the distances of the points selected.



Fig. 6: Reconstruction by Marco Carella, The Temple of Selinute.

Finally, once the rectified image, it can be inserted into a vector drawing software, with which we can proceed to redesign through the two-dimensional reconstruction of the ideal profile, and three-dimensional through an extrusion process of the discrete model, the object concerned scale.
Another major technical metric and redesign is the photo modeling, performed by software that allows you to generate point clouds starting from stereoscopic taken, using pairs of photographs. The information that is drawn from photographs, undergo calibration optical processing the photographs is a grid of dots capable of restoring the values of the distortion of the image point by point. Once the mutual reference of photographs, the selected points are determined and therefore the approximation of the result, and then the error committed. Finally, the operation of closing consists in the selection of the sampling area, belonging to the area of overlapping of the pairs of photographs, in order to start the process of generation of the point cloud deciding factor minimum distance between the points of the cloud that will be generated; more will be the minimum distance the greater the degree of definition.
Once aligned the point cloud to a measure known, it will be possible to develop and monitor directly the solid three-dimensional surfaces and mesh, in order to have a relief quite accurate profiles, measuring distances and removing profiles that help to analyze architectural elements.
With these methodologies analyzed, the discussion of the procedures redraw artifacts detected, is able to summarize the dimensional characteristics of the individual parts, in order to have total control over the entire peristasis of time.

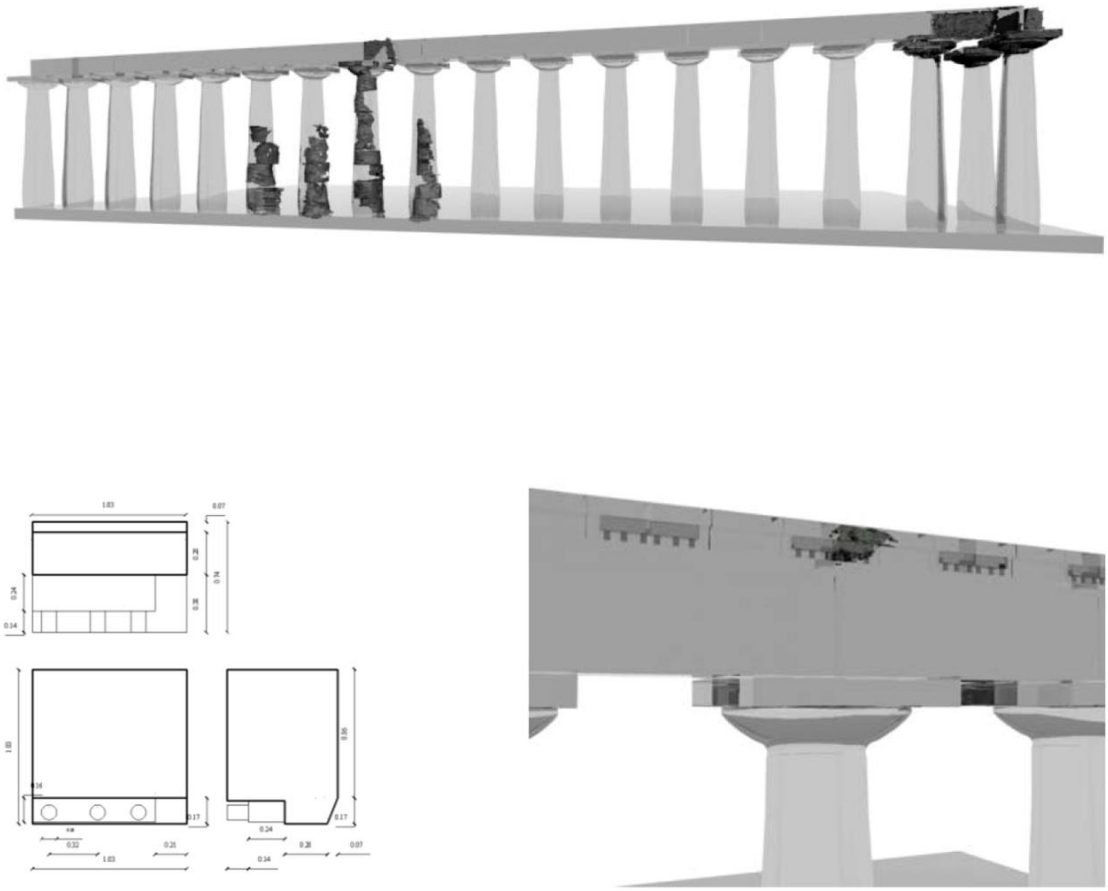

Fig. 7: Reconstruction by Marco Carella, The Temple of Selinute.



Fig. 8: Reconstruction by Marco Carella, The Temple of Selinute.

Bibliographical References

[1] RATTI, Carlo. *Smart City, Smart Citizen.* Egea, Milano, 2013. ISBN 9788823834132;

[2] RATTI, Carlo. *Architettura Open Source.* Giulio Einaudi, Torino, 2014. ISBN 9788806214272;

[3] GAMBARDELLA, Carmine. *Le Vie dei Mulini. Territorio e Impresa*. Napoli: Edizioni Scientifiche Italiane, 2003. ISBN 9788849506549;

[4] GAMBARDELLA, Carmine, *I layer della forma urbis*. Napoli: Edizioni Scientifiche Italiane, 2000;

[5] GIOVANNINI Massimo, *Spazi e culture del Mediterraneo*, Roma, 2006. ISBN 9788878909052;

[6] GAMBARDELLA Carmine, *Atlante del Cilento*, Napoli, 2009, ESI;

[7] GIORDANO Paolo, *Il disegno dell'architettura costiera. La costiera amalfitana_ il territorio, le città e le architetture*, Napoli, 2012, La scuola di Pitagora editrice;

[8] GIORDANO Paolo, CORNIELLO Luigi, *Atlante grafico e teorico amalfitano. La conoscenza e la modificazione del paesaggio costiero*. Napoli, 2012, La scuola di Pitagora editrice. ISBN 9788865421253.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Architecture as living sculpture .

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Abstract

"The history of architecture is the history of significant forms ... architecture is a living reality ... deals with existential meanings and translates them into spatial meanings" Christian Norberg-Schulz.
Architecture is the expression of man and its evolution, it is an answer to the need of shelter, define an inside and an outside, draw the line, leaving a trace.
Architecture's languages belongs to the period of which brings deep values, combining time's values with place's values and man's values.
However the contemporary architecture has greatly expanded its language, so that it blends with other arts becoming a "media object" would say Germano Celant, so he talks about architecture: "The building is intended as a 'sculpture' that arises in connection with the urban fabric. To the point that you do not look more use, but to sign". But there is a particular architecture's example as sculpture that contrasts with the idea of being the subject but only becomes a symbol of a contrasting architecture.

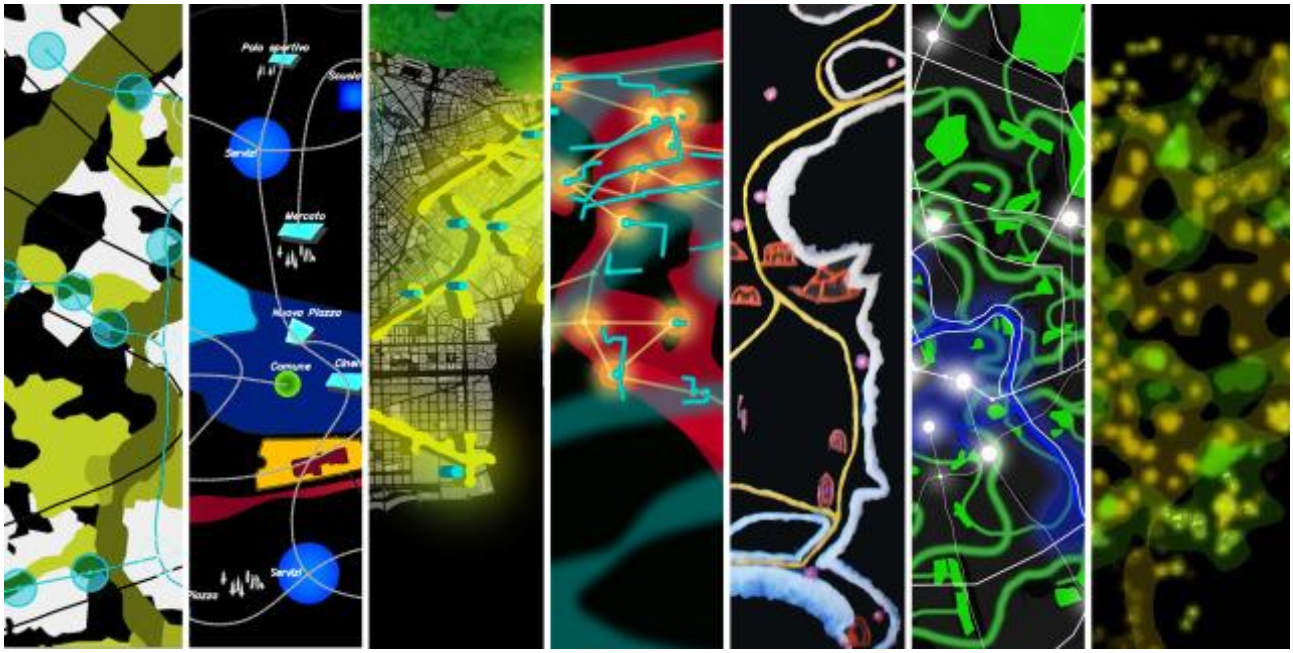
Keywords: Architecture, sculpture, art, plasticity.
Fig. 1: Sculpture House- Jacques Gillet. Date :1967



1. Introduction

In recent years, cities and landscapes are increasingly dominated by advertising and marketing. The works of contemporary architecture have as a basis the idea to excite. The modern architeture he had behind the narrow concept of form and function has been replaced as architecture that lives only in form, so we can declare significant this aphorism by Claes Oldenburg that says: "a building is distinguished by a sculpture just because inside there are the toilets. "

Fig. 2: Contemporary cities , Forme e disegni della città contemporanea, by Anna Terracciano.



This relationship between architecture and art is a very timely topic: the architecture extends beyond energy to fields that are not his, such as those of the Land Art, to imitate nature, animals, objects.
Today, as stated by Germano Celant, "the building is conceived as a sculpture that stands in disruptive relationship with the city. So much so that you do not look more use but to sign."
However, there are two currents that are generated from this new way of thinking about architecture. One explodes outward turning of the building in the architectural object are pure; the other instead implodes in itself: the building appears free, manages to be ordered element within the city but its interior is the result of a sculptural work.

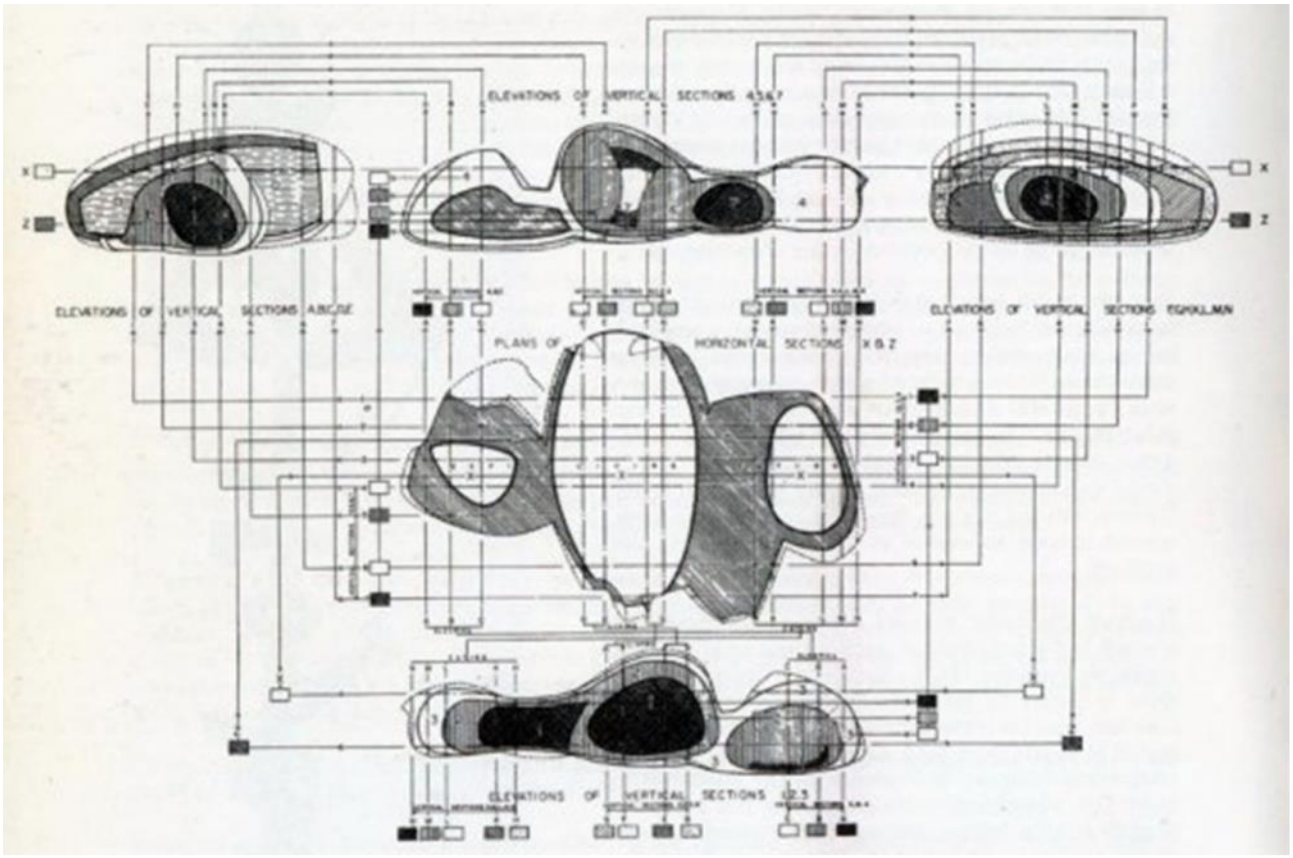


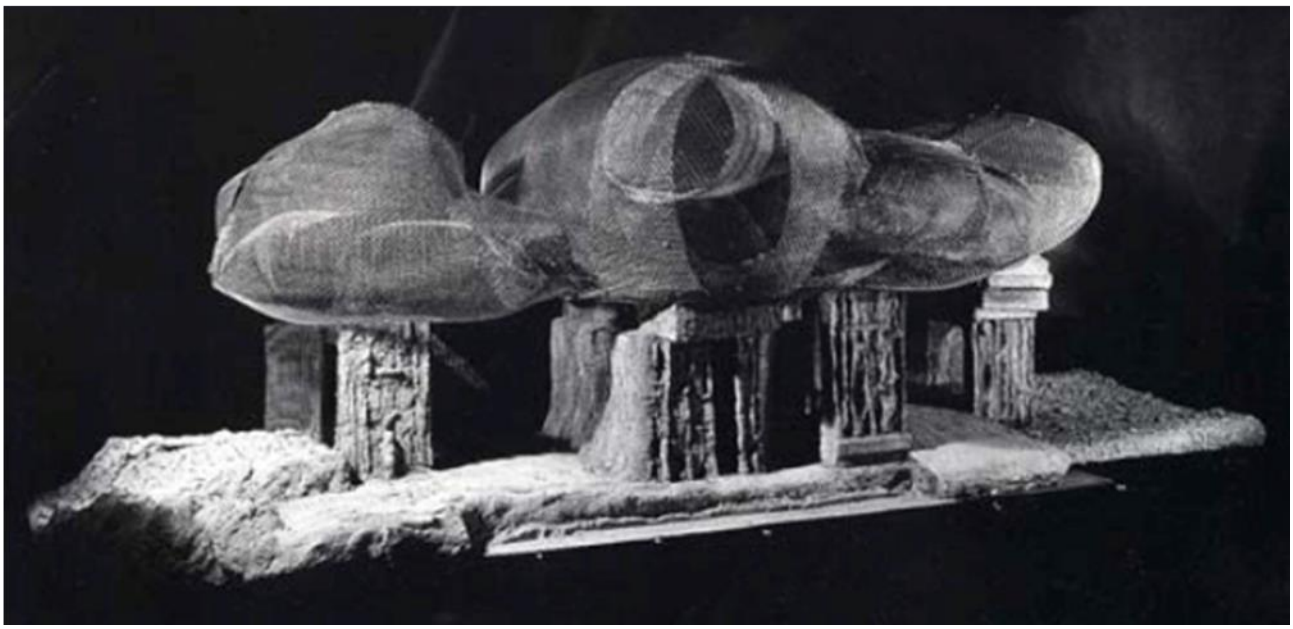
Fig. 3: A Disc in the City - Fernand Leger. Date: 1919.

1.2 Art and architecture

The tradition of architecture that combines art is full of examples.
Le Corbusier himself had a close link with the sculptor Henry Laurens and on the painter Fernand Leger. The work produced by Henry Laurens was focused on the study of the human figure, in many cases it was volumes generated by the intersection of geometric shapes that generated a special relationship between form and space, so a project apparently free from a formal point of view is instead conceived with the desire to control the space geometrically. The testing of free forms aroused great attraction by the architects of those years, think of the museum Silkeborg Museum or Endless House. In this project, shell-shaped, space is conceived from a spatial transformation continues: a space without end. The space without end is precisely the spatial characteristic of the proposed Frederick Kieslerche, concept that we find in other works of modern architecture as the TWA terminal Eero Sariseen.

Fig. 4: Endless House - Frederick Kieslerche. Date: 1950-60.





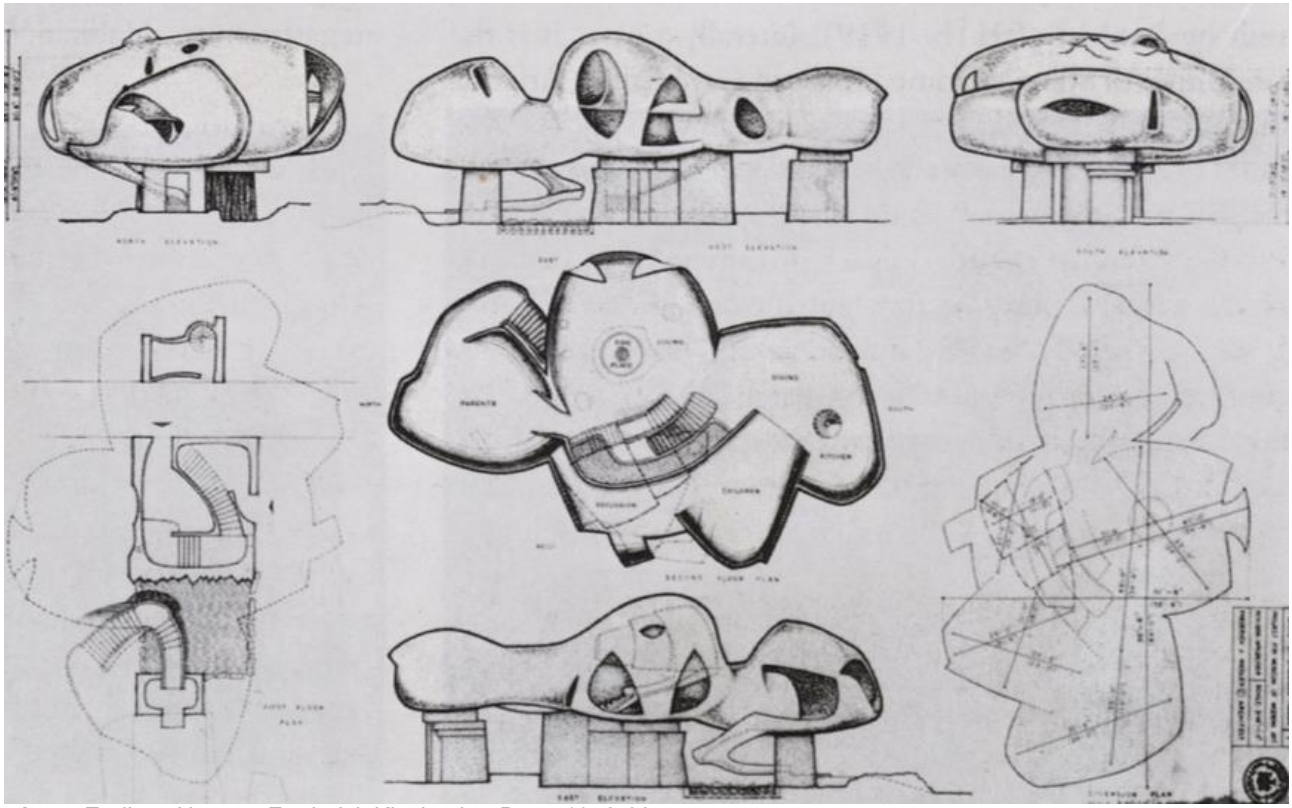


Fig. 5: Endless House - Frederick Kieslerche. Date: 1950-60.

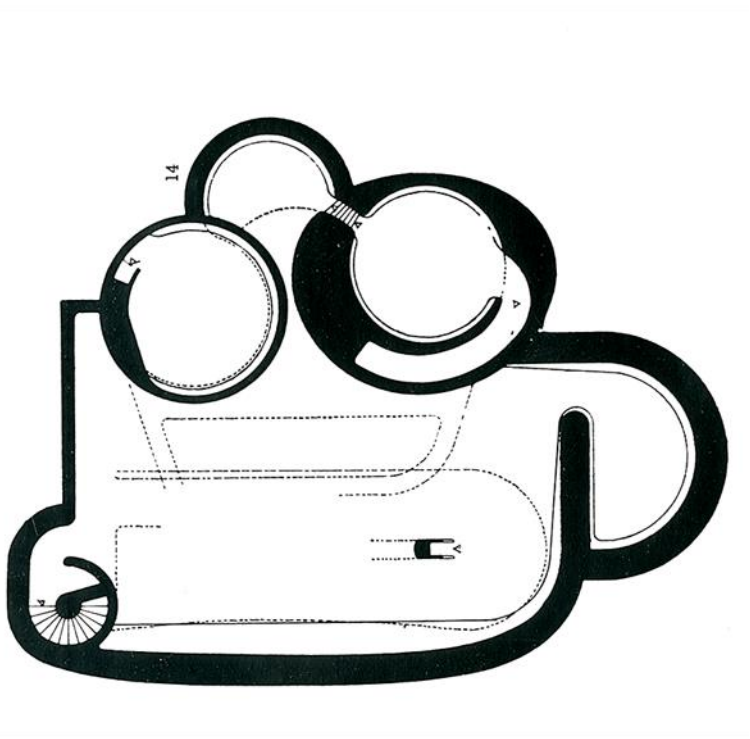
Fig. 6: Endless House - Frederick Kieslerche. Date: 1950-60.



However, the link between Fernand Léger and architecture and his collaborations with the architects of the last century is well known and concretely document: report had besides with Le Corbusier, with Mallet-Stevens, Buckminster Fuller and Frederick Kiessler. Another important architect: Paul Nelson, he was a friend, he published a paper in 1937 in which he declared the spatial quality and architectural work of Ferand Leger: <<In Lèger's latest works there is a new quality that could be described as spatian. One can almost measure the area of the walls, the space that exists around each one of them. Furthermore, one is tempted to not ook , but rather at the space, turn the painting around to see its reflection, its shape in sac, and measure the volume that it projects>>.
Below we compare two drawings, one is the work of Fernand Léger, Nu sur fond rouge, other design is the design of Jorn Utzon for the Silkeborg Museum.
The work of Lèger seems to be the “mother” of the project by Jorn Utzon, Utzon fact was particularly impressed by the paintings of Fernand Léger probably from that trip he made in Paris.
For this museum Utzon, using a simple and direct way of representation, the plants and the sections are extremely synthetic, retaining a considerable expressive power, it seems that the designs of Utzon are continuing the works of Lèger with the idea, hope , imagination and ambition of being able to transform into architecture, but to date the Silkeborg still not been achieved and who knows if one day it will be.

Fig. 7: Nu sur fond rouge – Fernand Léger.Date: 1927 . **Fig. 8**: Silkeborg Museum – Jorn Utzon.Date :1963.

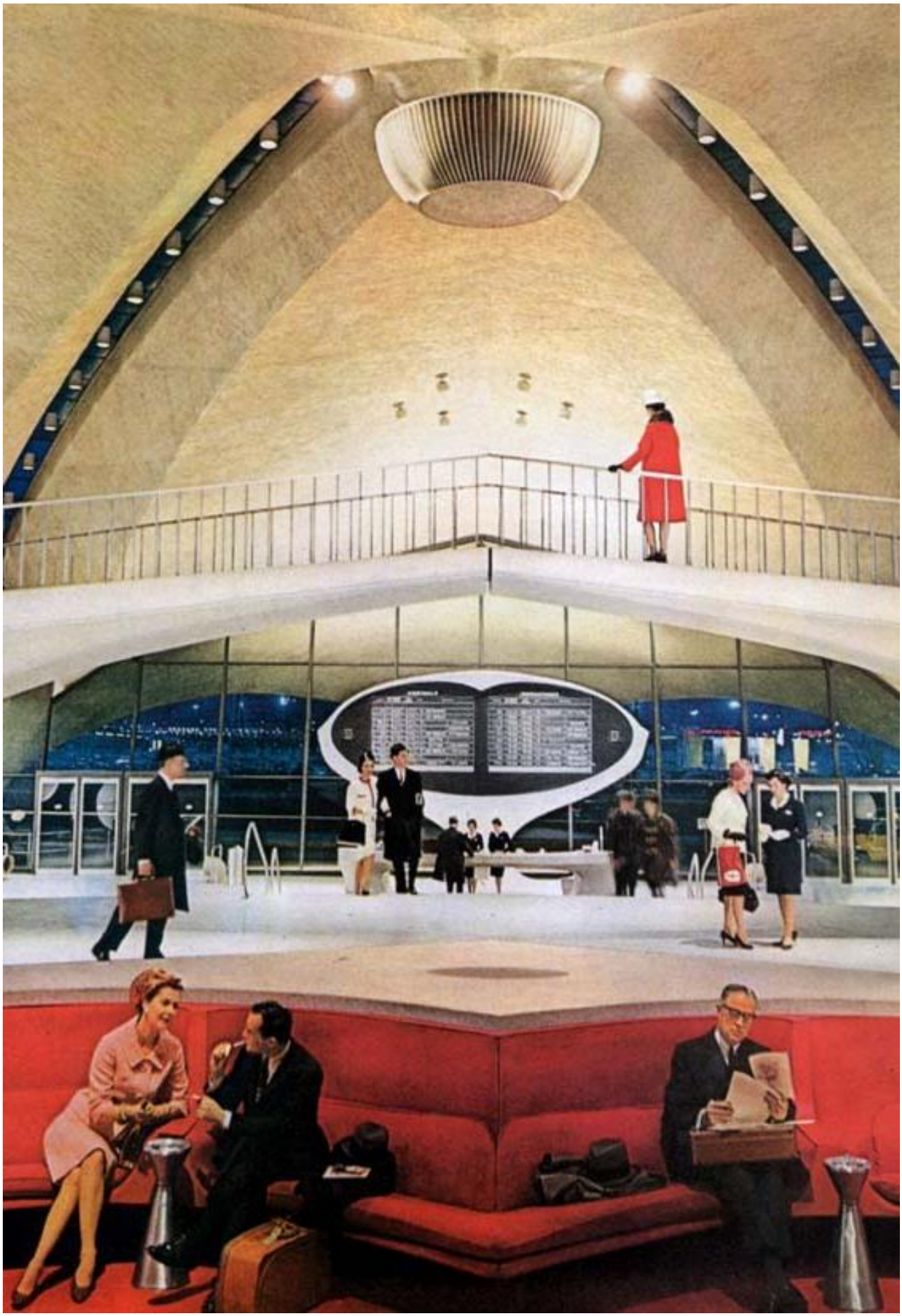




1.3 Examples of plasticity

The idea of architecture that works as the sculpture refers to the concept of plasticity. This section describes the work of two masters of the last century with particular determination and dedication approach concepts described above. The first is the master Eero Saarinen, the second is the author of the wonderful work that is the Sculpture House , Jacques Gillet.
Eero Saarinen, also famous for the determination with which he claimed his ideas, is son of the famous Finnish architect Eliel Saarinen. The young Eero internalized many of the thoughts of his father: the return to the simplicity of shapes and materials, respect for the craftsmanship and the knowledge that "ours is the age of the machine." Eero felt primarily a humanist and believed that architecture should reflect the company first, it felt like an architect of the second generation of modernists. According Saarinen the first generation of modern architects had to make it clear that the function was itself generating form and since this lesson was clear in his time architecture had to meet two needs: one physical and the other spiritual. In meeting the needs finish creates spaces for human activities and places of shelter, while to meet the spiritual needs of man must be attentive to his fears, hopes and desires.

Fig. 9: TWA Terminal – Eero Saarinen. Date: 1956-1962.



The work of Saarinen was paid to the search for an architecture that would represent the expression of his time and was based on the fundamental principles derived from nature. For this reason many of his works were completely different from the work of many of his contemporaries. The physical context was important to ensure that the building fits into the urban fabric asserting its presence, more distinguishable element in his work is the expression of the modern time: the technology. Immediately after Second World War there was a gradual change in the construction industry: the metal prefabricated panels represented a new way of conceiving j places, the assembly site of metal precast represents the possibility of building larger and larger, replacing the traditional facades of stone and brick. One of the many works that Saarinen fails completely to synthesize this his way of thinking is definitely the TWA Terminal in New York.

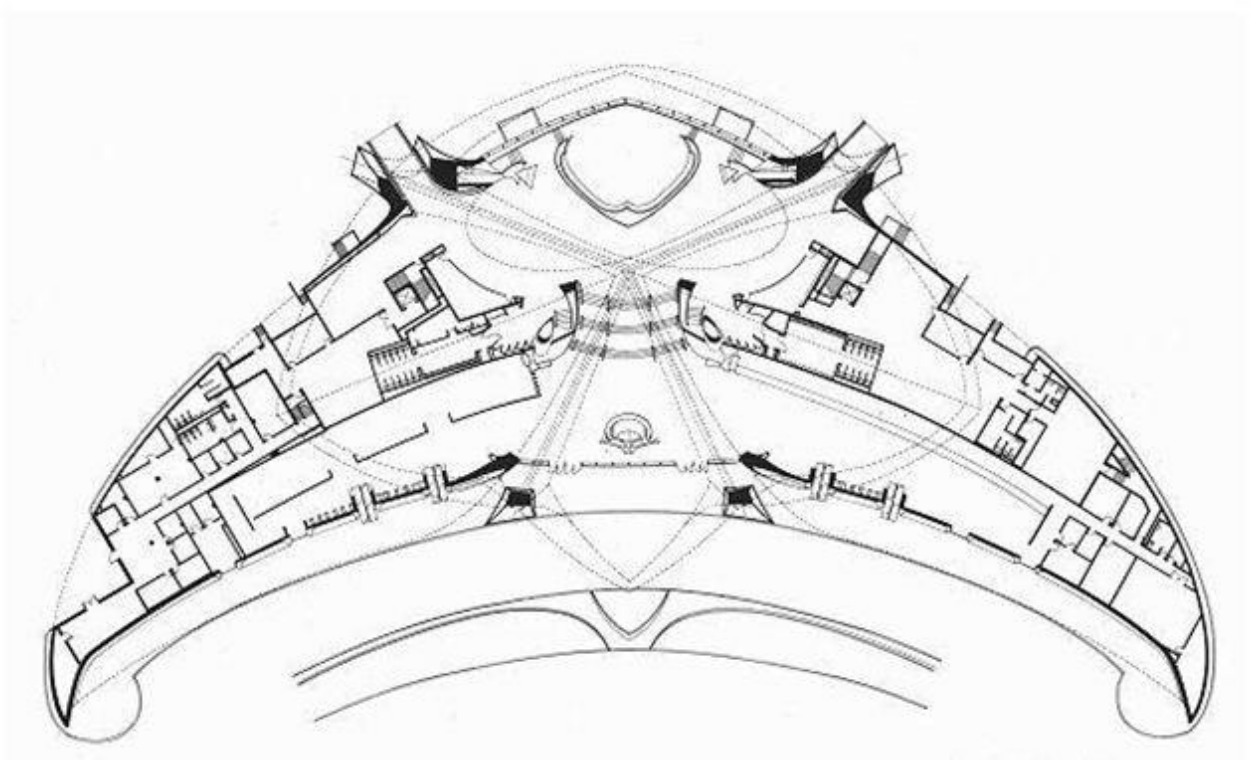
Fig. 10-11: TWA Terminal – Eero Saarinen. Date: 1956-1962.





This project is designed to bring the man to the flight, Saarinen reinterprets the concept of the vault, traditional system and masonry, is completely reinterpreted with the help of modern technology. The space is free, large unlimited, but if we look at the plans, elevations and sections now we realize the symmetry that governs the space. The terminal was on the opposite to the master plan of the airport and then the idea that the Finnish architect to design a building recognizable within the broad area of intervention.
The resulting architecture is an architecture of fluidity within the cement is set the motion that the theme of this project. The spaces flow into each other, the elements are derived from modeling of concrete as if it were clay, the visitor struck by the lines of this movement which does not receive neither the beginning nor the Order. This great architectural project of 50-60 years of the last century seems to belong to our contemporary cities, but in his years was considered inadequate to meet current needs so many that is used as an exhibition space not for the function for which it was meant .

Fig. 12: TWA Terminal,Plant. – Eero Saarinen. Date: 1956-1962.



Another interesting work is without a shadow of the beam project that Jacques Gillet made with sculptor Felix Roulin and the engineer René Greisch: the Sculpture House. Gillet wrote about His work :"I need to create. I need to make new work, original work, made with my own hands in the open air. And that's why I do it. I make architecture in the way a sculptor makes sculpture or the painter Creates paintings. I do not need a specific function to justify what I do. The function, for me, is in the doing. "The building was designed in 1965, by order of the brother of Gillet, whose family still lives there. This building seems to spring from the ground and today that its facade is completely covered by moss seems to even more of an element of nature. These are the years when you look for new domestic forms and there behind a return to the past, the man cave. The rigor of the functionalist houses is replaced by spaces organic undefined ,. The house was built in wire mesh shaped, creating a form organized around different solid elements, then on it was sprayed concrete forming a thickness of five centimeters. Only the windows contrast with the entire building but giving unexpected glimpses of landscape. The house was completed 14 years after it began, and after 40 years is a wonderful example of intuitive architecture.

Fig. 13- 14-15: Sculpture House- Jacques Gillet. Date :1967







Bibliographical References

[1] NIETO Fuensanta, SOBEJANO Enrique. *Utzon,Museo de Silkeborg 1963*. Madrid: Editorial Rueda S.L. 2004. ISBN 84-7207-167-7

[2] VENEZIA Francesco. *Francesco Venezia le idée e le occasioni.* Milano: Mondadori Electa 2006. ISBN 88-435-8351-4

[3] ESPUELAS Fernando. *Il vuoto, Riflessioni sullo spazio in architettura.* Milano: Christian Marinotti 2004. ISBN 88-8273-040-9

[4] CACCIATORE Francesco. *Il muro come contenitore di luoghi,Forme strutturali cave nell'opera di Louis Kahn.* Siracusa: Lettera ventidue 2011. ISBN 978-88-6242-038-9

[5] TERRANOVA Antononino. *Il progetto della sottrazione.* Roma: Croma Quaderni 1997. ISBN 88-7621-892-0

[6] VENEZIA Francesco. *Che cosa è l'architettura. Lezioni,conferenze,un intervento.* Milano: Mondadori Electa 2011. ISBN 978-88-370-8661-9

[7] UTZON Jorn. Idee di architettura. Scritti e conversazioni. Milano: Christian Marinotti 2011. ISBN 978-88-8273-128-1

[8] SERRAINO Pierluigi. Eero Saarinen. Modena: Inter Logos 2006. ISBN 978-3-8365-1334-0

[9] DOMUS 966

[10] Networks of design-Proceedings of the 2008 Annual International Conference of the Desgn History Spciety (U.K.),University College . Boca Raton, Florida: Universal Pubishers 2009. ISBN 10-1-39942-906-3

[11] Design and Nature III.Comparing Design in Nature with Science and Engineering . C.A. Brebbia, Wessex Institute of Technology, UK, 2006. ISBN 978-1-84564-166-5

HERITAGE and TECHNOLOGY
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Bathing facilities: memory and survey of a forgotten coastal heritage

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The contribution summarizes the results of a study on the events related to the design and the construction of the beach resort 'Roma', an imposing architectural complex located on the Roman coastal area. This beach resort, which was inaugurated in 1924, had been designed by one of the leaders of the Roman School, Giovan Battista Milani (1876-1940). The resort complex is the striking symbol of the urban transformation of the coastal township of Ostia (Roma). Its demolition, during the Second World War, generated a substantial alteration of the urban and social fabric of the new-town. A century after its inauguration, through a survey of the memory, we intend to add cognitive details which will enable the tracing of the design history of the lost architecture, both through a direct observation of graphic, iconographic and textual documents and through virtual reconstructions, thus returning a plausible framework for this forgotten coastal heritage.

Keywords: coastal heritage - drawings - survey - Roman School - Giovan Battista Milani

This contribution focuses on the idea of tracing the planning stages of what is a lost heritage, recreating a possible picture, including through virtual simulations.
The survey was carried out basing every consideration on the direct observation of an extremely detailed, even thougth fragmented, body of original documents – both iconographic and textual – obtained from a number of different archive institutions: Archivio Storico Capitolino, Archivio Centrale dello Stato Fondo Milani and, as regards the early experiences of the designer, from the Archivio Disegni di Architettura dell'Accademia di San Luca.
The 'Roma' bathing establishment was, until its demolition, a permanent facility for recreational activities tied to leisure time culture, specifically bathing. It was opened on 10 August 1924, as part of an ambitious requalification program involving the Roman coastline, at the same time as the laying of the foundation stone of the Palazzo del Governatorato (Vincenzo Fasolo) and the opening of the Railway Station (Marcello Piacentini), terminal of the new Rome-Ostia railway line. [1]
First and most evident expression of the transformation of what was the most important town of the Roman coastline, Ostia Lido, the 'Roma' permanent pavilion by the sea was conceived as a water terminal and perspective backdrop of an important urban road which, from the church of Santa Maria Regina Pacis (Giulio Magni 1916), in the city centre, ended by the sea. (Fig. 1)
This new bathing machine soon became a leisure time icon. It consisted of a number of ground floor premises linked to a pavilion built on the sea by means of a long promenade pier which, according to the idea of contemporary bathing establishments prevalent in the 19th century, was intended to be a sort of mediating structure in the new relationship between man, land and water. [2] [3] [4] [5]
Due to its social-political importance, the matter of designing the new 'Roma' bathing establishment became a much debated one. [6]
The project was commissioned from Giovanni Battista Milani (1876-1940), by the Società Elettroferroviaria Italiana which – as licensee of the Roma-Ostia electric railway and of the entire coastline excepting the harbour area – promoted the ambitious project, designed to represent a launch-pad for the coastal town closest to the Capital. [7]
During the Second World War, a few weeks after the evacuation imposed by the German command in

September, 1943, Ostia, the seaside town of Rome, was like a huge tinderbox ready to explode to prevent the presumed allied invasion. Among the coastal emergencies that could have offered points of reference for air reconnaissance planes, on December 1943, the 'Roma' establishment was demolished, thereby interrupting the particular dialectic relationship between Ostia and its sea. In this way, it was shattered a dream that had lasted almost twenty years, producing a big alteration in the consciences of the inhabitants and a deep fracture in the urban fabric.

The idea of building a series of leisure-time and bathing facilities had first been aired in the Ostia Nuova town-planning scheme drawn up in 1909 by Paolo Orlando, alderman for the Agro Romano. The perspective views among the project drawings express the intention of building the various facilities with a platform over the sea. Taking part in the development of this seaside quarter of the capital were some of the best known protagonists of the Roman cultural scene, reunited in the Associazione Artistica fra i Cultori di Architettura (ACAAR), which, in its 1916 Yearbook, published the report on the «Town-planning scheme for the seaside town of Ostia» written by Gustavo Giovannoni, as president and supervisor, A.U. Beretta, R. Consiglio, V. Fasolo, A. Foschini, V. Leonardi, G. Magni, F. Mora, T. Passarelli, A. Petrignani, G. M. Piacentini, Rebecchini, P. Rem-Picci and G. B. Sirletti. [8]

The plan for the seaside town adapts to the sinuous pattern of the district.

It presents an urban fabric which, following the morphology of the location – with three large rows of parallel dunes and gently sloping towards the coast– consists of two housing quarters by the sea and an area dedicated to bathing establishments.

The residential area comprises the "popular" quarter, located near the station and the "fashionable" quarter, dotted with small villas, located inside the pinewood.

The seaside area comprises wooden buildings on the ground and piers extending into the sea for hundreds of metres, so as to provide mooring facilities for passing boats and a particularly good view of the sea.

The 'Roma' bathing facility, built in 1924, represents the terminal of an urban road conceived in the Cultori's Plan of 1916, linking Piazza Grande, the town centre, with the sea, across the residential villa area. This urban road configures a dialectic relationship between the two symbols of the sacred and the recreational represented by the dome of Ostia's main church, the Regina Pacis (Giulio Magni, 1916) located on the highest dune and that of the 'Roma' bathing establishment (G. B. Milani, 1924) extending out to sea (Fig. 2).

A complex project that shifts from the urban to the architectural scale and reveals the background of the designer, Giovan Battista Milani, academic, professor and well-known member of the Roman School – centred on the study of the History of Architecture and Architectural Survey.

In relation to Milani's work, Giorgio Muratore, has underlined: «*the quest for an intimate consistency between the constructive organism and the very meaning of an architectural work, which placed him in direct contact with the lesson of the Sangallos, of Michelangelo, of Agostino di Duccio and therefore also of Leon Battista Alberti, resulted in his architectural research standing out first and foremost from a methodological viewpoint, as the rigorous and mature upshot of "good building" practice. His familiarity with the rich and consolidated manual skills, of which he was certainly not the anachronistic modern imitator (as many of his detractors sustained) but rather the natural continuator through that extraordinary work which was and remains "the mural framework", makes him one of the last great classic builders*». [9]

It should be pointed out that Milani had already addressed the topic of the spa facility as part of a competition in which he had taken part in his youth – the Poletti competition of 1898 in which he took second prize – thereby gaining entrance to the Pensionato Artistico in Architecture at the Reale Insigna Accademia di San Luca. By reading the textual documents of the competition and directly observing the extraordinary project drawings produced, a utopian experience is revealed very similar to that which took concrete shape twenty-six years later in the great bathing establishment conceived for the Lido di Ostia.

The tender notice called for the drawing up of a: *«Preliminary project for a building to be erected in Rome above a free area, isolated for public bathing, gymnastic exercises, various games and for the relief and culture of the spirit, by way of imitation of the ancient Thermae, but adapted to modern uses, excepting as regards the architectural style, which should be purely Roman (…). The building shall contain everything hygienically required today for different types of bathing, with large tanks for swimming (…) different sphaeristeria for playing ball and modern racket ball (…) large rooms for entertainment, billiards, reading newspapers, (…) conference room, a cycling track, a concert hall, a small shooting range, a restaurant (…), staff quarters (…) distribution premises (...)*». The project drawings required by the tender notice – general layout scale 1:500; two sections scale 1:250 and a perspective view – are drawn in ink and watercolour on paper and reveal the extraordinary expressive capacity of the 22-year-old Milani. [10]

The 'Roma' establishment project aroused much controversy over the years, but it was nevertheless several times reviewed in the architecture journals of the period: *L'Architettura italiana* and *Architettura e Arti Decorative.* In 1927, *Gustavo* Giovannoni promoted the project, indicating as evident references the Hagia Sophia of Constantinople. [11] [12]

Direct observation of the original drawings for the «Project of a bathing establishment to be built on the beach of Ostia. Rome, 18 April 1924», kept in the Archivio Storico Capitolino, reveals the symmetric spatial layout of the complex.
A double courtyard open towards the sea, accommodates a large quantity of surface functional to the overall fruition of the bathing machine which has about 400 small rooms and 100 bathing huts along the shoreline. Long wooden piers ending in small panoramic terraces surround and isolate the two sectors and the west and east beaches, flanking the main permanent parts in masonry.
The central pier, extension into the sea of the urban road, connects the two main sections of the building on the beach and of the sea pavilion; the latter has a central plan on two levels, covered with a dome, with eight flying buttresses and an outside terrace.
The large 'Roma' bathing establishment is a building that reveals itself through use with spaces dedicated to a broad range of leisure-related activities.
The two prevalent spatial ambits – recognizable in the building on the beach and sea pavilion – are integrated by the service spaces – consisting of the pier that links them both and of the piers used as bathing huts – making up a complex system and a sort of isolated fenced-off area with respect to the adjacent strands.
By means of an urban survey campaign, it has been possible, in relation to the site, to identify simple geometric relations founded on a square module with sides measuring 50 metres.
The entire urban road extends over 11 modules measuring 550 metres, corresponding to the distance between the opposing domes – the sacred dome of the church (Regina Pacis) and the profane dome of the sea pavilion (Roma); while the area of pertinence of the facility extends over a surface equivalent to 6x3 modules. [13] (Fig. 3).
Extending parallel to the coastline, the building on the beach plays multiple roles: major backdrop of the urban road which from the centre extends towards the sea; filter between city seaside neighbourhood and the sea; welcoming invitation for the user of the sea promenade.
It appears as an imposing urban wing with obvious reference to classic Roman concrete architecture, a theme dear to the didactics of the newly-established Scuola di Architettura di Roma (1919). Observing the original project drawings, we can see that the building is represented by means of four pencil drawings on paper scale 1:100, a plan view at entrance height, a section drawing and two perspective drawings; such representations have been reconstructed by trying to process the information in a scale close to 1:50.
The monumentality required by the project is accentuated, in the project graphics, by the presence of a human figure in the representation of the perspective views, both as regards the view of the sea front and that of the beach and pier.
The profile of the front towards the city, which is axially symmetric, consists of overhangs and recesses which converge in the monumental entrance portico preceded by a large staircase with mixtilinear pattern.
Majestic Doric columns dominate both the façade facing the sea and that facing the town, two for each span with centre distance of around 6 metres. The tripartition of the infill walls is also legible in the holes and diaphragms above the measurement height.
The monumental entrance portico – three barrel-vault spans with lacunars – is arranged on large perforated dividing walls surmounted on the façade by four statues.
This environment precedes the main hospitality area – the famous 'hall of lost steps' – which recalls, as many writers have pointed out, the configuration of the basilica of Maxentius and consists of a central nave that terminates in a huge groin vault with decorated intrados, supported by four monolithic columns and an equal number of lesenes of composite order.
At the height of the entrance floor, the plan shows: environments used for ticketing service and entrance to the bathing establishment, but also entertainment areas, a café and buffet room, a room for reading and writing, post, telephone and relative toilets.
The pavilion by the sea project – represented through a horizontal section showing the two main heights, a cross section and a view of the sea in scale 1:100, together with a detailed drawing – in a first version envisaged a circular building alongside which were arranged symmetrically two long environments arranged parallel to the beach.
In the final project, the two side arms were replaced with two small rectangular environments with apse shape on the shorter sides, the terraces and stairs were re-dimensioned, and the height-width ratio of the central rotunda was re-proportioned.
Made up of a system of flying buttresses and terminating in a dome with eight wedges, the central core is dilated in cleared spaces open between the arches themselves, providing major visual openings towards the sea and the coastline.
Built on two levels, at pier height is a large circular room with double height, used as a restaurant; the spacious surrounding terraces provide not only an excellent view but also protection from the sun by means

of temporary hemp fabric structures.
The pavilion is distinguished on the outside by an imposing dome which contrasts with the system of flying buttresses with pinnacles surmounted by casts of the Vittoria di Ostia. The reason for this choice is the discovery in Ostia, in 1907, of the statue of the Winged Victory, taken as the symbol of the town; the model was made by M. Bucci, who also designed the eight bronze sculptures portraying angels and placed on the terrace columns. [14].
From a structural viewpoint, the building has all its supporting structures in reinforced concrete, with land parts resting on stone foundations and sea parts on piles.
The reinforced-concrete pier structure, 6 metres wide and over 60 metres long, in the land part features square-section pillars with 50 cm sides placed at a distance of 6 metres the one from the other; while the sea part is supported by reinforced concrete piles with a square section and 33 cm sides.
The length varies from 9 to 12 metres and the piles are 3 metres the one from the other. The system is braced both horizontally and crossways with reinforced concrete trellises.
According to the same principle, the platform was built on the sea, with the circular room featuring double reinforcement to withstand both the overload of the crowd and the pressure of the waves below.
A single block of concrete connects the series of linked piles that bear the weight of the superstructure. The arches and filling walls are made of perforated bricks covered with cement plastering.
The roof is dome shaped with iron framework, interior covered with timber and outside covered with copper plate.
The concrete structure, left visible, is of considerable chromatic importance; with reference to this Gustavo Giovannoni, pointed out its modernity and remarked how perfectly it fitted into the context: colour, grain size, porosity and roughness due to the imprint of the reinforcement formworks go to make up a chromatic system which blends in naturally with the colours of the sea and sky.

The investigations carried out thus far have given us the chance to take a fresh look at a coastal architectural approach that has since disappeared; an unusual and controversial experience in terms of design in which it is possible to trace an improbable mix of architectural styles, made possible by the use of concrete. A type of architecture which has been defined as 'paradigmatic' and 'paradoxical', but which is very definitely ahead of its times from a media viewpoint. [15]
A century after its inauguration, this contribution intends bridging a gap in the intense architectural story of the ‘Roma’ bathing establishment of Lido di Ostia – one of a kind in the design experience of its conceiver, fulcrum of the urban and social development of a Roman seaside town – thus permitting the virtual evocation and restitution, although ideal, of a fundamental part of our environmental, architectural, documentary and intangible heritage. [16]

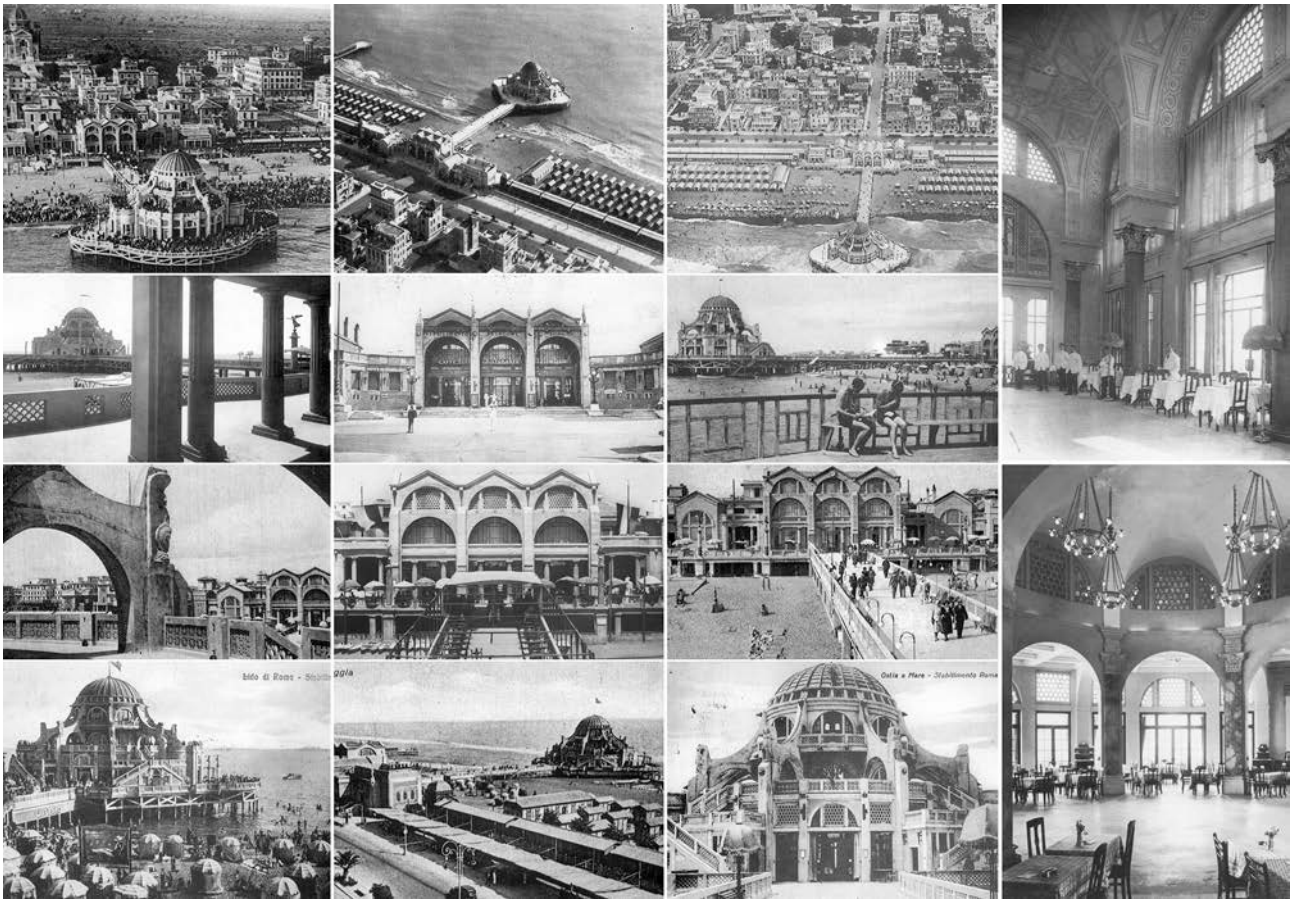

Fig. 1: Ostia Lido. The ‘Roma’ bathing facility (Giovan Battista Milani 1927). Images from the '30s. Cfr. BERETTA, D. Ostia attraverso le cartoline d’epoca. Roma: Dimensione Immagine, 1987.

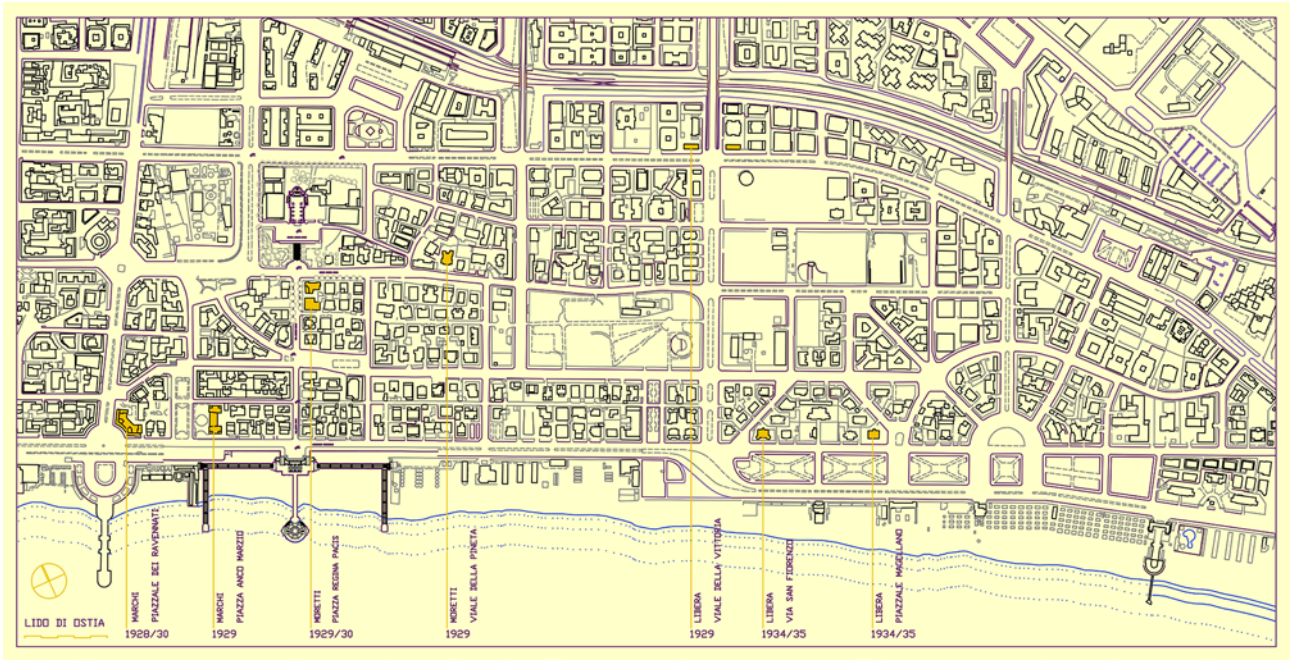

Fig. 2: Ostia Lido. Hypoteses of the insertion of the ’Roma’ bathing establishment in the current urban configuration. This drawing highlites the presence of some exempla of our architectural heritage.

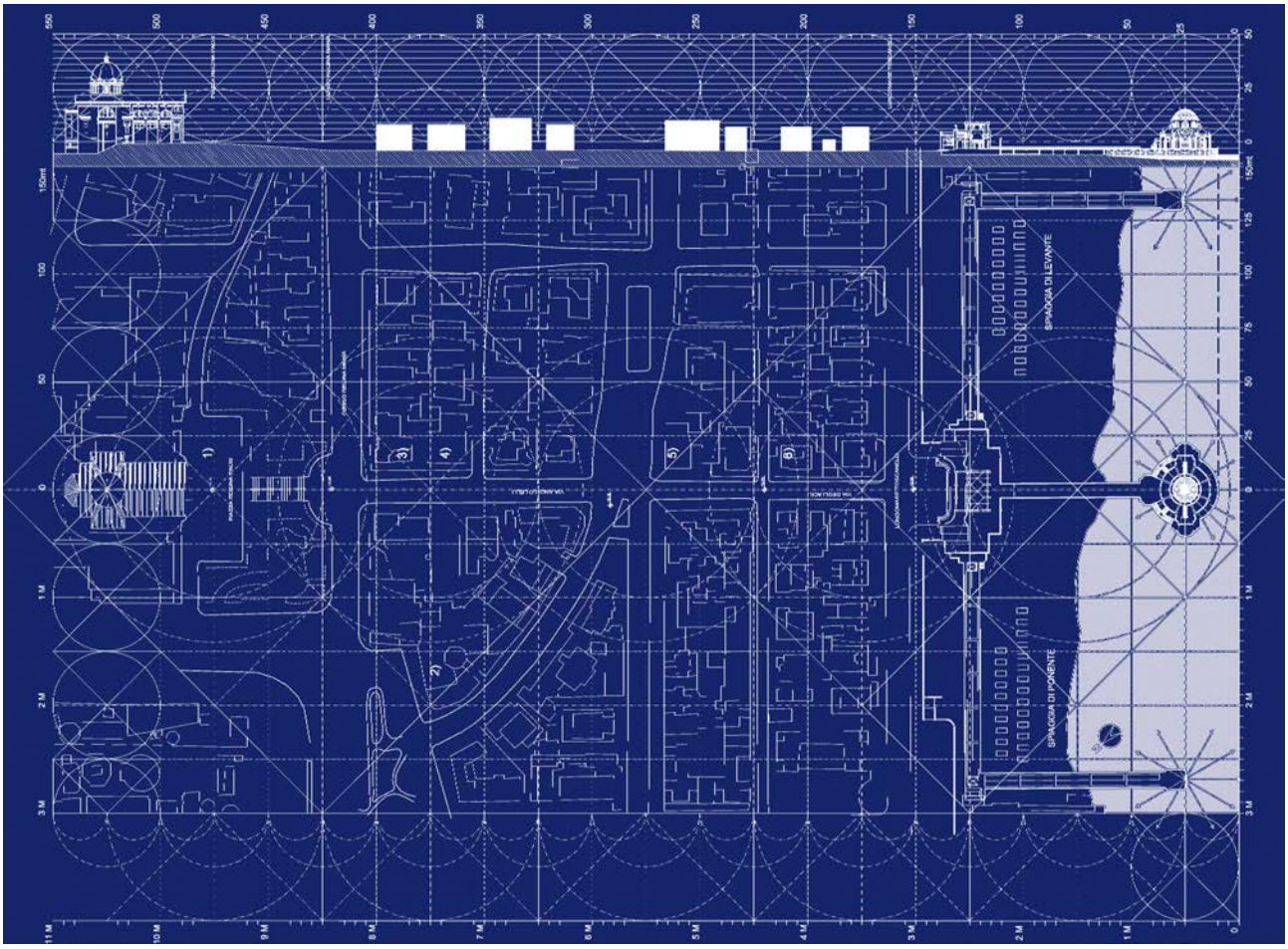

Fig. 3: Ostia Lido. Hypoteses of the insertion of the 'Roma' bathing establishment in the current urban configuration. The virtual recontruction of the urban road configures a dialectic relationship between the two symbols of the sacred and the recreational; they are represented by the dome of Ostia's main church, the Regina Pacis (Giulio Magni, 1916) located on the highest dune and the dome of the 'Roma' (G. B. Milani, 1924) extending out to sea.

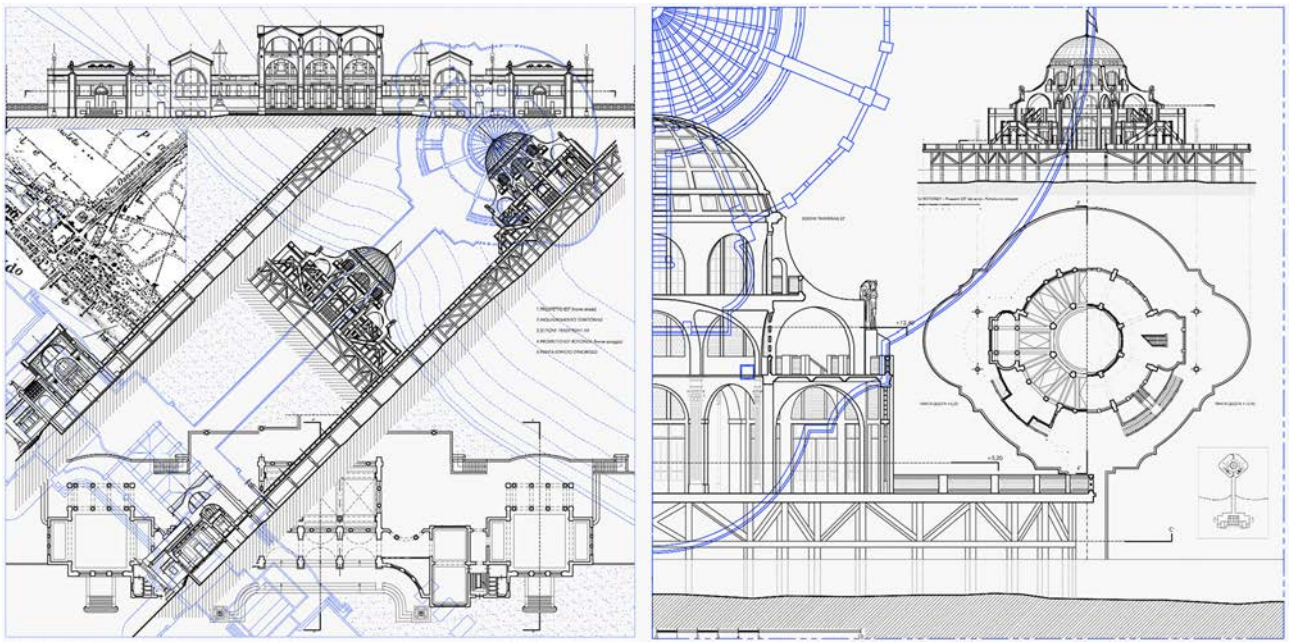

Fig. 4: Ostia Lido. Virtual reconstruction of the 'Roma' bathing establishment. Plan and elevations of the building on the beach and sea pavilion.

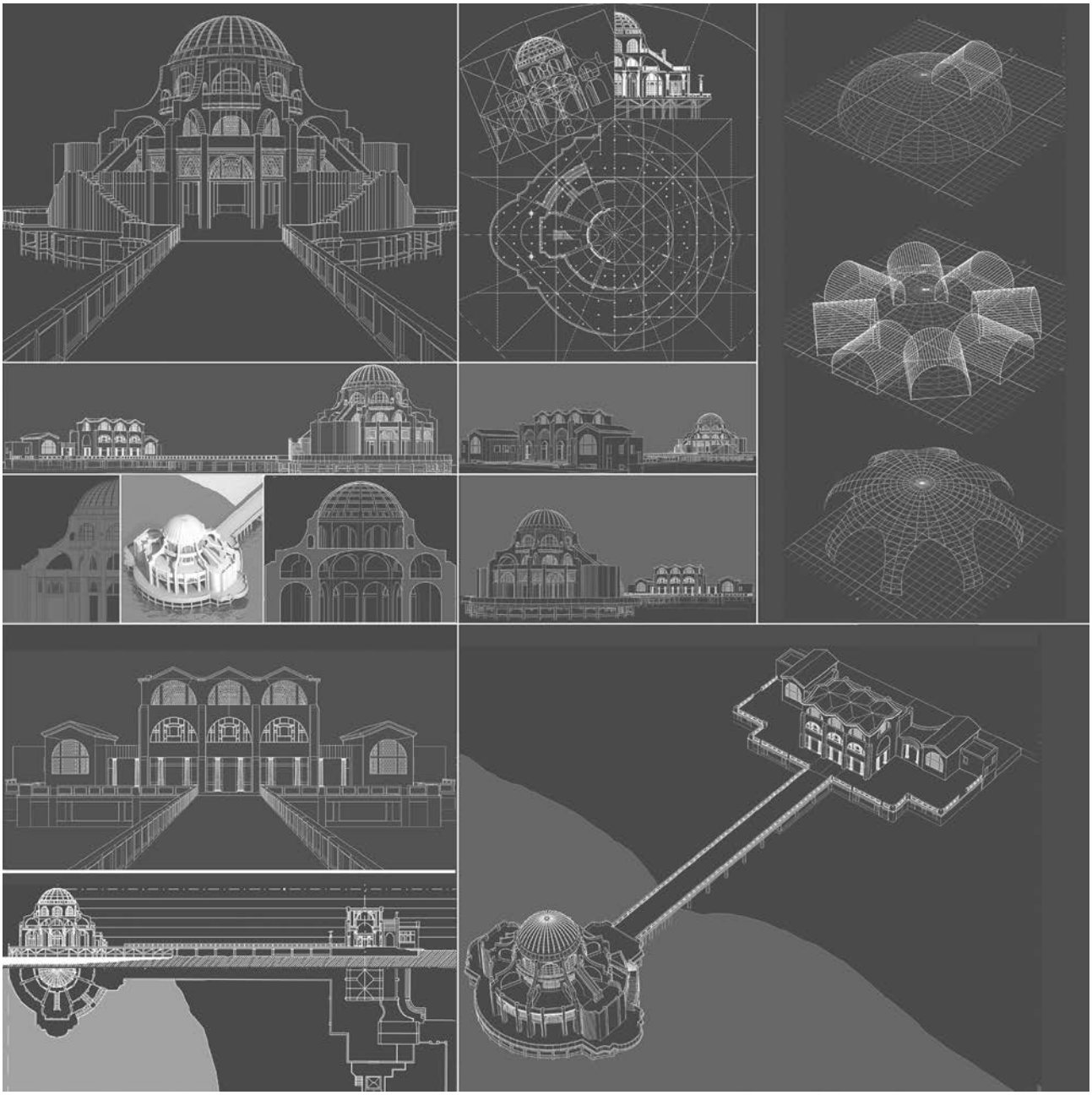

Fig. 5: Virtual simulation of the the 'Roma' bathing establishment.

Bibliographical References

[1] CIUCCI, G., DAL CO, F. Atlante dell'architettura italiana del Novecento. Roma: Electa, 1991, p. 110.

[2] SICA, Paolo Sica. Storia dell'Urbanistica. L'Ottocento, Vol.2, Editori Laterza, Bari 1977

[3] LA PIETRA, U., MORPURGO G. Cultura Balneare. Firenze: Alinea Editrice, 1987.

[4] ZANNI, N. L'immagine della città termale. Da Bath a Salsomaggiore. Trieste: Guerini e Associati, 1992.

[5] SALUCCI, Antonella. Le fabbriche dell'ospitalità: i "divertimentifici" marini. In AA.VV. Emergenza rilievo. Applicazioni di metodi operativi al rilievo per la valorizzazione ed il restauro dei beni architettonici e ambientali. Roma: Edizioni Kappa, 1999, pp. 37-46.

[6] STRAPPA, Giuseppe (a cura di). Tradizione e innovazione nell'architettura di Roma Capitale. 1870-1930. Roma: Edizioni Kappa,1989, p. 99.

[7] GIOVANNONI, G. Giovan Battista Milani (1876-1940). In Architettura. Rivista del Sindacato Nazionale Fascista Architetti, anno XIX, (1940), pp. 523-524.

[8] Piano regolatore di Ostia Marittima. Relazione della Commissione. Febbraio 1916. In Annuario dell'Associazione Artistica tra i Cultori di Architettura di Roma, Roma: Tipografia Innocenzo Artero, 1916, p. 95-116; tavole fuori testo: V e VI.

[9] MURATORE, Giorgio. Giovanni Battista Milani ingegnere-architetto tra scuole antiche e edilizia nuova. In MAZZA, A. Giovan Battista Milani, Progetti e Architetture Romane 1900-1940. Roma: CLEAR, 1995, p. 14.

[10] MARCONI, P. CIPRIANI, A. VALERIANI, E. I disegni di architettura dell'archivio storico dell'Accademia di San Luca. Roma: De Luca Editore, 1974, vol. 1 p. 53.

[11] GIOVANNONI, G. Lo stabilimento balneare di Ostia a mare. In L'Architettura italiana. Anno XXII (1927), fasc. 2, pp. 15-16.

[12] GIOVANNONI, G. Lo stabilimento balneare "Roma" alla marina di Ostia. In Architettura e Arti Decorative, anno VI (1927), p. 499-500.

[13] SALUCCI, A. Ricostruzione virtuale dello stabilimento "Roma". In Carlo MEZZETTI, Carlo (a cura di). Intersezioni DI/SEGNI. Roma: Edizioni Kappa. 2007, pp. 243-256. Isbn 978-88-7890-791-1.

[14] BOSCOLO. S., CRETI, L., MASTELLONI, C., MONACO, R., PAGLIA, S., PICCARRETA, M. (a cura di). Ostia - Gli Stabilimenti balneari. Il mare di Roma e la sua storia, dai primi del '900 ai giorni nostri, attraverso l'architettura della balneazione. Roma: Edizioni Architettura s.c.r.l., Roma 1986; pp. 29.

[15] ACCASTO, G. FRATICELLI, V. NICOLINI, R. L'architettura di Roma Capitale. 1870-1970. Roma: Golem 1968.

[16] COPPOLA, F. FAUSTI, G., ROMUALDI, T. (a cura di). La città interrotta. Ostia marittima 1904-1944. Roma: Sinesi 1997.

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Representing the time: the role of sequences representation in the design of visual information

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Abstract
In the design of visual information, one of the essential elements of the project planning is time. This concept, defined as a sequence in reading or viewing, appears today an important research key point.
The main objective of this paper is to identify the graphical illustration's role in communication processes, and to highlight how the image relates and influences learning spatial skills compared to traditional verbal processes.
In the field of communication through visualization, the attention is here focused on the design of instructions - such as those of the operating instructions or assembly of objects, or a path's indications in the public spaces - namely those tasks that require explanations of actions in space. In this specific type of visual communication images have to be arranged in a precise spatial-temporal configuration and require important representation and reading skills.
The representation of these processes has been extensively studied under different points of view, taking into account both the structure and the spatial-temporal configuration, of course without neglecting the Gestalt and the aesthetic-graphic components.
It is a vast research and experimentation field, which involves in it various disciplines: so, it was not possible to reach general definitions. However, the presence of a visual system shaped to receive the presented data has pushed to try to understand the operation of the receptive mechanism, in order to produce more useful representations and best thinking tools.

Keywords: instructional diagrams, graphic design, visual communication

1. Introduction

The communication of a process by means of graphic illustration is today a research field open and full of important developments. In a period when the global social system has broken down the barriers of verbal language, creating multiple interactions through a plurality of alternative media, increasing attention is being paid to the development of visual communication techniques that quickly become an efficient and effective system of conveying meaning.
The visualization as well as the verbalization generate a real language with precise rules and structures. That way, the task of translating concepts and processes into images becomes more and more complex, joining together skills of different types: those graphics and engineering to those of the psychology of perception to those properly artistic.
The main objective of this study is to identify the role of illustration in the graphic display of processes (i.e. instructional aids to the case of object assembly, or path's indications in public spaces etc.), and to highlight the importance of representation by images sequences according to space-time in the acquisition of spatial skills than traditional verbal proceedings.
In the field of communication through visualization, the attention is here focused on the design of instructions - such as those of the operating instructions or assembly of objects, or a path's indications in the public spaces - namely those tasks that require explanations of actions in space. In this specific type of visual

communication images have to be arranged in a precise spatial-temporal configuration and require important representation and reading skills.
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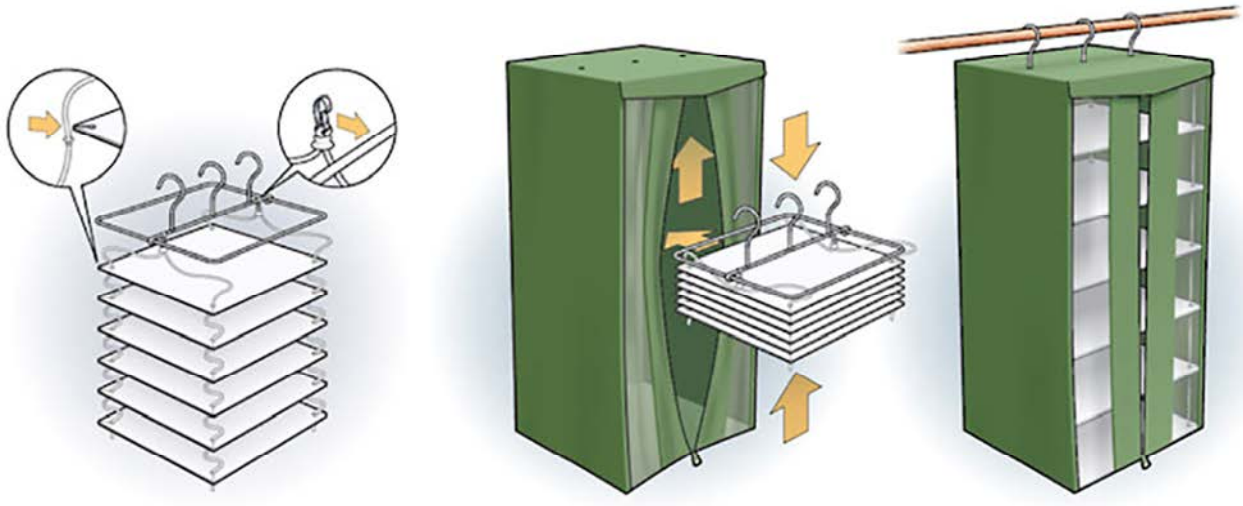

Fig. 1: Vic Kulihin. *Shelves*

2. Method

The research - widely oriented and for which many aspects are still under investigation - has been undertaken through two fundamental phases: a first focused on the collection of documents, from different fields, which have as object visual representations of processes, in order to create a vast repertoire, in the form of database, able to constitute a significant source of study.
A second step, of critical analysis, useful to extrapolate a set of recurring characters (syntactic structures, articulations space-time, etc.) and choices (representation methods, layouts, colors, typographic fonts, verbal references etc.) in order to understand the possible structuring of a language based on elements and reading mode widely shared.
The category of visual documents examined is very wide and goes by the instructions on the use of devices (an iron, a vacuum cleaner, a blender etc), to those mounting (houses, objects, furniture, toys, games rules) to the infographics to orient, used in public places. In all of these drawings it has been highlighted the ongoing search for a language that does not need the verbal culture and, overcome language barriers, is able, through visualization, to convey complete and effective messages and directions that might otherwise require long and complex translation and description processes, sometimes lacking the same capacity of conveying.
There were then considered the most significant cases - those most successful in relation to the analytical deductions performed - in terms of spatial arrangement, temporal sequence, conciseness of images (or pictorial symbols), graphic symbols (related to images, conceptual or arbitrary), and verbal references, with the aim of verifying the most effective ones in terms of understanding and consequently the cognitive approaches for the construction of better designs of processes, such as the method of segmentation of the actions in step by step diagrams and phases, the expression of the dynamism of the action or the symbolism.

3. Time and space in instructional design. Structure and role of depicted diagrams.

Among the methods of communication the verbal one is perhaps the most common and certainly occupies a priority place. Although the words have a purely symbolic structuring, in many cases they allow to express concepts, actions and relationships. With words it is possible, for example, express, much more easily than through pictorial and visual means, quality attributes, negations, hypothetical concepts. Nuanced expressions of thoughts, relationships or actions are expressed in the verbal language in a easier way and certainly free from ambiguity.
However this form of communication, even if it is the most used, is not the only method of conveying meaning and knowledge and cannot always be considered to be the most suitable. Pictorial communication

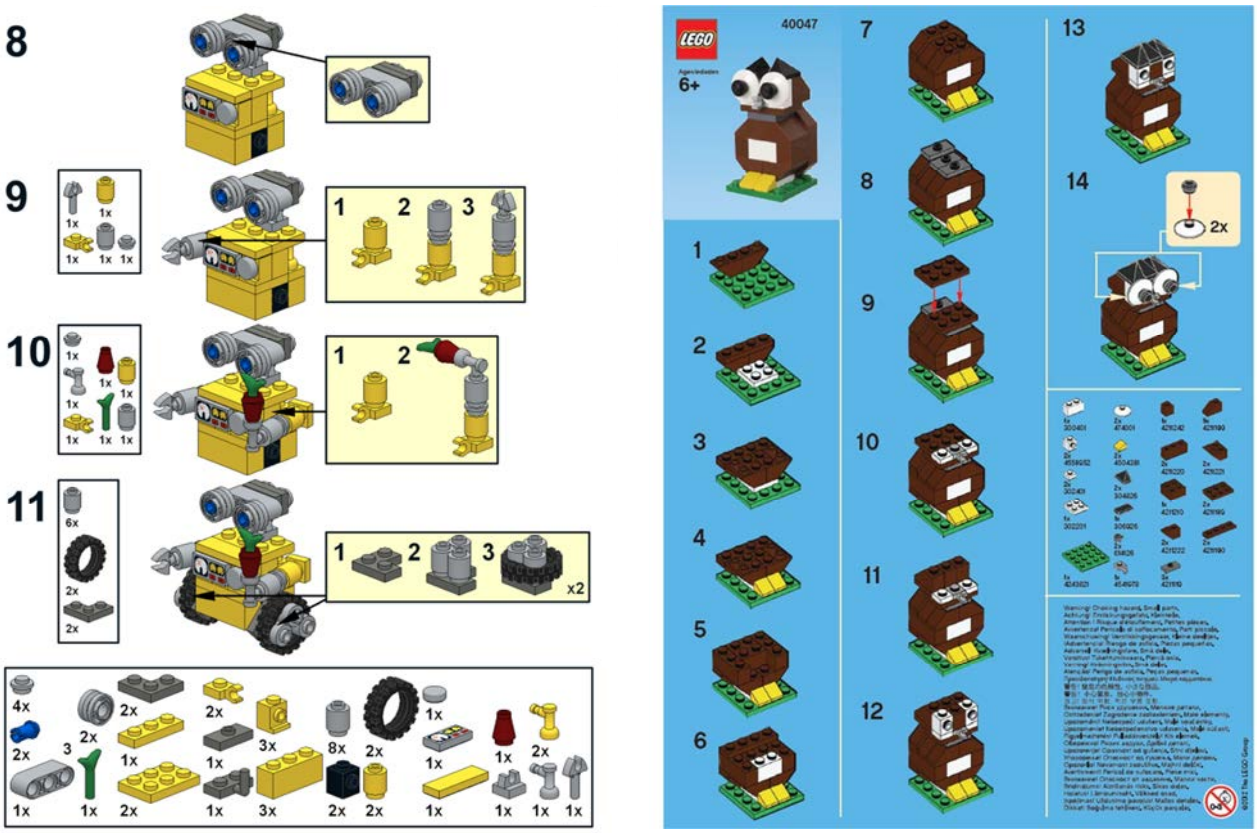

Fig. 2: Lego toys instructions

or gestural communication represent, in fact, other significant languages. Both, however, can be considered among the forms of visual communication to which is assigned a key role in the process of exploration of concepts and dissemination's information. Thanks to a careful manipulation of perception, cognitive processes and communicative intentions, it is possible to structure a real visual language capable, through technical and diversified media, to highlight relevant information to be transmitted and de-emphasize irrelevant details. The benefits of visual communication than verbal are numerous. The visual image fact exploits the perceptual similarity with the object of communication, unlike words whose signs are purely symbolic. It may also represent objects, parts of objects and structural relationships, mode of assembly, but at the same time telling actions or processes from diversified degree of complexity.

Before proceeding to a detailed analysis of this form of communication, they have been collected, in several areas, different sequences of images, products of visual design, studied to convey information or actions (for example, the instructions on the safety procedures in aircrafts which follows the visual-gestural explication by the shipboard personnel in order to go beyond the limits of verbal language), or manufacturing processes (eg. assembly instructions of a mechanical object).

The field of investigation therefore has been large. they have been selected various materials from texts and - more often - from all those representations of processes by images which are included to objects of daily use or recurring actions: by the instructions of use of appliances, to those of furniture assembly, the explanations of games, instructions of children's toys (to build or explain how to use them) etc. However they were considered examples where there was a space-time implication.

After an overall task of classification of the collected examples (for which it has been developed, in an experimental way, an informative database), it has been carried out, primarily, a research on the syntactic structure of the visual schemes by analyzing them in detail. In this phase it was not taken into consideration the aesthetic value of displayed information, on which nevertheless they were made some remarks in the margins.

From this study, as well as from the diverse research linked to recent experiences in the field of cognitive psychology, there was evidence that as in verbal narratives, also in visual communication processes through the illustrations it can be find a logical structure of the speech [1] consisting of a sequence well marked by a beginning, a middle part and an end.

The beginning generally is an introduction; the middle part consists of the development of a sequence of procedures - so-called step-by-step - in which the graphic and aesthetic appearance often plays an important role; the end is marked by indications of completion of transactions with a final-sate diagram. The presence of a narrative structure has been observed in several studies [2] [3]. From a semantic point of view,

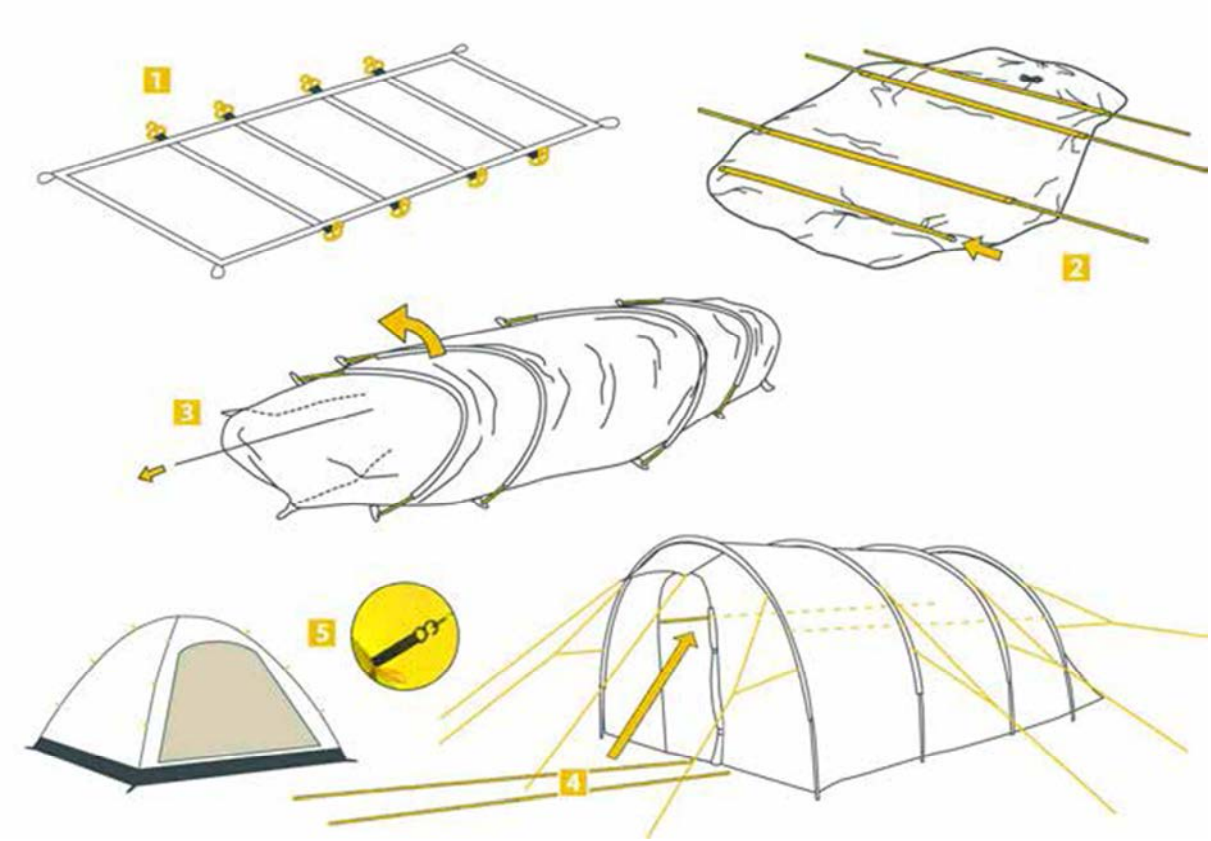

Fig. 3: Assembly instructions of a camping tent

it was possible to note how the representation of objects is performed with static images while the actions are characterized by the interrelationships of images in a sequence that alludes to the dynamism [3]. The diagrams often depict the temporal order of a process by illustrating states and changes to states [4].
Before moving the focus on the graphic design criteria of instructional diagrams it appeared necessary to make some observations on their visual structuring.
The introductory part of this type of diagrams is generally constituted by a list of items. As in the case of the ingredients of a recipe they are presented here the components used in the assembly/construction of the object. The methods of representation used are the traditional ones, but the most used are the axonometry and the perspective by virtue of the greater visual verisimilitude that characterizes them.
The development of the middle part is instead constituted by diagrams showing the sequence of steps required to assemble/construct the object. In this case the representation arises in space-time relationship a series of images in a step by step succession.
In this succession are depicted the joints, the transitions, action by action, from the beginning to the final state. It is significant to note also that in that diagrams there is no relation to the actual time intervals necessary for the performance of each phase.
However, the expression of instructions through steps seems to respond to the cognitive need of considering the assembly as a set of hierarchical operations [5]. For that, typically, assemblies of smaller parts with the most significant parts are associated with easier and faster operations. The parts are considered more significant in relation to some aspects such as function, size, or symmetry [6].
The sequence of still images allows the viewer to directly compare the state of the system at each important step [3].
Most of the time this section of the explanatory structure is composed by axonometrical drawings exploded, with lines and arrows (morphograms),all in the same scale, and observed from a single point of view. Nevertheless, the most significant are those graphs that represent the objects to be assembled from different points of view. In fact, in this way, it seems to overcome the difficulty of a bad point of view to a specific assembly step.
The final part, as in the textual explanations, is the conclusive element of the instruction. While verbal instructions generally are concluded with some suggestions on the object use, those graphics ends with the overall image of the object assembled.
It is evident that the fundamental part in illustrating a process is precisely the middle one, namely the one characterized by the set of sequences step-by-step. The structuring of the displaying path as a whole seems

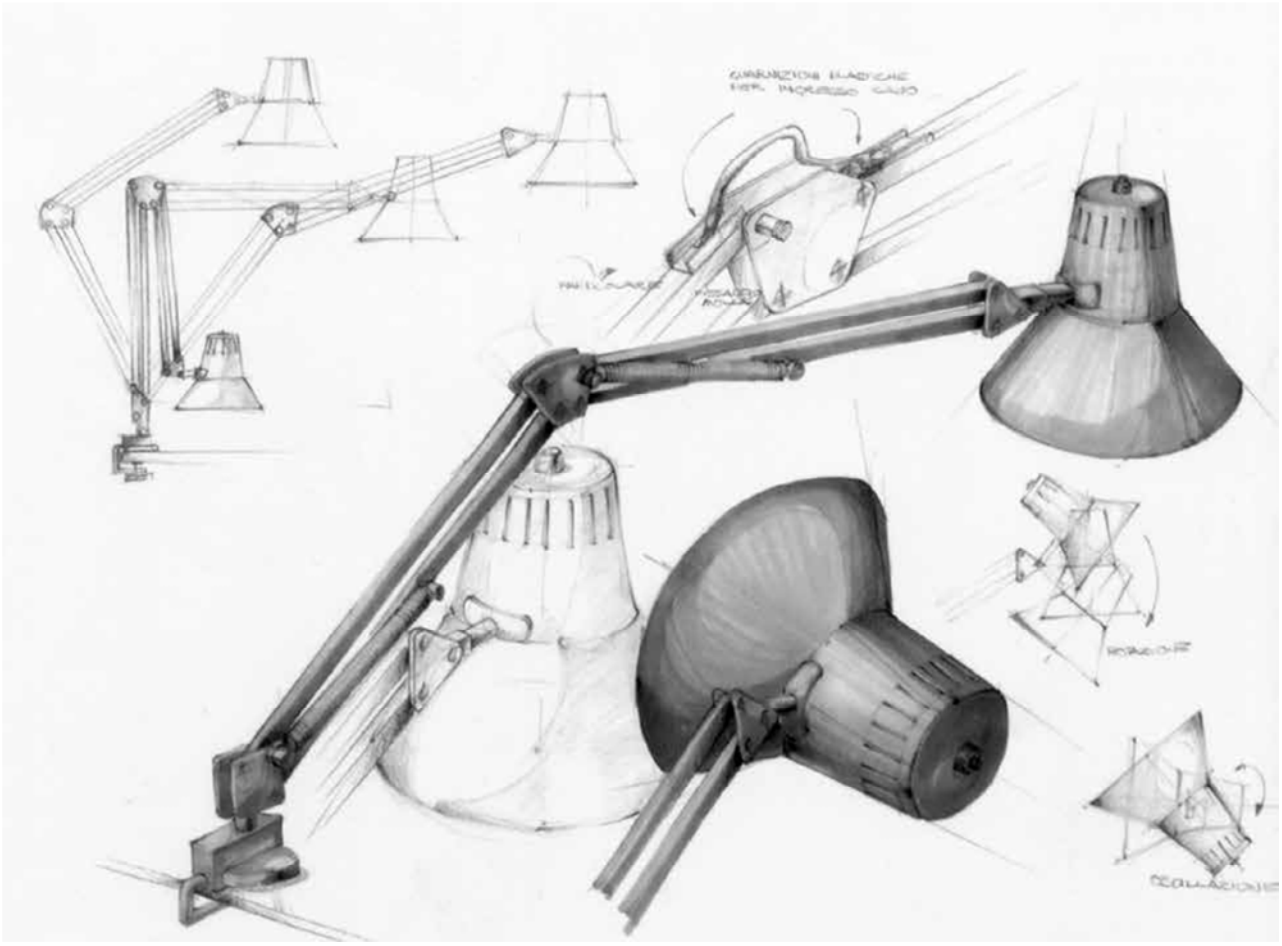

Fig. 4: Graphics sketches which show the movement of a lamp

to identify some basic principles useful for graphic design of instructions that, even for the compliance to experimental criteria of cognitive psychology, make them easy to understand and recognizable. From the comparisons made and the degree of significance of the success of the interpretative phase, it has been noted that the best outcome of the displaying process is got by the instructions based on a hierarchical representation of the parties and of the operations to be performed. The presentation of the center stage with chains of images in frames step-by-step - however the most frequently found in the most recent documentation - shows the preference of a guidance in image sequences, compared with an illustration only able to view all passages simultaneously [7].

Furthermore they appeared more effective among these instructions, those with more concise graphics. Another significant aspect is found in the type of illustrations for which were more responsive to the criteria of effectiveness those who resorted to diagrams alluding to the dynamic process of assembling rather than exclusively structural. The presence of arrows, and other guidelines in the exploded morphograms seems to give them a better quality of reading the sequence of operations.

Finally some notations can be made on views. As it has already been noted, although a single point of observation facilitates the recognizability of the object, this is not always ideal for the understanding of the assembly operations. In this sense, also on the basis of the experimentation in didactic experience, have appeared more effective the diagrams that, in relation to the maneuvers mounting, showed changes of point of view, while maintaining the same method of representation. It was shown that this also minimizes accidental alignments of edges or parts, facilitating the object's recognition [6] and the assembling parts. The fundamental principle that unites all the schemes deemed more effective is that of visibility: ie each part added to each assembly sequence must always be visible.

The communication of information through such visualizations has now become extremely common and has been tested over the years, in an informal manner, just by the users. This has led to continuous improvements and enhancements that have revealed the fundamental principles behind the design. Like all forms of communication, including the visual-related processes (e.g. instructional design), to be effective, must be represented properly, underlining, highlighting, and if necessary distorting the essential information and eluding rather those non-core. It is clear that to achieve significant results it is essential the collaboration between graphic designers and experts in different fields.

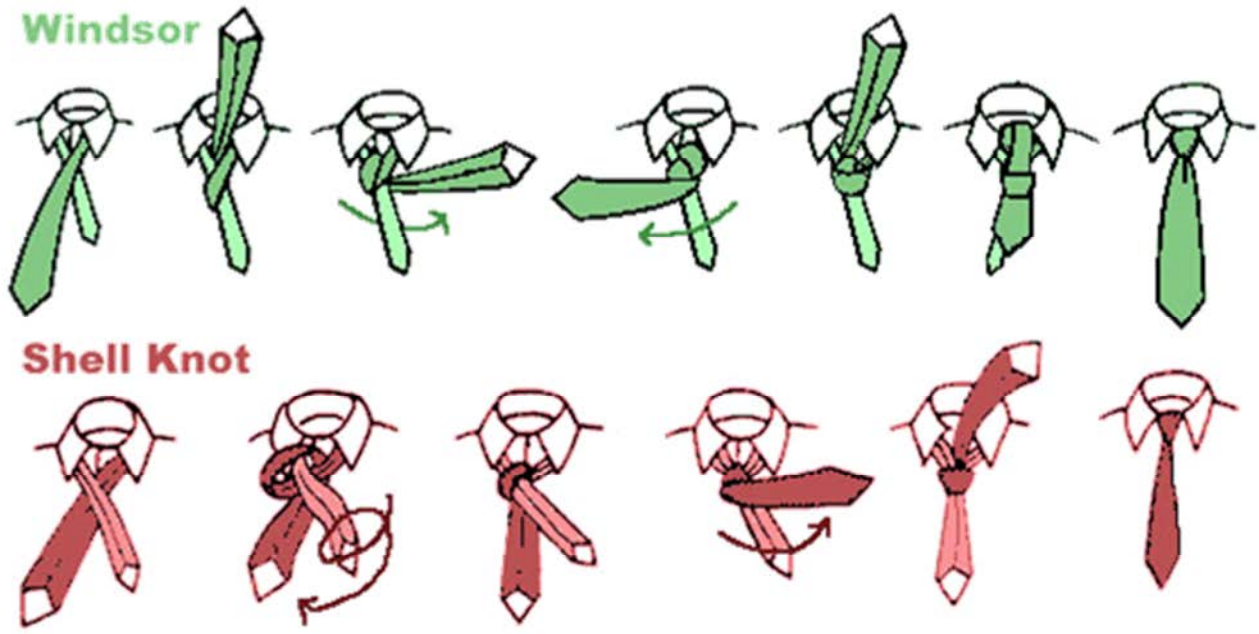

Fig. 5: How to tie a tie step by step

The process of visual communication is then to be placed in between art and science: on the one hand the structure of drawings and diagrams, their visualization and definition are based on rigorous assumptions drawn from cognitive psychology, geometry, optics, visual perception, etc., on the other their appearance - the importance of which appears indispensable - draws on the art field where the work of graphic designer translates into images not only visible things but also abstract, as thoughts and relationships, concepts of space and time. The definition of sets of semantic elements, descriptive or pictographic, comes from a work of interpretation and synthesis that is not easily delegable only to the scientific rigor, even if based on rational principles. The close linkage between science and art is easily detectable through a few observations on the illustrations containing actions with space-time implications in which the graphic representation of the dynamism becomes an essential component of the graphic designer's ability.

It has been recognized as communication is a process that does not allow ambiguity. The designs of instructions – for example – as also maps, must be clear and not cause misunderstandings. It must respond to abstract mental models. Apparently there is no space for creative design. So much so that, for example, in the industrial production of furniture or other objects to be assembled, in order to bring down the costs of graphic design - often commissioned to specialized teams of visual designers - are being tested computer algorithms for automated production of assembly instructions, according to the criteria of good design [3] [6]. Even in the design of maps were studied automatic generation systems. However, the graphic language through which certain views are expressed has to be considered as belonging to the domain of art. The act of giving a shape to things is a foundational element of graphic design and cannot ignore the critical ability of the designer who has the task to choose, select, discretize.

In the graphical representation of processes involving actions, the illustrations are characterized by images to which is attributed an inherent temporal development made it through the representation of a movement.

According to the principles of the Gestalt, the progression of the movement is displayed by means of the segmentation of a continuous motion in a set of discontinuous instants, overlapping or adjacent to each other, that suggest the continuity of the movement. That way the ability to display an action is clear but cannot be entrusted, regardless of the hand and the mind of the designer, solely to the machine.

The variables highlighted in these types of illustrations are nevertheless different and it is not always possible to tell that the only description of the action by images is sufficient to avoid creating misunderstandings such as to undermine the effectiveness of communication [8].

For example, with respect to the instruction sheet for safety in aircraft, Ernst Gombrich [9], expressed his doubts that a passenger involved in an emergency landing in the water would be able to properly wear the safety jacket.

Narratives with dynamic implications have been grouped into two sets: those in which the action is expressed through images linked by a relationship of succession narrative and those in which the movement is expressed through drawings that break the movement.

In the first group, the images represent the motion through subsequent and narrative steps, that seem an extension of the action with the effect of continuity, which is a temporality expressed on spatial base. As in the comics "through the juxtaposition in the space of more than one iconic statement and the establishment of a narrative instance it is possible to create a correlation between the images that synergistically contribute

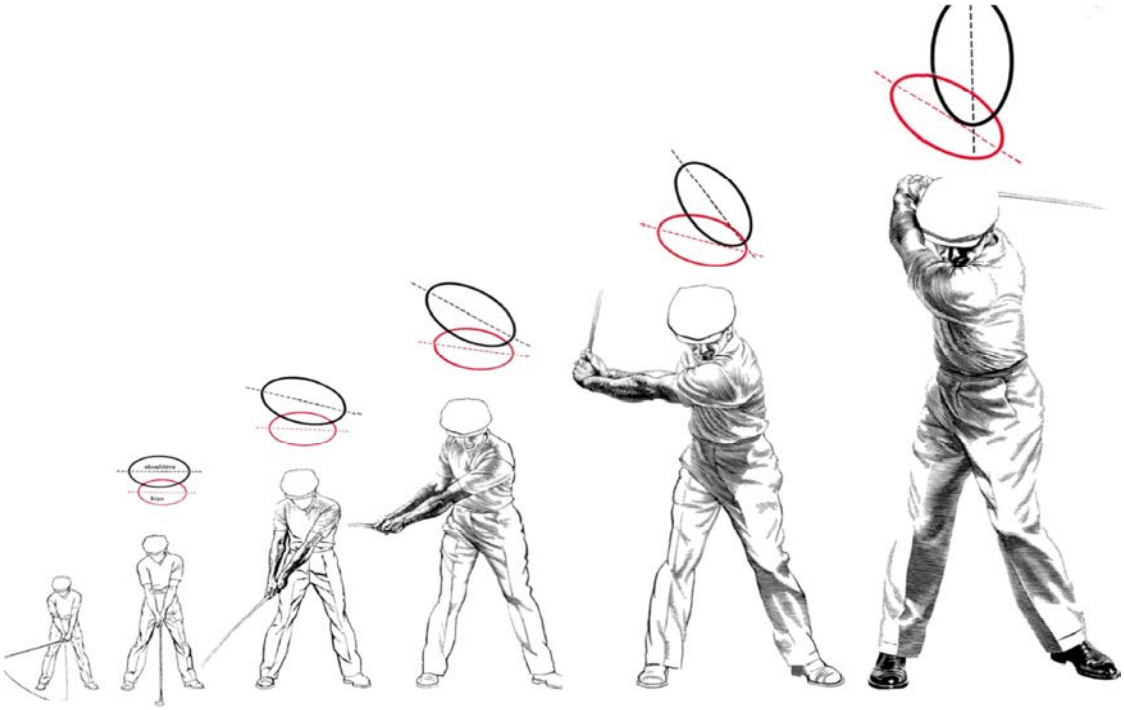

Fig. 6: Instructions for completion of swing in the golf

to the production of meaning" [10]. The feature of such visual messages was called by Thierry Groensteen "iconic solidarity" [11]. Placed inside a reading protocol that proposes the rules of the written language, images are fixed in strips, which follow a temporal organization. The reading progression in space of the strips gives rise to the narrative action.
In the second group drawn images represent a progression detached from spatial dimension. The graphic designer, in that case, manages the plane of the drawing by placing images and shapes hierarchically, so as to meet specific intentions, communicative and aesthetic. The graphic elements are not necessarily bound by the narrative point of view, but are configured as independent statements. In this case, the time subsequent to the motion manifests itself through a series of processes, with a relationship for sequence based on the transformation of the forms [12].
In both cases there are communication artifacts acts to graphically manage the temporal dynamics but their success, and the disambiguation information expressed, is correlated to the use of graphic symbols and sometimes even of words (verbal language). The analytical study carried out - as well as the educational experiences conducted - showed that the presence or insertion of signs suitably designed helps the interpretation of low complexity graphic images, by decreasing the ambiguity of information and by leading the reader to understand the meaning that was in the illustrator's intentions.
These graphics are typically consisting of signs (lines, crosses, arrows, etc.) that have strong semantic relationships with the language. Their combination, never random, is able to lead to even complex meanings. Their recurring use gave rise to the establishment of a kind of conventions that bring the graphical language syntax close to the verbal language.

4. Conclusions

This study, framed in the wide field of visual communication, has focused attention on the visual representation of processes with space-time implications that is still a research field in constant evolution and experimentation. Scientific representation and drawing constitute a fundamental part of the reflection in this area, however, there are significant influences of many areas of knowledge such as language, aesthetics, information and communication, and psychology. The graphic design then becomes at the same time a means and the result of a process that allows to convey information in a functional and aesthetic way. The drawing is the filter that facilitates communication between user and product, places, processes.
Through a research based on critical and analytical studies and a phase of experimental didactics, particularly focused to the expression of instructional design, it has been highlighted on the one hand the presence of a syntactic structure in the depicted diagrams, on the other the existence of special display mode of space-time dynamic by static figures. The manipulation of these processes allows to convey in the observer's mind at the same time concrete information and abstract concepts. This form of communication thanks to the images takes place in a direct and silent.

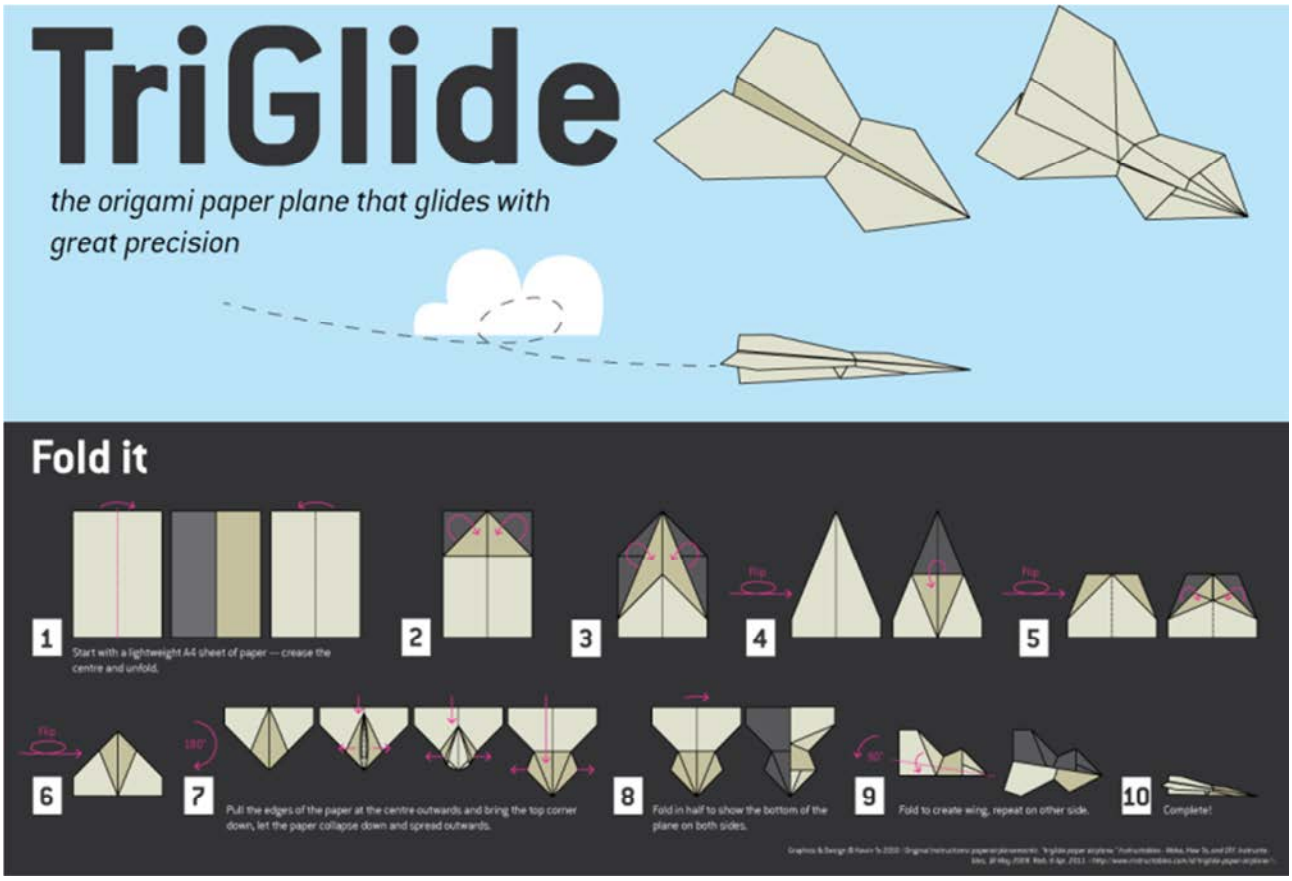

Fig. 7: Sequence of operations to achieve an origami

Bibliographical References

[1] TVERSKY, Barbara. HEISER, Julia. LEE, Paul. DANIEL, Marie-Paule. Explanations in gesture, diagram, and word. In COVENTRY, Kenny R. TENBRINK, Thora. BATEMAN, John. (Editors). *Spatial Language and dialogue*, Oxford: Oxford University Press, 2009, p. 119-131. ISBN 978-0-19-955420-1

[2] DENIS, Michel. The description of routes: a cognitive approach to the production of spatial discourse. In *Current Psychology of Cognition*, 1997,16 (4), Marseille: ADRSC, 1981-2005, p.409-458.

[3] TVERSKY, Barbara. AGRAWALA, Maneesh. HEISER, Julie. LEE Paul. HANRAHAN, Pat. PHAN, Doantan. STOLTE, Chris. DANIEL, Marie-Paule. Cognitive design principles: from cognitive models to computer models. In MAGNANI, Lorenzo (Editor). *Model-based reasoning in science and engineering*, London: King's College, 2007, p. 1-20. ISBN 978-1904987239.

[4] CHENG, Peter C-H. Functional Roles for the Cognitive Analysis of Diagrams in Problem Solving. In COTTRELL, Garrison W. *Proceeding of the Eighteenth Annual Conference of the Cognitive Science Society,* Hillsdale, NJ: Lawrence Erlbaum, 1996, p. 207-212. ISBN 0-8058-2541-X

[5] ZACKS, Jeff. TVERSKY, Barbara. IYER Gowri. Perceiving, remembering and communicating structure in events. In *Journal of Experimental Psychology: General.* GAUTHIER, Isabel. 2001 / 136, Washington: American Psychological Association, 1916-2015, p. 29-58.

[6] AGRAWALA, Maneesh. PHAN, Doantan. HEISER, Julie. HAYMAKER, John. KLINGNER, Jeff. HANRAHAN, Pat. TVERSKY, Barbara. Designing effective step-by-step assembly instructions. In *ACM Transactions on Graphics (TOG)*, Proceedings of ACM SIGGRAPH 2003. Volume 22, Issue 3, July 2003, New York: Association for Computing Machinery, p. 828-837.

[7] NOVICK, Laura R. MORSE Douglas L. Folding a fish, making a mushroom: The role of diagrams in executing assembly procedures. In *Memory & Cognition.* MULLIGAN, Neil. 2000 / 28 (7), Springer US, 1973-2015. P. 1242–1256.

[8] MIJKSENAAR, Paul. *Visual function. An introduction to information design*. Rotterdam: 010 Publishers, 1997. ISBN 978-9064503030.

[9] GOMBRICH, Ernst H. Pictorial Instructions. In BARLOW, Horace. BLAKEMORE, Colin. WESTON-SMITH, Miranda (Editors). *Images and understanding*. Cambridge: Cambridge University Press, 1990, p. 26-45. ISBN 978-0521369442.

[10] MENACCI, Jacopo. Limiti (e soglie) tra grafica e fumetto. In *E|C Serie Speciale*, 2009 / Anno III, nn. 3/4, AISS Associazione Italiana di Studi Semiotici, pp. 131-144.

[11] GROENSTEEN, Thierry. *Système de la bande dessinée*, Pars: Presses Universitaires de France, 1999.

[12] GAUDREAULT, André. *Du litteraire au filmique: systeme du recit.* Paris: Klinkensiek, 1999. ISBN 978-2200219901.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE

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Hollow clay elements of typical Calabrian tradition: typologies and construction techniques.

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Abstract
The “carusello”, a ceramic hollow brick, although it belongs to the hollow tiles category, is different because of its morphology and its assembly method. The kind of vaults traditionally built using “caruselli” are: barrel vaults, cross vaults, and those types of cupola vaults often detectable in spaces where there was the will to realize lightweight structures with wide spans. This work aims to give a contribution to systematize the knowledge of these kind of vaults through a close examination of the properties of the single ceramic hollow bricks, and of the structural compositions manufactured with their assembly. For this purpose a summarized diagram of the different types of “caruselli” has been arranged considering their morphology, and referring to examples found in ancient buildings still present in Calabria, in order to have a first classification to which the assembly method can be related. The assembly system is self-bearing and derives from the juxtaposition of staggered rows of “caruselli”, that are well-positioned next to each other, and with the circular base turned towards the structure intrados. The single modular elements were forged to guarantee, in their assembly, the parallel position of the vertical circular axis of symmetry to the curve generating lines of the structures.



Therefore, the work shows, through graphic representation too, how this lightweight, economic and easy to achieve ceramic hollow brick, can shape elementary arches, that, if placed next to one another, set up simple and compounds vaults and domes. In order to complete the work, a mineralogical petrographic characterization of micro-samples of material extracted from some “caruselli” will be carried out through specific laboratory analysis.

Fig. 1: Barrel vault with "caroselli" in Crotone

Parole chiave: ceramic, hollow brick, masonry structures.

Introduction
The ceramic hollow brick is an element traditionally used in the historic construction industry in Calabria for the realization of shell roof, with the purpose of lightening the masonry. It can bear considerable pressures, allowing the roofing of great spaces and at the same time assuring a low weight.

Since ancient times they had been looking for a method to relieve the deadweight of the vaults and reduce the pressure on the retaining structure [1,2]. The employees found the solution to all of the above-said difficulties with the “carosello”, the first hollow brick in history.
The kind of hollow elements changed from place to place, and they were different in the shape and in the assembly method.
Caroselli were not used only for vault structures, but they can be found in vertical walls, in floors, and in flexed - pressed structures like domes and shells.
This work examines vaulted structures, built with single hollow elements named “caroselli”, having a cylindrical closed body, with rather uneven dimensions and shapes [3]. These elements showed different features according to the production locality and the kind of manufacturing, for example tapered and long shapes, or squat and rough shapes. Generally, their height varies from 8 to 35 cm and the diameter from 10 to 25 cm (Fig. 2) [4]. The caroselli were made by potters using a lathe, one by one, and displayed smooth external surfaces or sometimes faint grooves, intentionally created to facilitate the cohesion to the mortar. Along the inner surfaces, the signs of the manufacturing were evident, caused by artisan’s fingers or by a specific stick.
The potter usually forged the element from a single clay piece, conveniently made humid, positioned in the centre of the lathe and modeled with the moving circular surface , assuring the vertical symmetry and the easy realization [5].



Fig.2: Types of caroselli in Calabria

1. The caroselli and their building techniques

Vaults were built juxtaposing longitudinal rows of caroselli according to the radial axis of the arch. These rows were staggered so that every carosello of the superior row could find support in the space between two caroselli put side by side in the lower row Fig. 3).
About the assembly technique, it can be said that maybe the caroselli were placed on a centering and caseharden with a mortar containing screened land without vegetable impurities. This mortar was made with hydrated lime and calcined gypsum as binder, useful to reduce the setting time of the vault. The structure was completed with a superior casting that assured its shell behavior rand named “caldana” [6].
The kind of the realized vaults were different not only in the complexity of the assembly, but also in the generating line which created the shape. In fact, they could be connected semi-circumferences or circular shapes generating barrel or cross vaults [7].


Fig. 3: Soverato - Cross vault realized with staggered rows of Caroselli

If it is wanted to locate the origins of carosello, it can be said that they belong to the building Roman tradition, and like other building techniques, it was abandoned during post-Byzantine period, and replaced with other techniques based on the use of heavier stoned material. It was reemployed in later time, by popular employees, but its use didn't become very common. This work will find important data, like the specific weight, and will study the tensional increment due to the increase of the spans of the vaults, until now unknown in the building branch.

2. Calculation of the specific weight

The calculation of the specific weight of the carosello is based on a simple operation process among solids. The element has been simplified in two cylinder one inside the other one. The former, that will form the external envelope, will have a radius r_2 of 4,5 cm and an height h_2 of14 cm, while the latter will have a radius of r_1 4 cm and an height h_1 of 14 cm.

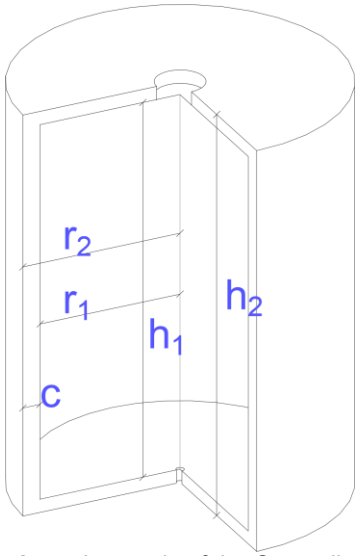

Fig. 4: Isometric of the Carosello

Supposing a constant thickness "c" of 0,5 cm separating the two cylinder, we will write the total volume of our solid, as subtraction of the two volumes previously described, easily expressible as a function of the geometrical characteristic of the smallest cylinder.

$$V_2 = \pi \cdot {r_2}^2 \cdot h_2$$

$$V_1 = \pi \cdot {r_1}^2 \cdot h_1$$

$$V_2 = \pi \cdot (r_1 + c)^2 \cdot (h_1 + 2c)$$

$$V_{tb} = \pi \cdot (r_1 + c)^2 \cdot (h_1 + 2c) - \pi \cdot {r_1}^2 \cdot h_1$$

$$V_{tb} = c \cdot \pi \cdot (2c^2 + c \cdot h_1 + 4c \cdot r_1 + 2h_1 \cdot r_1 + 2{r^2}_1)$$

$$V_{tb} = 2{,}5054 \times 10^{-4} m^3$$

After calculating the volume we have to multiply it for the specific weight of the full tile (18 KN/m^3 Tab. 3.1.I NTC 2008 or 1835,49 Kg/m^3[8]) to obtain the value of the single Carosello.

$$Weight\ "Carosello" = (2{,}5054 \times 10^{-4} m^3) \cdot \left(1835{,}49 \times \frac{\mathrm{Kg}}{\mathrm{m}^3}\right) = 0{,}460\ Kg$$

If it is supposed to base the analysis on the calculation of a vault composed of the typical staggered Caruselli method, is necessary to suppose the quantity of building elements contained in a cubic meter, and multiply them for the weight of the single object previously obtained.

Staggering and placing them next to each other, the volume meter cube will be made of 137 elements, repeating along the height six times and a half, totally giving 890,5 caruselli.

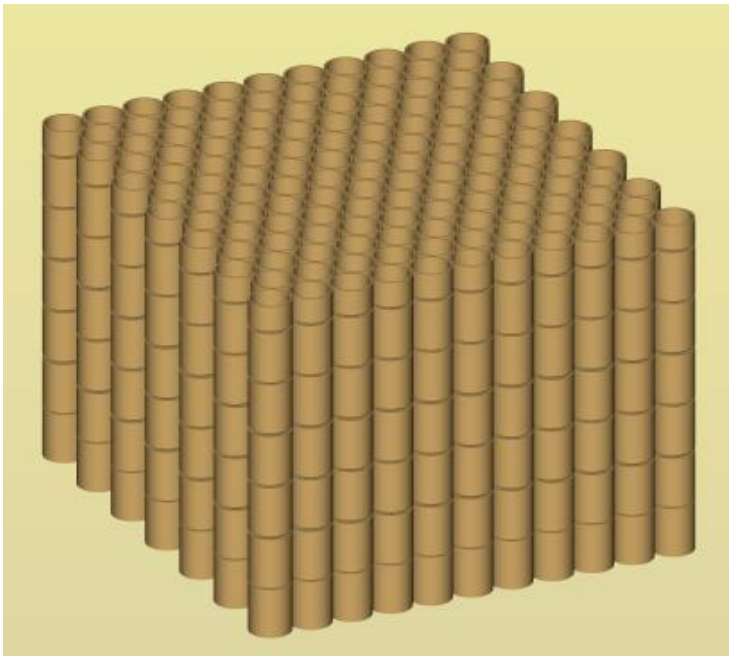

Fig. 5: Reconstruction of Caroselli contained in 1 meter cube

The specific weight of the carusello will be:

$$\gamma_{Carosello} = 890{,}5 \times 0{,}460\ Kg = 409{,}63\ Kg/m^3 = 4018{,}47\ N/m^3$$

3. Static Analysis of the barrel vaults

The purpose of the work is to underline the lightness and the giddiness of the use of the Carusello for the vaulted constructions, trying to establish a relationship between the increment of the tensions and the increase of the span. In order to find a solution, will be carried out the static analysis of three elements, presenting partly constant and partly variable geometrical characteristic, and considering only their deadweight. The considered vault will have a unitary radius and a thickness of 0,15 m and its span will increase of 1,00 m in two phases, shift from 4,00 m to 5,00 m and 6,00 m in the end.

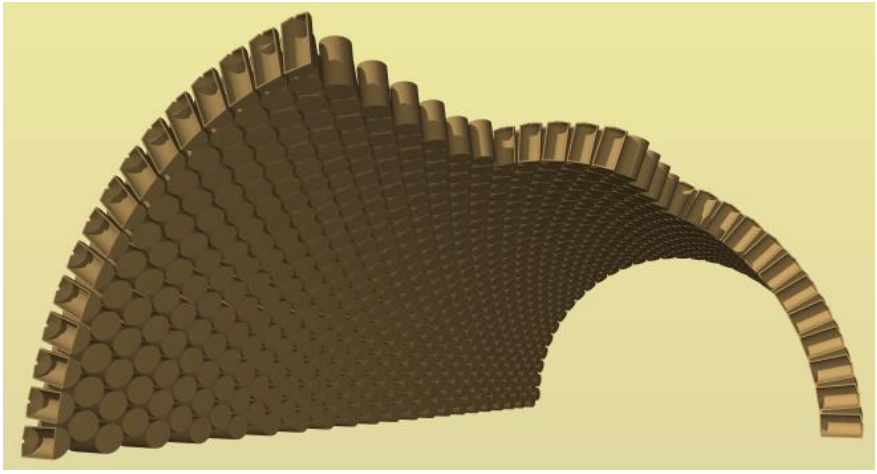

Fig. 6: Perspective of the 3D model

The static analysis of these elements generally happens considering the theory of the membrane [9]. These are characterized by a very thin thickness, without rigidity to bending, and the stress on them are in the tangent plane in order to guarantee the global equilibrium in relation to the external loads.
Considering a generic barrel vault with a directrix of equation z= z(y), where z is the vertical axis, turned downwards, of the triad of reference (O xyz), with the origin placed halfway along the length of the vault, the y axis tangent to one of the directrix in the highest point and the x axis representing the ridge generating line, it is possible to calculate the equation of the inner stress due to the deadweight (w), acting on the vault S1, S2 and T (eq. 1-2-3) [10].

$$S_1 = \frac{-2 \cdot w \cdot R \cdot (l^2 - x^2) \cdot cos\vartheta}{2 * R} \qquad (1)$$

$$S_2 = -w \cdot R \cdot cos\vartheta \qquad (2)$$

$$T = -2 \cdot x \cdot w \cdot sin\vartheta \qquad (3)$$

$$S_\eta ; S_\xi = \frac{S_1 + S_2}{2} \mp \frac{1}{2}\sqrt{(S_1 - S_2) + 4T^2} \qquad (4)$$

$$\sigma_\eta = \frac{S_\eta}{s} \; ; \; \sigma_\xi = \frac{S_\xi}{s} \qquad (5)$$

After obtaining the total stresses, is possible to calculate the stresses along the principle directions Sη e Sξ (eq. 4) and later to calculate the tensional status developed in the vault itself (ση e σξ - eq.5) comparing the results of the three case-studies we have examined [11].

x=2,00 m		x=2,50 m		x=3,00 m	
ση [N/mm2]	σξ [N/mm2]	ση [N/mm2]	σξ [N/mm2]	ση [N/mm2]	σξ [N/mm2]
0	-0,00401847	0	-0,00401847	0	-0,00401847
0,001442706	-0,00540013	0,002032326	-0,00598975	0,00265212	-0,00660954
0,003924706	-0,00770083	0,005238577	-0,0090147	0,006571704	-0,010347831
0,0064831	-0,0099632	0,008455706	-0,0119358	0,010440291	-0,013920388
0,008906942	-0,01198527	0,011467342	-0,01454567	0,014035215	-0,017113541
0,011089341	-0,01367236	0,014154212	-0,01673723	0,017223548	-0,01980657
0,012951975	-0,01496121	0,016424845	-0,01843408	0,019900118	-0,021909353
0,014432932	-0,01580733	0,018205936	-0,01958033	0,02197998	-0,023354378
0,015484626	-0,01618243	0,019441278	-0,02013908	0,023398186	-0,024095986
0,01607388	-0,01607388	0,02009235	-0,02009235	0,02411082	-0,02411082

Tab 1: Values of the principle stresses in the three vaults

The inner maximum tensional status, of compression and traction too, will generate in the point of maximum span of the vault, as we can read in Table 1, showing numerically as a simple passage from 4,00 m to 5,00 m will bring to a tensional increment of 25%, causing the passage of the values from ±0,016 N/mm^2 to±0,02 N/mm^2.
This percentage rises up to 50% when the passage is from 4,00m to 6,00 m assuming tensional values of±0,024 N/mm^2, and highlighting that for any more cm of span considered as regards the starting vault, the tensional state will increase of 0,25% as it can be observed in the following diagrams (Fig. 6, Fig. 7).

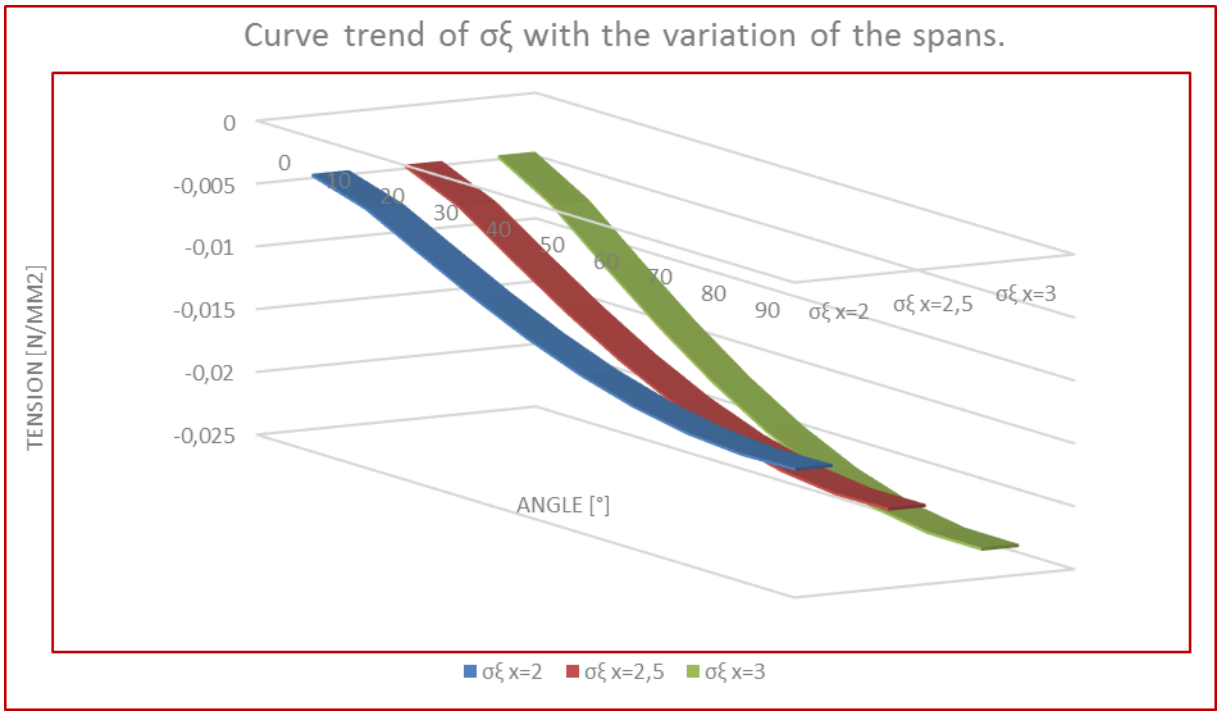

Fig. 7: Curve trend of ση with the variation of the spans

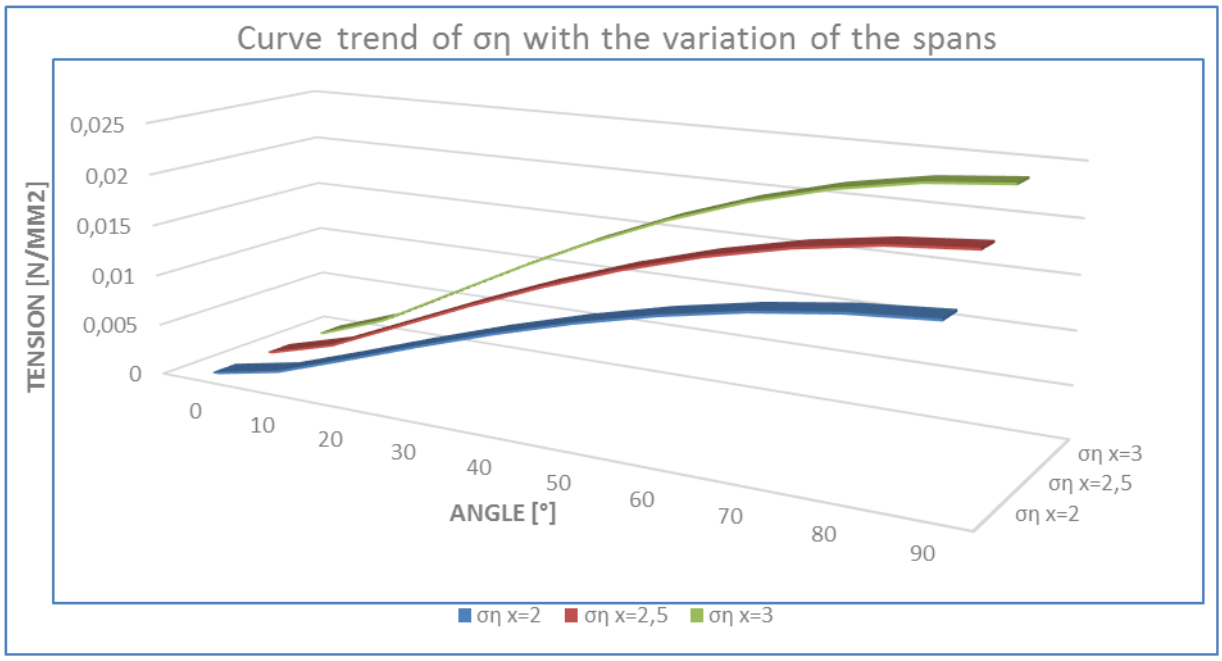

Fig. 8: Curve trend of σξ with the variation of the spans

Conclusions

By analyzing the obtained results it can be concluded that the buildings realized using caroselli were not only simple barrel vaults, but presented also a more complex structure, like the cross vaults with the cycloid or concatenating generating line.

Moreover, given their low weight structures made with these ceramic hollow brick have a seismic behavior interesting because they significantly reduce the seismic masses as well as presenting a low heat loss.

Another consideration that can be made is that the increase in stress due to the dead weight, inducing an increase in the stress of 0.25% to additional cm span compared to the case of the starting unit.
From a scientific point of view, it can be found a relation, based on the simplification of the carosello as a cylindrical volume with a constant thickness. This relationship has allowed to calculate accurately the specific weight of the elements: 4018,4 N/m2.

Bibliographical References

[1] ARSLAN E. A., Osservazioni sull'impiego e la diffusione delle volte sottili in tubi fittili, 1965, in Bollettino d'Arte, I-II.
[2] Marino L., Franchi R., 1987, Notizie su alcune strutture leggere apparecchiate con tubuli fittili, in AA.VV, "Conoscenze e sviluppi teorici per la conservazione di sistemi costruttivi tradizionali in muratura".
[3] Crisci G. M., Gattuso C. Some characteristics of a singular constructive ceramic element in Magna Greece, IV International Symposium on the Conservation of Monuments in the Mediterranean Basin, 1997 Rodi.
[4] Gattuso C., Caruselli nell'edilizia storica calabrese. tecniche compositive e caratteristiche dei materiali - Congresso Annuale IGII - Lo stato dell'arte 9, Ottobre 2011 - Cosenza;
[5] Codispoti R., anno acc. 2008/2009; Tesi di laurea: La risposta sismica ed il relativo intervento di miglioramento strutturale del Convento dei Cappuccini e della contigua Chiesa Santa Maria delle Grazie in Gerace (RC), Università della Calabria.
[6] Gattuso C., Olivito R.S. , Codispoti R. "Mechanical characterization of fictile elements typical of mediterranean architecture". Atti del convegno "Diagnosis, Conservation and Valorization of Cultural Heritage", Napoli, 2013.
[7] Scuro C., anno acc. 2011/2012, Tesi di laurea: Caratterizzazione di costruzioni in tubuli fittili siti nel territorio di Bisignano (CS): analisi statica di una volta e di una cupola , Università della Calabria.
[8] DM 2008 - Norme Tecniche per le Costruzioni e circolare esplicativa n°617 2009.
[9] Belluzzi O. , "Scienza delle costruzioni - volume 3", Zanichelli, Bologna, 1980.
[10] Como M., Statica delle costruzioni storiche in muratura, Aracne editrice, Roma 2010.Belluzzi O. , "Scienza delle costruzioni - volume 3", Zanichelli, Bologna, 1980.
[11] OlivitoR.S., Statica e stabilità delle costruzioni murarie, Pitag. Editrice Bologna, 2009.

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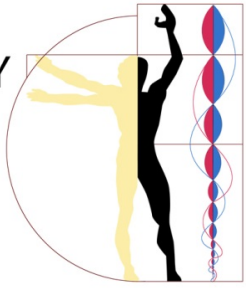

Best practice or bad practice? Technological perspectives, Administrative proceedings and urban perceptions in the historic cities: the case of Royal Arsenals of Seville.

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Abstract

Royal Arsenals, large structures without artistic value, have been a point of attraction to institutions such as major banks and municipalities, who see in them a strong potential.

Rehabilitation projects of The Royal Arsenals of Seville began in 1990 with archaeological works which have revealed that the original soil was buried more than 5 m deep. This finding led to a breakthrough in the understanding of medieval building and raised expectations in the first architecture team to recover its original size. The project had to overcome the technical difficulty of building under 4 m below the groundwater levels that exist in the building.

Different technical and engineering studies highlighted the extremely difficult and impossibility to isolate the big building of groundwater and cultural administration abandoned the proposal. However, a clear split between the desires of society and the administrative and technical world has been documented since then. Society sees no limits to the technological challenges and generates pressure to recover their original dimensions, meaning that only then the best practice for that building wealth would be performed. The administration considers the risk of practicing technological adventures of dubious effectiveness and high costs, opting for more sustainable strategies in terms of assets.

This article aims to show the contrast between public perceptions, technical and administrative when dealing with buildings of heritage value and explore its causes and possible gaps in social disclosure by the administration for not knowing how to transmit the criteria on best practices relating to Heritage.

Keywords: Heritage- Experience- Knowledge- Conservation in historic cities-Historic Arsenals

The Royal Dockyards through history.

The Royal Dockyards of Seville is a monument that has been working since the thirteenth century until today. Although if it was intended as a factory of ships and equipment production, their potential to assume different values and uses made it in another piece of the city and its memory; being both historical document and architectural object, makes it in a evidence of events and societies that were shaping it to reach what is now an emblematic monument of historical past of this city.

In 1946 the Royal Dockyards were considered by Torres Balbas, one of the most important Spanish architects of the twentieth century, the largest and most monumental medieval arsenal amog existing and it only had one-third of the original construction. Vestige of: the history of the Castilian Navy, great construction enterprise by Alfonso X, the history of the city, its port and its shops, reference generator of urban pattern. Powerful and simple architecture at the same time wich solidity and spaciality and spatiality has been enable to support different uses from the thirteenth century till today. With its 760 years and its rich history the

arsenal is part of the heritage of Seville as one of the most important medieval civilian monuments, defined as an Industrial Cathedral.
The implementation took place on the left bank of the Guadalquivir, outside the city walls, between the Postigo del Aceite and the Postigo del Carbón. . In this space a large rectangle about fifteen thousand square meters was set up. Over the centuries the old space has been divided in Real Maestranza de Artillería, Hospital de la Santa Caridad and Delegación de Hacienda (building tax office), coming to us only seven aisles. The archaeological interventions carried out between 1991 and 1995, supporting the building rehabilitation works, were focused on one of the aisles to find the evolutions undergone since its function as an shipyard untill use as army barracks, and they have showed the existence and conservation of the city wall, a tower demolished in the twentieth century and a gateway to the city, all of Almohad chronology.
With the conquest of Seville by King Fernando III of Castilla y Leon, achieved after a long siege completed with the defeat of Islamic rule, the city is incorporated into the Christian kingdom with the important role of first exit to Atlantic sea of the kingdom, beginning a propitious historical age that will continue during most of the modern age. Because of the permanence of the king in the city, it became the seat of the court which was to promote rapid organization and establishment of the Castilian laws. It was then instituted the Barrio de la Mar (sea quarter), with its own special jurisdiction and own mayor appointed directly by the king, whose settlers were receiving exemptions and privileges granted by the services to real politics.
The ambitious political project of Alfonso X to conquer the Strait of Gibraltar to resist the Moors of North Africa and to obtain favor of the Pope for his election as emperor, required the formation of a royal army, therefore, in 1252, the king orders the construction of a shipyard where build and arm a powerful fleet. For this reason was arranged this enormous arsenal with seventeen parallel aisles of 9X100 meter that lay perpendicular to the wall and Barbican of Almohad City. It is the largest arsenal across Europe; these buildings usually are constituted by 3/7 aisles that measure, on average, 9X45m, and certainly are the most conserved throughout Spain. The original function for which this building was built was the realization and maintenance of galleys and other various kinds of ships, for that reason it was chosen a place near the river to have a direct relationship with water to facilitate the entry and exit of the boats.
The Shipyard was the first foundation and building of the reign of Seville, only four years after the conquest and the location place was called Arenal. Witness of its foundation is an inscription in marble now kept in the Hospital de la Caridad.
With this foundation the King contributed to Seville sea power setting the beginning of the Spanish Royal Navy.
For the information available we can say that the activity and use of the Royal Dockyards remained intensely until the mid fifteenth century when documents tells that inside the shipyard stored boats were slowly rotting and the roof of the building was collapsing. In 1450 a gradual abandonment of activity and accumulation of silt and garbage is recorded and in 1477 the Catholic Monarchs order cleaning and restoration of premises. In this century the building underwent its first alteration, when, in 1493 he settled there the greates fishmonger's city.
With the discovery of America Sevilla becomes the port monopolizing Indian trade and shipyards saw its declining function as ships producer to become commercial space. In 1502 no longer galleys are produced in because they were not adapted to the oceanic navigation.
Throughout the sixteenth century continue the great transformations of the spaces of the old arsenal, adapting it to transatlantic trade. In it are installed stores, ovens, passages and the most significant changes with istalaciones of Customs (Aduana 1577) and Royal House of Quicksilver (Real Casa del Azogue1559). These years also was constituted the Hermandad y Confradia de la Santissima Caridad and burial poor who aimed to give a Christian burial to drowned men river.
The seventeenth century saw the decline of the commercial traffic of the city, the fillings of the mouth of the Guadalquivir made to decrease the number of boat entering in Seville and in 1680 trade diversion in Cadiz meant the end of the trading monopoly of the river port city that so much had benefited the medieval shipyard before and storage place after.
In the eighteenth century final fate of the last seven aisles that had remained in the hands of the Crown was the installation in these of the Royal Artillery Armory wanted by Carlos III in 1760.
The military use continued highly active also during the twentieth century and during the Civil War until 1969 whe the building becomes Heritage Site and in the following years the Maestranza leaves his role as artillery with the demolition of the artillery Park and Warehouse in 1975 (to this century also corresponds the demolition of Customs and the House of Quicksilver, 1940).
After abandoning its role as a military arsenal in 1500, the name "Atarazanas" remained in large part the building for three centuries in popular level and officer level. The name, "Maestranza de Artillería" has been used until 1988 when the building was purchased by the Ministry of Culture of the Government of Andalucía with the aim of transforming that in Andaluce Center of Contemporary Art (CAAC).
Is the new patrimonial guidelines which rescues the old name "Shipyards" as "brand" for its historical valuation: remarked the origin of the building and attract attention to the powerful medieval architectural structure, which offered a uniqueness to the new institution that was borning. Then it was born to Sevillian

society a new building previously hidden and unknown in the landscape of the historical center of the city, which was surprising. It reborn a new forgotten history, and a new name associated with new expectations of cultural infrastructure in a very optimistic time, socially and economically, that the city was living meanwhile the building of Expo'92. It began to speak about the most important medieval civil architecture building of Seville, since almost all of the surviving medieval buildings of the city were religious.Page size is A4 (21 x 29,7 cm). Top and bottom margins are 2 cm. Right and left margins are 2,5 cm. Always keep the specified space between paragraphs.
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The deadline for submission of full papers is March 25th 2015. After that date, papers will not be considerate for oral presentation and publication.

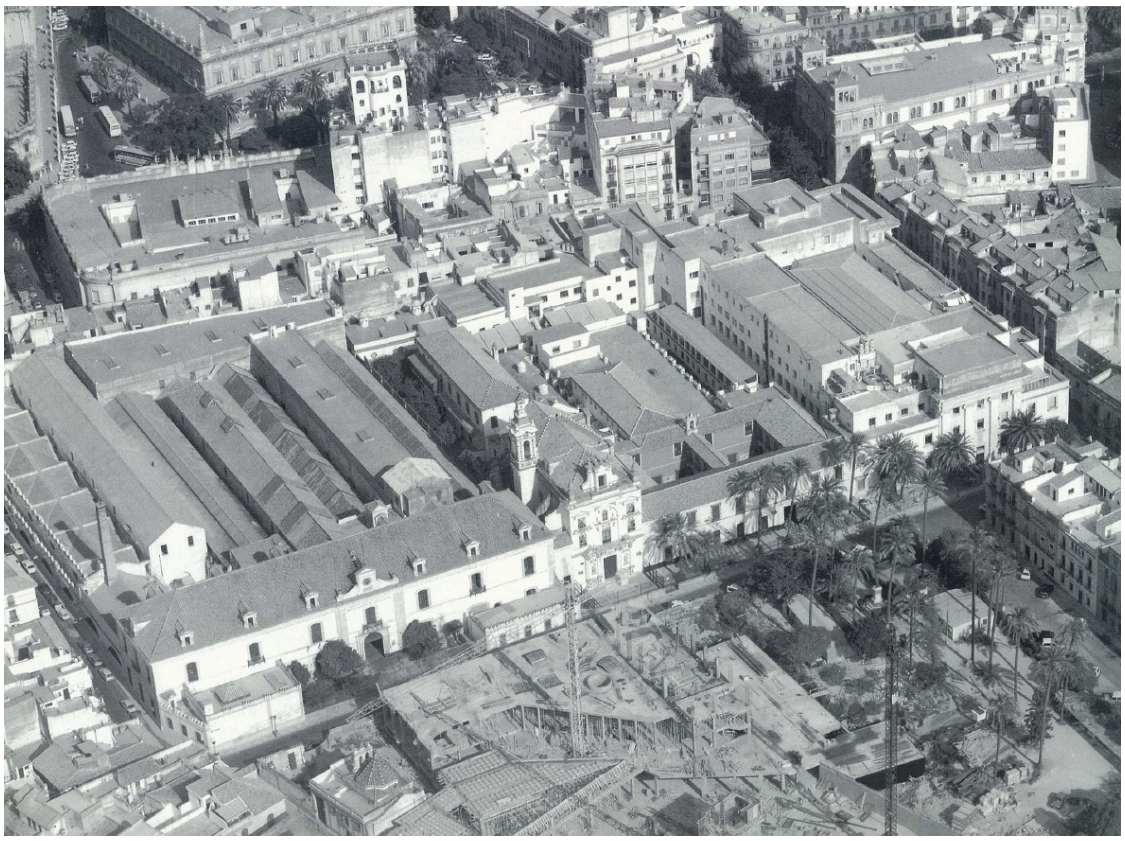


Fig.1 Aerial view of the Atarazana complex. This paper deals on the left part.

Architectonic proposals for the CAAC. 1988-1993.

The interior of military building in 1988 offered a series of large strange arches indicating that an important part of medieval building was buried but neither the entire path of the arches and the size of the piers was known. The archaeological work had spectacular results.
We were able to document the full breadth of one of the piers of the building, made bybrick, being 5.80 m thickness the deposits of modern and contemporary Ages wich was buring the shipyards. The soil in 1988 was at a depth of 7.65 amsl and the original ground level at elevation of 2.00 amsl. The exact type of foundation, built in mud wall trench (hydraulic concrete) with wooden sticks that held the building to the ground was also documented. As a surprise we saw the original timber formwork foundation of s. XIII that had been preserved for centuries to remain submerged. The work also documented the presence of subphreatic level from -3 m, implying that the medieval building was dipped in approximate2.80 m from the base, which made difficult the implementation of archaeological work.
Of these surprising findings emerged the first architectural proposal (AB / JM), supported by a drawing section where the current reality and the hidden underground building was displayed. The proposal suggested the complete emptying of the 7 aisle's arsenal to rescue the original height of factory ships. With this work we are able to achieve this spectacular spaces and large areas for exhibition and museum facilities by establishing two levels of use: the lower of the arsenal (- 5m) and the urban grade (0m), coinciding with the building of Carlos III (1786). To achieve this aim is raised to isolate the building of groundwater by constructing a perimeter concrete walls of 3,200 m2 to surround an area of approximate 6,000 m2, with its corresponding basal flagstone, the way underground car parks are built. The financial proposal did not include the technological problems of construction of the screens or flagstone surrounding the historic building, which would pass under the arsenal.

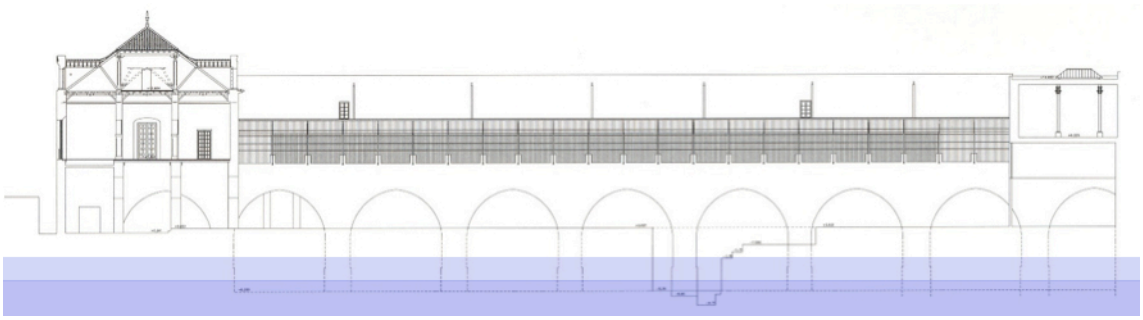


Fig.2 Level of groundwater on longitudinal section of Atarazanas

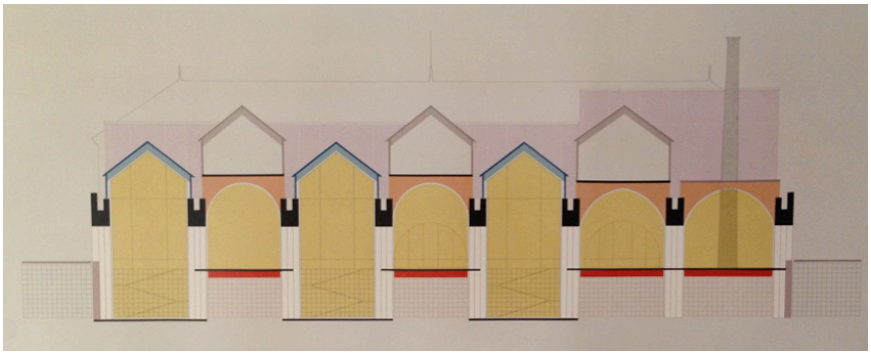


Fig.3 transversal section of emptying aisles of Atarazanas

A team of experts in museum installations was incorporated in 1992 with the aim of analyzing the general environmental problems of building and the moisture that would affect in the recessed parts of the subsoil. Among them was Paul Schwartzbaum, in these times chief curator of Peggy Guggenheim Collection in Venice; Ippolito Massari, humidity control expert in historic buildings, author of an important monograph on the matter and technical player in important projects musealization as Peggy Guggenheim Museums, the Fortuny Museum and Hercolaneum Conservation Project, along with others. These technicians were crucial for the maturation of the criteria and questions the chances of having optimal environmental conditions in some rooms excavated in the ground with such a high phreatic and the historical building firmly anchored to the ground, which boasted the continued presence of capillary moisture derived from the porous structure of the brick piers. In the original proposal, which emptied 7 aisles since -5m, dedicating five of them for exhibition was passed only 1of the other proposals and finally to none, keeping two aisles in the baseline for facilities by necessity of space. The technological solution for the isolation of underground level was the same, screens and concrete flagstone, although being smaller decreased constructive and economic problem.



Fig.4 Foundations of the medieval Arsenals with wood framework found during the Archeological works

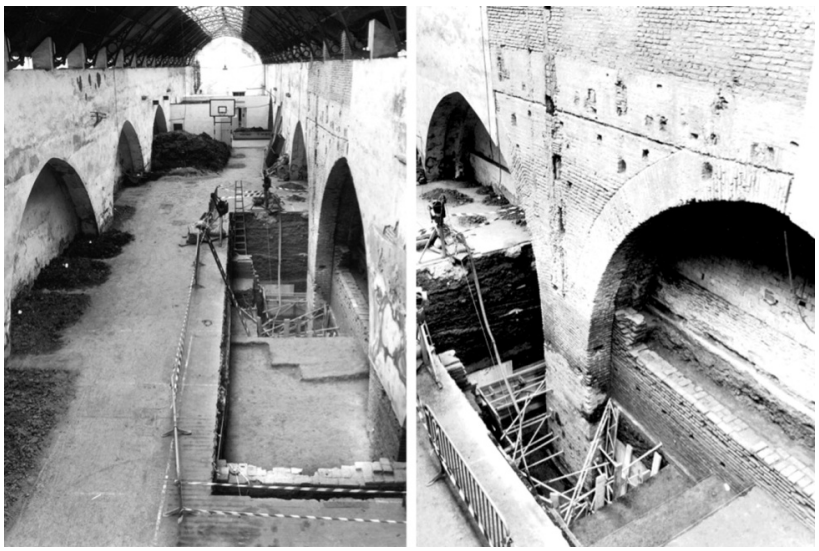
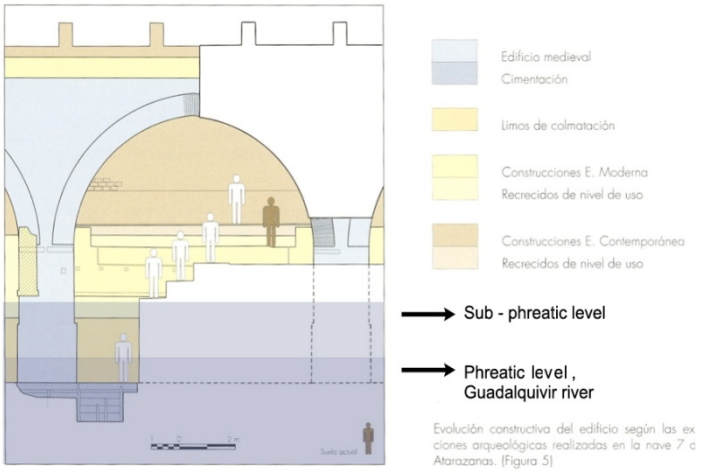


Fig.5 Archeological works to explore the total dimensions of medieval arsenals



Evolución constructiva del edificio según las ex ciones arqueológicas realizadas en la nave 7 c Atarazanas. (Figura 5)

Economic crisis, leaving the CAAC in Atarazanas and maturation of criteria.

The economic crisis that accompanied the end of the Expo'92 changed the sense of previous economic and institutional exuberance from which all believed possible, both from a technological perspective as economic, which was hardly hit in the next two years. The project of the Shipyards as CAAC, with significant infrastructure needs and economic endowments, was weakened. In the following years -since1994 to 1996- it attended to solve conservation structures to perform geotechnical studies and develop other more superficial archaeological excavations brought historical elements of great interest. The interior floor is also lowered by 0.85 m to equip the aisles of greater visual consistency, freeing medieval arches to the line of imposts, (7.00 amsl), coincident with the outer urban ground. The seat of CAAC was set at Cartuja, a monument adapted as a museum for Expo'92 and the Shipyards were closed as a problem for cultural administration itself.

In this whole process -very schematically written - attracted attention to the following aspects:

• The excessive freedom with which operated the architects on the original idea prioritizing grandiloquent aspects of the necessary rationality requires a historic building. This reality was clearly influenced by the strong political support of the initiative in the new Youth Spain autonomous powers and economic optimism of the moment. To this the lack of tradition in the treatment of cultural heritage, meaning that contemporary technological culture was prepared to resolve any problem. It was not realize that the real "heritage culture" is cumulative over time and in maintenance training, knowledge and best practices from the technical and the administration. The star project proposal was based on the recovery of the original dimensions of the building offering architectural spectacle and larger surface for the institution. This idea was disappearing as they got to know the economic reality of the building.

• The lack of sizing problems and technological feasibility inherent in building a base level on -5m eliminating the condition of subphreatic without compromising the structure of the historic building. The solution of a foundation with flagstone and concrete walls never was accompanied by reports on their viability.

In 1995, now abandoned the idea of Shipyards project for the CAAC is charged the first "geotechnical" (Vorsevi SA), delivered in 1996, to comprehensively study of the geotechnical properties of the ground on which the foundations of the old building of Shipyards are implants.



Fig.6 Performance of tests to study feasibility of using geothermal energy for climate control the Shipyards

Birth of citizen awareness of shipyards. Contrast of popular and administrative criteria in the new proposals. 1999-2012.

The closing of Shipyards for years created a problem for the regional government administration. He was born a monument –Las Reales Atarazanas- with a frustrated program of a great cultural project; the patrimonial valuation of medieval monument which administration had led, created a sense of belonging, identification with civil society of the city to be associated with port activities The patrimonial valuation of medieval monument which had led the administration created a sense of belonging, identification with civil society of the city to be associated with port activities (social, labor and trade) historic Seville, rather than the activities of power (historic buildings administrative), class (palaces) or ideology (religious monuments) that form usually most urban heritage. In addition, the building is located in excellent position on the tourist circuit of the historic center and the whole World Heritage, which generated expectations of economic development linked to the cultural. As a result of social and media pressure the building was opened in the state of works in 1999 under the slogan Recuperando las Atarazanas. Un monumento para la Cultura (Recovering the Shipyards. A monument for Culture). The success was impressive and the city could see for the first time the enormous naked medieval structure used for years for various events.



Fig. 7 The naked building hosted numerous events.

The increase in social perception of the importance of the monument and inactivity administration materialized in the emergence of citizen movements that demanded action on Shipyards. Among them came the Fundación Atarazanas, civilian, who served for years pressure on the administration proposing a project

of cultural and economic revitalization in 2007 called MUSA, Museo Sevilla Atarazanas. Un proyecto cultural del siglo XXI.
Passing the time regional administration -Consejería de Cultura- was not longer prepared to develop an own initiative in the building and caused the transfer to an entity for the development of a cultural project. For this purpose instructed the Andalusian Institute of Historical Heritage (IAPH) a framework document to govern the concepts and uses for the building.
The paper, called Feasibility study and adaptation as generating uses for the Reales Atarazanas of Seville[1], attracted attention to the methodology that it should apply to "heritage object" Shipyards was drafting a Conservation project, by developing a Basic Implementation Project should include a program of conservation and maintenance, even to define actions to ensure the retention and transmission to future well-spoken, their presentation and the enjoyment by the public. As intervention criteria it adhered to the guidelines (Letters) internationally accepted for study and intervention in cultural heritage as well as the Spanish and Andaluce Historical Heritage legislation concluding the following criteria with its associated explanatory text:
• Performance justified by conservation.
• Low intervention.
• Respect the authenticity of the building.
• Discernibility.
• Inclusion of new technologies.
• Interdisciplinary Approach.
• Increased documentation process.
In this context it developed the principles which should collect the different steps of action from the knowledge and analysis of the property to the maintenance and control program. In its program keys up to four different spatial units were defined:
1. **Urban Look**: relaxation area, historical connection of the shipyards with river and viewpoint of contemporary Seville.
2. **Virtual Space**: upstairs for multiple cultural uses.
3. **Space Shipyards**: the ground floor with a succession of aisles and archways from the line of imposts. It would be space for emotions. Among the key end-use manual is included fully respect the identity of the space defined as shipyards.
4. **Plan of uncertainty**: entry for the basement, as visible archaeological site.

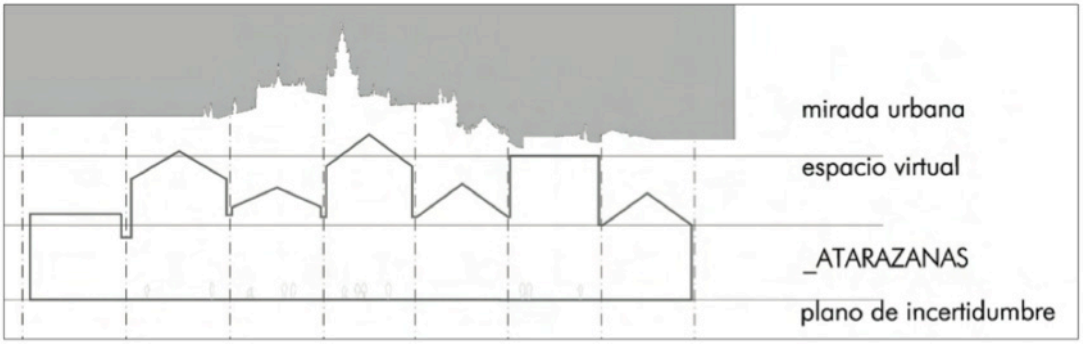


Fig.8 Plan of uncertainty for the basement

In this paper is collected the refusal to the idea of opening the medieval aisles as part of proposals to alter the heritage values of the building. In this final chapter, several proposals outside the Ministry of Culture are rejected because its success lies in a number of aspects which are unrelated to heritage. These proposals explicitly rejected MUSA, already mentioned. This feasibility study also included the following text: Citizens, through the press, is perceiving a slanted image of Shipyards, which has been designed as a place of conflict and not as a space for culture, highlighting the divorce between:
• A closed administration, lack of information and quite far from the public, which kept the monument as their own.
• Citizens, led by groups and associations that had been mobilizing the patrimonial relationship between Shipyards and the city and claim intervention.
As a sign of this disagreement between sides we cite Gonzalez Candela's comment made in 2012: All the media has collected a large number of cultural information, focusing on the activities in shipyards, which contrasts with the image of abandonment and disuse also that has been transmitted to the public[2].
In 2009 the Caixa Foundation won the competition for the sale of the building by the project presented for the implementation of Caixaforum Atarazanas. This Foundation (Fundación Atarazanas) promoted a competition

of ideas between architects; Guillermo Vázquez Consuegra was the winner[1]. As a general guideline of action, the architect suggested a continuous space as a public square for the ground floor of the shipyards. On the other hand, we must emphasize that a program of geotechnical testing was performed to test the feasibility of using refrigeration system for the entire complex of Caixaforum by Geothermal Energy, system that uses the groundwater, if it is abundant, to remove it, and use it in the system taking advantage of low outlet temperatures and inject it back into a closed circuit that involves implanting an environmentally sustainable technology not using chlorinated city water circuit and and reduce costs. The Fundación Atarazanas, whose idea of MUSA had rejected previously, raised another initiative on the ground floor, the space Atarazanas that, as we remember, they defended as compatible with Caixaforum project. In 2011 was presented to the media the Magna Galea Shipyards project. The aim was to Restor Shipyards to its original height....increasing the spectacular architectural volume of the building, catapulting its symbolic power and recovering its heritage dignity, for a long time buried ... We know that the expressive richness, the sculptural and monumental character of the shipyards space as well as the patrimonial revaluation caused by the recovery of the original ground elevation, will produce added effect as evocative memory and identity space, causing the enjoyment through knowledge and senses. It is a cultural, sustainable and innovative proposal, that encreases the social and economic fabric of Seville[3].
The project pesued partial emptying of three aisles to the grassroots level to recover the medieval spatial dimension and build a medieval galley as spectacle and object that condensed the story of the historic Navy. To support technological alternative the Fundación Atarazanas ordered a research project of two architects who devised a lattice wall named Constructive Retaining Wall System and Sealed Cargo Malla By Stereo and Precast panels that surrounded the depressed area and also insulated the floor of phreatic groundwater to make it usable to the public[2].



Fig.9 3D recreations of Galea Magna Atarazanas project

According with the documentation we have consulted, the architectural team was investigating this system at their request and it had made a first step in 2010 to explore the potential of the solutions and their starting definition. In 2011 it was presented, as a second stage of research, a first draft of architectural solution that allows musealization project: Galea Magna Atarazanas in order to realize the solution. The draft proposed to perform geotechnical studies on the state of the old factories, the land fill and the composition and fluctuation of groundwater -which had been made twice but, as we advised, they unknown because this information is not noticed- archaeological surveys to verify observations which were also made as we have suggested - topographical surveys also made- and studies derived for defining intervention containment of ground and size of walls containment of ground and volumetric last definition phasing plan and cost estimate.
The Magna Galea draft was rejected by the Foundation, which had a very tight viability plan, and by the architect Vázquez Consuegra for understanding this project incompatible with the concept of their own project viability plan. Subsequently, the La Caixa Foundation abandoned the project of CaixaForum

[1] This architect is the author of the project Museum Mare GALATA in Genoa
[2] Architects Juan Carlos Gómez de Cózar and Iñigo López Ariza, of the School of Architecture at the University of Seville. This structure is registered in the Spanish Patent and Trademark Office as a patent for invention, industrial property. Request: 2012-07-31.

Atarazanas and at present the building remains closed and is taking an assignment of the rights of La Caixa to another founding his own business system.
With respect to this last affair we should do the following considerations:
• the division of views and interests among the guidelines of the Ministry of Culture, very conservative towards the ground floor on one hand, and external proposals touted the means to pressure, insistent on getting the full spatial effect of medieval Shipyard, has been maintained to the end. These proposals had popular support, which was not free of misleading advertising by its defenders. IAPH guidelines on actions in the basement of shipyards -plane of uncertainty- may be seen as reasonable and cautious, but we believe that relied on is a general mistrust taken after the first proposals of CAAC, which were really viable.
• The technological proposal of Magna Galea was not kept in mind by the administration, which had already ceded the building. Anyway there was a general distrust of the Fundación Atarazanas on its purposes, including the heritage as a business, and methods of environmental pressure from the media, which irritated the administration.
• This mistake procedure from the beginning by all parties, as we have been noting during this paper, have prevented it has developed a context of scientific prospective that would explore possibilities resulting to enrich the heritage and own technological debate related to an heritage special case.
• We understand that the existence of uncertainties is not contrary to the development of scientific research, which can develop poorly invasive methods and in many cases and this can have very substantial contributions to heritage and technology.

Best practices and bad practices, concluding reflections.

Through this historic route between the events we want to expose and analyze the different approaches of administrations, citizens and technicians to the rehabilitation of a patriamonial monument. Main objective of this compilation is learning from past experiences for the creation of best practices that would be serve, in the future, to the management of heritage and not be unprepared again as in the mantioneted case of the Shipyards. Creating awareness tool that serves correctly performances although this knowledge come from an unfortunate experience. Greating knowledge that would serve as a tool for correcty performances although if this knowledge come from an unfortunate experience.
Reflections on the methods of general performances of administration / public / technicians in the Royal Dockyards have carried to recognize a series of paradoxes:
- First paradox. The refusal. The conservative society has proven to be more traditional for esthetics and very confident in the technology. The economic growth of the early nineties had been believe that anything was possible. It appeared an optimism in science and technology by which many projects that they supposed a huge economic cost, seemed possible even surpassing the limits of viability. When the crisis broke down this optimism, citizens and administrations were disappointed and doubt in all kinds of new proposals. In this way all projects that don't supposed spectacularity were rejected. The shipyards, however, had came out as a problem for the authorities and the technical, and as a new identity object for citizens. This conflict has still not been solved because it is impossible to apply to an industrial civil building the same principles and esthetic solutions applicable to religious monuments, which for their nature, are not utilitarian structures have more artistic value.
- Second paradox. Environmental resources. Through time changed the view of the nature, contrasted before and after exploited. Always on optimism and confidence in new technologies, it seemed more appropriate, in the first time, challenge nature and counter the problem of the waters of phreatic level. With the crisis, when technicians and administrations had to hit with the real lack of economic resources, they thought that was smartest and economic take advantage of the water instead of contrasting, and use it as a natural resource.
- Third paradox. Contrast to perceptions. In the years of debate about the different uses and rehabilitation of the shipyards, the absolute protagonist was the conflict between citizen and administration. We lived an hard contrast between perception popular, intuitive and mediatic, and perception administrative more reflective to values and culture. In this discussion the technicians have not been able to play the role of mediator being often good sellers of show and illutions and using the mediatic resources as a people instigators.
- Fourth paradox. On one side the administration and international charters value and promote the practice of historical and technological research for the enrichment and promotion of the heritage. In the case of the shipyards, administration, owns the building, refused a research proposal which had the aim to explore the promotion of medieval underground, although this option is still possible.
Unfortunately the case ofshipyards in Seville is not the only one and surely exist in Europe in the World other hidden stories of cultural heritage that lived the same fate or, in the other way,that has seen its projects realized. Finally, is very important that these stories are discovered to, thanks to experience, learn and create criterias in the best practices of recovering historical heritage.

Bibliographical References

[1] INSTITUTO ANDALUZ DEL PATRIMONIO HISTÓRICO. Estudio de viabilidad y adecuación como generadora de usos para las Reales Atarazanas de Sevilla. Documento administrativo. Junta de Andalucía. Consejería de Cultura. 2009.

[2] GONZÁLEZ, C. Guía del paisaje histórico urbano de Sevilla. Estudio temático 3. Percepción social del patrimonio en los medios de comunicación.

http://www.iaph.es/export/sites/default/galerias/patrimonio-cultural/documentos/gestion-informacion/percepcion_del_paisaje_historico_urbano_dThis architect is the author, for example the Museum project Mare GALATe sevilla a traves de los medios de comunicacion.pdf

[3] DEL VALLE, M. (Declaration of) Manuel del Valle, presidente de la Fundación Atarazanas, aparecidas en varios medios de comunicación de Sevilla el día 12 de febrero de 2011

[4] FERNÁNDEZ ROJAS, M. *Las Reales Atarazanas de Sevilla*. Diputacón de Sevilla, 2013.

HERITAGE and TECHNOLOGY
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Analysis of Ecological Criteria for Traditional Housing and Its Adaptation to New Housing Design

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Abstract
Various characteristics of traditional architecture, such as environment friendly, use of local and natural materials, energy saving, became important for contemporary ecological architecture. Currently, most of the contemporary buildings in Mersin, which lack local technology, cause the distortion of nature and environment, and high energy consumption on the contrary. In 19th century, Mersin was a small port town, though; it turned to be a metropolis today. The rapid growth of Mersin caused the loss of traditional houses, and mass production of apartment blocks that can be rapidly constructed and consumed. After the fast urbanization in Mersin there have remained a very small group of traditional houses, still existing in Mersin city centre and these houses preserve their ecological qualities. This study aims to examine traditional housing in Mersin, in terms of ecological aspects, revealing the relationship between the ecological architecture and vernacular housing technologies of Mersin, and developing some references for their adaptation to new housing design. For the case study, thirty traditional houses located in Mersin city centre, which have not been restored, have been chosen. Observation, trips, photography, checklists and drawings were the methods used for the analyses and the results were evaluated by the help of the charts and diagrams.

Keywords: Traditional housing, Mersin, ecology, sustainability, new housing

1. Introduction
Process of industrialization, rapid population growth in urban areas, unplanned structuring and technological developments have begun to damage the nature after the Industrial Revolution in the 18th century. Rapidly growing housing in Turkey indicates the increasing energy that is used. Thus, during the process of building design, application and usage, precautions must be taken in terms of reducing energy consumption. The concept of ecological architecture was revealed in order to provide sustainability of the environment to future generations, to reduce the damage to the environment and minimize the energy consumed in buildings. Besides aesthetics, ecological architecture is a thinking system that is environmentally-conscious and aims to protect the natural resources and habitats of living and while using technological developments. Increasing the ecological characteristics of the building reduces the harm to the environment. The features of the traditional architecture such as environmentally friendly, using local and natural materials, respecting the topography and focusing on energy-saving seem to remain in the background in the contemporary architecture. For centuries, human beings have revealed examples of architecture considering climatic data in the design and implementation of buildings. The relations of such buildings, designed by this system of thought, with the environment and nature, and the opportunities of technology are important resources for the solution of environmental problems caused by current urbanization. Established in the 19th century as a port city on the Mediterranean coast, Mersin has become a metropolis at the beginning of the 20th century. Many of the buildings detached from the locality were designed and built as high-energy use buildings. In this study, we aimed to examine the examples of traditional building architecture of Mersin in terms of ecological aspects and to reveal the relationship between the ecological architecture and architectural heritage, thus providing a reference to the new housing of this relationship. In the preliminary studies, environment, heritage, technology, memory, concepts of ecological architecture, history and geographical

features of Mersin, the historical formation process and architectural features of traditional houses have been discussed. For the case study, thirty traditional houses located in Mersin city centre, which have not been restored, have been chosen. Observation, trips, photography, checklists and drawings were the methods used for the detection of these 30 houses and the results were represented by the help of the charts and diagrams. In the conclusion, it is emphasized that ecological data of Mersin traditional house architecture and technological opportunities will be able to provide an insight for new housing design.

2. Mersin

2.1 Mersin History

Although being a place for many settlements in the ancient period, Mersin has a history only dating back to the 19th century in the modern period. While Mersin was a port town in the 19th century, it has turned into a metropolis today, continuing to grow rapidly. Mersin has developed as a port to accelerate the transition of the region it locates (Çukurova) to high capacity commercial agriculture and facilitate the Ottoman Empire's gaining the title of most important cotton producer and exporter [1]. Unplanned urbanization based on rapid population growth in Mersin, spreading around the city's traditional buildings, leads to extinction of the traditional texture of the city in time. This texture, forming the core of the city, was formed by a combination of different plans and elevations typology in a planned manner. Some of the buildings with their original features are still used today. The main reason for this study to be conducted on traditional the houses of Mersin is to reveal the ecological aspects of the buildings and thus to increase interest and awareness for these buildings in order to ensure the sustainability of this unique and quality heritage. Formation and development of the neighbourhood in the city is based on religious, cultural and political effects. This feature is one of the most important features of Mersin separating it from the traditional Ottoman city. [2] Considering the subsequent development of the city from the 1980s, it can be said that urban development has occurred under the pressure of rapid population growth and intense migration. In this context, it has been observed that the urbanization is intense and that healthy and liveable spaces have not been produced in the city centre including the working area. Intense rant pressure created in the city centre surrounds the architectural heritage there. [3].

2.2. Geographical Position

Mersin is located between 36-37 ° north latitude and 33-35 ° east longitude. Mersin portrays all typical characteristics of Mediterranean climate and meteorological conditions. Mersin is one of the cities which have the Turkey's highest sunshine duration. Sunshine duration is 7.4 hours per day and in the summer period it varies between 8-10 hours. Projects conducted taking the potential into account that Mersin is within the first zone in terms of sun beam amount in Turkey, energy savings will be accomplished. Energy consumption will be reduced. Forests and agricultural areas will be protected preventing the destruction of the nature. Thus, the natural wealth and heritage of the city will be transferred to the future generations. [4].

2.3. Traditional Mersin Houses

Mersin homes are usually built as one or two floor, mostly with cut stone, and sometimes with lathing used on the first floor or projection. Many of these houses have the north or east-facing garden. Thus, the open space that will allow the airflow is protected against the scorching sun coming from the south or west and the wind coming from the sea. Houses of Mersin, in which small families usually live, are built as two floors and there is no connection between the floors. In the traditional Mersin houses, projections, defined as enclosed balcony, are made from different material and colour than the building and they stand out as remarkable architectural elements (Fig. 1-2). They are decorated with items made from wood. [5]



Fig. 1-2: Example of the open/close projection. (Source: E.Gündoğdu)

Usually outdoor balconies in stone buildings are between the two floors. Balconies are equipped with iron grille. Facades show differences as side facade and street façade (Fig. 3). Street facades are decorated with

architectural elements and ornamentations. The side facades are constructed as bare. Building regulations are generally detached. Eaves are not in Mersin houses very often. The roof is made of wood and covered with French tiles [6].



Fig. 3: Example of the street/facade. (Source: E.Gundoğdu)

Louvered shutters made of wood are used for the ventilation of homes in traditional Mersin houses in order to prevent being seen from outside. Mersin houses have their unique, different and advanced aspects unlike the classical Ottoman housing typology. In terms of plan typology, there are many variations as *"Pipe (called tradionationaly hu", "Inner sofa", "outer sofa"* and *"Eclectic"* [7].

3. Investigation of the Ecological Aspects of Traditional Mersin Houses

3.1. Definition of the Study Field

This study includes examining the ecological aspects of sample traditional housing in the urban area defined in accordance with the criteria set out. As the research area, we selected a place where 129 of 220 registered immovable cultural properties in the city centre were situated (Fig. 4).

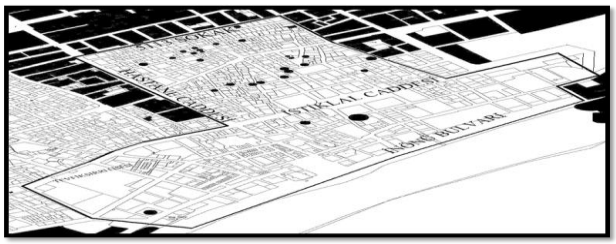

Fig. 4: The area of investigation.

3.2. Characteristics of Urban Fabric

Large green areas within the study area are surrounded by open space in the city, although there are not significant openings. Ataturk Park is located on the south and the public space is located on the west of the area. Major commercial and administrative centres of the city located in this area cause the density of the overall pedestrian and vehicle traffic. Possible use of existing buildings in the study area is as follows: housing, housing + commercial, trade, office buildings, banks, schools, social buildings, baths, mosques and churches in the form of hotels and offices. A large part of the monumental building located within the historic urban fabric has survived until today. The most important ones include Latin Italian Catholic Church, old Mersin Kindergarten, Nusretiye Mosque, Old Government House, Taşhan, Eskicami, Bezmeni-i Alem Valide Sultan Fountain, Fish Market, the Orthodox Church [8].

Street - building relationship in the buildings within the study area emerges in four different ways.

1. Street - courtyard: examples passed from the street to courtyard and then to building.
2. Street - building - courtyard: examples passed from the street to building and then to courtyard.
3. Street - building + courtyard: examples passed from the street to both building and courtyard.
4. Street - building: examples passed from the street directly to building without courtyard.

In the area, there are examples that are directly entered from street and without courtyard [9]. In the study area, there are examples with different plan schemes other than plan schemes with sofas. Inner sofa plan is a type of plan that is most commonly encountered of all. In the study area, the upper floors of buildings are used as housing and the ground floors as storage or shop.

3.3. Check List Formation

Ecological assessment checklists are h prepared in accordance with the guiding principles of design in terms of ecological architecture criteria. They are grouped under two titles as layout and design criteria. Ecological assessment checklists also include location, architectural properties, structural condition, ownership, usage, photographs, sketches and some of the drawings of structure. Number of stories of the buildings was defined while studying in the area. Structural system was analysed as timber, masonry construction and composite construction. Materials used in the construction of the structure were analysed as brick, stone and composite materials. While roof shape was pitched roof, gable roof and other, roofing was analysed as French tiles, Roman tiles and other. Structural condition is evaluated as good in structures with partial material deterioration; as less destroyed in structures with material and structural deterioration; as bad in structures with advanced materials and structural deterioration. Ownership was analysed as private, public and other, and usage was analysed as totally, partly and vacant house. Settlement criteria were analysed under three titles as topography, direction selection and green texture. Topography was analysed under 2 titles as the protection of the natural form the land and proper positioning of the texture. Under the title of protection of the natural form of the land, it was analysed whether the landfill or excavation process was in place on the existing topography during the positioning of the building. Under the title of proper positioning of the texture, it was analysed whether the positioning of the building was made according to the building of the street and terrain textures. In the selection of the direction, the orientation of the building was analysed according to the sun and the dominant wind conditions. Under the title of green texture, it was analysed whether the vegetation was used or not in the parcel and facade of the building.

Design criteria were analysed under 6 titles as building form, space organization, building shell, choice of materials, and use of renewable energy sources, plumbing and circulatory systems. Building forms in ecological design and surface area are important criteria for determining the building's heat retention. Therefore, building forms were studied under two titles as fragmented and large external surface area of the building form and small external surface area of the building forms. Large external surface area of buildings form: Construction of the buildings with wider fragmented and exterior space in order to increase the possible heat loss on the surfaces in hot climates. Small external surface area of the building form: Construction of the buildings with narrower fragmented and exterior space in order to prevent the possible heat loss on the surfaces in cold climates. Space organization was studied under two titles as plan and front typology. Plan typology is an important criterion in terms of heating, cooling and natural ventilation methods of buildings. Spaces that produce heat such as kitchens should not be in the centre of the structure for the cooling of buildings in hot climates. Space organization should be constructed so that ventilation can be made and the heat in the house can be reduced easily. It is important to heat the building in cold climates, thus spaces producing heat such as the kitchen should be constructed in the centre of the building. Front building typology in the natural ventilation and air circulation structure is associated with the occupancy and space in front of the building. Moreover, the movements in the facade of the building will change the surface area and thus the building will be affected from the outside air much. Building shell was analysed under two titles as spaces opened to adjacent wall and spaces opened to opposite walls. The rate and location of the spaces for doors and windows opened on the building shell determines the heat loss and gains of the building as well as the comfort conditions of the indoor area. In terms of spaces opened to adjacent walls, it is important to ventilate the constructions using natural methods especially in hot and hot-humid climates. Therefore, the decision where to place the space in the building shell should be given attention to ensure the efficient natural ventilation. Placing the window on the opposite side of the surface of the facade towards the air intake direction will provide high-speed close air flow. If the window is placed in the opposite direction and the direction of the wind, the air flow is provided through the interior space. Spaces opened to opposite walls: air flow rate inside the building can be provided by opening the spares for windows and doors on the opposite sides. However, a large part of the inside space will not be ventilated. Therefore, the inside space must be ventilated by opening spaces diagonally to the side walls. Material selection has been analysed under three titles as locality of material, recyclability of the material and the material reusability. In terms of the locality of the material, materials are requiring less energy in the production and transportation phases, and materials damaging the nature less should be used in ecological designs. In terms of recyclability of the material, materials should be chosen as the least damaging the nature during construction usage and demolishment phases, and they should be reusable after the demolishment of the building. In terms of the

reusability of the material, reusable recyclable materials reduce the consumption of natural resources. These features should be taken into consideration in the material selection. The use of renewable energy sources has been analysed under two titles as benefit from solar energy and wind energy. Benefit from wind energy air movement is required in hot-humid climate regions in terms of the ventilation of the interior. Air currents between the courtyard and the building occurring by means of natural convection in hot-dry climates are achieved by means of wind pressure in warm-humid climate regions. Plumbing and circulation systems were analysed under two titles as the use of rainwater and the recycling and reuse of wastes. In terms of the ecological approach of recycling and reuse of wastes, wastes are provided for usage as raw materials after being processed. Therefore, the recycling or usage of wastes that arise during the use of the structure is quite important. In terms of the use of rainwater, collection and reuse of the rain water is one of the precautions that that can reduce the risk of the exhaustion of the water in the world. [10]

3.4. Evaluation of the Architectural Properties of the Buildings Examined

Following findings have been obtained from the 30 buildings examined with the help of the checklists within the designated area:

3.4.1. Number of Stories

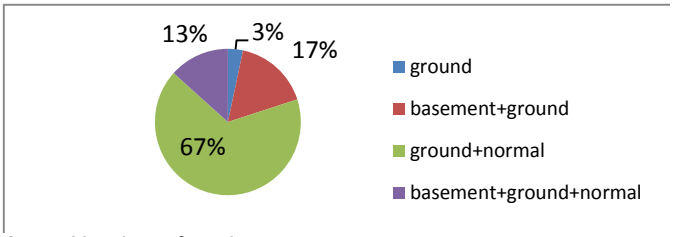

Fig. 5: Number of stories

Number of stories of the total 30 buildings examined are as follows: There are one building with a ground floor (taking up 3%), five buildings with a basement and ground floor (taking up 17%), twenty buildings with a ground and normal floor (taking up 67%) and four buildings with a basement, ground and normal floor taking up 13%). According to these findings, buildings have retained their connection with the nature and the environment because they are low-rise buildings. In this regard, the buildings have ecological characteristics (Fig. 5).

3.4.2. Structural Condition

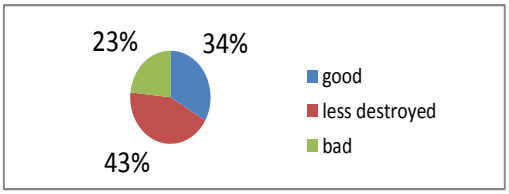

Fig.6: Structural Condition

Structural condition of a total of 30 buildings examined: Ten of them are in good condition (partial deterioration of the material) (taking up 34%), thirteen of them are less destroyed (the material and structural deterioration) (taking up 43%), and seven of them are in bad condition (severe material and structural deterioration) (taking up 23%). It is important in terms of sustainability that most of the structures are in good or average condition (Fig. 6).

3.4.3. Structural System

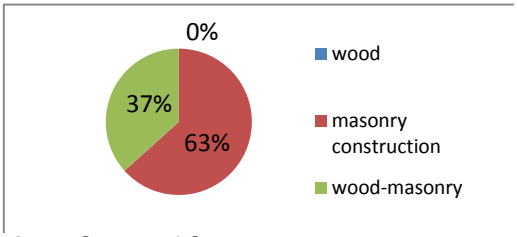

Fig. 7: Structural System

Structural system of a total of 30 buildings examined: Nineteen of them are masonry construction (taking up 63%) and eleven of them are wood-masonry construction (taking up 37%). No wooden building has been encountered. (Fig. 7)

3.4.4. Ownership

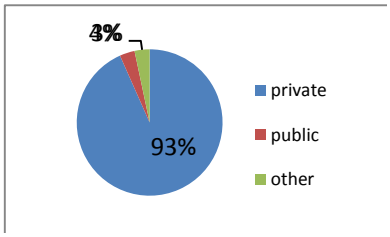

Fig. 8: Property Status

Ownership of a total of 30 buildings examined: Twenty-eight of them are private (taking up 93%), one of them is public (taking up 4%) and one of them is labelled as other (taking up 3%) (Fig. 8).

3.4.5. Material Condition

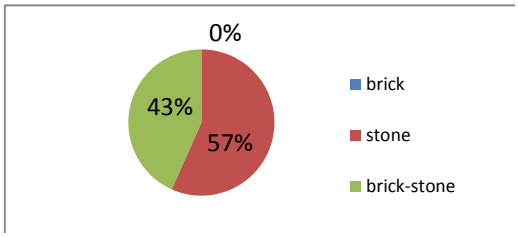

Fig. 9: Material Condition

Material condition of a total of 30 buildings examined: Seventeen of them are stone (taking up 57%) and thirteen of them are composite structures (taking up 43%).No mud-brick building has been encountered. Most of the materials used in the buildings examined are of stone or natural materials in composite structures. Stone buildings are ecological because they ensure that the building is warm in the winter and cool in summer. Composite structures made of stone and wood are stone buildings because of both natural insulating properties of stone and water vapour permeable and fresh characteristics of wood (Fig. 9).

3.4.6. Rate of Use

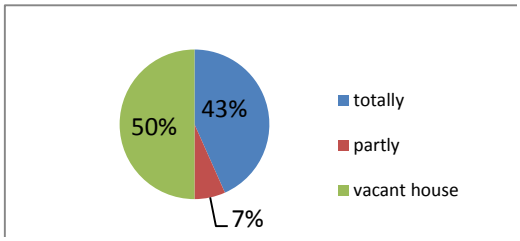

Fig. 10: Rate of Use

Rate of use of a total of 30 buildings examined: Thirteen of them are totally occupied (taking up 43%), two of them are partly occupied (taking up 7%) and fifteen of them are vacant (taking up 50%). That fact that 43% of the buildings are totally occupied and 7% of them are partly occupied shows the regular maintenance and repair of the buildings and the sustainable life around the buildings (Fig. 10).

3.4.7. Roof Types

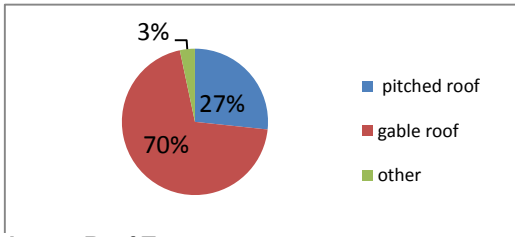

Fig. 11: Roof Types

Roof types of a total of 30 buildings examined: Eight of them are hipped roof (taking up 27%), twenty-one of them are gable roof (taking up 70%) and one of them is labelled as other (taking up 3%). Roof formation is generally hipped and gable roof. This prevents overheating of the building in summer and cooling in winter. It is ecological because it contributes the heating and cooling of the building (Fig. 11).

3.4.8. Roofing

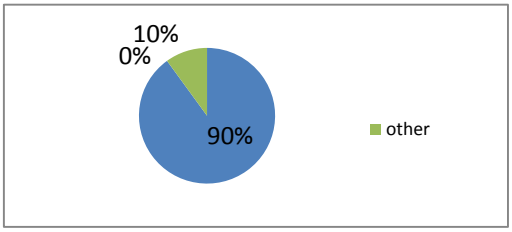

Fig. 12: Roofing

Roofing of a total of 30 buildings examined: Twenty-seven of them are French tiles (taking up 90%) and three of them are labelled as other (taking up 10%). No Roman has been encountered. The fact that roofing material is made from soil-based French tile is an ecological approach in terms of recycling (Fig. 12).

3.5. Evaluation of the Location Criteria

3.5.1. Topography

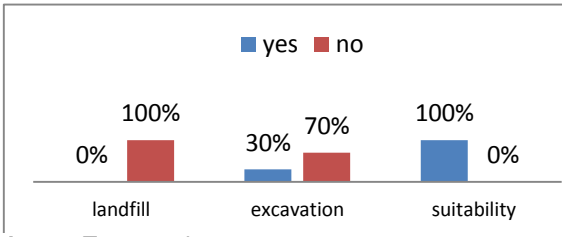

Fig. 13: Topography

Topography of a total of 30 buildings examined: Suitable placement for the existent texture – none of the buildings (taking up 100%) have suitable placements. Preservation of the natural form of the area - none of the buildings (taking up 100%) have no landfill below. 9 of the buildings (taking up 30%) have excavation. h 21 of the buildings (taking up 70%) have no excavation according to the findings, majority of the buildings are ecological because they do not interfere with the topography. (Fig. 13)

3.5.2. Orientation

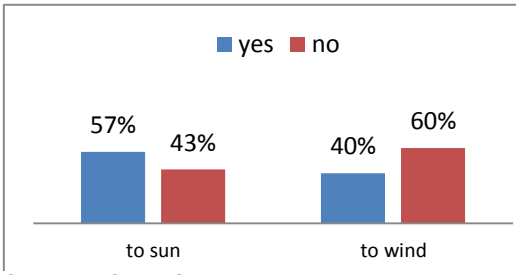

Fig. 14: Orientation

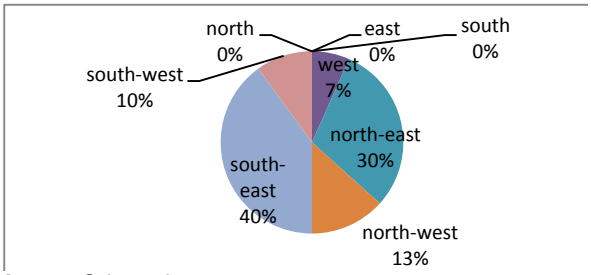

Fig. 15: Orientation

Orientation of a total of 30 buildings examined: Two of them face west (taking up 7%), nine of them face north-east (taking up 30%), .four of them face north-west taking up 30%), twelve of them face south-east (taking up 40%) and three of them face south-west (taking up 10%). Seventeen of them face the sun (taking up 57%) and thirteen of them do not face sun (taking up 43%).Twelve of them face the prevailing wind (taking up 40%) and eighteen of them do not face the prevailing wind (taking up 60%). According to the findings, 57 % of the buildings face the sun and 40% face the wind. For this reason, these buildings are ecological (Fig. 14-15).

3.5.3. Green Texture

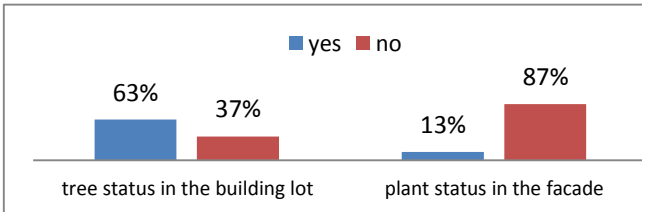

Fig. 16: Green Texture

Green texture of a total of 30 buildings examined: Nineteen of them have trees in their parcel (taking up 63%), and eleven of them do not have trees in their parcel (taking up 37%). Four of them have plants in their facade (taking up 13%) and twenty-six of them have plants in their facade (taking up 87%). According to the findings, sixty-three buildings with tree in their parcel and thirteen buildings plant in their facade are ecological (Fig. 16).

3.6. Evaluation of Design Criteria

3.6.1. Building Form

Building form of a total of 30 buildings examined is determined as small external surface area. Since the external surface area of the buildings is small and parts exposed to external factors are few, the energy loss will be minimal. For this reason, they are ecological.

3.6.2. Space Organization

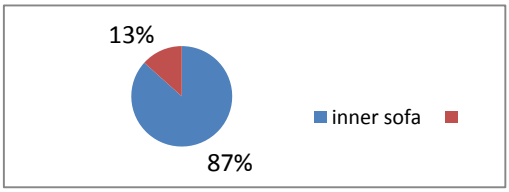

Fig. 17: Space Organization

Space organization of a total of 30 buildings examined: 22 of them are with inner sofa – vertical to front facade (taking up 73%), 4 of them are with inner sofa – parallel to front facade (taking up 14%), 3 of them are with outer sofa – parallel to front facade (taking up 10%) and 1 one them is with outer sofa– vertical to front facade (taking up 3%). 87% of the buildings have the inner sofa that facilitates the air circulation within the building. In this regard they are ecological (Fig. 17).

3.6.3. Building Shell

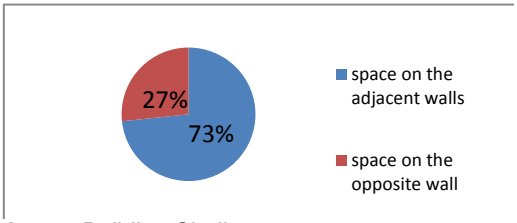

Fig. 18: Building Shell

Building shell of a total of 30 buildings examined: Twenty-two of them have space on the adjacent walls (taking up 73%) and eight of them have space on the opposite walls (taking up 27%). Buildings with space on the adjacent walls facilitate natural circulation of air within the building, thus they are ecological (Fig.18).

3.6.4. Material Selection

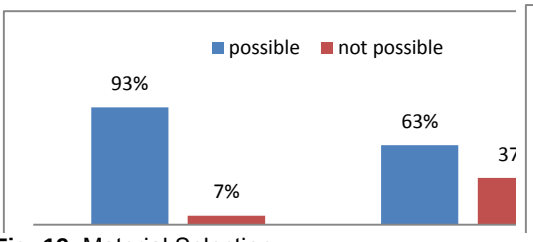

Fig. 19: Material Selection

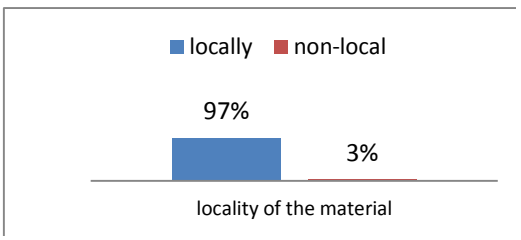

Fig. 20: Material Selection

Material selection of a total of 30 buildings examined: Twenty-eight of them have recyclable materials (taking up 93%) and two of them have non-recyclable materials (taking up 7%). Nineteen of them have reusable materials (taking up 63%) and eleven of them have non-reusable materials (taking up 37%). Twenty-nine of them are made of local materials (taking up 97%) and one of them is made of non-local materials (taking up 3%). According to the findings, these buildings are ecological as 93% of the materials are recyclable, 63% of the materials are reusable and 97% of the materials local (Fig. 19-20).

3.6.5. Use of Renewable Energy Source

None of the 30 buildings examined has been utilizing wind and sun energy. In this regard, these buildings are not ecological.

3.6.6. Plumbing and Circulatory Systems

In none of the 30 buildings examined, usage of rainwater and recycle/re-usage of wastes have been observed. In this regard, these buildings are not ecological.

3.6.7. Using Solar Panels on the Windows

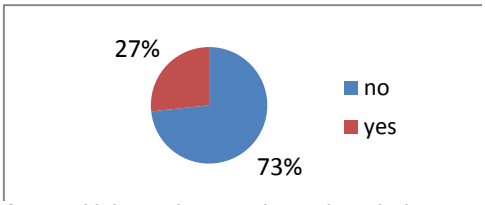

Fig. 21: Using solar panels on the windows

Of a total of 30 buildings examined, eight have solar panels on their windows (taking up 27%) and twenty-two have no solar panels on their windows (taking up 73%). Since solar panels control harmful lights of the sun, 27% of buildings with this feature are ecological (Fig. 21).

3.6.8. Direction and Form of the Entrance

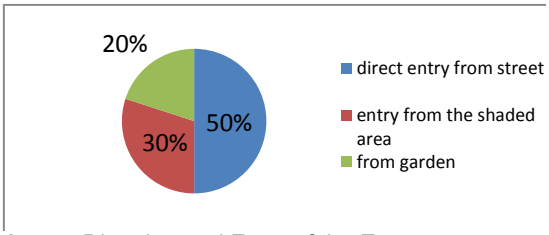

Fig. 22: Direction and Form of the Entrance

Of a total of 30 buildings examined, fifteen are entered directly from street (taking up 50%), nine are entered from the shaded area (taking up 30%) and six are entered from garden (taking up 20%). Entering the buildings from the shaded area and garden provides circulation of the cool air in the area, naturally decreasing the heat. In this regard, 30% of the buildings entered from the shaded area and 20% of the buildings entered from the garden are ecological (Fig. 22).

4. Evaluation

The number of the buildings has been increasing rapidly which are constructed ignoring the natural and cultural wealth of Mersin with the profanely interventions in the environment and nature. Urbanization gained speed with the zoning of many agricultural areas for construction, aims to produce and consume rapidly. However, global warming and its effects are felt every day more and more. Energy needs are increasing directly proportional to the speed of urbanization. Considering that energy resources in the world are quickly running out a future energy crisis is expected. In order to prevent this situation and reduce its effects, measures to minimize the energy usage in buildings should be taken. We need to take ecological criteria into consideration during the design, implementation and usage stages of the buildings without ignoring the climatic and natural riches of Mersin and we should design the buildings in accordance with the new facilities that technology offer. Buildings, not harming the natural environment and the ecological balance, recyclable and constructed with local and natural materials should be designed and produced. Energy production from wind and sun should be expanded. In this way, the destruction of nature will be prevented by protecting agricultural fields and forests, natural resources of the city will be passed on to future generations. Traditional Mersin houses built with traditional construction techniques are environmentally friendly and

nature conscious, and have ecological values. Traditional Mersin houses are suitable for the existing texture, reflecting Mersin's cultural diversity and ecological values The number and quality of the buildings are enough to form an urban fabric. During the field study, it has been observed that many of the buildings were abandoned, destroyed due to neglect and cannot be used. It is quite important for the sustainability of the traditional city heritage that this situation should be resolved quickly and accurately by the authorities. In this regard architects, engineers, their chambers, investors, local authorities, universities and government have many responsibilities. The executive body of the state should bring arrangements and sanctions with the law and regulations in this regard. Inıtiatives should be taken to encourage the investors in this regard (for example tax reductions, technical assistance, grants, loans etc.). Local authorities should examine the ecological status of buildings and their effects on nature and environment in the process of giving the registration and settlement to the buildings. Universities should provide counselling and training to people or institutions needing technical support on this issue. Chamber of the architects and engineers should give courses and training that will ensure the development of its members on this subject. Technical staff serving as architects and engineers must lead the customer in this regard and must give due consideration when producing their designs and projects. National awareness must be raised with the support of press and media.

5. Bibliographical References

[1] Toksöz, M. "Bir Coğrafya, Bir Ürün, Bir Bölge: 19. yüzyılda Çukurova." *Kebikeç İnsan Bilimleri İçin Kaynak Araştırmaları Dergi*si, Ankara, Sanat Kitabevi, 2006, sayı 21, ss.97-110.

[2] Akdeniz Kent Araştırmaları Merkezi, "*Mersin Kültür Envanteri: Kentsel Kültür Varlıkları Belgeleme Projesi 1*." Mersin, Selim Ofset, 2005.

[3] Ünlü, T. S. and T. Ünlü. "*İstasyon'dan Fenere Mersin / Mersin from Railway Station to the Lighthouse*." Mersin Kitapları Dizisi-1, Mersin, Mersin Ticaret ve Sanayi Odası, Başak Ofset, 2009.

[4] Buldum, B. ve M. Külekçi. "Mersin ilinin Güneş Enerjisi Potansiyeli ve Mevcut Durumu" VII. Ulusal Temiz Enerji Sempozyumu, İstanbul, 2008.

[5] Yenişehirlioğlu, F. and et al.., "*Mersin Evleri."* T.C. Kültür Bakanlığı Yayınları, Ankara, Alaz Ofset, 1995.

[6] Ibid

[7] Ibid

[8] Akdeniz Kent Araştırmaları Merkezi

[9] Ibid

[10] Çepel, N. "*Ekolojik Sorunlar ve Çözümleri*." Ankara, TÜBİTAK Yayınları, 2003.

Interviews: Asst. Assoc. Dr.İpek DURUKAN, Expert Tülin SELVİ, Mersin University, Faculty of Architecture.

HERITAGE and TECHNOLOGY
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Technologies to know and share the Cultural Heritage between East and West: geometric patterns in the decorations.

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Abstract
In the current global universe, the architecture (in all times and expression) is confirmed also as a highly communicating system. In particular, among East and West, considering the art and architecture (Islamic and not only), we will refer to the geometric patterns: a simple common matrix - the "katem" as "semema" (from Greek σῆμα) - can generate not only formal and significant system, but also structural system. The same geometry, that it is understood as a complex language, can develop architectural, decorative, symbolic or structural systems creatively, as well as to material and technological equipments. Which of these approaches appear confirmed in time and which are the new? An answer can be retraced, for example, from the seventies of the 1900s, when the studies on geometric patterns in architecture were resumed, thanks also to the massive introduction of the digital. You can do a few examples: the Petronas Twin Towers in Kuala Lampur City (in this case the geometric pattern has been chosen for its high symbolic value and it has been used in the plan scheme); the Centre Pompidou a Metz (France) and the Arab World Institute in Paris (in these two examples the pattern has been used in external covering and to absolve structural functions).
But such architecture can be seen and proposed as a cultured and symbolic language and therefore as an instrument of integration and peace between different cultures and peoples, in comparison of the identities, through the similarities and/or the differences. In this study we propose to test the possibility to weld the visual characters of this system to its constructive potentiality, through innovative technologies. Such technologies can help to reconnect formal modes and common meanings, making them more recognizable, appropriate contexts and are finalized coherently. This contribution is played the thesis work of Osama Mansour, quoted in the bibliography.

Keywords: architecture, decorations, geometric patterns

1. The confirmation of some matrices between Europe and the Arab Countrie
Prisse d'Avennes, was the first to observe in the book of 1877 named *L'art arabe* that complex Islamic geometric patterns were based on a scientific notions system transmitted by the Treaties on geometry applied; He argued that if someone possessed the Euclide elements, he could draw, without difficulty, the woven motifs more complicated than those of Cairo, of Baghdad or Grenada.
The publications of Owen Jones, Racinet, Prisse d'Avennes and others, were complemented by specialized books on Islamic ornament pattern. The two books of Jules Bourgoin*, Les arts arabes* of 1873 *and Les elements de l'art arabe: le trait des entrelacs* of 1879 analyzed for the first time the compositional principles of the structures underlying the geometric patterns, selected mainly from the Islamic monuments of Egypt.
As Owen Jones before him, Bourgoin ranking arabic ornament in terms of three geometric elements, plants and calligraphics, noting that these three elemets are always mixed with each other. He identifies the geometric patterns as essential feature of Islamic art in all regions and he attributes their origins to the art of late antiquity. In *Les arts arabes*, Bourgoin defines this art form essentially decorative, led by a conception of composition of geometric patterns, independent observation of nature and free of iconographic meanings.



Fig. 1: Panels 193-196-198 on islamic pattern in *Les arts arabes*, Bourgoin.
http://patterninislamicart.com/earlier-published-material/colour/11/elements-art-arabe?page=1

The personal approach he presented in his books for the construction of geometric patterns was based on his own observations, and not necessarily that of origin. He divides the geometric pattern in eight categories based on fundamental geometric elements that generated them: the pentagon, the hexagon, the dodecagon, combinations of hexagons and the triangular grids, the combinations of squares and the octagons. The book had the intention of giving endless possibilities of new geometric compositions applicable on architecture, wood, paint, furniture, metal, bronze, textiles, wallpaper, etc. Publications Bourgoin were followed by a series of other studying the principles from which Islamic geometric patterns derived. One of this is the work of A. Christie*, Traditional Methods of Pattern Designing*. Its access to the scrolls of Mirza Akbar gave him the original formulas used in the construction of geometric patterns on different grids. The scrolls of Mirza Akbar are preserved at the Victoria & Albert Museum, are attributed to Mirza Akbar, architect of the state of Qajar during the nineteenth century. The repeating unit of these scrolls has supported the universal definition given by Christie to pattern as "design consists of one or more devices, multiplied and arranged in an ordered sequence ". The book offered many examples of how Islamic geometric patterns are generated by repetitive modular units. Of course, the result of this research includes a vast repertoire of scientific output.

2. From geometrical motifs to pattern into Arab-Islamic architecture

In the Islamic context, the use of the geometry obtained ornamental effects that have no equivalent. The possibilities offered by the combinations of mathematically defined shapes have always fascinated artists and, in every age and religion in Islam, impose themselves in an increasingly complex, formal rules, patterns of composition and common motifs. In the field of application of geometry to arts, is the leading sector of the architectural decoration: in addition to the ornamentation of facades, portals, minarets, We can also consider balustrades, windows, doors, *mihrab*, *minbar* as examples of ornate geometric related to building structures.
Ornate geometric is applied to all materials used in the architecture, but some have a closer relationship.
The technique most closely linked to the problems posed by the geometric decoration is that of the coating in ceramic tile, by means of which, geometry is proposed as a solution to the math to fill a flat surface starting from standard components. Solutions complicated but satisfactory from the aesthetic point of view, generate plots of the effects of varied. One of these is to assemble the hexagons, solution that has its prototype in natural honeycomb beeswax, by which variant, obtained hinterland between hexes of equilateral trianglesit generates a grid of six-pointed stars. Another solution consists of two modules joint exactly complementary: an eight-pointed star and a cross from the ends triangular.
Diversifying the solutions, always based on the complementarity of complex geometric shapes, ceramists come to multiply the number of elements that fit together, so much so that it is sometimes difficult to distinguish the boundary between the technique of ceramic tile that of the *zellij* or inlay stone. In the first case the pieces are prefabricated, while the other two are cut out one by one, but the basic principle is the same and corresponds to the geometrical distribution of a plan according to precise mathematical formulas.
This principle of the geometric distribution of the plan creates two formal problems: that relating to the configurations and that of the grid (*pattern*), problems that do not concern the only mathematical logic, but also the phenomena of perception. As configurations we mean the new geometric figures from the combination of basic figures.

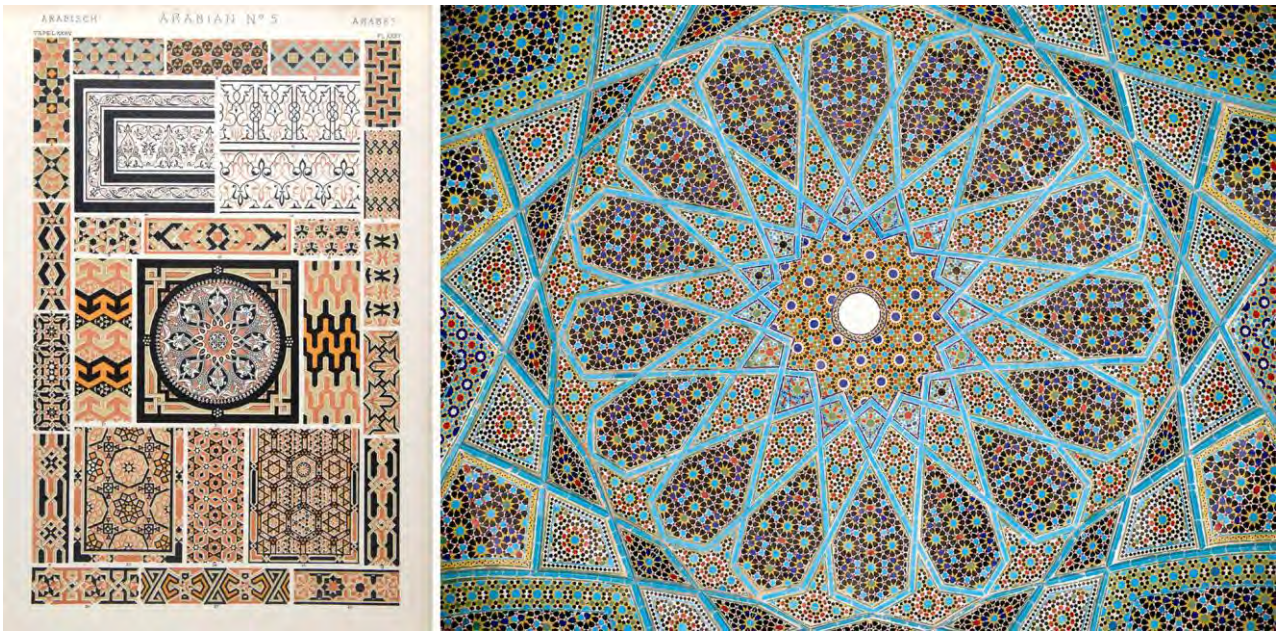

Fig. 2: Right examples of some major Islamic geometric patterns gathered by Owen Jones in The grammar of ornament, 1856 Left Iranian glazed ceramic tile work, from the ceiling of the Tomb of Hafez in Shiraz, Iran. Province of Fars: (1773) Also known as complex patterns Mosaic girih are popular forms of architectural art in many Muslim cultures.

An example is the star formed by the combination of a hexagon and six equilateral triangles, more complex examples are found in *Shamsa*, or "just", which occur in coatings *zellij*. The problem of the plot is similar to that of the configuration, except for the fact that it is based on a linear perception of geometric compositions. The dividing lines are therefore preferred and give rise to more or less complex grids. These games frame lend themselves very well to the realization of curtains carved stone, like that of the Great Mosque of Damascus, where the six gratings that are still in situ, are the oldest example in the Islamic world of decoration in geometric design.

There is talk of "analytical genius" of the "culture of arabesques," referring to two main characteristics of arabesqueshis being a construct formal direct geometric system and its constitution according to a principle of training-iterative combinatorial, characteristics which he defines features of a visual culture of deeply rational and project.

The geometric characterization of arabesques fact is evident when you consider that it is based on geometric principles of saturation of the plan for tessellation, through regular polygons, whose plot is the underlying order of the composition.

One possible classification sees a distinction between "closed orders", such as those stellar or Rosetta, based on rotational symmetries, and "serial orders" based instead of rhythmic sequences unlimited translational type. The modularity of the gratings can then grow indefinitely on all sides of the floor under the translational and rotational symmetries that, through combinatorial variations, generating regular periodic configurations.

The ways of building logical and geometric arabesques, start and grow mainly on repetition of autonomous structures and conventional, hierarchical rules and graduations scalar plant, readability of complex and decipherability bind to a general principle of iterativity which tends to have no limit. This principle involves iterative indefinite absence of a center, but also leads to not favor one of the three fundamental levels of the space in which it unfolds, eliminating any preferential subjective condition of viewing and observation.

These features make the compositions arabesque, flat and three-dimensional constructs essentially "anti narrative", where the ornament may seem an end in itself.

The geometric arabesque is considered the most unique system ornamental Islamic art has developed from the principle of the division of mathematics plan, in it the reason of the plot is combined with the reticular system of geometric texture.

The design of this type of decoration is summarized in three stages: the track base, the grid and the plot.

The track base is constituted by a grid of straight lines generated by the division of a circle into equal segments, the number of segments is generally a multiple of four or six, and consequently may generate squares and octagons, hexagons and equilateral triangles. Intersecting at certain points, the lines of base of the track forms centers of irradiation which, connected together, can be infinitely repeated. The grid constitutes a second linear pattern, obtained by doubling each of the axes of the track base, the effect multiplies the fragmentation of the floor and generates new geometric figures.



Fig. 3: Dome of the Rock, Jerusalem. Completed in 691 BC by artists and Byzantine workers, according to some would be the world's oldest Islamic building which still exists today.

The third stage, formed by the intertwining, is to proceed to a tape which passes from a grid line to another, interweaving with the portions of the grid that meets, alternating above and below. This intertwining binds together the geometric figures as in a mesh network, and some, positioned on the centers of irradiation of the track base, take the form of polygons in a star.
This type of decoration owes its charm to the effects of the perception that it generates, the line becomes a dynamic element that draws the eye and the viewer can follow the movement of the line or to dwell on the polygons that are generated. If formal logic interlacing geometric has the effect of causing a perpetual dissolution and re-composition of the figures, also has the distinction of not recognizing neither a center nor a limit and they can virtually extend to infinity.
A further feature of this aspect of Muslim ornamentation is the taste for symmetry with "changes" and the proposal and further study of very complex woven motifs that result in endless knots of a different nature. this is called "connectivity disjointed", that peculiar way of interweaving and additions that makes it appear each nodal point simultaneously inextricable and resolved, according to the head of the linear performance of which will follow the development.
It is not easy to find the meaning to be given to the Islamic geometric decoration on the interpenetration of different levels of significance, aesthetic, philosophical or symbolic. It 'clear that this complex art, sometimes called conceptual, reflects the development of the mathematical sciences. Louis Massignon, a scholar of Islamic mysticism, claims that the perpetual transformation of the geometric forms of the plot corresponds to the specific guidelines chosen by mathematicians of the Islamic world, overcoming the static model greek, Islam has therefore devised a mathematical concept that matches the dynamic trigonometry. Massignon explains this new orientation with a philosophical view which sees the world as an unstable grouping of atoms, philosophical atomism that reflects the religious idea of the transience of the world in front of the eternity of God.

3. Techniques and materials: the example of the brick

As is known, the construction of the Arabic (the structural type in the construction site, as well as to the details of construction) is rich in various technological possibilities and materials. Among these, the brick is widely used throughout the area that includes Iran and Central Asia. Its quality and mechanical properties have a direct impact on architectural forms: In fact, its weak tensile strength prevents its use in the entablature and involves, in particular in areas where wood is scarce, the use of arches, vaults and domes for coperture151. Beyond the structural implications, so it gave rise to a particular decorative art, favored by the shape of standardized elements and small in size.



Fig. 4: The Palace of Ukhaydir north of Karbala '(Iraq, 766-788). View of the courtyard and the time of the porch, where you see the blind arches and ribs.

This formal aspect was a problem for manufacturers, but also provided them with the solution: the uncomfortable feeling of monotony, in fact, obtained by the repetition of a module so small, it was resolved thanks to the various possibilities of manipulation in which the material is brick lent. In the oldest Islamic buildings in brick ornamental we find solutions that are part of what, in the western architectural tradition, be treated as the molding, the technique that allows to animate wall surfaces with elements in relief, swings, comedians, pillars, etc. Muslims manufacturers, taking a model already in place in front of the palace of Ctesiphon Sassanid (591-628) resort to a game of niches, blind arches or ribs products with the only provision of the bricks in the wall face, as can be seen in buildings such as the palace of Ukhaydir (764-788) or the door of Baghdad in Raqqa (772).
An innovative technique was founded in the tenth century and is located in Transoxiana in the Mausoleum of the Samanids of Bukhara. In this building the brick achieves a perfect balance between the structural function and the decorative. Almost every brick plays its role as an element of the construction and as part of a decorative element both inside and outside. Playing on the contrast between bricks projecting and those arrears, create light and shadow effects of the warp similar to that of a fabric.
The same magisterium (later known by the English term "brick style"), will be significant success Seljuk era (XI and XII century) also spreading to Pakistan and Iran. Pakistan is found in particular in the architecture of funerary complexes, Afghanistan and Iran is manifested in a number of minarets, mausoleums and small burial towers.
Produced in series and of the same size, the bricks become a modular element which allows the manufacturer to adjust their work according to the logic of the combination. As has been noted, the proportions of the brick used efficiently refine and change this logic. Regarding the criterion of construction, it is to explain that, for the purposes of a good cohesion of the whole, it is hardly necessary to recall the need to arrange the elements in such a way that they are offset from each other, implying the production of reasons interacting and tend to coalesce into a plot that can be repeated indefinitely '.
Another aspect of the art of brick is its perfect legibility is an art that performs and enhances its matter. Approaching, the viewer is always able to reconstruct the sequence of operations that have allowed to obtain the various effects, a sequence that is also a set of technical and mathematical formulas.
A simple formula is to place the brick alternately horizontally and vertically. The result is a pattern that takes the form of a herringbone and from which they can derive other by placing bricks cut.
Another formula is to play on the relief to get the effects of light and shadow. It can be done by offsetting in depth some bricks to the vertical plane of the wall or contrasting brick parallel to the plane of the wall to the other arranged at 45 degrees. However, there are more complex processes, which require prior preparation of the material, with a cutout of the bricks and reduction in triangles, or the bevel of the corners; in this way it is possible to create new combinations formal generating, in the veneer, different forms of shadow: zigzag, sawtooth, star. These formulas and magisteria are basic principles that can generate an infinite number of motifs, all to enroll in the logic of the combination of shapes inside a warp costante161.
The Persians artisans for example, does not only apply the principles that derive from the rhythm and geometry of the building using brick as both formal element that material, creating dense textures of mosaics. This technique is particularly suited to the creation of panels and ornamental epigraphic bands: it was used for example in the decoration of tombs and minarets as the Seljuk Gunbad-i Kabud in Maragha (1197) or the tower of Mas'ud in Ghazna (XII century). The realization of this type of mosaic, provides for the cutting of brick fragments according to geometric or calligraphic default, which are then arranged on the floor with his face down. After the composition is poured a layer of plaster so as to form a panel which is then transferred on the wall.



Fig. 5: Mausoleum of Ismail Samani in Bukhara (Uzbekistan, X century). View of the exterior and interior of the Mausoleum.

Some interventions add a touch of sophistication, particularly typical examples in Central Asia or Iran, as the inclusion of brick bearing on the visible side a reason stamped, or the introduction of grouted joints or sculpted or even , the insertion of fragments of clay coated enamel turquoise. Observed in the sunlight these works, clad in brick and glazed, give the impression of being covered in fabric.
Observed in the sunlight these works, clad in brick and glazed, give the impression of being covered in fabric. The mausoleums brick are interpreted by him as the transposition of the solid material tends funerary Turanian tradition.
Even the technical devices that come into play, in addition to visual effects, contribute to understand the link between this type of decorating with fabric. The assembly operations of the bricks have some analogy with those of weaving. Not surprisingly, the analogy between the two types of operations.
Since the beginning of the twentieth century onwards, the study of Islamic art and has developed into a specialized academic field in which research has led to accumulate a wealth of information previously unavailable. Archaeological discoveries, international exhibitions, studies and detailed research covering the entire period of Islamic art and architecture, have raised awareness of the complexity of the assets.
The use of the pattern allows not only to integrate several levels of the project, but can also be limited to delineate only the expressive, representative or symbolic architecture. Clearly it is sometimes difficult to be able to separate the different levels of the project that are often inextricably intertwined: we are still able to find in the history of architecture in attitudes towards the decoration, which are repeated cyclically.
The use and dissemination of the pattern of different scales of intervention manifests as research on the complexity and, at the same time, the consistency. The pattern allows to manage different levels of the project while maintaining a general order recognizable: this is also made possible by new technology, both design and construction. The spread pattern of the facade comes from this growing attention to the outer shell of the buildings, as we have seen, has its precedents in postmodernism.



Fig. 6: Detail of the decoration of the madrasa of Qal'a in Baghdad (XIII century). Pulling back the bricks arranged in horizontal than vertical generates a pattern in slight relief emphasized by square terracotta stamped.

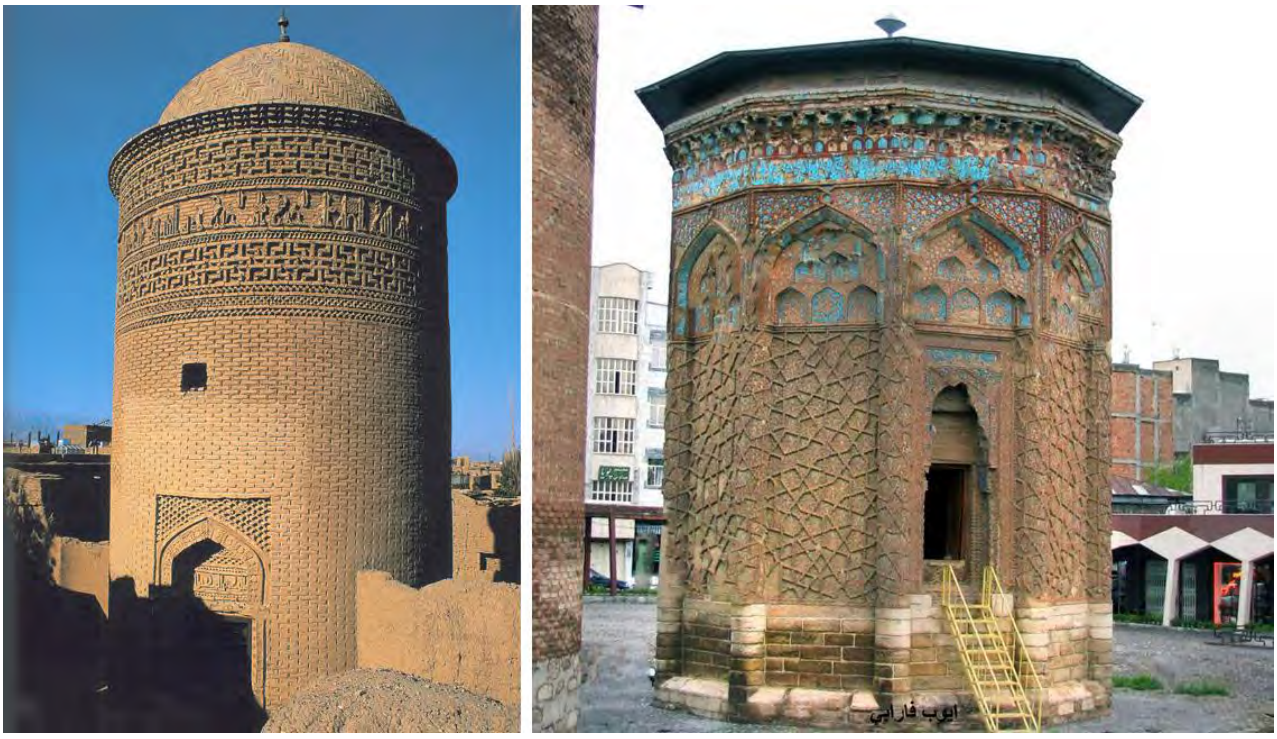

Fig. 7: Left Mausoleum of Pir-i Alamdar in Damghan (Iran, 1021-1026). Effects of light and shadow playing on the relief obtained. To the right of the tomb Gunbad.i Kabud in Maragha (1197).

Occurs then a disconnect between internal and external, that is, between what happens in front and what happens within the architecture: in this way the facade is an attractor and poster communication that does not take into account the internal . In fact, the architect is no longer involved with the design and the development of the entire complex (and therefore of its external and internal): those who design the facade does not coincide with the architect who later will the interior. This is because, as the different owners, the customer called an architect only the design of the exterior, selling different portions to customers who entrust then, in turn, their share to other designers. It is therefore clear that, from the outset, the project is developed taking into account mainly the marketability of the project.

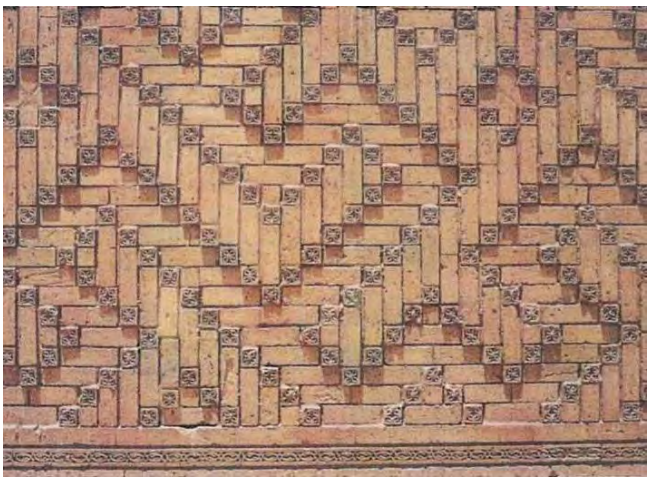



Fig. 8: Detail of the decoration of the madrasa of Qal'a in Baghdad (XIII century). Pulling back the bricks arranged in horizontal than vertical generates a pattern in slight relief emphasized by square terracotta stamped.
Fig. 9: Detail of the decoration of the tomb of Gunbad.i Kabud in Maragha (1197) .li seventies of the twentieth century and the recovery of studies on geometric patterns**.**

Another factor that contributes to the use of patterns in the facade is derived from the new environmental regulations born to optimize the energy efficiency: since the transparency of the modern movement is not efficient from an energy point of view, it is necessary to introduce environmental control systems that operate to layering of different panels, curtain-wall or densifying more opaque areas in the solar orientation.
It is also for this reason that many times the expression of the buildings may not have any relationship with the interior.
An example of an advanced pattern that integrates multiple layers of architecture, is the one used by Cecil Balmond in the project by Daniel Libeskind for the expansion of the Victoria and Albert Museum in London (1996-2004). This project could actually come together in different chapters of this work: it is not only a contemporary use of tessellation aperiodic, but also contains the golden number and fractal, and in it the pattern integrates both ornament and structure.
It constitutes an interesting example of the use, in contemporary times, the aperiodic tessellation, fractals and patterns, integrating aesthetics and structure. This shows that, although for educational matters we are required to separate the arguments for issues or to investigate aspects for separate domains, in reality in a good architecture these issues coexist together.

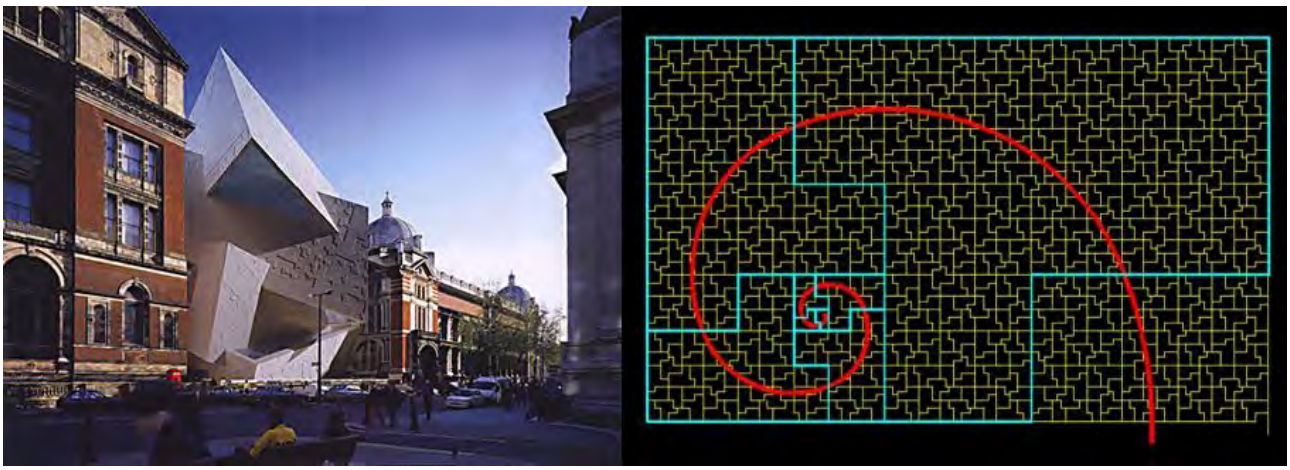

Fig. 10: Cecil Balmond and Daniel Libeskind, project for the expansion of the Victoria and Albert Museum in London (1996-2004).

4. Conclusions: examples in the contemporary

In the contemporary, urban transformations taking place in the territories of the Middle East have led to an "Islamic style", among other events, often flattened on European or American models. But in the world are worthy of interest episodes inspired own decorations derived from the philosophy of geometric decorations (including Islamic) and the pattern of these derivatives. So, inspired by these Cecil Balmond and Daniel Libeskind, the project for the expansion of the Victoria and Albert Museum in London (1996-2004); as well as the group ILUMA, for the Urban Center in Singapore (2009); or as the team FOA, the Ravensbourne College of Design and Communication, London (2010). It is a must, in conclusion, the “forerunner "Institute of the Arab world (of Islamic Arts at the Louvre), made in Paris in 1987 by Jean Nouvel. In one of the best-known texts, Mark Garcia pointedly notes that "the recovery of the pattern could allow, thanks to their flexibility, the overcoming of the gap between Western and Islamic architecture and represent a ground for experimentation and research, allowing, at the same time, aesthetic innovations with high visual performance and structural. " If the research is the art of the exchange, even the decorations between East and West will be an effective way of communication.





Fig. 11: FOA, Ravensbourne College of Design and Communication, Londra 2010. https://terraincritical.files.wordpress.com/2010/10/dsc01534.jpg?w=500 (consultato il 02/04/2015)
Fig. 12: ILUMA, Urban center, Singapore 2009https://terraincritical.files.wordpress.com/2010/10/dsc01534.jpg?w=500 (consultatoil02/04/2015





Fig. 13: Zaha Hadid Architects , the project for the Department of Islamic Arts at the Louvre , Paris 2005.http://www.eikongraphia.com/wordpress/wp-content/Louvre_4.jpg (consultato il 02/04/2015)
Fig. 14: Atelier Jean Nouvel, the Arab World Institute of Islamic Arts at the Louvre, Parigi 1987. http://upload.wikimedia.org/wikipedia/it/e/ec/Istituto_del_Mondo_arabo_facciata.JPG (consultato il 02/04/2015)

Bibliographical References

JONES, Owen. *The Grammar of Ornament*, London, Studio Editions, 1856. 172. ISBN 978-1445566238

BOURGOIN, Jules, *Les arts arabes*. 1ª ed. Paris: Veuve A. Morel, 1873. 243 p.

PRISSE D'AVENNES. Achille-Costant-Theodore-Emile. *L'art arabe d'apres les monuments du Kaire depuis le VII siecle jusqu'à la fin du XVIII*. 1ª ed. Paris: Morel, 1877. 416 p. ISBN 978-3836519830.

BOURGOIN, Jules. *Les elements de l'art arabe: le trait des entrelacs*. 1ª ed. Paris: Firmin-Didot. 1879. 460 p. ISBN 978-2012763616.

BOURGOIN, Jules. *Arabic Geometrical Pattern and Design*. 3ª ed. Paris: Dover Publications. 1973. 325 p.

WIETING, Thomas Warren. *The mathematical theory of chromatic plane ornaments*, Dekker, New York, 1982. 389 p. ISBN 978-0252725487.

CHRISTIE, Archibalf H. Traditional Methods of Pattern Designing, 2ª ed. Oxford: Clarendon. 1910. 368 p. ISBN 9780486222219.

HILLEBRAND, Robert. *Islamic architecture: form, function and meaning*, Edinburgh, Edinburgh University Press, 1994. ISBN 9780231101325.

ABAS, Syed Jan. SALMAN, Amer Shaker. *Symmetries of Islamic geometrical patterns*, Singapore, World Scientific, 1995. ISBN 978-981-02-1704-4.

CLEVENOT, Dominique. DEGEORGE, *Gerard. Ornament & Decoration in Islamic Architecture*. London: Thames & Hudson, 2000, 224 p. ISBN 978-0500510322.

MAROTTA, Anna. *Oriente e occidente nella decorazione come linguaggio complesso*, dalle "Zelliges" nel "Khatem" al "Drakslingor" celtico. In Seminario internazionale di studi. 1ª ed. Padova. 2005, p. 139-150. ISBN 9788871154466.

MAROTTA, Anna. *Decoration as a system. Survey and critical interpretation* (The ICOMOS & ISPRS Committee for Documentation of Cultural Heritage – XX International Symposium CIPA 2005 “International Cooperation to Save the World’s Cultural Heritage”, 26/09-01/10/2005, Turin (poster premiato con il “Best poster award”)).

MARK GARCIA, *Prolouge for a History, Theory and Future of Patterns of Architecture and Spatial Design,* «*AD*», n. 6, vol. 79, 2009.

MAROTTA, Anna. *Dal segno al simbolo: geometria e significato delle volte tra percezione e cognizione* (17-19 settembre, Convegno Internazionale “Disegnare il Tempo a l’Armonia”, Università degli studi di Firenze, Dipartimento di Progettazione dell’Architettura, Firenze),2009

TIZZANO, Antonella. *Un modo della visione tra passato e futuro: Rilievo, conoscenza e rappresentazione dell'ornatus in architettura.* Tesi di Dottorato in Beni Culturali, Politecnico di Torino, XXIV ciclo, relatore prof. arch. Ph.D. Anna Marotta, Torino 2012.

FASSINO, Mauro. *La progettazione parametrica come strumento di analisi: dai pattern algoritmici decorativi ai pattern "performanti", esempi nei Beni Culturali.* Tesi di Dottorato in Beni Culturali, Politecnico di Torino, XXIV ciclo, relatore prof. arch. Ph.D. Anna Marotta, Torino 2012.

MANSOUR, Osama. *La decorazione geometrica nell’architettura islamica : dalla teoria all’applicazione.* Tesi di Laurea Magistrale in Architettura, Politecnico di Torino, relatori prof. arch. Ph.D. Anna Marotta – arch. Mauro Luca De Bernardi, Torino a.a. 2013/2014.

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Identity+Innovation: how to give hope and opportunities to forgot suburbs. A comparative study between EU and China.

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Abstract
New challenges for the architectural project are globally emerging in order to the social economic changes and the dispute between ideological man and technological man. Avoiding any formalistic configuration, it should be based on the environment of the future: house, work and city.
This doesn't mean deal with the compact city or with the soil consumption, because it doesn't make sense nowadays *a-priori*, in particular in the new European socio-economic condition. Dealing with this problem means focusing on the regeneration of existing, in particular buildings and suburbs, till they reach a critical mass to host new functions, committed to the contemporary sustainability way of living. The new aesthetics must look at the tradition and innovation to transform the confused contexts and the suburbs, which lost identity. The regeneration of the suburbs, through the design of collective elements and the forecasting, hard but necessary, of the commercial function, can contribute to recreate new connections inside the territory, at both local and global scale.
In this Paper is proposed a qualitative research, carried by the Rural Architectural Intensification Research group of the University of Pavia in collaboration with researchers of the College of Architecture and Urban Planning of Tongji University in Shanghai, thorough interpretation and survey of numerous study cases between China and Europe with the aim to discover innovations and alternative design hypothesis that may explain the on-going phenomena in the deprived suburbs: interventions on materials, spaces and functions, capable of giving back social and landscape dignity to forget suburbs.

Keywords: comparative study; design strategies; architectural design; suburbs; identity and innovation

1. Introduction on urbanisation priorities in China and EU
We live in an interdependent world dominated by global opportunities and challenges. The economies and societies of China and the European Union are interlinked on an unprecedented scale in the history of their relations, and therefore they need to draw on experience from each other, strengthen interaction and cooperation, jointly seize the opportunities and cope with the challenges of the future, and strive to achieve win-win results. Policymakers from the European Union (EU) and P.R. China are stepping up efforts to achieve a strong and beneficial partnership on sustainable urban development. The major step forward in the relationship between China and the EU is the Joint Declaration on The EU-China Partnership on Urbanisation, signed by European Commission President José Manuel Barroso and Li Keqiang, Vice Premier of the People's Republic of China, on 3 May 2012. The Partnership is aimed at tackling challenges together through cooperative efforts between stakeholders at all appropriate levels, including national, regional and local levels. The Partnership will highlight, among others, the following subjects: 1) Strategies and policies relevant to the development of urbanisation; 2) Spatial distribution of urbanisation; 3) Sustainable development of urban industrial economy; 4) Urban public services system; 5) Urban infrastructure investment and financing mechanisms; 6) Urban housing supply system and patterns; 7)

Urban energy supply and demand management; 8) Urban mobility, public transport and smart transport; 9) Urban green buildings; 10) Urban ecological protection, environmental protection and treatment; 11) Protection of urban historical and cultural features and formation of urban landscape; 12) Urban governance; 13) Urban-rural integrated development; 14) Exchanges and discussions as well as personnel training on urbanisation development [1]. Thus, the subjects of interest listed above are the starting point of this research, which goal is to extent a comparative studies between China and EU on the construction of identity and innovation in margined suburbs. The focus of the research will be not only about their urban phenomenon but also comparing the corresponding stages of social development. It is necessary to point out that, understanding or explain China's issues using Western development experience and principles is impossible mainly because there is a societal development gap between China and developed countries, and differences in the social system make the comparative studies theoretical research isolated from reality. Aware of this risk of approaching an uncertain problem that involves different territorial scales and disciplines, we define, as first step, a precise application domain. The first problem which every research meet approaching a comparative perspective on the global significance of urban development in Chinese metropolitan areas is the scale factor. The reason is due to the current China's urban planning system, which includes two scales of intervention: the planning at the big scale and at the design at the small scale. Wheras, intervention scale in EU Countries is mainly oriented to the small scale. We think that between big scale planning and small scale design exists a new scale of investigation represented by the medium urban-scale (Figure 1). The medium urban-scale problems have become commonplace in both EU and China's urbanisation, whether in an urban redevelopment area or suburbs or an urban-rural part. They are not the large-scale or mega-scale developments, but new urban areas. This is the unique situation birthed from China's rapid large-scale urbanisation, and this research is the first study, which will demonstrate new possible comparisons and common understanding between China and EU urbanisation.

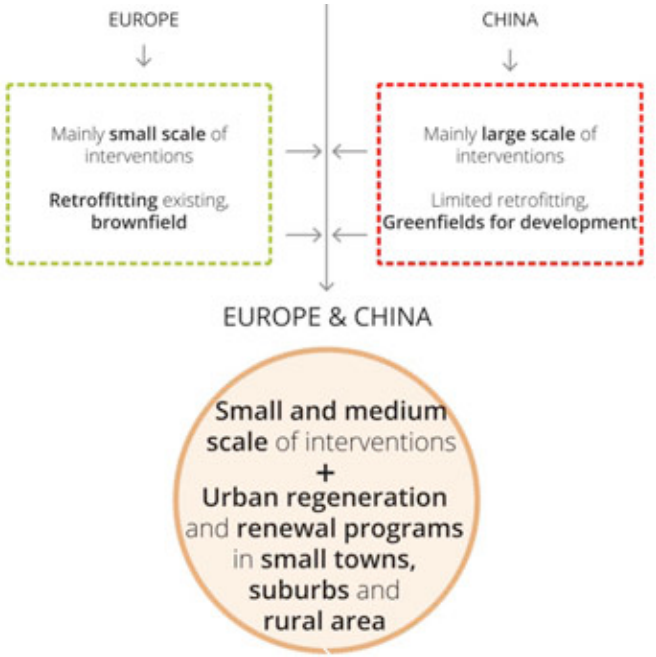


Fig. 1: This image represents the difference of the scale planning and design between EU and China. Nowadays between big scale planning and small scale design exists a new scale of investigation represented by the medium urban-scale which involves small towns, suburbs and rural areas. Source: Adapted by authors from O. Bina, (et al.), 2015 [2].

Despite the fact that China and the EU are in different stages of urbanisation those kind of urban area will be also the foundation upon which future communities are built. Therefore, we believe that now all economical, social, political ingredients are available to develop new knowledge, which can be combined to produce the best results, between European technology and China's organizational implementation skills. Figure 2, summarizes the nowadays policy area and tackled strategies on urbanization by China [3, 4] and EU [5] and the different aims addressed by the two side on the regeneration of small towns, suburbs, and rural areas.

China	EU
a. China is entering its second half of the urbanization process; this period is widely known as the transitional phase. The second phase of	a. Europe has focused on maximizing urban space, providing a livable environment and developing multi-functional urban systems. In recent years, this

urbanization takes place in two folds, the urban regeneration with new pattern(s) within the Central City as well as the urban renewal programs in small towns, suburbs and rural areas in the outskirts of mega-cities.	trend of innovative urbanisation has continued through the design and construction of smart, green and low-carbon cities.
b. After more then twenty years of hard work by proponents, the theory of sustainable development has received general acceptance in China. In the urban planning and in building construction industry, it means adhering to the concepts and requirements of ecological design. Based on the practical situation in China, the Ministry of Housing and Urban-Rural Development of the People's Republic of China has laid down the main principles of China's ecological design, they are: - maximally conserve resource (land, energy, water and material); - protect the environment; - reduce pollution; - provide healthy; - confortable and efficient use of space; - balance with nature in the whole lifecycle.	b. One of the challenges currently facing Europe is how to recover economic activity through the adoption of state of the art technology and new organizational structures. c. In order to meet the challenges and priorities for rural development in the 2014-2020 programming period, EU Member States and Regions are designing and developing a new generation of Rural Development Programmes (RDPs). This is a process that envisages many steps, from SWOT analysis and needs' assessment to planning of measures and resources, and a number of strategic choices are implied.

Fig. 2: Abstract of the priorities issued by EU on rural development and urbanisation matter (right column), and summary of new urbanisation plan for 2014 to 2020 priorities, published by China's Government on March 2014 (left column).

Notably, the presented research focus on the role that Architecture has in the process of creation of identity and innovation in forgot suburbs and rural context. This issue is already well known in EU countries (e.g. that issue was already explored in several documents and research report by EU), but it is a totally new phenomena recently occurring in China. In fact, as Li Xiangning underlines [6], China's contemporary architects *"are seeking their personal positions in such and intricate relation network of different poles such as architectural autonomy vs. social reality, globalization vs. localization, politics vs. form. […] A new trend correlative to increasing concern about social responsibility and equity in architecture is that more young architects turn eyes to the countryside, design and construct country buildings and even take part in its social reconstruction. Until nearly ten years ago, architects have concentrated on the architecture design and construction in the cities, ignoring the countryside because of its unfavorable economy and culture condition. While in recent years, the crowded streets and industrial pollution in cities have lost attraction to architects, who then turn to the countryside where the idyllic pastoral dream till can be realized. […] Some young architects persevere in building the countryside and even move out form their cities to become one member of the local community, such as Zhao Yang, who has settled in a small southern town, Dali. Instead of being a visiting architect to the minority region, his architectural projects, like Shuazi Guesthouse beside ErHai Lake, which combines local construction material with clear and simple spatial layout. His projects as well as his presence as a member contributed a lot to the reconstruction of local community value of the region".*

2. Methodology and definitions

The methodology to achieve the early mentioned comparison could be defined as follows:
- Knowledge preparation: definition of the application domain;
- Definition of the objectives and of the assessment parameters (taken from the policy area of both China and EU);
- Data collection in two steps: 1. Case studies selection in China and EU; 2. Documentation collection (also through site survey where is possible);
- Comparison and conclusion.

2.1 Definition of the application domain

The key question is how to make these areas good structures upon which communities can grow, being at once made up of tangible urban structures, functioning operational structures and social structures. This is not just about planning figures and control indicators such as capacity, traffic organisation or green coverage. If the medium urban-scale structural issues can be reasonably resolved, together with a package of planning guidelines, a decent urban backdrop would be provided for individual development projects. Current criticism about China's built environment is mostly concentrated in the medium scale. Architects are often seen trying to solve societal level issues when they are designing projects in China; however, they are

limited in their impact as the medium-scale level planning issues are not resolved. A new urban area's operational efficiency is directly related to the city's economy, especially the economic development after the area is urbanised, so this is the consideration that moves the decision-makers most. The economy in turn is closely related to the urban spatial quality, urban functions, traffic organisation, environment and other structural factors of urban planning and design.
On the other hand there are thousands of small towns all over Europe, with millions of people living in them. They have similar histories in their origins but now find themselves today under many different political regimes and statutory systems. Researches carried out by the European Council (e.g.: ECOVAST [7]) underline the challenges the small towns have to face and about the way small towns have, over many years, used their considerable assets to improve their local economy for the benefit of regional, national and European economies as a whole. Small towns are an important part of the hierarchy of European settlements. They are urban in character but on a much smaller scale than large towns and cities. Although some small towns may have lost some of their services through increasing centralisation, they still serve a hinterland of villages and rural areas, providing a valuable link between larger urban areas and rural areas, particularly in relation to rural/urban partnerships. Small towns with their local customs and traditions as well as their appearance and closeness to the natural landscapes around them form an important part of the diverse cultural landscape of Europe.

2.2 Definition of the objectives and of the assessment parameters
Goal of this section is the definition of policy areas, design strategies and design goals for advance a comparative evaluation between projects in both China and EU, which generate positive actions in the suburbs where they are located. With the aim to find a final common framework valuable for measuring the sustainability of urban and architectural design actions in a certain territory, we analyse a large typology of sources (texts, drawings, photos etc.) to uncover relationships between a set of terms they contain by producing a set of concepts related to the terms. This task is built on the groundwork laid in previous research [8, 9, 10], by the authors through the semantic analysis of a wide range of literature and documents, (e.g. the priorities issued by EU on rural development and urbanisation matter, and the new urbanisation plan for 2014 to 2020 published by China's Government on March 2014, etc.). One aspect that links Europe and China, thinking to a new future for forgot suburbs, is the need to create new opportunities for the population and for the cultural and environmental heritage. This means acting with interventions able to exploit the potentialities of the existing or to create new opportunities to restore hope and vitality to the suburbs. With this aim and through the process early mentioned we are able to set out broad key categories of intervention for both China and EU. They are:
- EU's categories of intervention to create new opportunities to restore hope and vitality to the suburbs:
a. Development of local business capability: The creation of SME companies linked to agriculture and non-agriculture activities, which make the most out of a rural region's potential, could improve the population's quality of life, bucking the current trend towards the socio-economic decline of these regions;
b. Development of cultural and tourist activities: The actions which have an impact on the existing architectural heritage try to move away from the idea of second homes and therefore seasonal regeneration, which is purely based on massive tourism. The region needs to be permanently inhabited, only then it can avoid falling into decline.
c. Environment preserving: Protection of environment and natural resources, in particular, focusing on the re-naturalisation of a region become an opportunity for its more general regeneration of the whole territory.
d. Facilities for population: The regeneration of functions and activity programs in villages and in rural areas go through integrated initiatives including diversification of services, creation of new productive activities and investment in the enhancing of cultural heritage, and strategy for the directly involve local inhabitants, which aim is to improve the quality of life in rural areas and to develop the attractiveness of these areas for future generations.
- China's categories of intervention to create new opportunities to restore hope and vitality to the suburbs:
a. The Change in Social Structure – Future Population: There is a general movement of young and able exiting the town and moving into the cities in search of better living opportunities. A consequence of such is the ageing population of town. With the uncertainty on the main composition of the future population, this puts the direction of the town questionable. New attractiveness of these areas for future generations and consideration of pro-tourist scheme or a pro-users scheme is highly essential in determining the future of the town.
b. Job Opportunities for the Future Population in a Changing Economic Structure: In this phase of economic transition and upgrading, there is a shift of focus in the nature of economic activities taking place in town. Firstly, the traditional focus of the economy of a town is the agriculture industry. With the changing nature of the society, less people are less willing to be involved in this industry and naturally the reduction in this industry. The development of local business can give new job opportunities for the future population.
c. Fragmented Spatial Structure at the Historic Core and Town Scales: At the scale of the historic core, it is hard to conclude whether the spatial structure of the town is clear. Looking at the overall structure the

town seems to be clearly outlined but with individual plots that are fragmented spatially. Often, new areas are planned independently from each other and they are very much segregated in terms of the physical environment as well as the functionality as a town. Regeneration and participation in community reconstruction can give new role and quality of the historical heritage in the town to avoid the adverse limits by urban construction.

2.3 Design strategies: finding a common ground between EU and China.

European and Chinese suburbs are different realities, whose being abandoned is often dictated by different reasons, but they may have, however, the same reading tool. Combining the key issues of European and Chinese cases (coming from the own social, environmental and cultural aspects) and considering several case studies on the two realities, the research proposes four main reading and study categories for the interventions.

The overlap of these four categories and of their key points produces a “vitality matrix” of the projects, which aims both to guide a quantitative analysis of the intervention, both to indicate some guidelines for future works. The actions, here organized in these four broad categories are not to be read only by points, but, as much as possible, they should be related to each other, both within the same group, and both between different groups. They are (Figure 3):

1. BUILDING & DESIGN - the construction of the building itself is an important action for the transmission of the cultural heritage, the enhancement of the history and of the local business. The design and the construction of the intervention become a key moment to re-enhance the economy, the environment and the communitarian spirit of the suburbs.
2. ENVIRONMENT - means enhancing the quality of the territory, its natural resources, its characteristic elements and the territorial natural systems in which it is inserted (agroforestry, green systems, ecological corridors, etc.). It means pay attention to quality issues while preserving quantitative aspects of the natural heritage. In this category is underlined the ability of the intervention to integrate the environmental aspects with the local activities and with the energetic resources.
3. COMMUNITY - who actually makes a place a living place, is the community that lives it; the renewed sense of community is increasingly present in the cultural debate, particularly in the architectural one. New services, places to be shared and focal spaces represent the ability to stimulate a sense of belonging (to a place or to a social group) that strengthens the quality of the intervention and helps to give hope to people, improving their life quality.
4. ECONOMY - A definitely difficult component to be evaluated and to be predicted, but likewise important to achieve the object, is the economic aspect of the intervention; considered both as a set of actions aimed at reviving the productive activities and the employment opportunities, both as economic sustainability within a plan on larger scale. It takes into account the enhancement, in a sustainable way, of the peculiarities of the natural and cultural heritage resources.

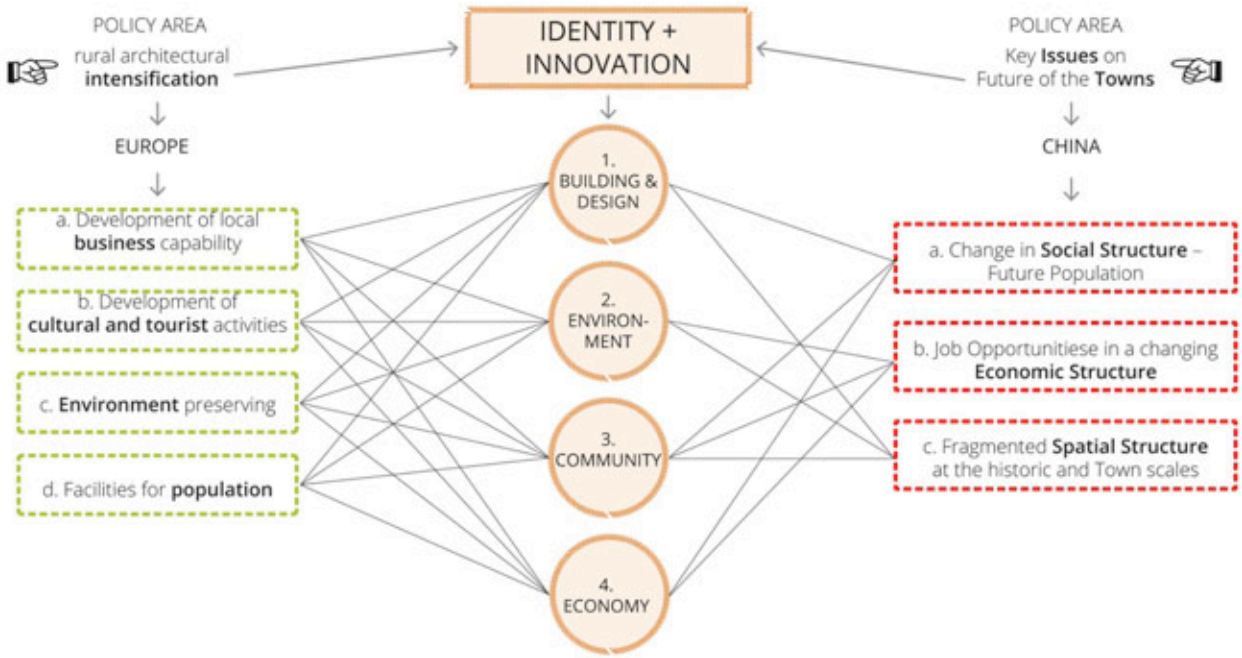


Fig. 3: Identity+Innovation: the overlapping and correspondences between EU and China’s policy areas which produces a set of common categories to extend a comparative assessment of the projects in both countries.

2.4 Definition of common parameters of design strategies and design action.
Within the methodology previously described, the four main areas of intervention have been subdivided into several design goals, describing the appropriate design strategies and design actions. Those new framework have been the main tools for a qualitative examination of several case studies and for the following comparative analysis.

1 Building & Design
a - use of traditional building techniques – combine technological innovation with building techniques that come from local tradition, employing workers that adopts and transmit the building skills (as a cultural heritage).
b - application of traditional building typologies – the configuration of the intervention is based on building typologies that come from local tradition, so to preserve the typological heritage and employ the building typology that best suits the social and environmental context.
c - use of local materials – use local building material to incentive local economic activities, bequeath tradition and limit the environmental footprint of the construction.
d - use of recycle materials – use building material recovered from collapses or demolitions, to reduce the ecological impact and educate to the recycling practice.
e - design aim of link with past – a design approach based on the research of links with past and pre-existing
f - design aim of sense of place – a design approach based on the research of links with the sense and the identity of the place.

2 Environment
a - use of local (and renewable) energy resources – beyond limiting the energy consumption during the construction and life phases of the building, use of locally produced and renewable energy resources.
b - enhancement of the local environment as heritage – protect and support the local natural environment as unique cultural heritage.
c - enhancement of local natural resources – promote the cultural, economic and productive quality of the local natural resources, as attractive and endorsing element of the context.
d - links to productive micro activities – the productive activities that are host or that have been promoted by the intervention are linked with the environmental context.
e - sustainable design approach – opt for an ecologically sustainable approach, and for the construction phase and during the building life (materials, techniques, typology, 0 km, etc).
f - prevent environmental risks - prevent the instability of the land (i.e. hydro-geological and earthquake risk).
g - limit to soil consumption and depletion - protect the quality of soil resources and reduce the consumption of soil.

3 Community
a - design of usable spaces for the community – create spaces that can be publicly used by the community.
b - design of focal points for the community – create places that can become central and significant spaces among the community.
c - creation of new services for the community – the intervention brings (directly or indirectly) opportunities for new services for the community.
d - enhancement of communitarian awareness – intervention that increase the quality of the communitarian awareness and the feeling of belonging.
e - support exchanges with the outside – boost inter-territorial cooperation, relations and exchanges.
f - improving public safety – increase the safety perception among the population.
g - facilitate initiatives to defend weak groups – improve of the quality of life of weak groups by creating spaces and developing services addressed to them.
h - facilitate initiatives to enhance youths – create environments where easily develop working, business and residential opportunities addressed to young people.

4 Economy
a - economic sustainability inside a plan – the economic and productive impact is evaluated as sustainable inside a wider economic plan.
b - flexibility of the building on the productive market – the intervention set up productive flexible spaces, that can accommodate activities able to reorganize themselves, once the market changes.
c - catalyst for productive activities – the intervention promote the creation or strengthening of working possibilities for the community.
d - immediate job creation – direct creation of new jobs employed in the activities hosted or promoted by the new intervention.
e - new tourist attraction – development of the tourist local appeal, due directly to the intervention.

f - enhancement of the historical heritage for tourist aims – the intervention enhance the local historical heritage with consequent tourist development of the context.
g - enhancement of the natural heritage for tourist aims – improvement of the quality of the natural patrimony with consequent increase of the tourist appeal.
h - return of appeal in the agriculture industry – support agriculture business with bio-economy, short chain, landscape cultivation preserving, diversification and innovation.
i - links to the local environment – the productive activities are linked with the context and the natural resources.
j - reuse of abandoned factories and empty office buildings – recovery of the existing building heritage, renewing it through functional and spatial interventions and linking it to the local economic system.

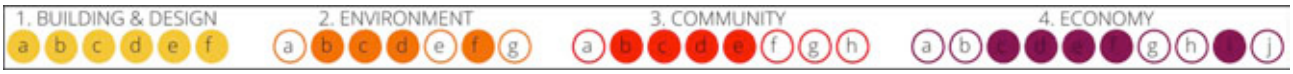
3. Selected case studies in China and EU

This section is analytical description of the 6 Case Studies, (the original Report is composed by 80 case studies of which 40 in EU Countries and 40 in P.R. China). The output is a collection of semantic matrix representing the four categories and design actions achieved by each projects.

Jananami Visitor Center, Yushu, Qinghai, P.R. China. TeamMinus Architects, 2013.
After the earthquake of 2010, Yushu, a very regarded Tibetans religious center, launched the reconstruction starting from the reparation of the Janamani temple and the construction of the Visitor Center: square building with a courtyard in the center, and 11 wood observation decks. The stone masonry is done by local masons, using the same kind of local rock from which Mani stones are carved. [11].



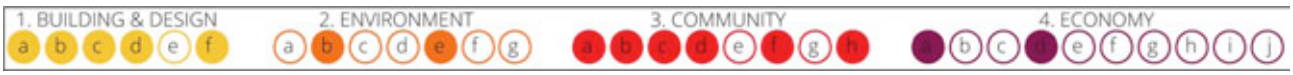
- services for visitors and local community;
- construction features of typical Tibetan layout;
- built with local materials and construction techniques;
- part of the materials come from recycled earthquake debris;



Mulan Primary School, Huaiji, Guangdong, P.R. China. Rural Urban Framework Design, 2012.
This project is an extension, not just of the existing old school and of its classrooms, but an extension also of the courtyards with the creation of new open spaces links. A new public space is formed by a sequence of steps that create before an outdoor classroom, then a roof, then a ground plane that defines the edge of the courtyard. The classrooms are surrounded by a porch that filters the lecture spaces from the square. [12].



- creation of services and public spaces for the community;
- traditional courtyard typology;
- recycled old tiles from local villages.

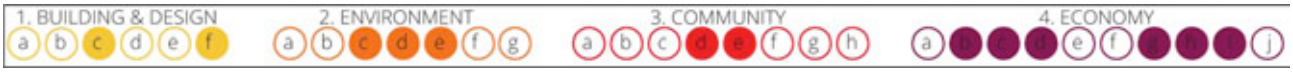


Wuyishan Bamboo Raft Factory, Xingcun, Fujian, P.R. China. TAO (Trace Architecture Office), 2013.
The Wuyishan Bamboo Raft Factory, surrounded by the county fields of the Wuyi Mountain, is a manufacturing of bamboo rafts used to sail the Nine Bend River in Wuyi Mountain. A central courtyard, set

on an artificial bedding, is formed by three main building – a storage warehouse, a manufacturing workshop and an office and dormitory building. [13].



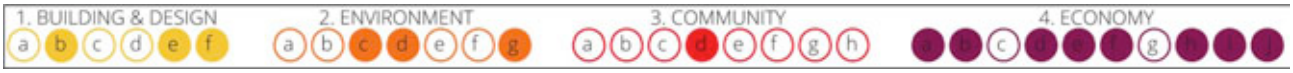
- integration of production activities with the local natural environment and resources;
- the layout answers to functional, topographical and climate features;
- construction with local materials;
- research of sense of place as essential issue of the design.



Farm holiday, Principessa Pio, Ferrara, Italy. Map Studio, 2014.
Aim of this intervention is to preserve the existing building structure and ensure its functionality through a systematic set of works which, in accordance with the typological elements, allows to combine the need of the conservation and careful recovery to the need of the transformation for a new special accommodation business. The site is settled inside the fortified wall of Mantova, but it's unique location allows an optimal use of outdoor spaces and adequate shelters for machinery for the maintenance of the fields. [14].



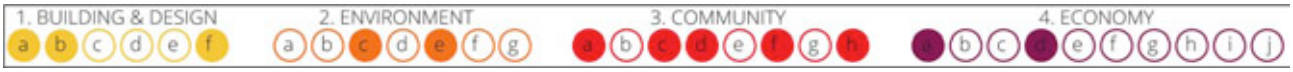
- restoration of existing;
- insertion in an historical context;
- flexibility for future activities.



Kirkmichael Primary School, Ayrshire, Aberdeenshire, UK. Holmes Miller Architect, 2014.
The design approach has promoted a locally contemporary design solution which is based upon an understanding of South Ayrshire's rural character and integration of landscape, building and settlements. The building form represents an interpretation of disaggregated farm-steadings which have been linked and clustered together in a nucleated form that defines and controls movement through and around the new school building. The design utilises steep symmetrically pitched roof shapes together with a simple long narrow plan form, typical of most rural locations, and flat, minimally articulated facades. [15].



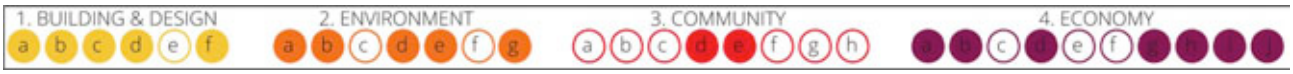
- looking for a contemporary reading of local features;
- proposal of local typology configuration;
- courtyard for scholar safety and control.



Torre de Palma Wine Hotel, Monforte, Portugal. João Mendes Ribeiro Architect, 2014.
The project for the installation of a Wine Hotel aimed to respond to the new functional program while respecting the architectural and morphological features of the built aggregate and its surrounding landscape. The intervention included the remodeling of the old farm buildings and the construction from scratch of a new set of buildings, based on precise gestures, respecting the lands' exceptional features. To unify the space, the main yard was paved with stabilized clay, bounded by a perimeter in white marble cobblestone. [16].



- new activities linked with the territorial fetures;
- restoriation and new construction;
- use of traditional typology and materials.



4. Results and discussion

This study is in its early stage and further depth analysis of both methodology and approach are under exploration by the authors. However, the first important result achieved is the objectives to put in contact two strongly identified territories that are on their own phase of urbanisation development. A unique procedure and an instrumental framework have been built. Using widespread technologies and software, authors built a matrix that aims is to create a common ground for advance comparison between EU projects and Chinese projects with the aim to discover innovations and alternative design hypothesis that may explain global significance of the on-going phenomena in the deprived suburbs.

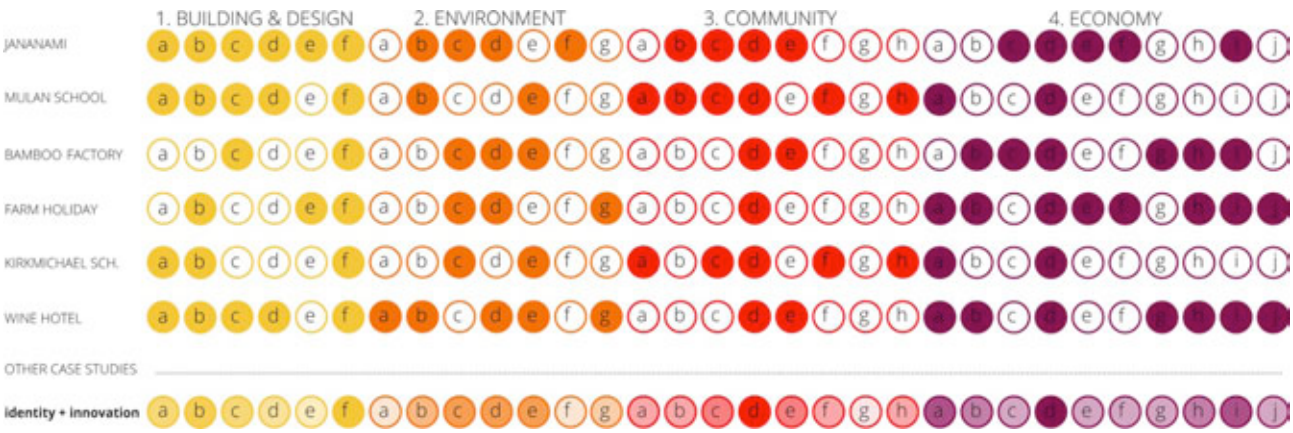


Fig. 4: Identity+Innovation matrix.

Figure 4 represents the Innovation+Identity Matrix obtained by the evaluation of each projects. The last below row is the summary assessment of the all projects evaluated. Dark coloured fields mean that many projects achieve the goal; a light coloured field means that fewer projects cope with the goal. Also, it is possible to create a sort of ranking of the case studies, which reach a certain numbers of goals, but for clarity these occurrences are not listed explicitly here. From the whole diagram we can assess several results. Mainly we are interested to point out a general trend of innovation and identity created by projects to enhance the liveability of marginalized suburbs in both China and EU. For example a design approach based on the research and links with the past and the pre-existing elements is needed and, at same time, the aim of the sense of place that means the research of links with identity of the place is mainly reached. For the environment category, the enhancement of local natural resources to promote the cultural, economic and productive quality is one of the prominent aspects of innovation but, in contrary, a lack of use of local energy resources and the prevention of environmental risks are claimed. Moreover, for the community construction the goal of enhancement of communitarian awareness through architectural interventions that increase the quality of the sense of community is the first target to be achieved. However, the sense of community has to

be improved through: a major accuracy on design spaces that can be publicly used by the community; improving public safety increasing the safety perception among the population; and, creating environments where easily develop working, business and residential opportunities addressed to young people. Finally, the economy category, considered both as a set of actions aimed at revitalising the productive activities and the employment opportunities, is a difficult component to be evaluated and to be predicted. However, the most important goal achieved is the creation of new jobs employed in activities hosted by the projects. On the other hand, it is important to underline that the average of goals achieved by each projects is quite low if compared with others categories. The main reason is that a sensible economical goal could be achieved only by the combination of strategic measures. Planning and architectural design can provide results in term of economical improvement by multi-sectorial development able to simultaneously be strategies for the protection of architectural heritage, the natural environment, the population and for tourism.
Next analyses are planned mainly for improve the comparative significance of the intervention between EU and China. Notably, the next steps of the research will be the complete computerization of the whole process improving and also completing the semantic analysis and further visualization through visual data mining. Another interesting issue will be the continuous upgrading and indexing of the case studies report: to reach this aim it is necessary to improve each project description and to use data mining techniques. Moreover, authors are now working on the general framework for transform the qualitative assessment into a quantitative result. For example the well known “Fuzzy logic” can be used to transform such qualitative evaluations. With Fuzzy Logic it is also possible to synthesized more complex evaluations derived from non-expert judgments.

Bibliographical References

[1] European Union, *Joint Declaration on The EU-China Partnership on Urbanisation Brussels*, 3 May 2012, http://eeas.europa.eu/delegations/china/eu_china/sustainable_urbanisation/sustainable_urbanisation.htm

[2] BINA O, BALULA L., RICCI A., The “eco” and “low-carbon” cities agenda and the spacescale-efficiency nexus: experience in the EU and China. URBACHINA Final International Conference, January 2015. HAL-UrbaChina Open Archive, https://hal.archives-ouvertes.fr/FP7/

[3] ELOSUA M., GIPOULOUX F, GOULARD S., LI S, NI P. *Urbanisation in China: The impact of the tax-sharing system and the definitions of new strategies*. UrbaChina working paper no.1 November 2013.

[4] Shanghai Planning and Land Resource Administration Bureau, Shanghai Urban Planning and Design Research Institute. *Shanghai in transition: Urban planning strategy*. Shanghai: Tongji University Press, 2012.

[5] European Commission, Forum, "CITIES - Cities of Tomorrow: Investing in Europe", February 2014, http://ec.europa.eu/regional_policy/index.cfm/en/conferences/urban2014/

[6] Li X., “Towards a “Critical Pragmatism”: Contemporary Architecture in China”, *Area*, 2014/137. Milano: Il Sole 24 Ore Business Media s.r.l.

[7] The European Council for the Village and Small Town (ECOVAST). *The Importance of Small Towns*. Cranbrook, Kent: Stationery Express UK Ltd, 2014. http://www.ecovast.org

[8] SHA Y., WU J., JI Y., TING CHAN S.L., QI LIM W. *Shanghai Urbanism at the Medium Scale*. Berlin, Heidelberg: Springer, 2014.

[9] CATTANEO T., SHA Y., JI Y., “Architectural Design Strategies for the Rural Development in Europe”, *Urban Architecture* (UA), 2015(1), 109-111. Harbin: Heilongjiang Science and Technology Press

[10] CATTANEO T., DE LOTTO R., *Rural-Urban-Architecture. Design strategies for small towns development*. Florence: Alinea Editrice, 2014.

[11] http://teamminus.com

[12] www.rufwork.org

[13] www.t-a-o.cn

[14] www.map-studio.it

[15] www.archdaily.com/566944/torre-de-palma-wine-hotel-joao-mendes-ribeiro

[16] http://holmesmiller.com

HERITAGE and TECHNOLOGY
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Not restoration but plannet and preventive conservation

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Abstract

Cultural heritage is exposed to a continuous risk of degradation that may be more or less worsened and accelerated by the environmental conditions in which the property is located. Both technological innovation (new investigation techniques and new materials) and process innovation (new methods of prevention and conservation) may help to reduce or delay the degradation or, at least, the costs of maintenance and restoration. However, the solutions adopted so far in our country seem to be characterized by a poor diffusion of technological and process innovation, according to the aforementioned definitions, and this is due mostly not to a particular lack of knowledge and research in the field, but rather to a limited implementation of conservative quality processes in which these technologies can be applied. The diffusion of technological and process innovation is particularly deficient in the area regarding the historical-architectural and archaeological heritage, which is exposed to a high risk of degradation by external agents. In this context, although the Code of Cultural Heritage and Landscape (Legislative Decree 42/2004, art. 29) has stated the need to spread the conservation planning approach, stressing that the conservative process must be based on "a coordinated, coherent and planned activity of study, prevention, maintenance and restoration ", there are still few interventions based on the use of innovative technologies.
Policies are mostly concentrated on large restorations, often dictated by conditions of urgency or communication, and neglect instead investments in continuing care in time of the cultural heritage and in the diffusion of a good practice among the institutions and the owners of the assets. Nevertheless, it should be noted that, at the national level, there are currently some protocols for the diagnosis and monitoring. Furthermore, in restricted areas, some Guidelines for the programmed Conservation have been defined and computer applications have been implemented for the conservation plans of monuments. That being so, the widespread adoption of innovative methods in the context of the planned conservation practice can become a tool for the development of the sector, generating cognitive, conservative and economic benefits for the cultural heritage.
The contribution that we would like to present in this forum regards two cases of study, for which specific methods, experiments and actions have been developed and tested to conduct the policy of heritage conservation, by virtue of the adoption of technological and process innovation, essential elements for the sustainable management of the cultural heritage of our country.
The projects were organized in three stages: Mind, the study of a methodological approach, scientifically verifiable at different levels. Knowledge, understood as appropriation of information across multiple subjects activities made available by various sectors of diagnostics (understood as surveys and investigations to verify the preservation conditions of the heritage and the causes of degradation, and to identify preventive interventions designed to limit risk situations) and as monitoring of the historical research and of the direct investigation (understood as activities of regular and systematic control of the condition of the asset in its context).
Experience, tested on two heterogeneous case of studies which have completed a first fundamental step to ensure their care.

Keywords: Preventive and planned conservation, maintenance building, conservation officer

Principles

After a ten-year debate about the theme of planned preservation, this is the time for assessment. In this context there have been numerous occasions when various actors have shown their interest in historical heritage, funds have been invested and new ideas have emerged in order to develop tools and methods of execution to assess and validate the operations for the preservation of artifacts. Thanks to this new discipline, new work activities have been promoted, while old procedures, which had been abandoned as obsolete, have been rediscovered and long debates about the methods and the practice of the new approach have ensued.

Before describing the results of two highly dissimilar experiences, both of which have the possibility of receiving non-repayable money to be spent on the promotion of planned preservation activities, it would be useful to go over the stages that have led to the definition of this discipline.

When talking about restoration in relation to planned preservation, the first aspect that needs immediate consideration is the ambiguity behind the description of the maintenance activities relating to the architectural heritage. Maintenance is often superficially regarded as the occasion for small, minor restorations. Maintenance was meant to be a care prevention activity but it simultaneously introduced interventions which were not properly executed with respect to preservation. This fact seems all the more serious if we consider the fact that existing buildings care works have used the preservation excuse, seemingly innocently, to avoid bureaucratically long planning procedures.

The lack of planning, even of minor interventions, results in a casual series of actions, which do not correspond to the activation of a "preservation process". This process is characterized by the necessity to include a sequence of distinct consecutive stages (scheduling, planning, execution and management) instead of limiting actions to existing buildings to a restricted time period.

In accordance with what has been affirmed above, without a vision defined as "process-related" it is not possible to ensure that planned and reliable preservation will be achieved.

The cultural trend that needs to be promoted is a life cycle oriented approach, which relies on constant care to suggest positive, ongoing, sustainable practices. The sustainability of this method lies in the smaller impact of single interventions on factories, in less economic commitments in the long run, and in the constant checking of the "health state" of artifacts.

The second principle of "planned preventive Conservation" depends on the awareness that any and all interventions on existing buildings are possible thanks to the multidisciplinary contributions of operators who have realized that it is not possible to go on working independently. Today, more than ever before, every choice relating to historical factories requires assessments that are not limited to architectural conservation only. Today, knowledge is implemented by the support of disciplines such as archiving, history, archeology, use of modern scientific methods (chemical, physical and mechanical investigations), modelling, and monitoring.

The evolution of architectural conservation objectives has gradually turned the restoration site from a place of traditional (knowledge based) learning, into an occasion for innovation. Today, with modern techniques and new tools now available, it is possible to revise material culture, to learn historical building techniques and to discover the materials features and devices that have ensured the durability and sustainability of the factories of the past.

The third key aspect to develop this knowledge is found in the definition of maintenance, that is, the "set of necessary operations to preserve the proper efficiency and functionality of something".

This definition may lead to dangerous and hasty conclusions.

In fact, historical factories are not usually in operation and they rarely reach the level of efficiency. In fact, with the parameters (conventionally used) that are suitable for new buildings, efficiency is rarely achieved and, at any rate, only after restoration. At this point, it seems difficult to carry out maintenance work on a historical artifact because, in most cases, it is not ready for further use.

Here, the definition of maintenance must shift to the definition of planned conservation. Contrary to maintenance, the latter does not imply efficiency, but rather, consists of constant care interventions. The interventions are useful to slow down and keep the process of slow deterioration under control and help avoid any serious degradation of artifacts.

The difference between conservation and maintenance becomes less clear as every maintenance action "acquires the relevance and the awareness that are typical of the conservation project".

However, this process may involve disciplines which, thanks to their pragmatic approach, are not greatly related to the world of restoration. These include management economics, which is particularly useful to gain involvement of local people that take up the proactive roles of promoting activities of development and enhancement.

From this perspective, it is important to recall the key words given as guidelines for the preservation process of existing buildings. They are the conceptual links that support the idea that conservation is not bound to theoretical or abstract logics, but to practical systems that imply constant and regular activity. As far as organization is concerned, constantly proposed virtuous strategies, planning abilities, the high quality of execution and assessment competence can maximize conservation. Meanwhile access, enhancement and

positive economic results allow for money and reinvestment of resources.
The procedural framework is reflected in current regulations, which are intended to preserve material authenticity, to check the deterioration evolution and to adopt interventions that are valid and effective for the existing buildings. In this way, management possibilities may find positive synergies with historic architecture and may guarantee redevelopment.
Last, but not least, is the ability to learn as a natural consequence from constant visits to the property.
According to the role of the different actors involved, there are different levels.
The managers of the property (owners or directors) must become aware that their role is decisive. It mainly consists in “living” the factory, reporting possible faults and identifying experienced consultants and operators.
The management of activity needs to be run according to a shared plan. Therefore, it is important for technicians and operators to use the same language and to share their experiences, which will be at the disposal of visitors to factories.
The projects concerning the Chiesa della Disciplina in Verolanuova and three castles in Valtenesi have been developed following the three suggested steps, namely Mind, Knowledge, Experience.
Mind is the study of a specific methodology that is scientifically verifiable at different levels. Knowledge is the appropriation of information through the wide range of multi-disciplinary activities made available by the various sectors of diagnostics (surveys and inspections to check the conservation conditions of properties and the causes for deterioration and to identify preventive actions in order to limit risk situations), of monitoring (regular and systematic controls of the property conditions in its context), of historical research and of direct survey.
"Experience" tested on two heterogeneous study cases that have completed the first key step to ensure their proper care.

The castles of the Valtenesi

Defensive structures of Valtenesi can be found along the shores of the western part of Garda Lake, and they are close to any town in the surroundings. These castles were built on top of moraine hills; over time, many small villages rose. In some cases, their walls have been demolished, which led to a partial loss of artifacts.
“Recetto Castles”, so called because inside their walls people settled their houses, never had a military purpose. In case of attack, people just used to shelter in there, but no other defensive action was undertaken. This quite marginal aim is the reason why these castles never caught Venetian governors’ attention: just in a small percentage of travel reports of the time can accounts of these ancient buildings be found. The lack of interest provoked that only few documents were written about the topic, the majority of them consisting of singles sentences.
Different ways were to be found in order to study the subject. Specifically, attention was paid to direct analysis of buildings that presented analogies in their constructive phases, shapes, techniques, materials, status of conservation, ownership. In particular, uniqueness of ownership was a fundamental aspect in the project: in fact, walls and towers belong to towns, and towns are the only authority to speak to and interact with.
At the beginning of 2000, local administrations undertook some very expensive restoration works of the castles, and after some 7/8 years, those projects provoked critical damages, because the artifacts were weather-beaten, but not well protected. Unluckily, the economical situation made impossible another expensive intervention, so it was decided to organize a more precise and accurate project. In this case, the main goal was to safeguard an optimal level of preservation of the castles, by adopting innovative technological systems and good maintenance works. In this way, technological devices were supposed to keep their own functionality. The second goal was to optimize and standardize interventions on similar and close buildings, promoting in this way an economy of scale. Lastly, the third goal was to create professionals who, as public employees, guaranteed over time their presence and potential intervention.
During the years spent observing pathologies spotted on the buildings (the inspection began in 2006, even before planning a specific project of conservation), their own evolution could be evaluated, previous inappropriate interventions (such as stucco and tinge works) were registered and reported. Then, as stated in the publication by Regione Lombardia (Lombardy Region) “La conservazione programmata del patrimonio storico architettonico. Linee guida per il piano di manutenzione ed il consuntivo scientifico” (The programmed conservation of historical architectural heritage. Guidelines for maintenance plan and scientific evaluation.), technological devices were named; this operation highlighted how inappropriate the proposed method of cataloguing was, because it couldn’t be adopted for single buildings such as city walls and towers. Analyzing the strategy of action prearranged and the one actually adopted, a delay of some operations, such as organizing the construction site, or undertaking other activities previously set as side-works. Especially, a good decision was to postpone some physiochemical analyses in occasion of the availability of structures for sample taking, as positive was also modifying the kind of these structures in order to optimize the catalogue of gathered information.

Similar changes were made in the study of humidity and dynamic action on towers. It was proved that food results about the same goals could be obtained with some equipment already in the building site, and in this way a good deal of money was saved. After the results of the investigation, and after reporting them to authorities, maintenance works proved positive the strategy adopted and announced during the education course held for administration staff and external technicians. Plus, the relatively low cost of scaffolding was another determining factor that stimulated the preservative project, even after obtaining a free grant. Indeed, from a previous research, a main issue was reported to be the excessive cost of scaffolding. On average, the burden of scaffolding reached a bearing of 1/3 or ½ of sum total.
Beside these economical considerations, there are also reasons of conservation that lead to consider the scaffolding to have a negative impact. When there are possibilities to set a scaffolding, it needs to hook to the real estate, thus provoking holes on surfaces, even precious ones, and no attention enough is paid to this qualitative aspect by workers: they just proceed in a hasty way. Plus, care for surfaces is left behind also because the choice of grip connectors is made according to specific considerations, and there are no wide possibilities of choice.
Using some lift platforms proved pointless too. In the territory around each castle it is not always possible to come close to their walls with this special kind of instruments, because of the very morphological shape of the ground. Either the platforms have their sides on the slopes, or there is a moat between the walls and the zone accessible to vehicles. The entry arcs of strongholds and of ravelins are an obstacle too to entering the site with lift machines, because usually these structures are very short and narrow. Even trees and woods grown around the walls can be an impediment. Final basket rotations and their limited extent make very difficult to get closer to the walls covered in branches. Moreover, even though rental charges are relatively low, also the “dead” time need to be taken into the account when evaluating rental days: it is the time required to climb up and down the machines.

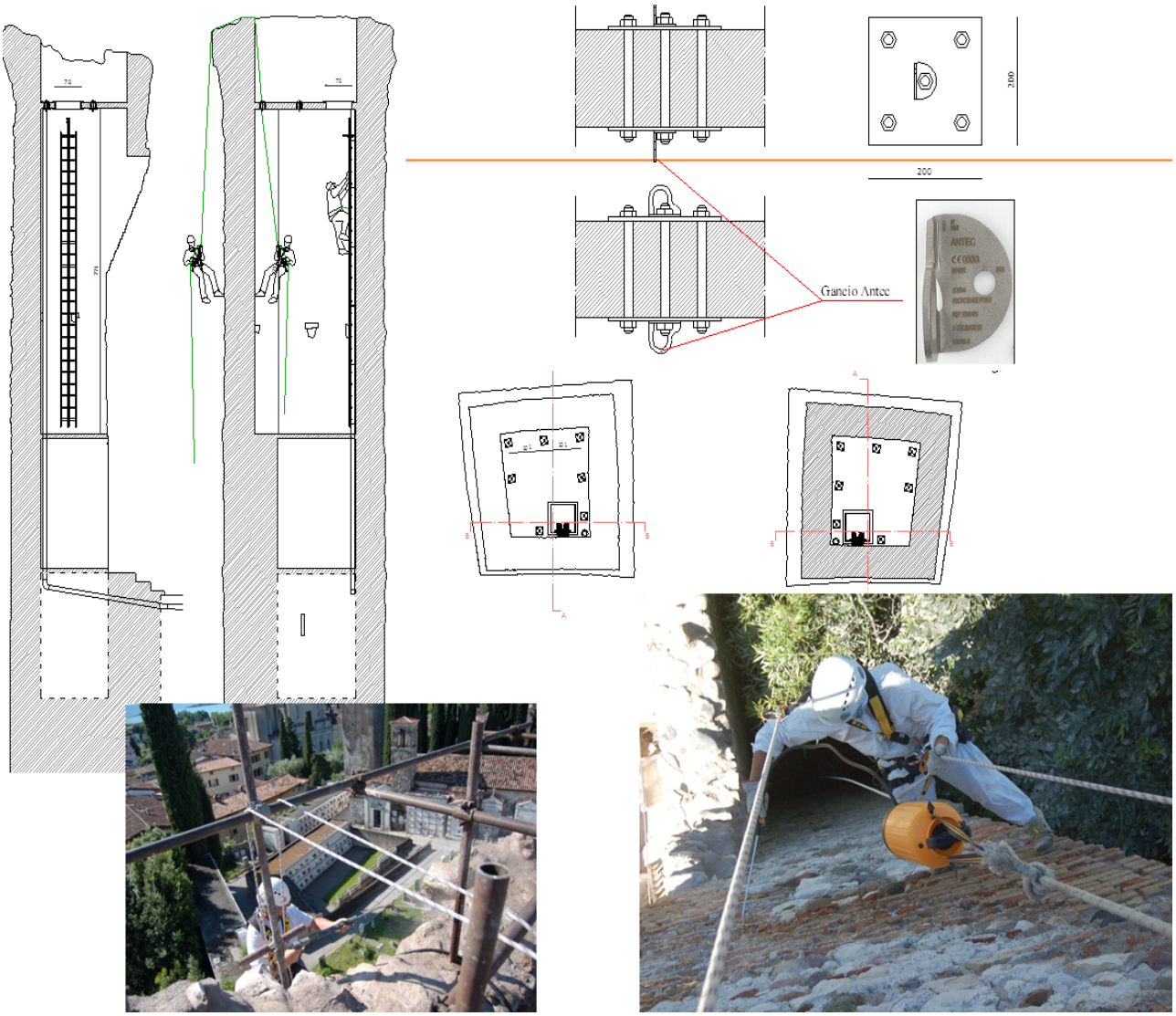

Fig. 1: Castle of San Felice del Benaco

In other cases, finally, also the architecture itself of the building can be an obstacle to observation trough these platforms, as it happens for the towers: in order to be viewed from any perspective, it is necessary to figure out at least two accessible areas where to place the lift machine to go full circle around the towers.

Of course, these castles were built in order to defend and protect those within their walls, so it is quite natural that some obstacle comes up even nowadays, when it comes to “attacking” them.
What follows from these observations is that an intervention on an historical building can be undertaken just as long as the sum total of operations of restoration is determined in a limited percentage by the fixed cost of rental charges.
If the cost of operation on an artifact is moderate, not only can the project be set, but no discussion about the topic is even required. The added value to the restoration of the castles lays in carrying out the works just without any scaffolding: hooks were secured within the walls, so that the workers, licensed OG2 and for activities on rope, could fasten and climb down the ramparts and easily reach any surface to treat. Of course, the places where to set the hooks were studied on purpose, in order not only to be of help for workers, but also to facilitate some structural requirements. For example, when it came to set an anti-seismic metallic protection all around the wooden attics or on topping of towers, some eye-bolds (golfari) were used with a double purpose: securing the insert and sustaining the workers.
The idea not to use scaffolding on the towers highlighted a major problem. During the public tender it was noticed that double-licensed companies are very rare. Workers with a license for rope-working are not capable of dealing smoothly with cultural goods, because they’re just used to activities on rocky surfaces. Promoting this kind of activity among restorers might prove a good lever for a growing occupation.



Fig. 2: Castle of Manerba del Garda

The particular project adopted for Valtenesi castles proved very positive, especially because of the spreading awareness about the tools and strategies used. In these kind of operation it is not possible to envisage a spot operation, which is by definition occasional and random. It is impossible to foresee how and where the vegetation will grow, because it is determined by the weather.
The highness of the castles and their unbreachability inspired an “assault” through ropes, displaying an economy that is likely to guarantee a long-lasting care of the buildings, if well administered. The construction

site for the “programmed maintenance” assumes the shapes of a “day-hospital”, and it carries out focused intervention, done with specific timing and moderate costs.
With the data gathered, a “medical record” was filled out, in order to allow a comparison between planning and operational experiences.
Wish is that these data can be of renewed interest and help in following operations.



Fig. 3: Castle of San Felice del Benaco

The church of the Disciplina di Santa Croce in Verolanuova

The church of the Disciplina in Verolanuova is a complex and articulated monument that differs in many historical, archaeological and social aspects that have stimulated interest and solicited knowledge. The present church of the Disciplina di Santa Croce was the parish of San Lorenzo in Verolanuova, before the new basilica was built in 1633 in an adjacent area. After being given the title of parish the church was assigned to the Disciplini who promoted a campaign of structural changes that met the needs of the congregation. Since that time, various events have produced constructive and decorative changes, up to the current architectural conformation. In the last century, there has been less focus on the antique church, so much so that the original vivacity is replaced by a period of inactivity that culminates with the collapse of a portion of an external wall that supports the embankment adjacent to the church in 1930. This shows the precarious state in which some parts of the building were found. There was a long period until relatively recently (80’s and 90’s of the‘900) when necessary restorations were made to guarantee the stability of the church. The works required a considerable investment but unfortunately it did not start the virtuous circuit necessary for the conservation of the temple and it was closed to the public again. Interest for cultural patrimony reflects the values in which the local society sees itself.
The forced closure of the church of the Disciplina, used as a storage place, as well as representing a general inattention provided occasions for wrong doers to damage and loot items of furnishings and works of art. Time, on the other hand, had proceeded to deteriorate the architecture that had completely lacked maintenance for years.
Only in more recent years (2007) following some site inspections, a series of virtuous interventions were undertaken to clean the inside, to catalogue goods that were still conserved and to periodically open the church, thanks to the availability of volunteers. As a result of a fortunate situation, the Cariplo Foundation promoted a competition, within the cultural sector with the purpose of “spreading innovative technology for the programed conservation of historical architectural patrimony”. The objective of using the cultural heritage as a driving force for the economic and social development of the territory, provided the occasion to start a profitable campaign to promote knowledge about the historical building for its architectural restoration and functional recovery.

A cultural responsibility for maintenance, individuation and transfer of good practice for programed conservation, diffusion of new methodologies and diagnostic technology represent only a few of the key elements of the presented project that while aimed at the church of Disciplina, can be extended, from a methodological and organisational point of view, to many other artistic heritage around the territory.
Knowledge, prevention, inspection, organization of interventions, dealt with through the collaboration and synergy of various professionals, have substituted the idea of restoration as a way of bringing back the original aspect (renovation) and without further changes, to promote the concept of conservation seen as an evolution open to the relationship between man and built heritage. The result of these principles, a testimony of the proposal and project outcome, is the richness of the contributions that offered, overall, a complete evaluation of the church of the Disciplini, the transformation process that had an effect on it, and the degradation phenomena that regard it.
The first part of the program concentrated on the historical background where it originated and the transformation of the temple. In this case, the archival documents that were examined in the “Notarile Brescia” fund were vast and ample. They were found at the State Archive during the “Pastoral visits” and conserved at the episcopal archive, in the hospital archive in Verolanuova and in the parish archive. The research shows how the visiting sub-delegate of Borromeo, considered the church as the private chapel of the Gambara palace, which was an important artistic commission in the Verolanuova territory and in general in the province of Brescia.
The cognitive methological approach then led to planning the interventions directly after examining its architectural, material and structural characteristics. The architectural research done during the tests to verify the state of conservation of the foundation exploited seven test excavations to provide useful answers correlated to the archealogical literature. This helped to understand the long history of this church that underwent continuous and irreversible transformations that were often barely visible but evidenced by the stratigraphic research on the coatings and the pictorial finishes. The occasion permitted to highlight the still present evidence regarding the decorations of the renaissance period that showed various conditions of conservation that were them in good condition in some areas, while in others, the paintings, if not torn showed very bad conservation conditions.



Fig. 4: Church of the Disciplina Santa Croce: prospectus

The direct reading of the building finished with the study of the vault in “cameracanna” that was built for the arrival of the Disciplini in the church. This constructional method was very diffused in churches and buildings

not only in the geographic area considered but also in other regions. It was an answer to the need or want to hide the existing coverage to radically change its aspect or the function it had in its setting also as a result of a change in style. The vaults made in “cantinelle” were lighter and faster to build with respect to those in masonry and more economical using construction technics that were still poorly understood. This revealed a series of critical situations regarding conservation that derived from the materials as well as from the solutions that were developed.
The last part of the program, finally, addressed a series of investigations that focused on a more accurate assessment of the problems of the building. The wide range of research done on the inside of the church prompts reflection: The acquisition of preliminary knowledge for conservation interventions, shared at most levels, in order to be effective, must be guided and governed inside a global frame that collects and organizes information from research that traces mutual connections and generates new relationships.
The valid choice of an analysis program and not less importantly, the correct management, interpretation, and use of results, constitute a guarantee and a quality base for the conservation project. In this respect, the first part of the test used the cognitive possibilities given by the thermography. The environmental situation on the inside of the church was verified including the reaction on the surface of the paintings that were subjected to various solicitations, in particular to fluorensce UV and to infrared riflettology. Small samples of material were used to recover samples of mortar for physical-chemical analysis. The characterization campaign was mainly addressed to the enticement mortar of the perimetral walls in order to have information to relate to the historic data in possession.



Fig. 5: Church of the Disciplina Santa Croce: photomontage of the painting hidden by a curtain

A different topic regarded the studies aimed at an in -depth analysis of the geomorphologic situation in the area and of the structure with the objective of offering a complete image of the subsoil and to obtain numerical and physical data to use in a consolidation project for anti-seismic purposes. An accurate analysis done by coring in depth was integrated with the collected data from the georadar directed in specific areas where construction elements that were not visible could be present. The process ended with the mechanical characterization and the prevision of the seismic behavior of the walls.

Conclusion

The two cases under analysis clearly show that the two operating paths pursued greatly differ each other. None of them exhibits higher quality with respect to the other, having the architectures traced the most suitable path depending on building features, typology and materials and having the usage triggered substantial transformation processes in some cases.
The different paths share the same objective, that is to identify the most suitable restoration work for the factory and to create a “medical record” or “identity card” transmissible to the personnel in charge of the property. In the first case the preliminary investigation process was more limited. The majority of the information have become visible only at the beginning of project. At the same stage some preliminary assumptions have been ascertained. It has been perceived that the standard cataloguing procedure applied to technological elements of the factory was both redundant and unable to clarify specific issues. Of primary importance has revealed the management of the building site, being conscious that within the military architecture an enclosure wall or a tower have played an important a role.
The second case depicts a more traditional investigation process suitable for a wider typology of buildings. Professionals with different background have kept in touch with the aim of sharing opinions about problems and expectations.
The valuable expertise in hand has demonstrated that the conservation intervention plan is prone to the understanding of the available expertise itself and, like a doctor, leads the therapy of the patient.

Bibliographical References

DELLA TORRE Stefano, *Quadro generale di riferimento per l’analisi dei bisogni del comparto dei Beni culturali* Skill, Rivista semestrale di ANAIP Lombardia n 35 pp31-38

English Heritage, *Conservation Principles. Policecies and Guidance for susteinable management of the historic environment*, English Heritage, 2008.

AA.VV., *Le mura di Lucca dal restauro alla manutenzione programmata*, 2005, Città di Castello, Alinea Editrice.

AA.VV., *La conservazione programmata del patrimonio storico architettonico. Linee guida per il piano di manutenzione e consuntivo scientifico*, Guerini e associati, Milano, 2003.

AA.VV., *Imparare dagli errori. Un archivio aperto di casi di guasto a supporto di progetto e gestione di sistemi tecnologici edilizi*, Regione Lombardia, 2004.

BESANA Daniela, *Progettare il Costruito tra Conoscenza e Interpretazione*, Alinea Editrice, Città di Castello, 2008.

CECCHI Roberto, GASPAROLI Paolo, *Prevenzione e manutenzione per i beni culturali edificati*, 2010 Città di Castello (PG), Alinea Editrice

CECCHI Roberto, GASPAROLI Paolo, Preventive and Planned Maintenance of Protected Buildings. Methodological tools for the Development of Inspection Activities and Maintenance Plans, 2012, Firenze, Alinea International.

SCALA Barbara, *La documentazione del cantiere di Restauro: il caso del castello di Polpenazze del Garda*, Tesi di Specializzazione in restauro dei Monumenti, Politecnico di Milano, Rel. Prof. G. P. Treccani, Prof. L. Jurina, 2009

CANEVA Giulia, La colonizzazione biologica della cinta muraria di Lucca: linee guida di un progetto di studio di biodeterioramento e di biomonitoraggio, in GIUSTI Maria Adriana, *Le mura di Lucca, dal restauro alla manutenzione programmata*, 2005 Firenze Alinea Editrice.

CANEVA Giulia, Sistematica delle comunità vegetali nella pianificazione degli interventi di restauro, in *Atti del Convegno Scienza e Beni Culturali, il cantiere della conoscenza il cantiere del restauro*, 1989 Bressanone, Libr. Progetto Ed. Padova.

VENTURELLA Piergiorgio, PRZYBYLKA Daniel. *Lavori in quota, manuale tecnico e installazione dei dispositivi di ancoraggio dei sistemi anticaduta*, 2007 Roma EPC Libri.

CANZIANI Andrea *La conservazione programmata è la capacità di vedere i beni culturali nel tempo e governare le loro trasformazioni*, 2009, Milano Electa.

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Construction Site Information Modelling and Operational Planning

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Abstract
In restoration projects, construction site design is of great importance because it helps in driving designers' choices depending on some criticalities often present in historical contexts such as surrounding situation, production techniques and workers' health and safety issues. The ongoing research has the aim to integrate the construction site designer activity in a BIM design team since the early design phase of restoration projects. The objective is to find, all together, better solutions for project feasibility complying quality, time, costs and, above all, workers' safety. Nevertheless BIM potentiality clashes with its not yet completed development from both restoration and construction site points of view. In particular, for site design it has been found the need of a semi-standardized database of elements representing restoration works and working places complete of technical and operational information. Thanks to this database, consisting in a series of BIM to be inserted into the unique design model, lots of site situations can be prefigured and studied with an optimization of the whole project since the preliminary design. Its application on the case study of restoration of Basilica di Collemaggio (L'Aquila) allowed the implementation of such a database, developed in the early research stage, assuming some design feedback on field. Furthermore, the experience of BIM site design since the early phase of design pointed out its usefulness in studying/optimizing work sequences and calculating temporary working places cost.

Keywords: CoSIM, HBIM, Operational Analysis, Restoration construction site

1. Introduction
Operational planning for interventions on historical buildings is always arduous due to the particular context and to frequently scarce information at disposal about the building and the past works on it. Therefore, Building Information Modelling makes available a graphical container of information, if properly managed. At present, we can define two different types of Building Information Models related to historical buildings. The first one concern the digital representation of the entire building and its history, to be used as information container for the management of the building itself. It may be hopefully, in the future, the only kind of model to be used for each type of intervention. The second type of BIM for existing buildings is a then a sort of "temporary model" specifically created for a single intervention. The definition of this second type is due to the actual stage of BIM implementation in Italy, in which historical heritage is not yet rendered in digital form. The process of computerize historical building occurs then when an intervention needs to be designed. For this reason, the "temporary planning model" has to be converted into a permanent model that contain the history of the building. For this reason modeling techniques in cultural heritage are to be studied in deep in order to have at disposal a useful model for each phase of the building lifecycle. These modeling techniques shall take into account both the modeling of the existing building, subject to intervention, and the modeling of construction issues related to intervention itself.In order to simplify the process a three steps working method has been studied:

a) Building Survey
b) Restoration Design
c) Operational Planning

The method concerns in particular with modelling techniques of restoration works and information sharing between designers. The database filling, made by ready BIM elements representing restoration activities, aims to get a faster design process and to assure a complete availability of information about the existing building and intervention to carry on it.
Testing on case studies, such as the presented Basilica di Collemaggio restoration, permit to refine modelling techniques and develop the database with new works.

2. Literary review

The wide diffusion of BIM during the last years permits to extend the research in this area to different aspect of AEC Industry. The most studied aspects are certainly concerned with design and management of new-construction buildings rather than existing ones. Volk et al. [1], for example, observed in a wide literary review a "scarce BIM implementation in existing buildings" both from industry and from research points of view. Difficulties in conversion of existing matters into BIM objects and in reaching certain data of already realized buildings could be a reason of the not wide development of BIM in this area. In addition, many studies and researches applied in existing building have been taken into account maintenance and facility management of recent structures rather than architectural heritage. Although this difficulties, in the last years research observed some developments concerning HBIM (Historic Building Information Modelling) or, in some cases, about BHIM (Building Heritage Information Modelling). In particular, a great impulse to the diffusion of HBIM has been the improvement of 3D survey techniques such as laser scanning. In this sense, Murphy et al. [2] aim to create a "prototype library of parametric objects" starting from the collection of survey data in order to produce complete architectural 3D models not only characterized by surfaces but also by parametric information (e.g. construction methods). Conversion of such particular objects concerning historical buildings (e.g. classical orders columns) into parametric objects has been a great challenge to face, due to distinctiveness of many elements [3]. Another challenge is to represent actual conservation conditions of an object in order to manage possible maintenance/restoration intervention. Oreni et al. [4] follow this way, studying HBIM for several aspects, starting from model render of 3D survey to make it interoperable for conservation and restoration management. The aim of operational planning has to be achieved by adapting modeling methods of historical elements to construction site design and management needs. The purpose is to use the model for operational planning improvement with the chance to have at disposal a series of useful parameters about building and works/interventions to be performed. In literature, operational planning and BIM approach is often limited to 4D schedule of intervention, particularly focused on new construction. [8, 9, 10]
The need of data extraction from the model is, for example, highlighted by Kim et al [11] and focused on generation of schedule from quantity data of the BIM. The presented research concerns, in addition, with the restoration project on existing building and with the particularity of restoration works. Furthermore ergo-technique approach considers all site needs such as time, costs and, above all, workers' safety.

3. Ergo-technique modelling for existing building

At the moment, as highlighted in the introduction, BIM modeling process of an historic building arises from the exigency to design restoration interventions. In this context, in any case, the Ergo-technique modeling process begins by the building geometric survey and its development into an HBIM. Starting from a complete HBIM, the design activity of working phases is obviously easier since the availability of geometric and technical information. In order to design and manage construction site activities, HBIM needs to be developed in a model able to become a Construction Site Information Model (CoSIM) [5]. A CoSIM is composed, in fact, by (i) the development of a BIM (or HBIM in this case) with operational information related to building elements and (ii) the site technological-productive elements (e.g. cranes, scaffolds, fences, etc.) characterized by their own information. Such a developed CoSIM, as showed in the case study, is able to easily manage information for carrying on construction site design and operational planning in a BIM design team, with the possibility of better coordination, faster information reaching and lower possibility of errors. In order to guarantee these advantages is necessary to assure the availability in the model of useful information related to working phases and their adding and/or developing simplicity.
Flowchart in Figure 1 summarizes the proposed methodology in order to approach a BIM restoration project with the aim of operational planning. The process leads designers to a precise information exchange and management.
As said before the first steps concern geometrical information acquisition by survey and their rendering into parametric elements (HBIM). Having compared the HBIM level of discretization with the building decay maps, if they are suitable, is then possible to merge that maps in the model.
As an example, if only a part of a roof slab is decayed and the model is set so that the roof slab is a single element, the roof slab has to be modeled in two different portions: one for the part in good condition and one for the decayed part.

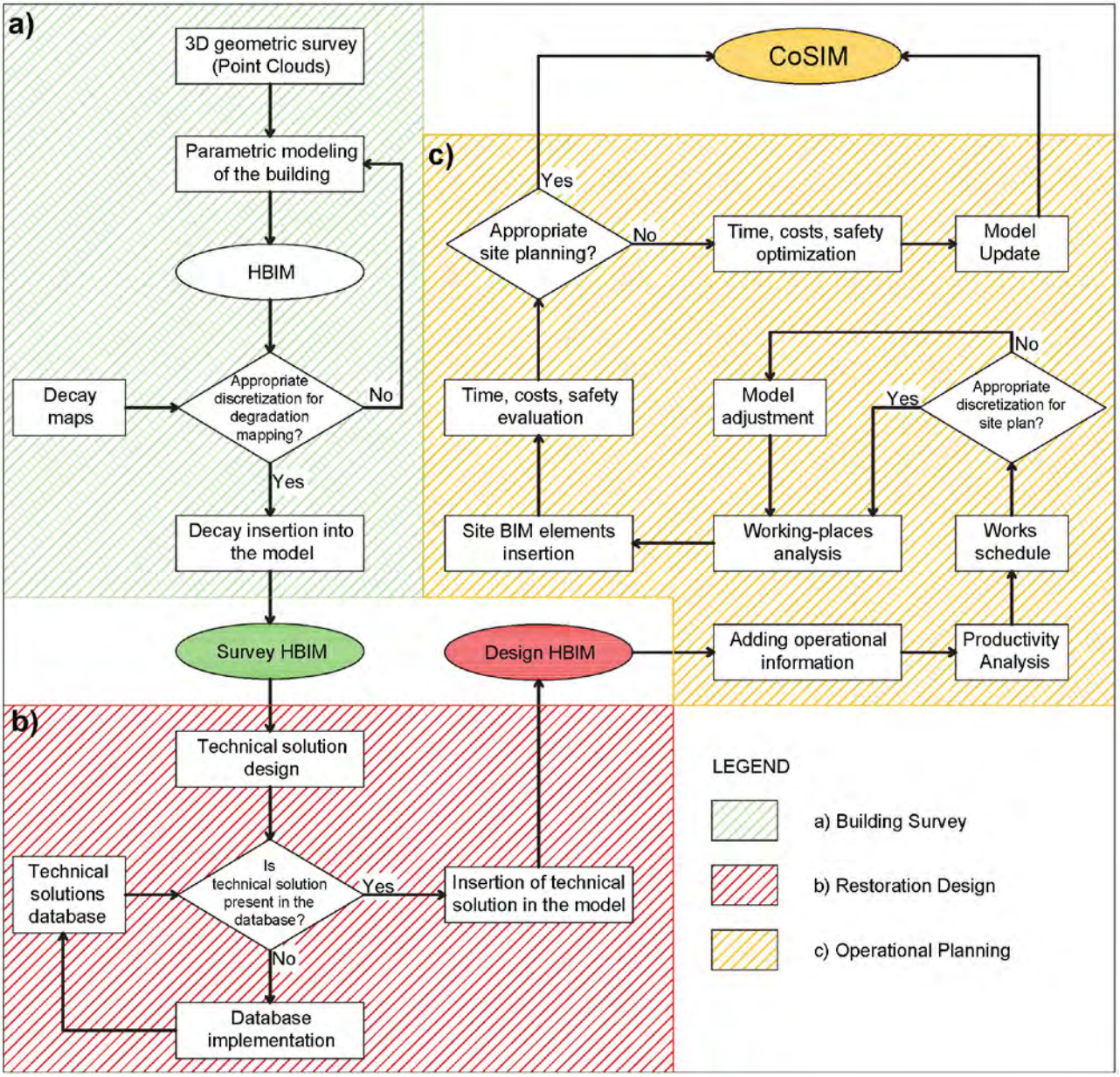

Fig. 01: Working method for realize operational planning on existing building project by the use of BIM

The second step concerns the design of the technical solutions to be applied on the elements to be restored. This issue highlights a different design approach dealing with new construction or restoration projects. In the first one the technical solution is simply identified by a unique technical element to be implemented (*i.e.* an element added in the BIM model). Instead, in a restoration project, the design approach becomes much closer to that of the site designer whose task is to design the intervention works. In fact, in case of restoration, the scope is to design intervention on existing elements in order to eliminate or mitigate degradation conditions. Thus, the design job of a BIM user will be to characterize the technical elements of the HBIM by adding them descriptive specification and computable information made of virtual surfaces or volumes representing the designed restoration activity. Since the great variability of restoration intervention types, the construction of a BIM database of restoration solutions has been started, so that designers could have at their disposal some premade virtual elements that can be easily inserted into the designed HBIM. The database building process started from modelling some technical solutions taken from a price list and adding any technical known missing information, using the proposed evaluation measure units (*e.g.* m, m^2, m^3, etc). The technical solution database has been tested and implemented on the go in some real design processes assumed as laboratory case histories. Such a model, completed with descriptive specifications, is then ready to be developed and analyzed in a CoSIM. First it is necessary to complete the specifications previously associated to the BIM elements with operational information [7] related to construction product on site lifecycle. (*i.e.* Procurement, Stockpiling, Handling, Provision and Laying).

Then it is necessary to add to the BIM elements all that resources information related to productivity. These parameters have to be focused on operational planning exigencies such as safety, time and cost control with the aim to drive site designer to their satisfaction since the design stage.
Once such operational and productivity information has been added, the site designer has at his disposal, for each object of the model, a data sheet which allows the works scheduling. In order to obtain a proper work plan for 4D modelling, the site designer has then to verify that the discretization of the CoSIM is suitable in order to take into account the exigencies to avoid interferences against safety and site general productivity. Otherwise, he will have to adapt the model, operating on single objects quantity. (*i.e.* the exigency to split the unique designed "reticolatus" surface in many different objects, as explained below).
The above mentioned situation is almost always present, as observed in the cases of study, as the survey model does not use "intervention phases" as driver and obviously could not do it. That's why, at the beginning, the model cannot consider some operational constraints that may involve the need to divide the intervention in different phases and the result is that the site designer has always to divide in working units (even of the same type), the modeled objects.
The final step to achieve a complete CoSIM is the functional-spatial and technological-production site design [6] through the insertion of construction site elements (*e.g.* scaffolding, cranes, sheds, etc.) in the model. This activity has to be supported by a number of meaningful 3D site views, along the contract time, which help in assessing site safety and productivity by scanning the construction site phases, thus following a 4D approach. Assessing time, cost, and safety for each works unit in the project WBS is then possible to obtain a CoSIM useful in order to manage the execution phase of the project.

4. Case Study

The case study here presented refers to the restoration of Basilica di Collemaggio (L'Aquila) after significant damages produced by the earthquake of 2009. Due to particular structure of the church, earthquake affected primarily transept area, with the collapse of two main pillars and consequently of the central dome, that is now covered by a metal-structure roof.
Also octagonal columns and walls of the naves were subjected to a lot of damages so that, just after the earthquake, in was necessary to reinforce that structures with temporary facilities as showed in Figure 02 (b)



Fig. 02: (a) External view of the Basilica with temporary roof and (b) internal temporary structures

Restoration works are promoted and funded by ENIservizi and involves "Soprintendenza per i Beni Architettonici e Paesaggistici per l'Abruzzo", "Politecnico di Milano", "Università degli Studi di Roma, La Sapienza" and "Università degli Studi dell'Aquila". Intervention concern in particular the reconstruction of the transept and structural rehabilitation of columns, walls, and roofs. Surfaces restorations and plants will be the final activities to return the church to the city of L'Aquila.
Design phase started from an accurate laser scanning and photogrammetric survey of the whole church and surrounding territory. The survey was carried out with the aim to reproduce as much as possible geometric irregularities [3], also taking into particular account state of conservation of damaged elements.
The geometric 3D survey, made especially on point cloud, was rendered into an interoperable model to be used by different designers for their analysis such as structural, economical and operational. In particular starting from the HBIM created by the survey task group, the operational planning task group has developed, as described in the previous paragraph, the CoSIM of the project. Hence, each element of the starting HBIM has been studied taking in consideration the work to be carried on it. At the beginning some difficulties was founded in managing a model that has to be useful for architectural, structural, economical, and operational analyzes.

In particular, the following main issues were faced for the completion of the operational model, largely due to the absence of specific IT BIM tools for HBIM and ergo-technique modeling:

- Need of different elements discretization for each analysis
- Difficulty in operational parametrization of particular elements

Despite these difficulties ergo-technical modeling method seems to be suitable for the aim of calculate and optimize construction site times and costs, by helping in reducing modeling times and in managing directly operational information. Almost all items subject to intervention has been studied for turning HBIM into a CoSIM starting from reconstruction of the transept, that got methods from new construction BIM, and following with works on the naves that concern more restoration issues. In particular, some of naves activities (*i.e.* octagonal columns repair and walls reinforcement) are here analysed showing how operational modelling has been used and its advantages and criticalities. In general, operational design is driven by the need of optimization of work sequences for respecting a very limited time for construction and for containing site costs. In particular, operation information primarily inserted and then extracted from the model has been managed for scheduling works taking into account many contemporary activities and to calculate and optimize costs for the realization of site facilities such as fences and scaffold. Furthermore CoSIM allows to visualize the sequence of contemporary working-places studying thus actions to be performed for workers safety.

4.1 Octagonal column repair

Column repair consists in substitution or adjustment of damaged ashlars with steel reinforcement of joints. This operation needs to be carried on by unloading the column itself with placement of a metal structure below arches (see fig. 03). The survey of columns has been carried out by a precise study of each ashlar in order to choose which one to replace with a new one, or which one to repair. In any case the activity consist in the extraction from the column of the ashlar, its adjustment/replacement and its reinsertion in the column. For these reason HBIM in this case has been created with an high level of detail by modelling each ashlar and identifying the damaged ones. This approach resulted very useful for survey and for architectural design, but is too detailed for operational scheduling. If we consider CoSIM, such an approach could be useful for studying in detail single activities of workers for safety issues, but more complex for calculating general time and costs. For this reason in CoSIM column has been treated as three main elements (plinth, shaft, capital). For this reason all BIM ashlars has been covered, in the model, by a unique solid corresponding to the shaft. This way the technical solution chosen by the designer can be inserted in a single BIM element and can be visualized by a simple click on it (see figure 03). However single ashlars modelling has been useful (and so has been not deleted) since the possibility of counting for each column the blocks to be replaced.

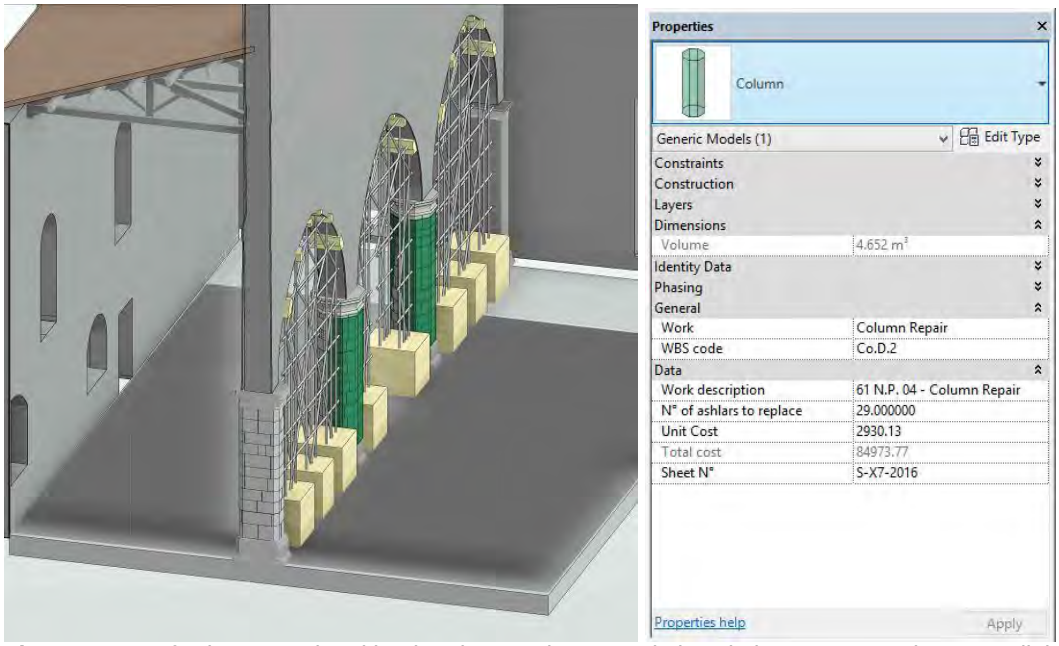

Fig. 03: HBIM of columns works with related properties – "Work description" parameter is an URL linked with the descriptive specification (see table 1)

From descriptive specification is then possible to add specific operational information in order to develop technical description of the solution into an operational description. Single operations of handling, stockpiling and laying have been then described as showed in table 1. These information permit the CoSIM implementation for this work. In fact such a detail allow to study in deep single operations to be carried on and estimate the total time for replacing single ashlar. This way, for each column, has been obtained automatically the total duration of intervention useful for scheduling. The model has been then populated with site elements like unload structure, mobile scaffold and stockpiling areas in order to study functional-spatial organization of the work. Figure 4

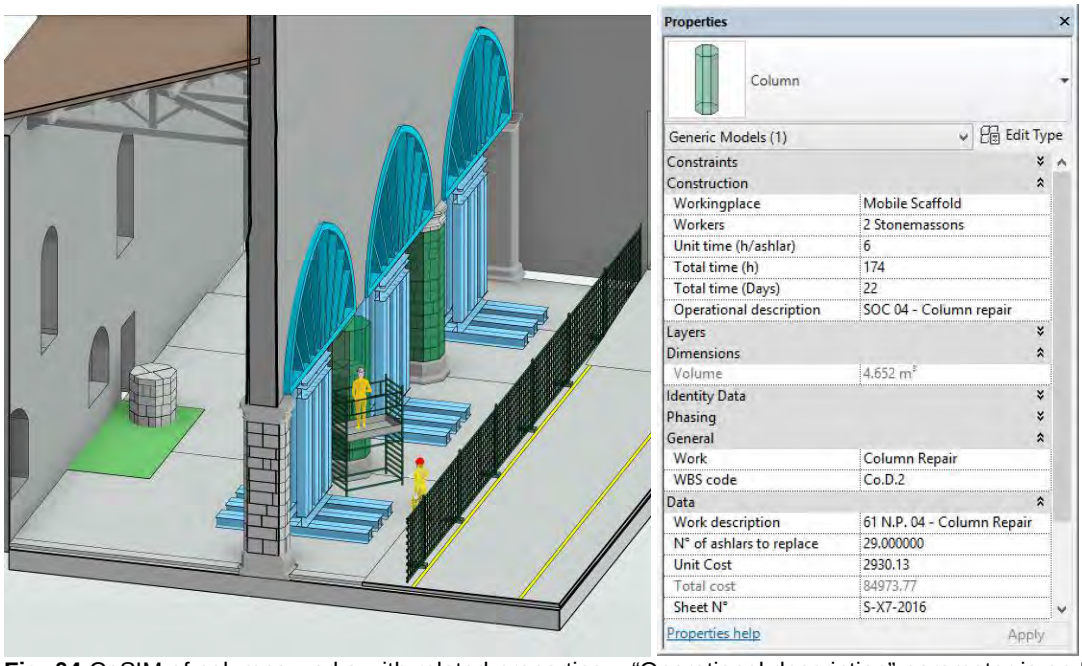

Fig. 04 CoSIM of columns works with related properties – "Operational description" parameter is an URL linked with the operational and technical specification of the work.

61 N.P. 04 – Column Repair	SOC 04 – Column Repair
Column repair by ashlars replacing/adjustment and steel reinforcement: • Damaged ashlars removal and numbering starting from the top of the column • Repair on site of slightly damaged blocks with mortar • Pins position drawing and wood templates generation. • Holes for steel pins execution • Adjusted/new ashlars remounting with insertion of pins in mortar joints	Column repair by ashlars replacing/adjustment and steel reinforcement: • Damaged ashlars removal starting from the top with the use of manual equipment. • Mobile scaffold use for ashlars removal on the top • Ashlar handling to floor by the use of a winch or similar equipment. • Assisted manual handling on floor with a forklift or similar equipment. • Blocks stockpiling in the assigned area (see site layout) • Wood templates generation in the assigned woodworking area (see site layout) • Mortar production in assigned area with the use of mixer or similar equipment (see site layout) • Blocks repair and hole execution by drill in the assigned area (see site layout) • Manual handling of mortar container on the mobile scaffold • Adjusted/new ashlars handling to the top of the column by the use of a winch or similar equipment • Blocks laying with the use of manual equipment and winch

Tab. 01 Descriptive specification and related operational and technical specification of the column repair

4.2 Walls reinforcement

Walls reinforcement is made by “reticolatus” technique and consists in insertion of a steel wire mesh in joints between wall blocks, as showed in figure 05. This mesh is strained by the use of particular screws inserted deep into the wall.



Fig. 05: Screw insertion into wall joint and completion of “reticolatus”

This particular work at the beginning was not inserted in HBIM but in 2d views of the Basilica. With the need of operational implementation to build a CoSIM this work has to be modelled also on the walls rendered from the survey. The peculiarity of the work would tend to model each screw in order to count automatically the total. However, this method imply long time to insert each screw and, then, the work is not clearly visible in model views. Furthermore, like for the column, there were the need to select in the model an element that contain the technical description of the intervention chosen by designer. For these reason “reticolatus” has been modelled as a surface applied on the wall (see figure 08). Number of screws are so counted as a number in a surface unity (m^2) and the operational computation take into account also the time to put in place the mesh. Figure 08 shows the result of using a surface for this kind of work with related design parameters. In the same way of other works, as showed in column repair, descriptive specification has been added taken from price list description and adding information from a real test carried on site (that permit to choose the screws type in function of the wall characteristics). Information gained from the test has been recorded into the database and will be so available for other intervention.

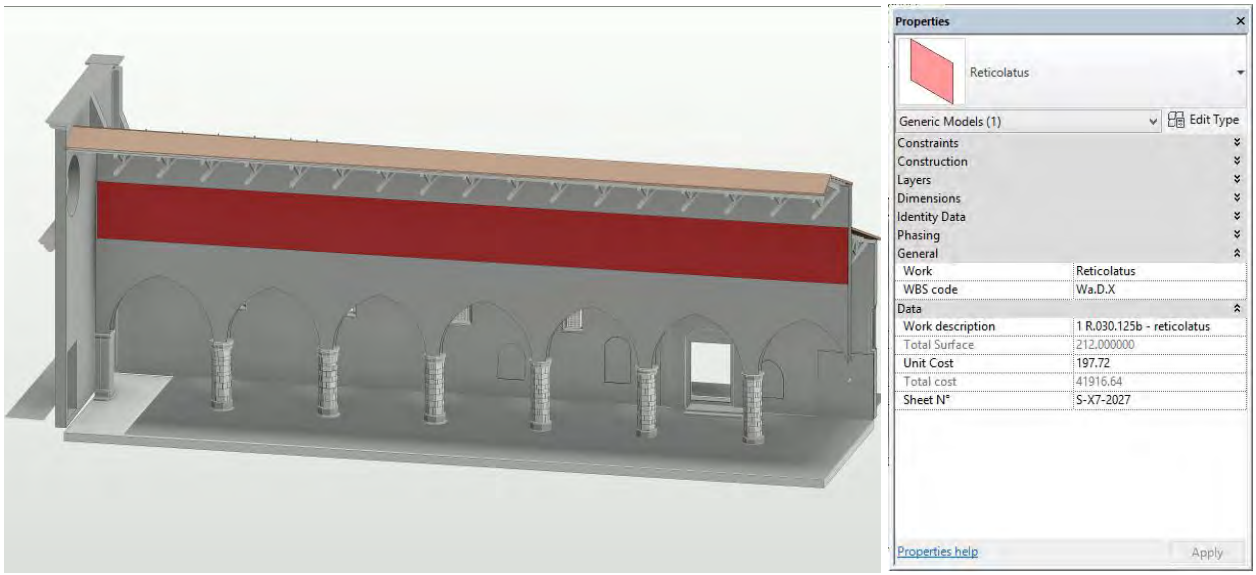

Fig. 08: HBIM of “reticolatus” works with related properties – “Work description” parameter is an URL linked with the descriptive specification

Regarding operational information the field test allows also to measure specific duration of each activity. Operational and technical specification of the work contemplates the use of a scaffold as working place due to the height and extension of the work (and also due the need of use it also for roof works). Material handling on scaffold is provided by the use of winch. Specific passages are contemplated on the scaffold for this reason. Figure 09 shows CoSIM for “reticolatus” work on the internal wall of the central nave.

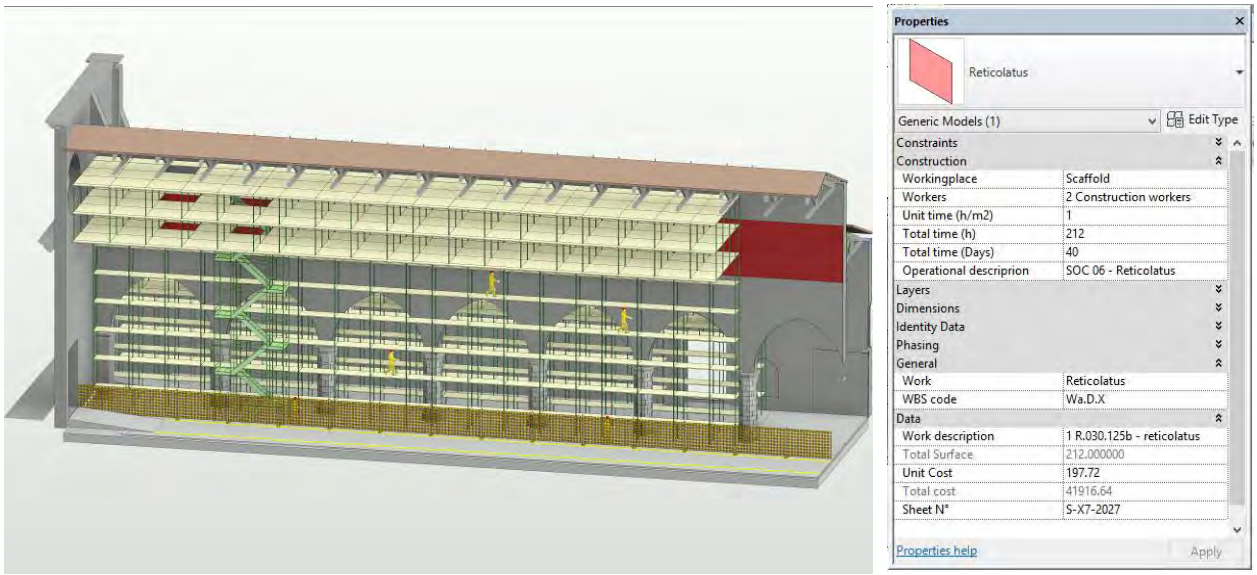

Fig. 09 CoSIM of “reticolatus” works with related properties – “Operational description” parameter is an URL linked with the operational and technical specification of the work.

4.4 CoSIM and operational planning

After the CoSIM implementation of each work is then necessary to put together all information inserted and obtained to optimize operational planning of the whole construction site. As an example we can consider the works to be done on the nave, considering in particular the two described. The early work schedule, made without insertion of site elements, has considered first the repair of all column, then the scaffold mounting, and finally “reticolatus” and some works to be made on the roof. Duration calculation of these sequence brought to an excessive duration to complete the naves works. The second imagined solution assumed the contemporary realization of half of columns and different portion of “reticolatus” in order to reduce this time. Nevertheless this solution would have implied the use of 14 unloading steel structures at the same time, with an high increase of costs. Figure 10 shows the final solution that involves a gradual progress of each work along the naves.

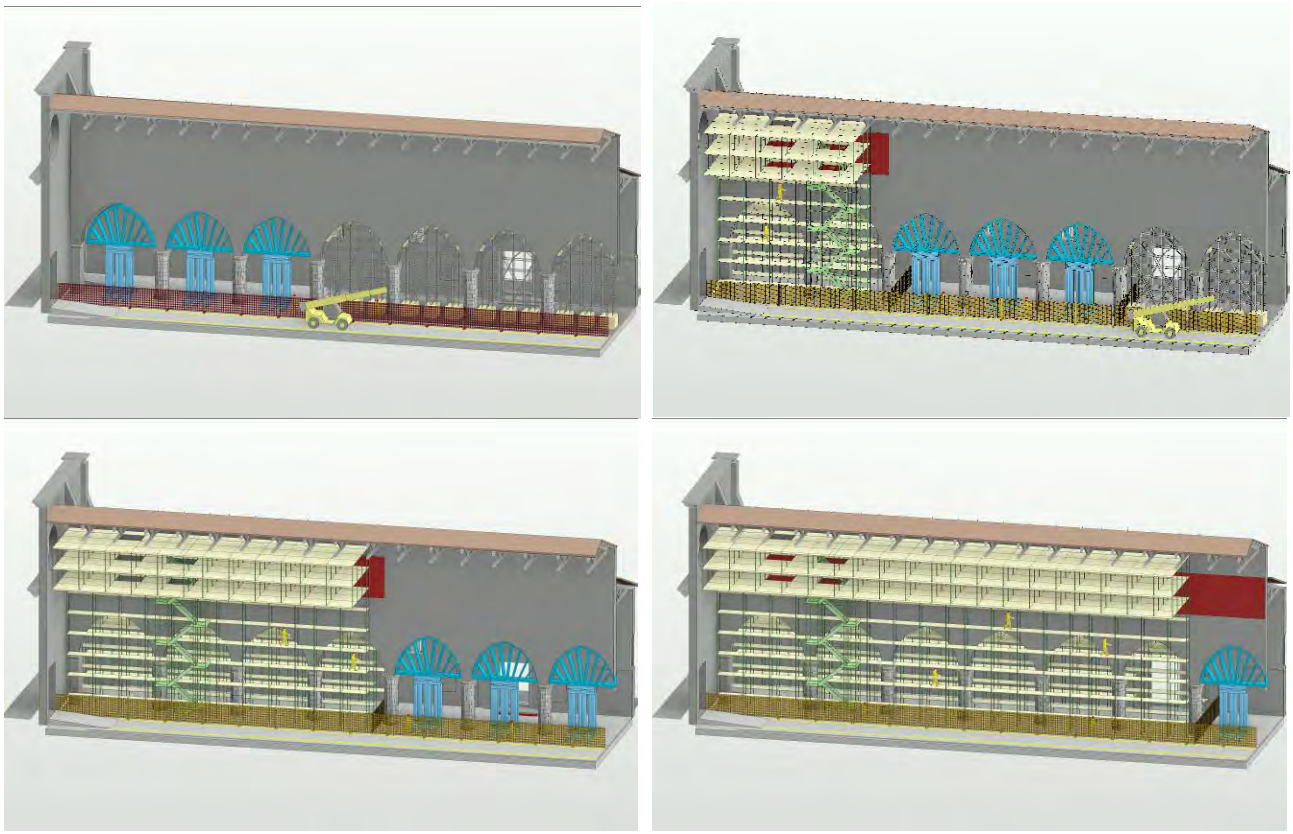

Fig. 10 Working sequences of the naves derived from CoSIM optimization of operational planning

As showed, works start with contemporary repair of 4 column with the use of 6 unloading structure that will be reused for other column. Once finished the first step, the ashlars repair moved to the subsequent four columns while in the first portion begin scaffold mounting and "*Reticulatus*". This sequence permits to have on site only six unload structure, which cost is very high, and to optimize rental time of scaffold thanks to a gradual mounting. Thanks to contemporary works, time respect has been achieved as well. In order to re-calculate time, this approach requested once again a different discretization level of the model. Taking as an example "reticolatus" works, the total surface described in the previous parameters required to be divided into some smaller surfaces that covered each work step in the naves. However these adjustments of the model, once developed, resulted not so difficult with the advantage of automatic calculating of time and costs of single portion.

5. Conclusions

The case study shows the two main issues of the ongoing research. The first concern with the development of a standardized method to manage restoration design information with the aim of operational planning. Despite the difficulties encountered in modeling issues, this method has ensured the availability of whole design information during the entire design process. In such a wide and difficult intervention as the restoration of Basilica di Collemaggio, this fast information exchanging allowed to respect the narrow design time granted. Lot of time can be further saved with the availability of an inventory of pre-constituted BIM representing all the characteristics of restoration works. The construction of a BIM database represents, obviously, a great early effort but permit, in standard use, to avoid modeling criticalities during design stage and to assure a precise information availability. In the case study, for example, some works were already available in the database, such as surface finishes or localized demolitions, and has been used with good results in term of design time. The two presented work items show, instead, two kind of new database implementation.
Column repair represented, in fact, a work completely created for this project. "*Reticulatus*" modeling technique, on the contrary, can be considered similar to surface finishes as they are both represented and calculated by square meters. For these reasons, modeling of "*reticolatus*" consists in the development of another work item yet present in the database. Obviously technical specification completely change for such a particular work that required a field test to be properly designed. Database aims mainly to get quicker the work of site designer for operational planning and production of the Construction Site Information Model. The CoSIM, as results from application in several case studies, permits a detailed analysis of constructability issues. In particular, CoSIM approach assists site designer, and consequently other designers, to become more aware about operational criticalities that affect in particular restoration construction sites. This consciousness permit to solve during design phase these variables of the construction process, which may cause the failure, at least economical, of an intervention.

Bibliographical References

[1] VOLK, R., STENGEL, J., SCHULTMANN, F., Building Information Modelling (BIM) for existing buildings – Literature review and future needs. Automation in construction, 2014, 38, pp. 109-127.

[2] MURPHY, M., MCGOVERN, E., PAVIA, S., Historic Building Information Modelling-Adding Intelligence to Laser and Image based surveys of European classical architecture. In ISPRS Journal of Photogrammetry and Remote Sensing, 2013, 76, pp. 89-102.

[3] ORENI, D., BRUMANA, R., DELLA TORRE, S., BANFI, F., PREVITALI, M., Survey turned into HBIM: the restoration and the work involved concerning the basilica di Collemaggio after the earthquake (L'Aquila). In ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume II-5, 2014, pp. 267-273.

[4] APOLLONIO, F. I., GAIANI, M., SUN Z. BIM-based modeling and data enrichment of classical architectural buildings. In: SCIRES-IT, 2012, 2(2), pp. 41-62.

[5] TRANI, M. L., CASSANO, M., MINOTTI, M., TODARO, D., Construction site BIM requirements, Procs. 30th Annual ARCOM Conference, 1-3 September 2014, Portsmouth, UK, 2014, 663-672.

[6] TRANI M. L., Construction site design, Maggioli Eds., Volume, 2012, pp. 266.

[7] DI MELCHIORRE S, TRANI M, Operating & safety information in the construction stage a performance-based approach. In: "CIB W102-2005", Lisbon, Portugal

[8] MOON, H., KIM, H., KAMAT, V. R., & KANG, L.. BIM-Based Construction Scheduling Method Using Optimization Theory for Reducing Activity Overlaps. Journal of Computing in Civil Engineering, 2013.

[9] MOON, H., KIM, H., KIM, C., & KANG, L., Development of a schedule-workspace interference management system simultaneously considering the overlap level of parallel schedules and workspaces. Automation in Construction, 2014, 39, 93–105.

[10] SHEN, Z., ORR, K., CHOI, W., KIM, N., & KIM, H. Object Based 3D Intelligent Model for Construction Planning Simulation in a Highway Construction, Construction Research Congress 2014, 1478–1487.

[11] KIM, H., ANDERSON, K., LEE, S., & HILDRETH, J. Generating construction schedules through automatic data extraction using open BIM (building information modeling) technology. Automation in Construction, 2013, 35, 285–295.

[12] EASTMAN C., TEICHOLZ P., SACKS R., LISTON K., BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. John Wiley & Sons, New Jersey, 2008.

[13] FAI S., GRAHAM K., DUCKWORTH T., WOOD N., ATTAR R., Building information modeling and heritage documentation. In CIPA 2011 Conference Proceedings, XXIIIrd International CIPA Symposium, 2011, Prague, pp.8.

[14] CENNAMO G., SAVOIA S., The approach to BIM - Building Information Modelling as excellent instrument for the definition of design strategies and for knowledge, simulation and management of the buildings and architectural heritage, 2014,International journal of systems applications, engineering & development.

[15] ARAYICI, Y., Towards building information modelling for existing structures. In Structural Survey Vol 26 No. 3, 2008, pp. 2010-222.

[16] MALLASI, Z., Dynamic quantification and analysis of the construction workspace congestion utilising 4D visualisation, Automation in Construction 15, 2006, pp. 640-655.

[17] MA, Z., SHEN, Q., ZHANG, J., Application of 4D for dynamic site layout and management of construction projects, Automation in Construction, 2005, pp. 369-381

[18] PALOS, S., KIVINIEMI, A., KUUSISTO, J., Future perspectives on product data management in building information modeling, 2014, Construction Innovation.

[19] TRANI M, BOSSI B, CASSANO M, BIM Technology for Restoration Site Design. In: “Research, Development, and Practice in Structural Engineering and Construction” ASEA-SEC-1, 2012, Perth, Australia

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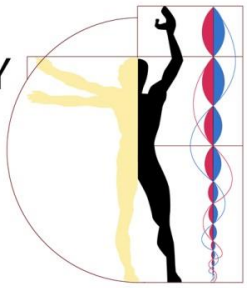

Key Enabling Technologies for an accessible Cultural Heritage: methods of application of the EU 2014-20 Programme strategy for Culture

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Abstract
The reflections expressed in this paper result from the analysis of the European strategy for the enhancement of cultural heritage, in connection with the recent evolution of the concept of cultural heritage itself. In fact, we must address the existence of a significant digital cultural heritage that needs to be adequately managed and used.
The Digital European Agenda believes that setting structural conditions that allow this heritage to be preserved and shared represents a strategic primary target, a resource to strengthen European cultural identity. In order to reach a similar result, the European strategy has identified in innovation, enhancement and development of Key Enabling Technologies (KETs) a preferential channel both to build open source systems able to connect data, increasing knowledge, enlarging the number of users, and - through the application of technology designed for the construction of an evocative, empathetic and interactive experience with cultural heritage - to generate innovative services of fruition able to attract new audiences and give rise to a cultural identification process. In times of ethical and political complexity, times in which Europe needs to build a strong awareness and strengthen the cohesion of the many European identities which compose it, creative technology must serve cultural heritage. This heritage should be accessible and shared: the blend of knowledge and experiences has the potential to shape a new European culture, thus making it possible to achieve the primary goal of developing a smart, sustainable and inclusive Europe– for the new planning period EU 2014-2020 - . This paper aims to analyze the application procedures of the European cultural strategy for 2014-20, relating some representative study cases from Southern Italy.

Keywords: Key Enabling Technologies, Digital Cultural Heritage, European Cultural Identity, EU 2014-2020 Program, Open Data.

1. European Policies and KETs. (VDF)

1.1. Introduction.
In all its forms, cultural heritage is of fundamental importance for the collective memories and for a peaceful and assertive coexistence of groups but also for the personal development of people, enabling them to find their place in society. It also serves as a source of inspiration for the growth of every citizen's personality and

talent. Referring to the European contest, it is one of the elements at the heart of the construction of a united Europe and, in this sense, it plays a key role in providing a sense of European belonging and EU citizenship in addition to a national citizenship. Cultural heritage and values can foster and sustain our capability of overcoming the current EU crisis through the stimulus for revising EU policies so as to provide a solid basis for the emergence of a truly European cultural heritage and identity, in order to pass it to future generations [1].

Today the digital "revolution" has radically changed our habits, behaviors and opportunities. The transition to digital is impacting identities and cultures and transforming the nature of the knowledge that we will pass on to future generations as well as the ways we interact with it. In this new cultural asset that is continuously developing, it is necessary to respond to the growing urge to share cultural resources, research and knowledge to allow open and widespread access. In fact, digital cultural resources can promote creativity and generate innovation in research, design and methodology, lead to richer interpretations of the past, provide new perspectives for issues relating to identity and culture, and generate social and economic benefits. This huge European cultural heritage can be transformed into digital resources, where integration and reuse through research-led methods can create values for cultural institutions and heritage, tourism, cultural and creative industries. The principal aim is to enhance the diffusion of cultural resources and analyze them to improve our understanding of how European identity can be constructed and strengthened, finally to use those resources to foster innovation across sectors [2].



Fig. 1: Billbord of the AthenaPlus Workshop on Interactive digital storytelling for mediation and valorisation of cultural heritage, held at Berlin on 10/09/2013. https://museidigitali.wordpress.com/

1.2. Europe and Technologies.

The application of ICT Key Enabling Technologies is producing innovative approaches to the creation of art as well as to the preservation of cultural heritage. In fact, technology is causing a revolution in this area and opening up new ways for the audience to relate to art and cultural heritage.

In the EU Commission Communication "Preparing for our future: Developing a common strategy for key enabling technologies in the EU" (COMM 2009 512 final, Bruxelles, 30.9.2009) the Commission defines KETs as "knowledge intensive and associated with high R&D intensity, rapid innovation cycles, high capital expenditure and highly skilled employment. KETs enable process, goods and service innovation throughout the economy and are of systemic relevance. They are multidisciplinary, cutting across many technology areas with a trend towards convergence and integration" [3]. On the basis of current research, of economic analyses of market trends and of their contribution to solving social challenges, micro-/nanoelectronics, nanotechnology, photonics, advanced materials, industrial biotechnology and advanced manufacturing

technologies (recognized as a "cross-cutting" KET) have been identified as the EU's KETs. KETs are a key source of innovation because they enable a wide range of product applications. In fact, KETs feed into many different industrial sectors in heterogeneous ways, from materials through equipment and devices, to products and services. For their cross-cutting nature and systemic relevance to European industries, KETs will drive the strengthening and modernizing of the industrial base as well as the development of entirely new industries in the coming years. For example, the micro- and nanoelectronics industry has its natural downstream in ICT [3].
Horizon 2020 is the new framework program which, for the first time, supports the integration of research and innovation activities, thus allowing the translation of knowledge into marketable goods and services. Horizon 2020 gives particular attention to the development and application of KETs, highlighting their importance for growth and jobs. A considerable part of the KETs activities planned under Horizon 2020 will be dedicated to cross-cutting activities, which will join together different KETs in order to develop innovative products and to contribute to the solution of social challenges, as well as to the preservation and enhancement of European cultural heritage and identities. Cultural heritage is an established domain of study for human-centered computing – from the design of technological interventions at heritage sites, to the analysis and evaluation of the role of shared and of personal technologies in heritage settings. For a long time the concept of heritage has focused mainly the role played by official institutions which offer visitors certain contents and interaction for interpretation and education purposes. Cultural heritage is in fact a much more fragmented domain where different communities can play a significant role and where new socially inclusive and participative ideas of heritage have become widespread. Different communities of stakeholders are involved in the preservation, communication and sharing of heritage holdings: from the community of professionals managing them, to the communities of volunteers, of special interest groups and supporters of the institution engaging with them. Technology can feature in a number of activities for all these groups, and also be a tool to support visitors in their experience of heritage. Overall, communities of interest around heritage with different degrees and professional training are increasingly defining their idea of cultural heritage value, thus defining and reconfiguring itself. This integration of cultural heritage at different levels has a strong impact on the sense of belonging to a European community and on the participation process of European citizens [4].

1.3. **European Policies for Culture.**

The societal challenge 'Europe in a changing world – inclusive, innovative and reflective societies', included in the Horizon 2020 program, gives a prominent position to the European cultural heritage and creative expression as well as to the diversity of its society which creates a potentially very vast research agenda. There are different ways to use technologies with cultural purposes. Technology can be used to support and promote access and reuse of digital cultural heritage resources (available in scientific collections, archives, museums, libraries and cultural heritage sites); enable new models and demonstrations of the analysis, interpretation and understanding of Europe's cultural and intellectual history; bring cultural content to new audiences in novel ways, through the development of new environments, applications, tools, and services for digital cultural resources (e.g. mobile and wearable devices). The use of art technologies can develop a multidisciplinary reuse of Europe's cultural heritage, enabling collaboration and partnerships and co-production of knowledge across different sectors and communities of researchers and users. The documentation of cultural assets is inherently a multimedia process, addressed through digital representation of the shape, appearance and conservation condition of the heritage/cultural object. The digital model is expected to become ‘the’ representation and research needs to acknowledge the changing role that reconstruction, preservation and conservation now play in the representation of heritage and its analysis [5].
One setting of KETs’ application is in the field of digitization. Digitization and preservation of Europe’s cultural memory, which includes print (books, journals and newspapers), photographs, museum objects, archival documents, sound and audiovisual material, monuments and archaeological sites is one of the key areas tackled by the European Digital Agenda. European actions in this area, including the development of Europeana, Europe’s digital library archive and museum, were supported by the European Parliament and the Council, most recently in a Parliament resolution of 5 May 2010 and the Council Conclusions of 10 May 2010. The Workplan for Culture 2011-14, established by the Council at its meeting of 18 and 19 November 2010, highlights the need for a coordinated effort in the area of digitization [6].
The development of digitized material from libraries, archives and museums should be further encouraged in order to ensure that Europe maintains its place as a leading international player in the field of culture and creative content and uses its wealth of cultural material in the best possible way. Europe needs to act now to secure the benefits of digitization and digital preservation. If Member States do not step up their investments in this area, there is a risk that the cultural and economic benefits of the digital shift will materialize in other continents and not in Europe. Digitization is an important means for ensuring greater access and use of cultural material. Online accessibility of cultural material will make it possible for citizens throughout Europe to access and use this material for leisure, studies or work. It will give Europe’s diverse and multilingual

heritage a clear profile on the Internet, and the digitization of these assets will help Europe's cultural institutions to continue carrying out their mission of giving access to and preserving our heritage in the digital environment.



Fig 2: Europeana Logo. http://www.findingdulcinea.com/news/business/2008/November/Europeana-Aims-to-Digitize-Europe-s-Libraries.html

Moreover, the digitized material can be reused – for both commercial and non-commercial purposes – for uses such as developing learning and educational content, documentaries, tourism applications, games, animations and design tools, provided that this is done with full respect for copyright and related rights. This will give an important input to creative industries. Digitizing and providing wider access to cultural resources offers enormous economic opportunities and is an essential condition for the further development of Europe's cultural and creative capacities and of its industrial presence in this field. Europe's cultural material should be digitized, made available and preserved in full respect of copyright and related rights [6]. The EU Structural Funds can be and are being used to co-fund digitization activities as part of projects having an impact on regional economies. However, such use could be more widespread and systematic. Mass digitization processes can gain in efficiency due to scale. Therefore, the efficient use of digitization capacity and, where possible, the sharing of digitization equipment between cultural institutions and countries should be encouraged. The cost of digitizing all of Europe's cultural heritage is high and cannot be covered by public funding alone. Private sector sponsoring of digitization or partnerships between public and private sectors can involve private bodies in digitization efforts and should be further encouraged [7].

Europeana, Europe's digital library, archive and museum, was launched November 20, 2008. The further development of the Europeana platform will depend to a large extent on the way the Member States and their cultural institutions feed it with content, and make it visible to citizens. Measures to achieve this effect should be encouraged. In spite of progress made across the EU in the preservation of digital material, in several Member States no clear and comprehensive policies have been defined for the preservation of digital content. The lack of such policies poses a threat to the survival of digitized material and may also result in the loss of material produced in digital formats (born-digital material). The development of effective means of digital preservation has far-reaching implications that go beyond cultural institutions. Issues related to digital preservation are relevant for any private or public organization, which are obliged to or wish to preserve digital material.

Web-harvesting is a new technique for collecting material from the Internet for preservation purposes. It involves the active collection of material on the part of institutions rather than merely waiting for it to be deposited, thus minimizing the administrative burden on producers of digital material; national legislation should therefore make provision for this technique. It would be very important to ensure the use of common digitization standards defined by Europeana in collaboration with the cultural institutions in order to achieve interoperability of the digitized material at a European level, as well as the systematic use of permanent identifiers. Also, it would be very useful to ensure the wide and free availability of existing metadata (descriptions of digital objects) produced by cultural institutions, for reuse through services such as Europeana and for innovative applications; also it is necessary to reinforce national strategies for the long-term preservation of digital material, update action plans implementing the strategies, and exchange information on the strategies and action plans, promote the widest possible access to digitized public domain

material as well as the widest possible reuse of the material for non-commercial and commercial purposes [6].

KETs also have the potential to bring growth to regions and enhance their overall competitiveness. In particular for less developed regions, it is of key importance to have access to these technologies in order to modernize the industrial base and improve competitiveness. The EU Commission has therefore identified KETs as one of the investment priorities for regional innovation financing in its proposal for revision of the European Regional Development Fund (ERDF). By introducing the new concept of 'smart specialization' as an 'ex-ante conditionality', a more strategic approach to regional innovation financing has been proposed. Smart specialization seeks the involvement of all regions in using their diversity to their advantage to achieve smart growth. A process of urban and regional development is foreseeable when e-heritage becomes a prime source for the creation of value, through the spontaneous reconfiguration of self-organized networks of independent business units, which cooperate to exploit opportunities provided by cultural heritage. Localized value-enhancement processes enable the cultural heritage sector to shape the changing nature of their particular niche in the tourist market [8].

The localized value enhancement of cultural heritage is aided by the networking potential of ICT. It seeks to capitalize on the existing cultural networks, to promote their growth and creative potential and connects them to entire regions and geopolitical contexts, working as an incubator that enlarges virtual communities. This way a technological link is established between heritage and a sustainable tourism economy based on the cultural richness of places. The major innovation lies in the capacity to bridge the gaps between three fields of knowledge and planning - governance, organizational culture, and language—by electronic means. It is necessary to identify the appropriate technologies to communicate the cultural content that has been previously elicited. Through Web-delivery technologies, many aspects of cultural heritage can be effectively conveyed using graphics, images and sound. This includes online digital reproductions of art exhibits and architecture, audio clips of music, video clips of dance and theatre, etc. This can help to overcome the obstacles posed by multiple languages. Moreover, the recent developments in the field of virtual reality have the potential to bring virtual cities and museums to Internet users. 4D technology can be used to incorporate the visual chronology of the cultural heritage, allowing users to observe its growth and development over time from a multitude of angles. Virtual reality applications can be used to combine historical evolution and cultural identity with information society, which would enhance the dissemination of cultural heritage. Also mobile phone technology is being employed as a hand-held tour guide in many cities in Europe. More sophisticated systems can also offer multimedia presentations via mobile phone (WAP) to gain content access to information. Mobile services such as these offer users a real-time and real-place information source that gives immediacy to their experience of the cultural heritage and also enables them greater flexibility in selecting alternative ways of visiting. Similar strategies can be employed to provide information in the case of buildings and historical sites as well. Future applications may exploit the combination of mobile multimedia telephones (WAP), with geographical positioning systems (GPS), so that information can be delivered based on the person's actual location [9].

Considering this scenario, the recent revision of the European programs for the new programming period 2014-2020 provides an opportunity to reflect on new funding opportunities for culture, as a strategic resource for the social and economic development of local communities. Beyond the programs entirely dedicated to culture, as Creative Europe, there are in fact other sources of support, in particular the structural funds of the Cohesion Policy 2014-2020, the main funding instrument of the European economic and social policy, created to promote a balanced, harmonious and sustainable development of the Communities, by reducing the inequalities between different European regions and making them more attractive, innovative and competitive places, where to live and work [10]. The new 2014-2020 programming identifies 11 priority issues including the Thematic Objective 6 : Protecting the environment and promoting the efficient use of resources . The Expected Result 6.7 "Improvement of the conditions and standards of supply and use of cultural heritage in the areas of attraction" specifically concerns cultural heritage. Among the actions to be taken in order to achieve this result provided for by the Partnership Agreement Europe - Italy for the 2014-2020 programming is the realization of innovative products and services for improving the fruition of cultural heritage through the use of advanced technological solutions. In the Partnership Agreement the Thematic Objective 6 refers specifically to the development of Key Enabling Technologies [11].

Recent years have seen dramatic changes, including the impact of ICT, which have radically modified the way of searching for information. This fact must not be overlooked in the definition of a territorialy strategy and needs to be considered within a systemic view of territory, territories can in fact take advantage of thepotential offered by the widespread use of KETs to relaunch competitive destinations. About half of the Italian regions are moving toward the identification of cultural and tourism niches; heritage exploits the potential offered by the widespread use of Key Enabling Technologies for the fruition of resources and accessibility to services.

The case of these regions is significant because it shows a new approach to cultural policy and cultural heritage in tourism and identifies a driver of development for the area, thanks to the promotion, in the areas

of cultural attraction, of business networks operating in the cultural, creative and performing arts sectors, with companies operating in the traditional production. Therefore, these essential investments in technological innovation should be supported (digital platforms, digital objects, exponential expansion of online databases, increase in cataloging made with the support of advanced technologies, etc.), which remain the indispensable premise for any strategy aimed at exponential growth of the industry.
This strategy will include the development of applications and processes related to "cultural and creative industry", of technologies in areas such as the protection and fruition of cultural heritage, industrial design and *made in Italy*. The areas of activities ranging from knowledge, interpretation, conservation, enhancement, restoration, diagnosis, the identification of innovative and intelligent management, protection, fruition and cataloging. i.e. start -up of applications and technologies for a more intelligent management of cultural heritage - tangible and intangible - such as the design of software for virtual communication of archaeological and monumental venues (APPs for Smartphone, Augmented Reality, QR Code, etc.); projects for cataloging of museum collections, archives, libraries, photographic libraries, intangible assets with digitization and georeferencing data. Networking of digital resources through systems Linked Open Data and Open Access (in line with the criteria set out by Europeana, the system of digital networking of European cultural heritage promoted by the EU).
The proposed strategy for heritage and cultural activities must be strongly linked to actions aimed at other thematic objectives, in particular with the objective Theme 1 "Research and Innovation" for a drive to technological innovation through sustained advocacy and promotion of applied research in ICT dedicated to the development of culture, for Universities and companies or other forms of public -private joint venture partnerships; for investment support for research and development in the field of cultural heritage; for the definition of digital applications and other high technologies for the best fruition and promotion of cultural heritage; for research and development of advanced technology solutions for social use of cultural heritage, also with reference to the target of the bearers of visual impairment and other disabilities.
It is also necessary to form a strong connection with the Thematic Objective 2 for the development of the Digital Agenda that, also in this area, must have strategic value to modernize the administrative processes of the ordinary public cultural institutions and the private ones having public interest; promote internationalization, through the network, of the historical, artistic, architectural and archaeological, archival and bibliographical, demo- ethno-anthropological heritage; encourage the integration of public knowledge with the publication of cultural data in open format (open data and linked open data), so that organizations and businesses can benefit from knowledge to develop technologies and services in the cultural field; enhance interoperability and integration between different public services that make possible the use of services in digital mode; provide infrastructure also resorting to reuse provided by the Digital Agenda.

2. European feelings and models of development through examples from Southern Italy (VA).

2.1. **Belonging and Glocalization.**

At present European Culture is conceived as being composed of a double layer: on the one hand, it is conceived as a top-down political affair, on the other it is something that is perceived as being a bottom-down process.
In 2015 we celebrate the 30th anniversary of the creation of the annual European Capital of Culture [12]. A goal in the formation of a new and self-conscious process of construction of a new kind of identity of European Citizenship, that is grounded in a new awareness of local differences and particularities, and also in the cultural boundaries that create a common sense of belonging to something greater than our specific and limited horizons.
However a European sense of belonging originates not just as a feeling of inclusion in a unique community, in fact historically it has often been felt as a sense of belonging in opposition to others (Arabs, Normans, Saxons, etc…). The feeling of being part of the European community is linked to this double sense of inclusion and distinction [13]. at present however we are witnessing the creation of a new feelings of affinity, which originates from the concept of “glocal”. “Glocal” is not just a synonymous of “international”: the focus here is on the bi-univocal and inseparable relationship between local particularities and a global vision.
Indeed “Others are not just any others” [14]: it is still true that folklore conveys identity, but it is also true that things are now changing. We are witnessing the birth of a new kind of connection, fed by the use of web: like-minded individuals form their our community, and form symbolic links that aid in the construction of those new identities [14]. We are therefore developing a new model of construction of affinity, based on the sharing of similar interests.
From a geographical and local point of view, anthropological-related studies have highlighted the risk of a “glocal short-circuit”, that is the attempt to standardize tradition, by constructing a representation of tradition

that is perfect and attractive in a global manner. The integration of local and international must therefore be carried out with attention to authenticity which must be safeguarded[15].
At present we are also witnessing a sea change in terms of culture: the result of an even more word-wide-web connected world is a change concerning the actors in cultural fields. Audiences are not the same as two-decades ago: at present they have an active role in the development of culture.
We have gone from rat-like visitors (a definition based on the concept of a "gratification approach", Lawrence 1993 [16]) to a conscious and active visitor that possesses the notion of identity formation developed in everyday life, who consequently has a different approach to Culture and Heritage [14]. Visitors are today not only culture consumers, but also culture performers. This means the end of top-down culture as we have known it in the past, and the formation of a kind of stakeholder democracy, that is a community-driven process [15].

2.2. **Changing World, changing Heritage.**

We must overcome the rhetoric of democracy as a bottom-up process and clearly outline concepts, role and responsibilities. In particular, we must keep in mind that also the concept of Heritage has greatly evolved in time. The Intangible Cultural Heritage by UNESCO in 2003 [17], marked the shift from a notion of Culture centered on the "universal and national value" based on standards of excellence. From this moment cultural expressions can be defined not only as an object, but also as a process in its wholeness and complexity [15]. The immaterial heritage receives its connotation from a subjective and social element, which together with the objective and territorial element is essential for the creation but also for the re-creation of heritage. The difficult task in now to build local development around innovation in the management of cultural heritage.
More and more culture is related to broadcasting and media. It is not a coincidence that one of the principal tools for the implementation of European regional policies in the Structural Funds and Cohesion Fund - the above mentioned Creative Europe – resulted from the merger of the sectors Culture and MEDIA. This points to the awareness of the fact that it is not only a matter of transcribing cultural content on digital support: what is also essential is that digital itself *is* culture, and allows the overlapping of the two concepts: digital is for culture, and digital is culture.



Fig.3: Creative Europe Logo. http://ec.europa.eu/culture/

Innovation, and consequently technology, could be the key to improve and enhance culture in an even more techno-friendly word. We must however note the disproportion between the Structural Funds allocated by European Union in the years 2000-2013 and the funds allocated for culture: only 1,7% of the resources have been invested in Heritage projects [18].
Not only has our way of relating to the world and to others greatly changed, but also the way to travel and experience art and culture: this is a no-distance word, something that is evident if one considers some cultural web tools such as the above mentioned Europeana - together with the Google Art Project - [19]. Every user could enjoy an art gallery visit, or participate in the creation of a common identity through his contribution.
Furthermore, regarding real travel, a recent survey conducted by Tripadvisor highlights the fact that a large part of travelers (61%) use social media to interact with the surroundings [20]: technology is the principal instrument used to gain knowledge about places, and is recognized as one of the most promising forms of development in tourism, in particular heritage tourism.
These tasks make it necessary to address two main problems related to technology as a means for the enhancement of knowledge: the problem of copyright, discussed above, and quality of contents.

These problems are the natural consequence of a sharing culture. The fact that there is no control over content is due to the total absence of mediators. Sharing culture is probably the most powerful aspect in

knowledge management, and transparency, traceability of information, is essential. There is a serious need to identify levels of content curation, and technology could help to identify and make explicit the source and level of curation of each piece of information. At present we need rules to regulate this kind of process that is informally called public curatorship [21]. Indeed the issue of institutionalization related to information society is on the Agenda also in our country [22].

2.3. **The Italian Profile.**

In Italy we can argue that there is a lack of entrepreneurship in the cultural sector, as reflected by the poor participation to European projects such as Europeana. The projects that carry out European Policy and provide economic investments are responsibility of National Departments. This entails the rusk of cutting out the real actors of culture during the management process [23]. Also the most important museums in our country have poor social media communication. According to Museum Analytics – a platform dedicated to the analysis of the indicators concerning the major museums around the word – Italian Museums that can boast an online presence and make a good use of social channels, such as Facebook and Twitter, are only 48 out of 6000 (24): less than 1% (exactly 0,8%) of the immense Italian Museum Heritage. Although the number of Facebook likes cannot be considered one of the essential parameters, the Italian museum that has the greater number of fans on Facebook, the MAXXI Museum in Rome (with 73,841 likes), is 20 times less visible that the most visible museum, the MoMa in New York (with more than 1,500,000 users) [25].
So it is clear that communication strategies, the strengthening of digital and sharing strategies, must be greatly improved. This might be a good strategy also for the development of small museums scattered around Italy. The enhancement of the regional and sub-regional cultural spots is in line with the “Regional Policy contributing to smart growth in Europe 2020”, promoted by the EU. One of the most convincing tools in this direction is the program URBACT, that promotes good practices to improve urban policies, through the implementation of regional smart specialization strategies [26].



Fig 4: Advertising for the competition URBACT III. http://www.lwbproject.com/my/news.php?id=628&cat=23

The sense of community could be the starting point of a process of regeneration of a sense of identity, which means becoming aware of heritage, in particular local heritage.
In this sense, much work is carried out in Italy by Universities, that in this particular moment are attempting to serve as mediators between territory and culture: in the city of Naples, a promising project is carried out by SUN (Second University of Naples) with the aim of tracing not only a map, but through a “sensitive survey” that uses a technical approach to record and process sense and physical data, a map of feelings in the area of Porta Nolana [27]. This kind of approach allows to draw a “map of diversity” that could result in a global sense of belonging to a multi-cultural and multilayered society and geographic context.
Regarding not human geography but Heritage (conceived as structures) and the sense of identity that those could generate, another work based on the use of KETs, carried out in the same University – Department of Humanities - is the MARA (Mobile Augmented Reality for Archeology) Project, which aims to simplify the

treatment of important remains from the past that are not simple to understand [28]. The project could support communication of data from studies and the exploitation by archaeologist, creating a simple (for the user) structure for the semantic archaeological content. This is a user centred model, in which the service needs to be activated by a human being, in contrast with the service centred model where the contents are searched by the app.
An important peculiarity of this tool is the context awareness, that is the capacity to profile the user and direct him or her, considering specific features. The MARA app creates an intersection between environmental context, user profiles and contents.
Another project being carried out in Southern Italy is the Smart Heritage Project regarding two important archaeological and scenic sites in the Puglia area: the ancient village of Specchia and the San Giovanni Evangelista Monastery in Lecce [29]. The work is carried out with the application of ITC in the enhancement of cultural structures and objects through digitalization in which the same users can become developers. The real value in this work is the number and variety of actors: Universities (Department of Heritage Science and Late Roman Age of Bari University, Department of innovation Engineering of Salento University) have a remarkable role, but there is a great number of supporting actors also: the Municipalities, some private lenders, the Puglia Region, and the Ministry of Economic Development and finally Europe, through the European Funds for Regional Development. Europe is thus involved and in this case is one of the main funders regional and Sub-Regional Smart Project that include the local people in a virtuous circle that strengthens the European heritage and the links between local context and Europe. We can say that a similar political and managerial approach constitutes a key strategy: such a collaborative model is indeed winning in the perspective of a real European glocalization.
The need, from a European and Italian point of view, is not to broaden the cultural offer, that is already massive, but to qualify the existing places of culture – in particular local - in that they could improve and become places of attraction, able to interpret the territory and its resources through complex models of integration.

Bibliographical References

[1] David MORLEY, Kevin ROBINS 2002, *Spaces of Identity. Global media, electronic landscapes and cultural boundaries*, Routledge, Taylor & Francis Group, London and New York ed. 2002 (first ed. 1995).

[2] JPI Cultural Heritage Coordination Unit (ed. by), *JPI Cultural Heritage and Global Chance. Strategic Research Agenda*, EU Commission (JHEP CSA) 2014.

[3] COMM (2009) 0512 final - 30/09/2009 - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - "Preparing for our future: Developing a common strategy for key enabling technologies in the EU" [SEC (2009) 1257].

[4] COMM (2011) 808 final – 30/11/2011 - Communication from the Commission to the European Parliament, the Council, the European economic and social Committee and the Committee of the Regions 'Horizon 2020 - The Framework Programme for Research and Innovation'.

[5] European Commission Decision C(2014) 9294 – 10/12/2014 – Horizon 2020 – Work Programme 2014-2015. Europe in a changing world: inclusive, innovative and reflective societies.

[6] L 283/39 – 29/10/2011 – Commission Recommendation of 26 October 2011 on the digitization and online accessibility of cultural material and digital preservation (2011/711/EU).

[7] Anaïtis MANGEON, *Open Data in the Cultural field*, in Tafter Journal. Esperienze e strumenti per cultura e territorio, n. 2013.

[8] COMM (2012) 341 final - 26/06/2012 - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'A European strategy for Key Enabling Technologies – A bridge to growth and jobs'.

[9] Frank M. GO, Ronald M. LEE, Antonio P. RUSSO, E-*Heritage in the Globalizing Society: enabling cross-cultural engagement through ICT*, in Information Technology & Tourism, Vol. 6, USA 2003, pp. 55–68.

[10] Valentina MONTALTO, *La cultura per una crescita intelligente, sostenibile e solidale. Verso un uso strategico dei Fondi Strutturali 2014-2020* in Tafter Journal. Esperienze e strumenti per cultura e territorio, n. 59/2013.

[11] Ref. Ares(2014)3601562 - 30/10/2014 - Decisione di esecuzione della Commissione Europea del 29 ottobre 2014 che approva determinati elementi dell'Accordo di Partenariato con l'Italia (CCI2014IT16M8PA001).

[12] http://ec.europa.eu/programmes/creative-europe/events/2015/2302-mons-30-ecoc_en.htm

[13] Theopisti STYLIANOU-LAMBERT, *Symbolic Boundaries, Identity, and Art Museum Visitation*, in The International Journal of Arts, , 2009, http.//www.arts-journal.com, p.119-129, ISSN: 1833-1866.

[14] Theopisti STYLIANOU-LAMBERT, *Re-conceptualizing Museum Audiences: Power, Activity, Responsibility*, in Visitor Studies, 2010, 13(2), p.130-144, ISSN: 1064–5578.

[15] Mara CERQUETTI, *Dal materiale e all'immateriale. Verso un approccio sostenibile alla gestione nel contesto glocale*, in Il capitale culturale, Supplementi O2 (2015), p.247-269, ISSN 2039-2362. http://riviste.unimc.it/index.php/cap-cult © 2015 eum.

[16] Ghislaine LAWRENCE *, Remembering rats, considering culture: Perspectives on museum evaluation*, in Sandra BICKNELL e Graham FARMELO (Eds.), *Museum visitor studies in the 90s* , 1993, London: Science Museum, p. 117-124.

[17] UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage, referred to as UNESCO meeting in Paris, approved on 17 October 2003, ratified by Italy on 27 September 2007 (L.167). http://www.unesco.org/culture/ich/index.php?lg=en&pg=00006

[18] KEA 2012. The Use of Structural Funds for Cultural Projects – Prepared for the European Parliament. Bruxelles.

[19] https://www.google.com/culturalinstitute/project/art-project

[20] http://ir.tripadvisor.com/releasedetail.cfm?releaseid=808058

[21] Sara RADICE, 2013.,*Patrimonio Culturale Digitale: Visitatori, Utenti, Partecipanti*, In *Progetto E Memoria Del Temporaneo*, Eleonora LUPO,Raffaella TROCCHIANESI (Eds.), 2013, Design & Cultural Heritage, Milano, Electa, ISBN 978883709751, p.69-82.

[22] PRIN 2010-2011,*La regolamentazione giuridica delle Tecnologie dell'Informazione e della Comunicazione (TIC) quale strumento di potenziamento delle società inclusive, innovative e sicure*, ongoing project , carried ot by the European University in Rome, financed for the years 2013-2015.

[23] Valentina MONTALTO, *La cultura per una crescita intelligente, sostenibile e solidale. Verso un uso strategico dei Fondi Strutturali 2014-2020 per la cultura*, TAFTERJOURNAL,59,2013 http://www.tafterjournal.it/2013/05/06/la-cultura-per-una-crescita-intelligente-sostenibile-e-solidale-verso-un-uso-strategico-dei-fondi-strutturali-2014-2020-per-la-cultura/

[24] http://www.museum-analytics.org/

[25] Eugenia MORATO, *How web presence strategy can help museums to be a digital breeding ground for innovative communication,* TAFTERJOURNAL,70,2014.http://www.tafterjournal.it/2014/04/11/how-web-presence-strategy-can-help-museums-to-be-a-digital-breeding-ground-for-innovative-communication/

[26] http://urbact.eu/

[27] Caterina Cristina FIORENTINO, Alessandra CIRAFICI *Authenti-city. A militant design project,* in Le vie dei Mercanti, XI Forum Internazionale di studi, Heritage, Architecture, Landesign, (Aversa 13-15 June 2013), ISSN 1723-0993.

[28] http://parsec2.unina2.it/mara/index.php/component/content/?view=featured.

[29] http://www.smartheritage.it/progetto

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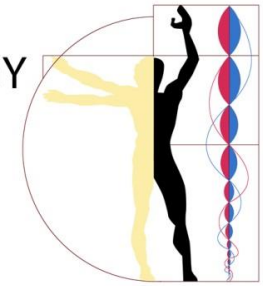

Environmental protection *versus* a simplification and development policy: searching for a difficult (but achievable) balance

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Abstract
The high number of administrative burdens (e.g. in urban, building or environmental fields) linked to the opening and management of industrial or commercial activities, often represent an unaffordable (due to being unreasonable) cost for citizens. In this context, regulatory uncertainty should also be added, along with Italian multi-level governance system, which usually implies the involvement of several authorities, not always acting in coordination. Therefore, competitiveness and development goals have recently imposed the rationalization of administrative procedures, along with the reduction of bureaucratic burdens, by means of the implementation of simplification measures: such as identifying a "one-stop" public office for all the authorizations required, or introducing simplified authorization procedures. However, some simplification measures are clearly in conflict with several environmental protection principles and criteria, insomuch as their enforcement would entail an unacceptable sacrifice of an adequate consideration of public interests. That being stated, the aim of this paper is to identify the legal criteria suitable to guarantee the achievement of the delicate balance between efficiency and development, on the one hand, and environmental protection on the other.

Keywords: Environmental protection – Simplification policy – Public administration – Sustainable development

1. Introduction.

The Italian Department of Public Administration and Innovation, together with employers' associations and ISTAT, has recently (2012) calculated the administrative burdens on businesses, with the result that the overall annual cost of bureaucracy on Italian small and medium-sized businesses was higher than 1.3 billion euro. In fact, for more than a decade, Italian legislature has been pursuing policies with a view to simplifying the suppression of these negative factors, in order to also reach the European *standard cost model* target, namely the reduction of bureaucracy by at least 25%.
There is no doubt that the large number of authorisations requested by the various disciplines (urban planning, construction, commercial, environmental) involved in the realization and management of industrial or commercial installations and the associated functional complexity entailing the necessary involvement of multiple administrations (not always coordinated), are likely to constitute a heavy administrative burden for the business owner, out of all proportion as a result of a sectorial and non-unified approach [Poel, Merneffe, Bielen, van Aarle, Vereeck , 2014].
In this context, there has long been the need - for reasons of competitiveness and development - to streamline the procedures related to the opening of a business, such as identifying a single reference office, as a centre of the confluence of several instances aimed at obtaining the required authorizations (cf. one-stop office for productive activities, arts. 23 et seq., Legislative Decree n. 112/1998), or introducing single authorization schemes (cf. art. 12, Legislative Decree. n. 387/2003 regarding the production plants of electricity from renewable sources or art. 1 Law Decree n. 7/2002 on the subject of electric power plants above 300 MW).
For a production system, even protecting the environment is an added cost, due to the financial investments and structural requirements for the continuous upgrading of the facilities. Nevertheless, for a long time, environmental protection was considered essentially incompatible with policies of administrative simplification in Italy. In fact, the first legislative reforms (cf. arts. 14, 19 and 20 of Law n. 241/1990, as amended by the law n. 537/1993 and n. 127/1997) that introduced simplified logic into

the system have all (at least in principle) expressly excluded the operation of typical simplification institutions (the service conference, the declaration of an activity's commencement, the silent equal assent) to procedures involving environmental interests. In other words, it was believed that in relation to some particularly delicate interests "*a discipline that involved procedural simplification, sacrificing the proper weighting of certain values*" could not be applied [Casetta, 2008].
Even the jurisprudence stated from the beginning that the primacy of the value to be paid to the environmental protection would lead to the conclusion, for example, of consider rarely possible the exceptions of the ordinary authorization system by simplifying the relevant proceedings with the prediction of a mere declaration of the starting of the activity (cf. Administrative Tribunal of Campania, Naples, Sec. I, 20 July 2006, n. 7597).
Moreover, it is evident that the importance of the interests pursued by public administration in charge of the protection of environmental assets also affect their procedures, on which instances of efficiency, promptness, effectiveness, cost, are often recessive compared with the irresistible need for a comprehensive and complete preliminary fact-finding. If simplification is to be considered, for instance, the possibility to take decisions without reference to the opinions not received in time, or the actual elimination of authorizing regimes, the "reaction" of the legislature tends to consider contributions and decisions from the offices responsible for the protection of an environmental asset to be irreplaceable [Rossi, 2014].
Along with the profile of the fragility of the interests involved – and connected to it – there is the question of the inherent complexity that characterizes the field of environmental protection. It has been highlighted how the simultaneous involvement of multiple administrations – often with non-substitutable technical skills – and the necessary widespread participation, in the preliminary fact-finding, by the stakeholders of the interests (individual and collective) involved in the environmental processes, end up making physiologically inappropriate, if not impossible, the application of simplification models [Renna, 2009]. In particular, the general phenomenon represented by the intertwining of horizontal authorities (between same level administrations) and vertical authorities (between administrations on different territorial levels), is even more significant in cases where environmental interests are involved, often due to the disparity between the size of the interest (national, if not global), and the territorial level (local) which is basically given the task of satisfying the same interest [Endrici, 2005].

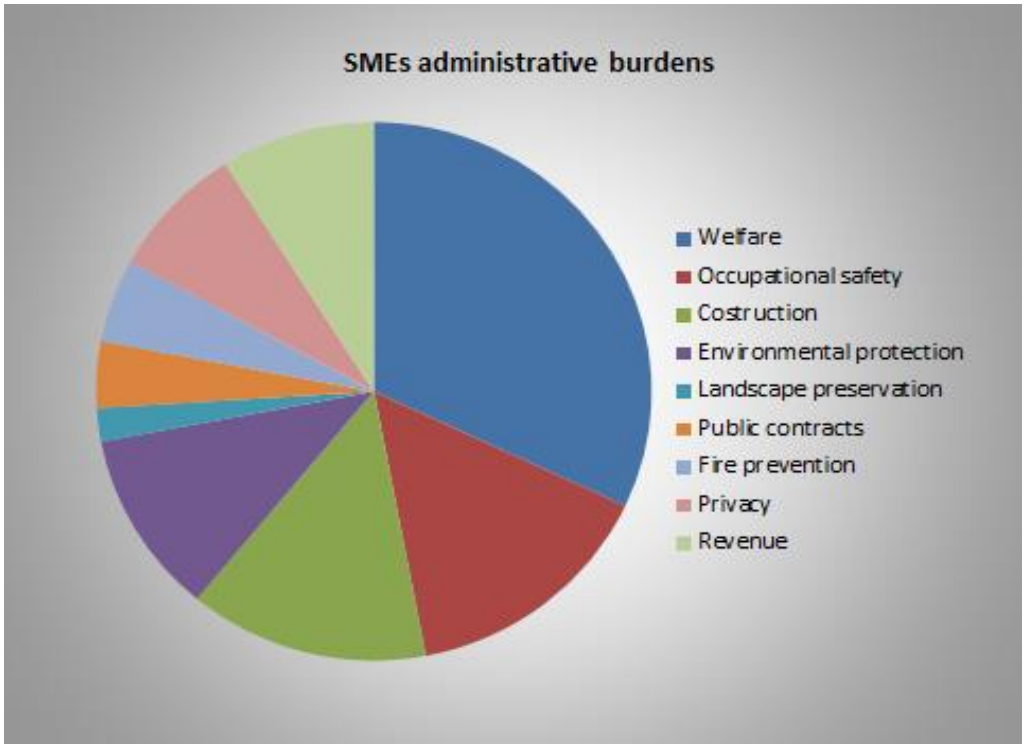

Fig. 1: Bureaucratic costs of small and medium sized businesses (2012). Source: Cgia - Mestre

2. Non-acceptability of the thesis of absolute incompatibility between environmental protection and simplification.

Doctrine has clarified that the complexity and sensitivity of a matter cannot completely preclude the introduction of simplification profiles: along with the prevailing need to ensure a proper and complete assessment of the necessary elements of preliminary fact-finding, there is – also relevant in the field of

environmental protection – the equally important need for effective administrative action, open to a logic of simplification. In other words, is necessary to identify the bureaucratic procedures that are essential for the better attainment of the purpose of protection, and to bring out those contributions and procedural steps objectively not substitutable: then, is possible to enforce, even in environmental procedures, regulations and institutions of simplification, aimed at eliminating any element that - without adequate justification - burdens the initiatives of citizens and businesses.
It is evident that if the need for a more sustainable balance between human activity and socio-economic development requires paying special attention to the actions of preventing and reducing pollution, it cannot paralyse development itself, but must be implemented through appropriate forms of information and prior assessment of the real impact of the various activities, allowing to find the best sustainable solutions, while taking into account all the interests involved [Sandulli, 2001].
This context includes the recent extensions of (some) simplification provisions as well as to procedures involving environmental interests: in particular, in relation to the service conference, the eventual dissent of an administration entitled on the protection of an environmental interest no longer entails the "failure" of the conference, due to there being a mechanism for overcoming dissent through the involvement of the Council of Ministers (cf. art. 14-*quater*, l.n. 241/1990). The legislature has clearly held that the necessary and strengthened procedural balancing of environmental interests at the service conference should not completely exclude the application of simplification mechanisms aimed at reaching a final decision, but rather adapt to the operation of fragility of the interests involved, through the identification of a different model of overcoming the dissent (the centralization of the decision-making).
This operation of balancing between the need for efficiency and simplification and appropriate weighting of environmental interests was not carried out in relation to the discipline of public advisory activities and expert evaluations. Under Articles 16 and 17 of l.n. 241 of 1990, there is still a regime that an eventual inaction by the administrations in charge of the environmental protection cannot be overcome through the generally expected (or other specifically identified) models of simplification, resulting in a blocking of the procedures. The prevailing doctrine criticizes this legislative choice, to the extent that – if it is true that the contribution an administration protecting an environmental interest can never be omitted – it is equally true that this does not mean having to recognize a *veto* power (furthermore silent) to these administrations, excluding *a priori* the use of simplification models, i.e. replacement types (addressing subjects with technical qualifications and skills equivalent to that defaulting) [Fracchia, 2003].
In fact, if it is true that we cannot deny the difficulty of identifying the procedural rules capable of ensuring the right balance between the demands of efficiency, economy, achieving a result and the need for a proper weighting of environmental profiles in preliminary fact-finding, this cannot, however, justify solutions which, *a priori*, preclude the application of procedural models capable of overcoming unjustified positions of mere obstructionism (in some cases) held by administrations responsible for the protection of environmental interests.

3. The actual boundaries of simplification policies in relation to environmental procedures.

Obviously, the opening to the logics of simplification for environmental procedures does not allow for the unconditional application of all the institutions of simplification. In the previous paragraph, we saw how the discipline of the service conference is successfully simplified in some passages, but in this same context, the legislature has made a not equally shareable choice. In particular, a provision has been inserted whose "markedly" simplified nature is likely to affect the adequate protection of environmental assets: this refers to the new paragraph 7 of art. 14-*ter*, l. n. 241/1990 (as amended by l. 30 July 2010, n. 122), where it states that "*The assent of an authority, including those responsible for the protection of health and public safety and the protection of the environment (excluding the measures concerning Environmental Impact Assessments, Strategic Environmental Assessments and Integrated Pollution Prevention and Control) and of the landscape and territory, is to be deemed acquired when its representative has not, at the end of the conference's proceedings, definitively expressed the will of the authority represented*". In practice, decisions destined to impact (even significantly) on the environment are likely to be taken without "the voice" of the administration which should rule on the environmental compatibility of the initiative even being heard. The danger of this hypothesis comes from the fact that the possible production of environmental damage – not expected precisely due to the failure to pronounce of the probate administration – is likely to prove irrecoverable for objective impossibility of restoring the *status quo ante* [Giulietti, 2012].
The assessment of incompatibility with environmental procedures is even more evident in relation to those institutions of simplification, including the Declaration of an Activity's Commencement (now known as s.c.i.a.) and the silent equal assent, which do not operate on the preliminary stage of the procedure, but rather have a direct impact on the final decision: one thing is trying to rationalize (and simplify) the procedural moments, another is simplifying in the sense of withdrawal of the exercise of

public power. In other words, a procedural rationalization in accordance with the constitutional rule of efficiency (art. 97) is admitted, but we cannot accept in the present context a “step back” of the public function in fulfilment of the principle of horizontal subsidiarity (art. 118 of the Constitution). [Perfetti, 2008]. It is evident how it is relatively acceptable the planned general inapplicability of these mechanisms in the presence of environmental interests, to the extent that it would otherwise also legitimize the failure to consider such fundamental and fragile legal situations (cf. Constitutional Court., 17 December 1997, n. 404; Constitutional Court, 27 July 1995, n. 408; Constitutional Court, 1 July 1992, n. 307).

The jurisprudence has held that the non-applicability of Articles 19 and 20 of l.n. 241/1990 to procedures relating to the environment does not make it impossible to provide special cases of silent equal assent or s.c.i.a.; so, the legislator can legitimately introduce specific rules in this context, unless there is no express prohibition, deriving from European laws or Constitutional principles (see Counsil of State, Sec. VI, 29 December 2008, n. 6591; Administrative Tribunal of Puglia, Bari, Sec. II,14 January 2010, n. 53. *Contra*, Administrative Tribunal of Lazio, Rome, Sec. II, 13 December 2007, n. 13241). In the various sectorial disciplines on the environment, there are examples of silent equal assent (cf. Art. 13 l. n. 394/1991, regarding protected areas) or of Declaration of an Activity’s Commencement (cf. Art. 215, Legislative Decree n. 152/2006 regarding the disposal of waste; art. 212 Legislative Decree n. 152/2006 regarding enrolment in the national order of environmental managers; art. 272 Legislative Decree. n. 152/2006 regarding air pollution), but these are residual situations, entailing no particular “risk” in terms of environmental pollution; otherwise, in fact (especially in the case of s.c.i.a.), they would end up giving to the private autonomy the responsibility for the assessment of the compatibility or not of an activity with the parameters of environmental protection. With rare exceptions, the administrations responsible for environmental protection are called upon to exercise their powers expressly and within the time strictly necessary, not through silence or forms of liberalization in place of public responsibility, which would have uncertain and often uncontrollable outcomes [Spasiano, 2009].

It should be added that – beyond the inherent dangers of a possible massive operation of pseudo-liberalization even in areas where environmental profiles emerge – the same special features that characterize the environmental authorizations make them irreplaceable by juridical models such as the silent equal assent or s.ci.a. In fact, upon closer inspection, almost all the authorizations in this sector are not merely aimed at allowing citizens to exercise a certain activity, but rather contain numerous requirements that the recipient is obliged to comply under penalty of revocation of the authorization itself. The conforming nature of these measures evidently responds to unavoidable instances of protection of the environment, to the extent that the ability of citizens to exercise that particular activity can only be subject to continued compliance with the emission limit values and/or additional conditions. The management of an industrial plant with a high pollution potential, for example, is subject to an authorisation that cannot be limited to a *one-off* check of the requirements prescribed by law, but it must also contain a number of obligations and additional indications, such as: all the measures needed to meet the required standards of environmental protection, the emission limit values, systems of periodic inspection, the measures relating to exceptional circumstances (plant start up, malfunction or definitive suspension of industrial operations). As previously described, the need for the administration to identify the prescriptive contents of the environmental authorization, which make it effective, has as an obvious consequence the inapplicability (with some exceptions) of procedural models which exclude the issue of an express and formal final decision by the administration.



Fig. 2: Industrial ILVA plant in Taranto; an example of unsuccessful balance between simplification policies and environmental protection

4. Simplification understood as rationalization: the benefits in view of a more effective environmental protection.

It is possible to state that - if introduced correctly - certain simplification mechanisms are compatible with the protection of the primary environmental interests. However, in this context, simplification should not be seen (only) as a reduction in bureaucracy or elimination of interventions of public power, but rather as a "rationalization" of procedures. In this sense, it is possible (or rather, desirable) - even within the procedures relating to the protection of the environment – on the one hand, to act on the too often (and unnecessarily) complex procedures, merging them where possible, or otherwise eliminating any duplication of investigation and reducing the "bureaucratic stages"; on the other hand, it is possible to identify systems of functioning coordination between the different administrations that the transversal nature of the subject and its multilevel dimension involve. Naturally, it is still essential the inviolability of full emersion and appropriate weighting of all the interests involved, and – in general – the irreplaceable of the authorizations with substantial "non-decision" mechanisms , such as the s.c.i.a and the silent equal assent.
To fully understand the delicate balance between the requirements of simplification and the environmental protection, at this point, perhaps there is a need to change the perspective and clarify that - in general, but even more in this context – simplification cannot represent a value in itself to be pursued, but rather a tool aimed at: 1) facilitating – as much as possible – the private investor in achieving their purposes (satisfying, at the same time, public interests such as increased competitiveness of the national economic system); 2) pursuing objectives of economic efficiency and rationality of administrative activity (through the optimization of available resources) [Ferrara, 2000].
Starting from this premise, the prejudice that sees simplification institutions inherently in conflict with the requirements of environmental protection is no longer valid. However, there is more. It has been noted that not only environmental protection policies are not incompatible with (moderate) procedural simplification interventions, but - in some cases – these latter prove to be even instrumental in a better environmental protection: for example, this is the hypothesis of the simplification mechanisms with an incentive function, where their application in favour of a business activity is bound to a good behaviour from an environmental point of view. It is worth considering the benefits in terms of financial guarantees that the law recognizes to those working in the field of the cross-border transport of waste and are in possession of UNI EN ISO 14001 or EMAS certification (art. 194, Legislative Decree. n. 152/2006) as well as that simplified procedures for the renewal of authorizations necessary for plant management (art. 209, Legislative Decree. n. 152/2006).

4.1 The Integrated Prevention Pollution and Control (IPPC) model.

The claim that simplification institutions are not necessarily in a position of mutual exclusion with the needs of an adequate preliminary fact-finding is further confirmed by the institution of the Integrated Prevention Pollution and Control (IPPC). This authorization model is one of the clearest examples in which the choice of a simplified procedure (as unified) is not the result of a balancing between instances of good administration (in this case, concerning transparency and completeness of the preliminary fact-finding) and instances of cost and promptness of administrative activity, but is itself aimed at the most complete and adequate preliminary investigation.
The legal institution of the IPPC (cf. Legislative Decree. n. 152/2006, Art. 29-bis et seq.) is applied to the field of industrial and agricultural activities with a high pollution potential, in connection with the issue of several authorizations relating to the emission of substances harmful for the environment. In practice, instead of asking for individual authorisations related to specific sectors (air, water, soil, waste), a uniform procedure was established, intended to create a single measure, called IPPC: whoever intends to carry out an industrial activity with a potential high impact on the environment, no longer has to deal with the different administrations responsible for the protection of individual assets, or to obtain different required authorisations for each environmental factor; the current authorization model entails a single procedure (under the responsibility of a single administration) that will take into account the different aspects involved [Bohne, 2008].
Today, the IPPC is commonly considered one of the most interesting and effective examples of procedural simplification, to the extent that it allows citizens to achieve a result (positive or negative) in a relatively rapid and linear way, through the replacement of the fragmented set of skills and administrative procedures that characterize the system of environmental controls linked to the opening of a high impact productive activity. Upon closer inspection, the institution in question does not meet only (or even mainly) instances of simplification. In fact, it is correct to speak of simplification in reference to the IPPC, but not in the traditional sense – as a tool to make the procedure more

streamlined or to overcome procedural stalemates – but rather as the application of measures aimed at reaching more effectively the legal result which tends the law, a result which, in this case, is of adequate protection of the environmental assets involved [Calabrò, 2012].
In relation to a productive activity which could harm the environment, a traditional/sectorial approach - consistent in the differentiated analysis of the impacts that this activity has on several factors (water, air, soil, etc.) and in the next issue of specific authorizations – is not always effective in terms of real protection. The risk of this method is to ignore the phenomenon of the transfer of pollutants from one receptor to another (e.g. from water to air): the harmful effects arising from the implementation and management of a productive activity do not consist, in fact, in the mere sum of the levels of pollution of water, air and soil individually measurable, since these effects combine with each other causing an exponential multiplication of the overall effect of pollution, which is decisively higher than the sum of the individual pollutants autonomously considered [Renna, 2009]. Therefore, an integrated approach, through which environmental protection is dealt with as a whole in relation to the different matrices that compose it, is the only one able to guarantee a global vision of the pollution and their interconnections, necessary to provide a realistic assessment of the harmful effects arising from a productive activity [Maglieri, 2006].
A further advantage of the application of this integrated approach is in the fact that the study of the interrelations between pollutants requires an "upstream" analysis, through the monitoring of the entire production process, which allows the intervention – with appropriate prescriptions – in the various stages of the procedure; whereas, on the contrary, the traditional approach was based on the simple reduction of the "downstream" pollution, through the provision of limits to the emission points of the plant (so-called *end of pipe* technique). In this sense, the principle of the interconnection of the various environmental aspects arising from the production activity aims to overcome the fragmentation of the authorizations – often untied to the detailed knowledge of the production process – and to encourage the integration of methods related to the reduction of the migration impacts and of the polluting effects concerning the several environmental matrices [Nanetti, 2006].
In light of these considerations, it is possible to infer that, in relation to the IPPC, the effects of simplification are secondary, but perfectly compatible with those of protection. The legislature has clearly tried to reconcile the requirements of environmental protection with those of greater simplification and efficiency of administrative action: the introduction of an institution aimed at ensuring the highest standards of environmental protection, entails, at the same time, a positive (although indirectly) impact also on the national economic system, reducing existing administrative burdens and simplifying the procedures and the jurisdiction system.

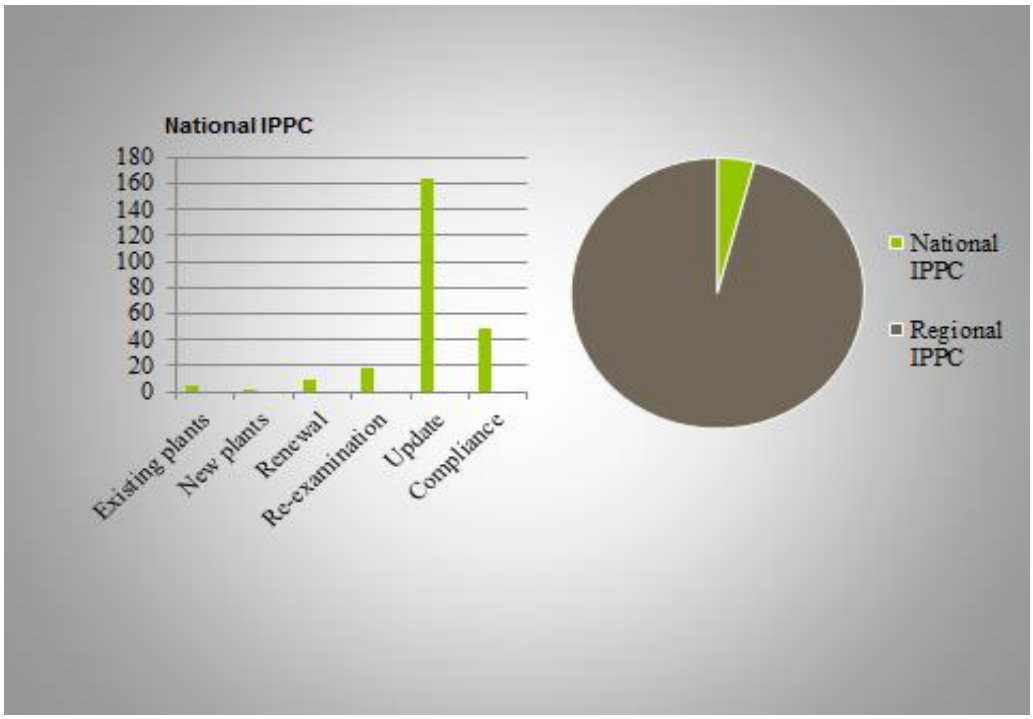

Fig. 3: Quantitative data relating to the IPPC procedures, updated to January 2015. Source: *www.aia.mianbiente.it*

5. Conclusions.

Legal institutions such as the IPPC – if properly regulated and enforced – show how the introduction of procedural simplification models not only can be fully compatible with environmental protection policies, but may even be able to ensure a more efficient implementation of these policies. Ultimately, in the presence of particularly delicate interests, such as those of environmental protection, reasonable instances of simplification are considered perfectly legitimate, as long as they are configured not as a final goal to be achieved, but rather as instruments capable of allowing for the most effective pursuit of protection of the assets. In this sense, it is possible to speak of effective simplification only in the presence of interventions that do not result in a mere acceleration or reduction of procedural stages, but tend to implement rationalization processes, thus encouraging administrations to achieve a more satisfactory public interest fulfilment.
This relates to the benefits arising from the so called "integrated approach": as noted in the previous paragraph, in fact, the reduction of the procedures and the unification of the authorizations in an unique final measure – while bringing undoubted effects of simplification – essentially respond to the need to allow for a full and contextual assessment of all of the potential damage that an industrial activity may cause on the various environmental assets, also evaluating the reciprocal interactions. It is evident, otherwise, that a leaner discipline – that unifies the procedures and, as seen, makes it easier for companies to undertake new business initiatives – is bound to have a positive effect on the overall national economic system, stimulating an outcome commonly called *win-win*, double advantage, for the company and the environment (see. European Commission Green Paper P*romoting a European framework for corporate social responsibility*, Com (2001) 336).
In other words, this leads to the reading of the administrative simplification proposed by that best doctrine that – in reducing the tension between efficiency and completeness of the preliminary fact-finding – interprets the simplification not as an outright reduction of the procedural burden, but as the adequacy of the procedures compared to the decision goals, "not as mere acceleration of the administrative procedures, but as an intervention aimed at implementing their rationality" [Scoca, 2008].

Bibliographical References

[1] BUTTI, Luciano. *Le imprese e il problema ambientale nella prospettiva europea: dal semplice rispetto della normative all'approccio integrato e all'ecogestione*, in *Rivista italiana di diritto pubblico comunitario*, 1996, p. 1091-1113.

[2]CASETTA, Elio. *La difficoltà di "semplificare"*, in *Diritto amministrativo*, 1998, p. 335-362.

[3] CAIA, Giuseppe. *La gestione dell'ambiente: principi di semplificazione e di coordinamento*, in GRASSI, CECCHETTI ANDRONIO, *Ambiente e diritto*, Firenze: Olschki, 1999, p. 237.

[4] FRACCHIA, Fabrizio. *I procedimenti amministrativi in materia ambientale*, in FERRARA, FRACCHIA, OLIVETTI RASON, *Diritto dell'ambiente,* Roma-Bari: Laterza, 1999, p. 143-238

[5] FERRARA, Rosario. *Procedimento amministrativo, semplificazione e realizzazione del risultato: dalla " libertà dall'amministrazione" alla libertà dell'amministrazione*, in *Diritto e società*, 2000, p. 101-119.

[6] SANDULLI, Maria Alessandra. *Tutela dell'ambiente e sviluppo economico e infrastrutturale: un difficile ma necessario contemperamento*, in *Rivista giuridica dell'edilizia*, 2001, p. 3.

[7] ENDRICI, Giovanna. *Territori e ambiente*, in BARBATI, ENDRICI, *Territorialità positiva. Mercato, ambiente e poteri subnazionali*, Bologna: Il Mulino, 2005, p. 131.

[8] MAGLIERI, Alessandra. *L'emersione dell'interesse ambientale nel procedimento amministrativo: prospettive e limiti della semplificazione*, in *Diritto amministrativo*, 2006, p. 847-903.

[9] NANNETTI, Francesco. *Impatti del testo unico ambientale sulla normativa IPPC*, in *www.dirittoambiente.com*, 2006, p. 1-6.

[10] PERFETTI, Luca Raffaello. *Il permanere dei paradigmi disciplinari e le difficoltà della semplificazione*, in *Nuove Autonomie*, 3-4/2008, p. 457-474.

[11] FIGORILLI, Fabrizio. *L'autorizzazione integrata ambientale quale ulteriore strumento di semplificazione*, in *Nuove Autonomie*, 3-4/2008, p. 683-690.

[12] SCOCA, Franco Gaetano. *Accordi e semplificazione*, in *Nuove Autonomie*, 3-4/2008, p. 557-567.

[13] BOHNE, Eberhard. *The implementation of the IPPC Directive from a comparative perspective and lessons for its recast*, in *Journal for European & Planning Law*, 5/2008, p. 1-33.

[14] SPASIANO, Mario Rosario. *Riflessioni sparse in tema di semplificazione amministrativa*, in *Nuove Autonomie*, 2009, p. 75-86.

[15] RENNA, Mauro. *Le semplificazioni amministrative (nel decreto legislativo n. 152 del 2006)*, in *Rivista giuridica dell'ambiente*, 2009, p. 649-671.

[16] GIULIETTI, Walter. *Danno ambientale e azione amministrativa*, Napoli: Editoriale Scientifica, 2012.

[17] CALABRO', Marco. *Semplificazione procedimentale e esigenze di tutela dell'ambiente: l'autorizzazione integrata ambientale*, in *Rivista giuridica di urbanistica*, 2012, p. 201-233.

[18] POEL, Kevin; MARNEFFE, Wim; BIELEN, Samantha; VAN AARLE, Bas; VEREECK, Lode. *Administrative Simplification and Economic Growth: A Cross Country Empirical Study*, in *Journal of Business Administration Research*, 2014, p. 45-58.

[19] ROSSI, Guido. *Diritto dell'ambiente*, Torino: Giappichelli, 2015.

HERITAGE and TECHNOLOGY
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Wayfinding Accessible Design

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Abstract
This text is the result of an ongoing research that shows how accessibility take an important role into a wayfinding and landscape design project related to an historic route named 'Via Regina' which is connected with the famouses Via Francigena and Via Spluga, all along the frontier between Italy and Switzerland. It puts particular emphasis on accessibility and orientation in the paths and places used by everyone but also and especially by people with different abilities, allowing them to have access and to appreciate the beauties of this historical walk. The project consider the "Design for All principles" as guidelines to develop a wayfinding system as inclusive as possible, with last generation technology supports like the Finger Reader, Ownfone system, dyslexic fonts, Circuit Scribe system, QRCode+Arianna Phone App and other existing tactile and sound devices (sound shower, magnetic field, tactile surfaces and floor, Braille system, 3D sculptures) and panels with the correct readability (distance, fonts size, colors) and perception for the user. Also we want to underline and re-evaluate the concept of "Slow Walk" and the tendence to prefer the slow fruition of the landscape in opposition to the stress-like style of life we conduct every day. We include in this process the valorization of the typical materials, folks and traditions, history of pilgrimage, smuggling, commerce exchanges, architectures and places of worship that are reflected into the project supports.

Keywords: Design For All, Wayfinding Design, Landscape Design, Accessible Devices, Arts and History

1. Wayfinding Design and Accessibility
The aim of the research project is to reinforce the shared identity of Northern Lombardy (Italy) and Southern Ticino (Switzerland) by preserving and enhancing the shared cultural heritage present in the historical network of footpaths that connect the regions concerned. The research is part of a wider cross-border program, the aim of which is to implement measures to protect, enhance and promote the landscape and the historical and cultural heritage of the area.
In addition to the Politecnico di Milano in the role of leader, the partners in the program are: the Fondazione Politecnico di Milano, Iubilantes Association, Mountain Community Lario Intelvese, University of Applied Sciences of Italian Switzerland, Cultural Heritage Office of Cantone Ticino, Mountain Community Lake Como and Lugano valleys, Museum of Via Spluga, Town of Cernobbio, University of Pavia.
The "Via Regina Lariana", from Como to Sorico, is one of the oldest routes of historic and cultural exchange between Italy and Switzerland. The beautiful Swiss-Italian footpath along the Via Francisca and Via Spluga, with which it forms a continuum, is a fundamental "system" of transalpine soft mobility, the potential of which for European development has so far not been adequately grasped. It possesses all the characteristics required to be identified as part of a Major European Cultural Route: a trail and a territory, therefore, to know and to protect, and to maintain intact for those who travel on foot.
The specific objective of this project, called "I CAMMINI DELLA REGINA", ID 33829732, Misura 3.1, P.O. Cooperazione Transfrontaliera – INTERREG IT-CH 2007-2013", born from the synergy between cultural experts, local museums, government departments, landscape designers, architects, designers and

geomatics engineers, is to create an adequate tool for the full development of this important route and the surrounding area.
In summary, the project has the following specific objectives:
To compare methodologies and experiences in the safeguarding of assets, heritage and cultural landscape, in particular axis of pedestrian crossing, artifacts found along these pathways and building requalification, restoration and maintenance of the sections of footpaths, bridleways, curbs and construction building present on the ancient roads (toll booths, fountains, springs, river bed of the streams, fords, houses, customs, hospitality and reception sites in general) and religious buildings (churches, newsstands, canonical pathways votive , chapels) exploitable as such or, in the case of canonical, reusable as functional structures to the path and / or reception related.
To support collaboration, exchange and mobility between operators and cultural institutions, strengthening ties and exchanges of experience, research and identification of best practices carried out in the specific field by the various partners;
To promote recovery and enhancement of the peculiarities in the local cultures and the use of innovative tools for communication and promotion of cultural heritage and historical memory of the cross-border.
The research group of the Politecnico di Milano, Department of Design, coordinated by Roberto de Paolis and composed by Massimiliano Mandarini, Silvia Guerini, Maria Rita Ferrara, Umberto Tolino, Francesco Zurlo, Marina Parente, Arianna Vignati, has dealt, among other, to develop together with the Laboratory of Visual Culture of the Department of Environment, construction and design of SUPSI - University of Applied Sciences of Italian Switzerland, coordinated by Andrea De Lucchi, the project of integrated visual communication (brand identity) identifying the identity values expressed by signs of visual and material culture in the area through the design of products, services and communication artifacts (signage, visual identity manual, information points, the drafting of guidelines, promotional gifts and gadgets, computer interfaces, printed and digital publications), to be implemented in four languages (Italian, French, German and English), taking into account the regulations and recommendations on the design of traffic signals for slow and soft mobility.
In the analysis of case studies related to signage was made a choice amongst targeted selection, for both national and international level, where cases were collected with examples of innovative and integrated products and services capable of giving identity, narrative paths and specific orientation to the itinerary.
This identified systems of product and service recurring scenario analysis led to the identification of a list of solutions for a typological signage system in the “I Cammini della Regina” described below.

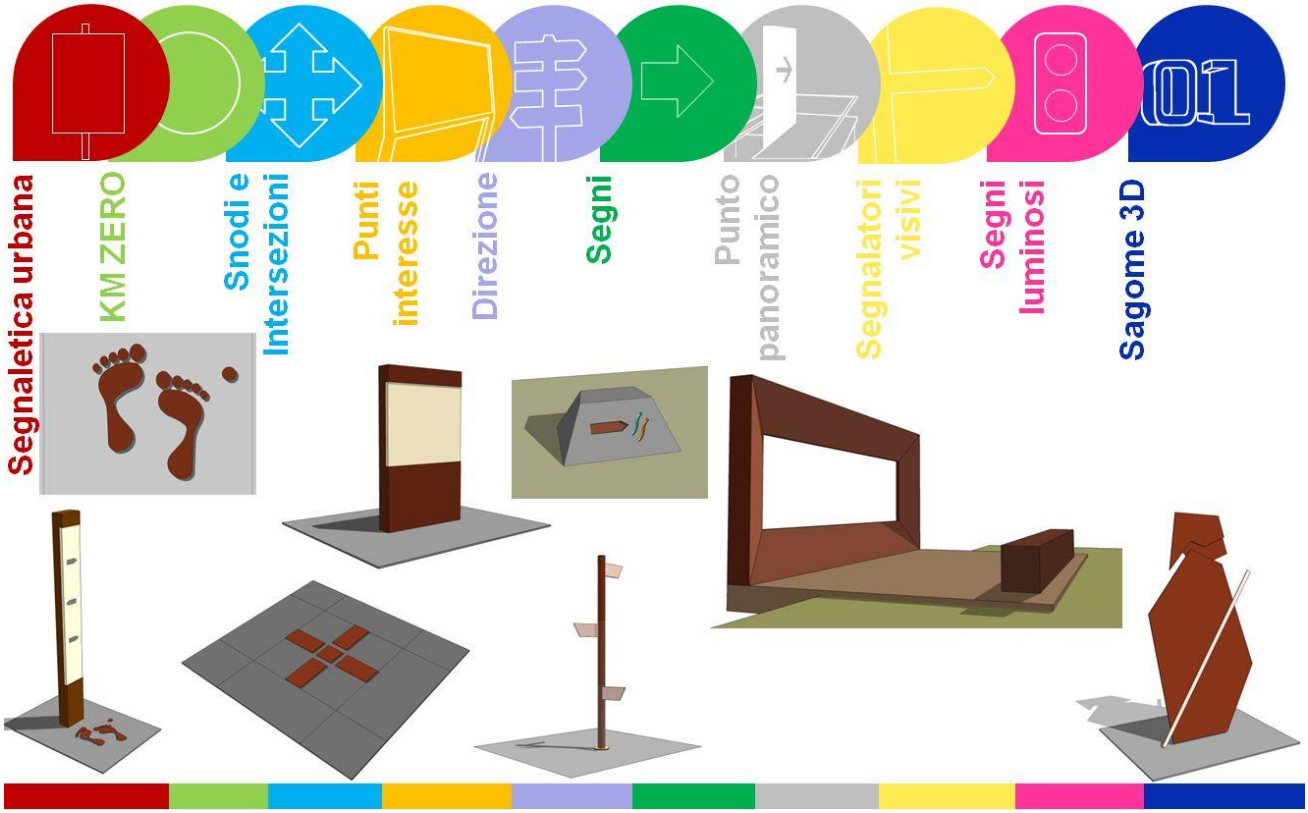


Fig. 1: Abacus for the typological classification of the elements of signage and visual communication.

- Km ZERO: a general philosophy with which to make the products, through the use of products and elements of the territory and from short distribution;
- Recognizability of the signage for urban elements and illustration of the points of interest of the territory;
- Joints and intersections: identification of innovative design to connote the places of intersection and flows;
- Points of interest: elements for the points of interest promotion in physical, digital, traditional and innovative form;
- Directions: design identity for the territory to be used for directional indication systems placed all along the routes;
- Signs: use of sugns systems and traces of horizontal and vertical surfaces, replacing the traditional signage to identify a context, a direction, a point of interest or a route and to communicate specific features of the territory, and with simplified and easily actionable modalities, time and travel/run distances;
- Viewpoints: one of the main purposes of the project is to create the terraces, balconies or structures jutting on specific areas that allow users to contemplate the panorama and the environmental landscape in a safe way.
- Visual Indicators: visualization of the inside or outside of a building, an area of interest or even a single item.
- Bright Signs: systems that accompany the visual displays but also the traditional signage and points of interest in order to create a new bright design, even through portable objects dedicated to a specific purpose, representing the character of territorial recognition even in the twilight hours and allow the night fruition of the itinerary.
- 3D Silhouettes: 3D templates communication will replace traditional bulletin boards and will be placed in the main sites, buildings or routes, which may represent the work, crafts or the characters that define the identity of the land and the wealth of material culture.

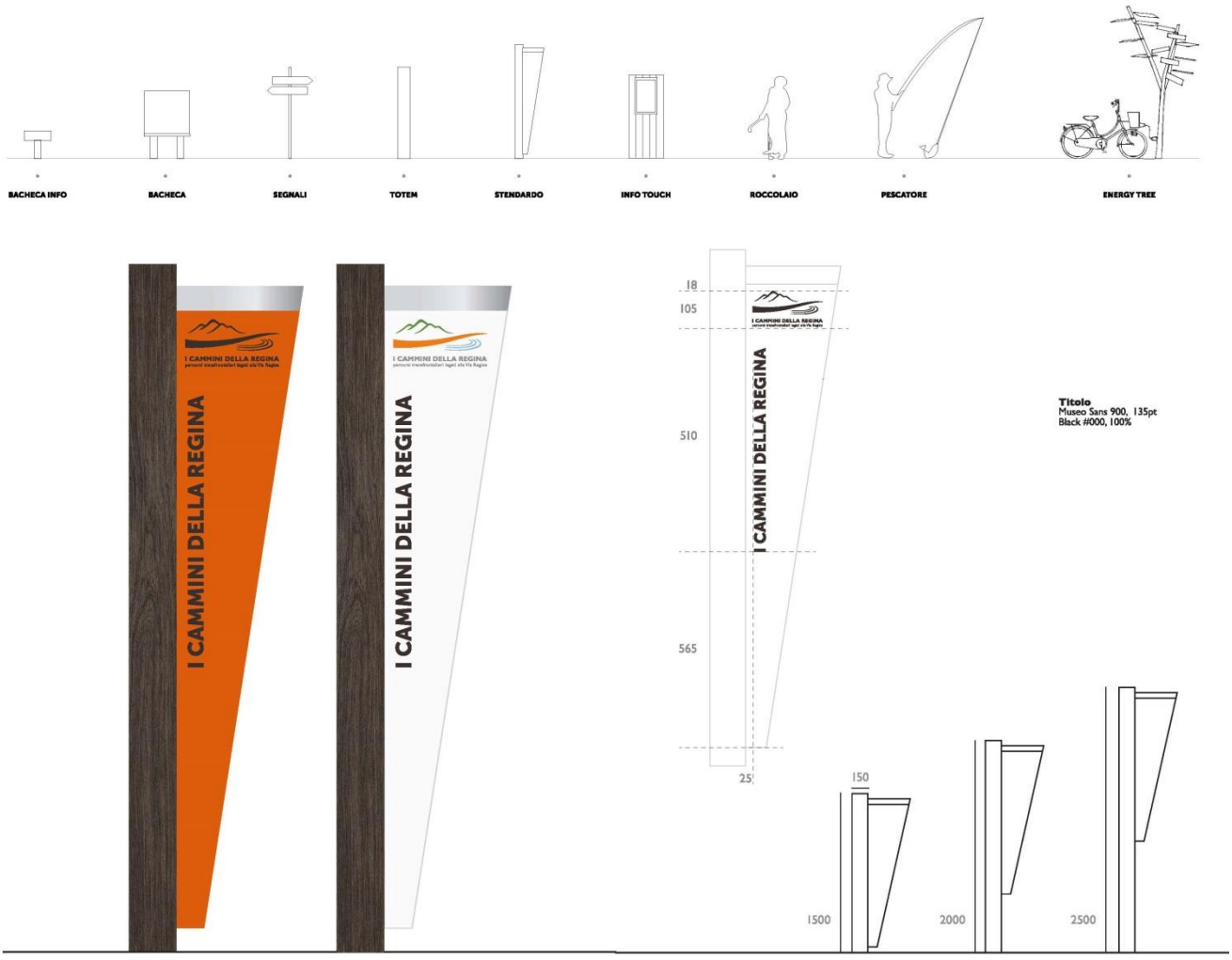


Fig. 2: Supports abacus. Study for banner design.

In this context, a particular attention has given to signage for all and accessibility and the use of the trail by an enlarged and differently abled target.

2. Design for All Principles

The project consider the “Design for All principles” as guidelines to develop a wayfinding system as inclusive as possible. Design For All is an association, a group of members, architects, engineers, lawyers, operators all around the world that share the unique purpose to develop the principles for a better way to use things considering everyone as a user despite of their problems or limits.

2.1 Guidelines for an inclusive wayfinding system

Here below you can find the Design for All guidelines written by the founders in 1992 (copyrighted), explaining in simple words what is and for who is conceived the Design for All.

“Equitable Use: The design does not disadvantage or stigmatize any group of users. Flexibility in Use: The design accommodates a wide range of individual preferences and abilities. Simple, Intuitive Use: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level. Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities. Tolerance for Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions. Low Physical Effort: The design can be used efficiently and comfortably, and with a minimum of fatigue. Size and Space for Approach & Use: Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of the user's body size, posture, or mobility.” Also, a new system of classification (ICF 2001) give a new definition of disability and includes not only the disabilities diagnostically determined but also other kinds of health conditions without distinction between physical and mental. “The new ICF focuses on analyzing the relationship between capacity and performance.

If capacity is greater than performance then that gap should be addressed through both removing barriers and identifying facilitators. The new WHO ICF specifically references Universal Design as a central concept that can serve to identify facilitators that can benefit all people” (humancentereddesign.org)

This clarify in which direction we would move in our project, the wayfinding system should consider everyone who want walk along this historical and attractive path between Italy and Switzerland, and for ‘everyone’ we mean people who can’t walk, see or hear or speak, or with mental desease but also people who have other kind of problem - celiacs, heart sufferings, diabetes, short stature, elderly people, families with toddlers and even strangers who don’t understand the local language - not considering the diagnosis in itself but the gap between capacity and performance in doing things and identifying facilitators.

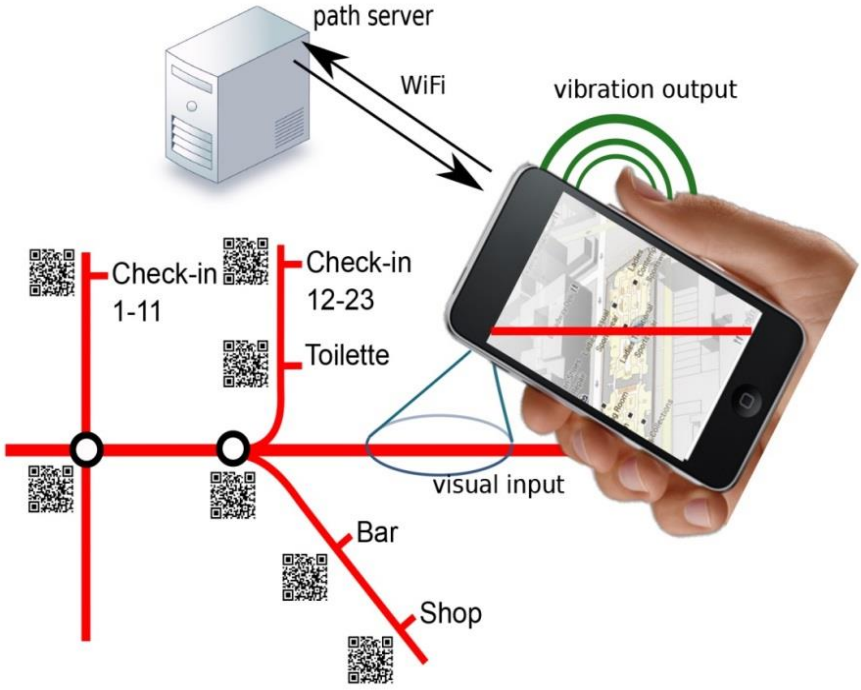


Fig. 3: Arianna App example of functioning. www.webnews.it/2014/01/09/arianna-il-bastone-virtuale-per-i-non-vedenti/

2.2 Main rules in wayfinding project “for all”

Speaking about facilitators, we usually use this term to indicate all the visual, tactile, textural and sensory elements, that represent a support for the user who can’t get over an obstacle, someone who wish and want to take benefit of the territory services, but that for different reasons can’t reach them in a standard way.
In the case of wayfinding design, it can be a panel set too high, a text written too small, a path which is not feasible, a sound which is not audible in a complex society like ours.
Another aspect to consider is the emergency situation; it is important that the information about how to do and who to contact in case of an accident are very clear and understandable.
Hence the need to take inspiration from good design so that it can carry useful examples of 'human-centered' wayfinding systems in which objects and supports are accessible to everyone, without distinction, to overturn the obstacle into a free-path and the disadvantage into opportunity. “[…] on the one hand we have to think to the supports that help the person overcome the obstacles to a normal communication, on the other hand we must try to reduce the obstacle itself” (P. Cecchini).

In practice, here are some ergonomic aspects to be taken into consideration.

The roads width should not be less than 1.40 m; to the readability of the panels it is recommended a **font size that is at least 3% of the reading distance**; it is preferable to use **letters and pictograms of 30 mm and 50 mm size** respectively, for a distance of 1 meter, while 150 and 250 mm for a distance of 5 meters.
The font is preferable in sans **serif version, in one or maximum two styles** (Futura, Century Gothic, Arial, Frutiger, Gill Sans, Helvetica, Univers, ..) , at least 18 points with 1.5 line spacing.
The height of the panels should be 1.50 mt for the readability even from below.
For orientation signs, **the height of the fonts must not be less than 4.5 mm and 15 mm**.
It's a good practice to provide information panels all along the way, especially in the decision points that indicate **where you are and what you are getting**.
Also, for eye-impaired and blind people, it should be added a reminder signage, in relief on the ground, to pay attention and to announce the near panel.
In the case of visually-impaired people it should be used at least **70% contrasts among different colors** and shapes that is suitable for an optimal understanding of the message.
The same principle should be adopted for the sounds, into the range of **mid-low frequencies** without cadence and with a good pronounce.
Vertical pillars all along the way and tactile elements on the ground, help blind people to redirect their walk, at the same way as panels in Braille placed all along the route and in front of the main points of interest.
http://www.architonic.com/pmpro/marcal-signaletique/3103170/2/2/1. They can be used also as a limit support all around exposed objectsto allow blind people to realize their real size and shape.
A useful support are **small-scale sculptures** that represent particular things that we find on the path: a building, an architectural element, a typical material that the blind user can touch to realize the characteristics (we called it ‘haptic approach’). This support can be associated to Tooteko App (see next paragraph).
The tables in Braille or the **multi-sensory plans** (which schematically represent the structure of a path in relief, with big characters and Braille) should have a **space below of about 70 cm** to allow the approach of a wheelchair, and a **height of 80 -130 cm** for the readability.
The **Wire Ariadne** is and remains one of the most adopted systems, it consist in an horizontal embossed line with which the blind is fitted with stick helping him to follow the direction of the street; it is mainly used for indoor spaces but it is increasingly applied in the outside too (the platforms of the train stations or airports).
Finally, for an approach that is as natural as possible even for those who can’t easily make the walk due to motor problems, the roads should be maintained in a standard width of 140 cm, some steps can be equipped with special elevated pedestrian facilities that allow the passage without drastically change the natural habitat.
Panoramic points are another important element in a walk, they allow us to see the beauty of a whole natural landscape; for those who want to enjoy the scenery but have difficulties to reach it, it is useful to implement the structure with specific devices, and if possible it should be equipped with all the tools described above (tactile boards , subtitled audio-visual interfaces , ..).
For the displacements it is required an unobstructed area of 150 cm in diameter and an area of vision between 60 and 100 cm.

3. Technological devices for an accessible fruition accessibility

3.1. Arianna App and associated QRcode

A recent application (2014) allows you to read your position and direction through a special scotch tape fixed on the floor and provide an auditory guidance (when the line on te floor is under your finger, your

smartphone intercepts it via webcam and emits a vibration). This system can be associated to QRcodes all along the way, when you are in front of a sculpture, a typical object, a panoramic view, etc. and make you a detailed audio description. The QR-Code and the dedicated app allow you to access information (mainly sound but also video with subtitles) that enrich your knowledge about the path you're walking on, it is friendly-user with an easy approach for an individual use, to allow a more complete experience of walking .
http://www.webnews.it/2014/01/09/arianna-il-bastone-virtuale-per-i-non-vedenti/
For the hearing-impaired and deaf people is important to point out, when available, the presence of **magnetic field** to listen **using telecoil hearing aid**. Usually the presence of magnetic field is signalised by a specific icon (an ear strikeout and T). This allows hearing-aid wearers to exclude background sounds and focus the listening to the speaker; subtitles are welcome especially when the speaker is over.
It's useful to provide the route with multimedia information points, all along the route.
Another useful device is the 'sound shower", which delivers sound from a specific point where the user is located in, under it, so that he can receive information without disturbing people around.
http://www.euphonia.fr/douche-sonore.html

3.2. OwnFone

This phone has been created using 3D printer and customized for everyone even in Braille; if the blind user doesn't know Braille code, he can have a raised text on the keypad.This system allow special users to have a Braille interface and buttons to contact particular people in case of need creating a constant conncetion between the blind users and their friends or family. An Haptic touchscreen help to recognize the contacts he fixed on, with a credit-card size and customizable screen with two or four programmable buttons pre-programmed to call friends or family members or emergency service. Alternatively Apple's VoiceOver is another app that read the screen allowing users to navigate their phone sing gesture-based controls.

3.3. Dyslexie Font

In 2008 the dyslexic designer Christian Boer, has invented a font that facilitate people suffering dyslexia to read and produce text using a particular font which is especially conceived to reduce dyslexic troubles like leisure confusion and bad legibility. This font is a classic "Sans Serif" but with some modifications on the bottom/top/side of the letters, in orientation and dimension. Every letter distinguish from all the others by their shape so that everyone of them is unique. The designer create a website to present and diffuse this font.



Fig. 4: OwnFone prototypes. Now in production, you personalize the haptic display with the contacts you want

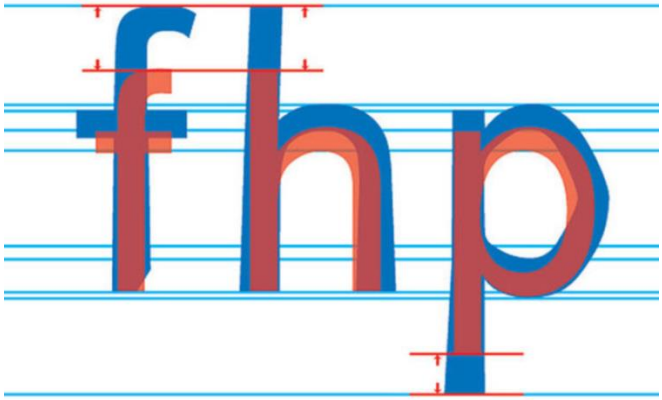


Fig. 5: An example of Dyslexie Font (blue) in comparison with a classic Sans Serif font (red). www.dyslexiefont.com

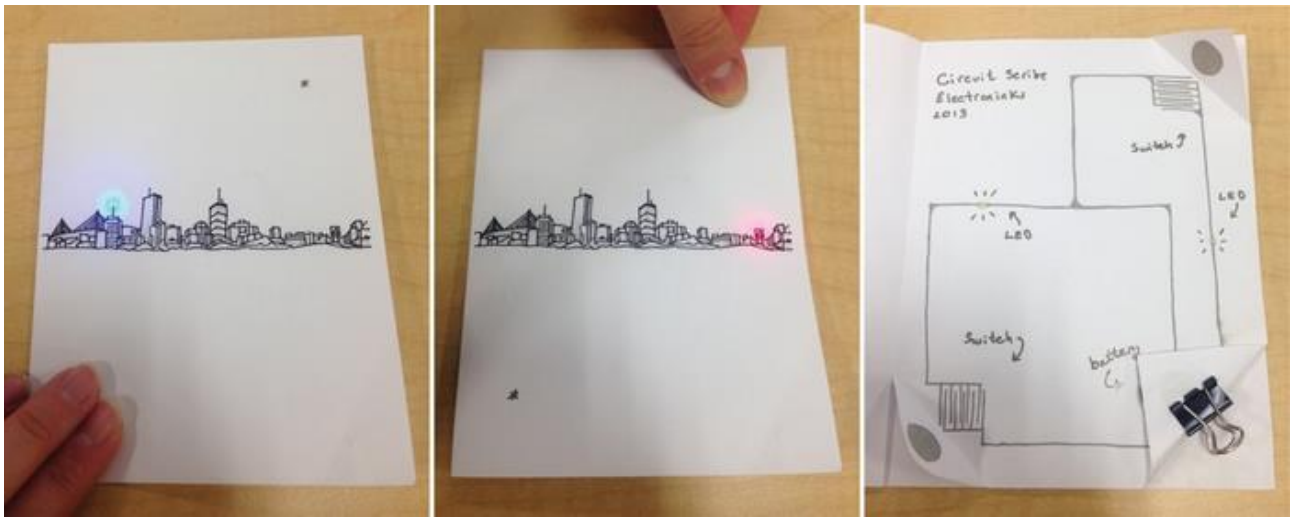


Fig. 6: An example of the Circuit Scribe process www.kickstarter.com/projects/electroninks/circuit-scribe-draw-circuits-instantly



Fig. 7: The Tooteko components: the 3D model with hotspots on, the ring that read hotspots, the app on the tablet with wi-fi connection

3.4. Circuit Scribe

Circuit Scribe is an application to make light with a liquid conductor circuit and a little battery and it activate with a simple gesture. You can draw smooth lines with conductive silver ink to create functioning circuits instantly with a coin battery, a paper clip and LED and associate them with other components. You can apply it on a lot of supports so it become an instrument that help in the creation of other objects. Besides you can draw what you want in the form and shape you have in mind. It is possible to use it with Arduino another open source application that allow people to create a lot of electronic stuffs. It can be used into a map where each stop light up when you reach it, like in the Via Regina's route.

3.5. Finger Reader

Finger Reader is a device that enable blind users to read books or other written supports, line by line in a sequential manner scanning the text the finger is following, providing real time speech and tactile feedback. The ring on the finger has a camera that focus words at a fixed distance using the sense of touch when scanning the surface; also the device does not have many buttons to facilitate the use by an eye impaired user. Two vibration motors are fixed on the top and bottom of the ring to provide haptic feedback and indicate to the user how to move the finger. Here is the hardware process "[..] we look for text lines by fitting lines to triplets of pruned contours; we then prune for lines with feasible slopes. We look for supporting contours to the candidate lines based on distance from the line and then eliminate duplicates using a 2D histogram of slope and intercept. Lastly, we refine line equations based on their supporting contours. We extract words from characters along the selected text line and send them to the OCR engine. Words with high confidence are retained and tracked as the user scans the line. We record the motion of the user to

predict where the word patches might appear next in order to use a smaller search region." (http://fluid.media.mit.edu/sites/default/files/paper317.pdf)

3.6. Tooteko

Tooteko is a system that allow blind and partially sighted users to learn informations about art and monuments in scale (tactile models), by touching them.
Many museums are equipped with scale models that represents big architectures or monuments and art works. Tooteko enables the blind users that touch models to receive real-time auditory informations about what they are touching with their fingers.
The auditory data is activated by the contact of the hand on different parts of the model and in case of multiples touches in sequence, this sequence is respected in the audio too. This is innovating in comparison to classic audio-guide which gives informations but doesn't follow the tactile perception.
Tooteko is composed of: an hi-tech ring; a tactile surface tagged with NFC sensors; an app for smartphone and tablet.
How does it work? The ring read the NFC (Near Field Communication) tags positioned on the model (with hotspots) and via the app send them to the smartphone or tablet that activate the audio track referred to each NFC touched tag. Everything happen in wireless mode. The hotspot-NCS tags are recognizable via braille keys on the surface.
This system can be applied on any 3D surface (statues, architecture models, sculptures, 3D plans, etc).

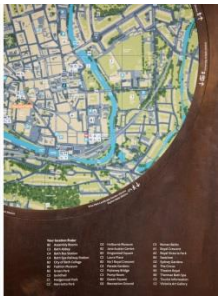
4. Conclusions

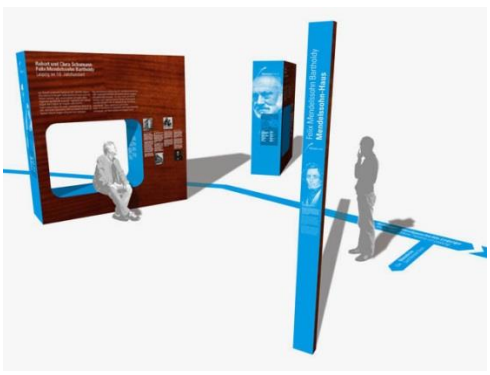
We have seen how it is important to include accessibility in a project and especially in a wayfinding project, where you must orientate people all along a great path into nature. Everyone has the right to access to the beauties and panoramas that this route can offers. It is essential to develop supports and visual symbols that everyone can understand without distinction and give information in the most efficiently way considering different parameters like speech, volume, length, distance, space around the user, color contrasts, support dimensions and materials, relief elements.
Some last generation technological devices can be adapted to the project, here are some examples:
- blind people could "see" a church on the Via Regina route touching the scale tactile model positioned in the interior and hearing the description of each part they are touching in sequence using tooteko;
- the stops in the Via Regina Plan could become luminous when you visit them in order to evidence how many stops remain to visit. This would be possible using Circuit Scribe; the same system can be adopted in a Via Regina Map and card leading to a personalization, a souvenir and a record about our own tour;
- the content of the panels all along the route can be written using dyslexic font, this would be readable by everyone but especially by whom are suffering from dyslexia at differents stages and have difficulties to distinguish letters;
- Arianna App is an useful application that can be adopted for blind people when they are in limited spaces all along the Via Regina route like panoramic points or crosspoints, so users can choose where they want to go and what they want to see in the area near around: watch the panorama, go to the toilet, go to read the information panel or go to visit the church just near to them.



Fig. 8: Supports abacus. Study for Via Regina wayfinding system. Other samples from the guidelines for the different types of panels.





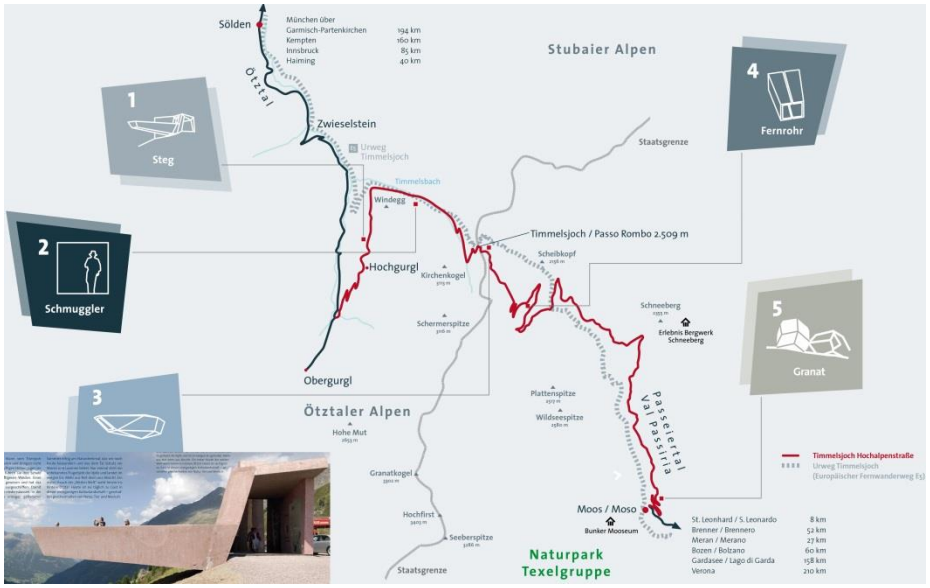




Fig. 2 Esempio schematico di un punto d'informazione TL (punto info)

Figg. 9-16: Some of the case studies we considered during the research phase of the project.
9-10. F1rst Design Studio (DE) – Touristisches Leitsystem Stadt Solothurn – www.basig.net/portfolio - 3D orizontal signage that exploit the structure of the street and its surface
11. PearsonLloyd (UK) – City of Bath Wayfinding System – www.pearsonlloyd.com – an exemple of use of material in armony with a strong presence of historic and architectural elements typical of the city of Bath in Great Britain
12. BuroNorth (AU) – Fall Creek Alpine Resort – www.buronorth.com/projects - an exemple of integration of a peculiar signage structure into the natural environment. As in the Via Regina route, the nature presence is very strong.
13. NTK Studio (DE) – Notenspur Leipzig – www.n-t-k.de/orientierungssysteme - this system exploits the orizontal orientation signage integrated with vertical totems and multifunctional stand
14. Adler & Schmidt Studio Leitsystem Rheinhald Pfalz - www.adler-schmidt.de/de/komdesign/orientierung/rheinland-pfalz.html - It show how powerful is a 3D sample of a place, for touch and sight
15. Timmelsjoch - www.timmelsjoch.com – a project with strong similarity with the Via Regina one in particular for the panoramic point structure
16.Swiss standard pedestrian signage system. Example of an information panel along a swiss route. The swiss pedestrian signage is standardized for all the country regions in format, color and typography rules.

Bibliographical References

[1] ROY, Shilkrot. MAE, Pattie. HUBER, Jochen. NANAYAKKARA, Suranga C. LIU, Connie K. *FingerReader: A Wearable Device to Support Text Reading on the Go*. In AA.VV. Proceedings of *CHI 2014 Extended Abstracts on Human Factors in Computing Systems*, April 26-May 1, 2014 Toronto, Ontario, Canada.

[2] AA.VV, *Pour une signalétique accessible à tous. Guide methodologique de conception d'une signaletique accessible à tous destinée aux decideurs publics et aux concepteurs*. 2014, with the support of Saint Etienne Metropole et Ville de Saint Etienne
http://www.developpement-durable.gouv.fr/Publication-d-un-guide.html

[3] AA.VV. *Guide pour l'accessibilité dans les espaces naturels. Outil d'accueil et d'interpretation*. Cahier technique n° 85. Aten 2012 - http://ct85.espaces-naturels.fr/

[4] *Culture et Handicap. Guide pratique de l'accessibilité* (pdf format) edited by Ministère de la culture et de la communication – France – 2007 - ISBN : 978-2-11-096811-1
http://www.culturecommunication.gouv.fr/Politiques-ministerielles/Developpement-culturel/Culture-et-handicap2/Guides-pratiques/Culture-et-handicap.-Guide-pratique-de-l-accessibilite

[5] AA.VV., *Azione 2. Proposta di segnaletica di percorso della Via Francigena. Cap 2* in *Via Francigena. Una nuova offerta turistica italiana.* Interregional project coordinated by Regione Toscana in collaboration with MiBAC - Ministero dei Beni Culturali e Ambientali, Italy
http://www.toscana.confcooperative.it/C10/Notizie%20Federcultura%20Turismo%20S/Document%20Library/manuale_Francigena_14_4_09.pdf

[6] CENTI, Stefania, MOSSONE Maria Chiara, BORGHETTI Jacopo, TRAMONTI Eleonora, *Il prodotto turistico accessibile* (pdf format) – Edited by Eu.For.Me project financed by the European Commission

[7] CECCHINI Piero, *Le nuove tecnologie per non udenti*. Cap 2, Par. 2.2 – in *Tecnologie multimediali per l'handicap*. A cura di COSTA Aldo – Provveditorato agli studi di Bologna Progetto Marconi.
http://www.bo.istruzioneer.it/cliccando/cap22.pdf

[8] *Access Today.Parks recreation tourism.* Fall 2002 – Special Volume Issue 8. USA. A publication of the National Centre on Accessibility - 2805 East 10th St, Suite 190 Bloomington, IN 47408.
http://www.hfrr.ksu.edu/doc2143.ashx.

[9] Via Regina. History and culture: http://www.viaregina.eu/l-antica-via-regina

[10] Circuit Scribe system: http://www.classthink.com/2013/12/04/circuit-scribe-working-electronics-textbook/
https://www.kickstarter.com/projects/electroninks/circuit-scribe-draw-circuits-instantly

[11] Tooteko Talking Tactile: http://www.tooteko.com/web/wp-content/uploads/2014/10/Tooteko_cartella-stampa-ITA.pdf

[12] Arianna App: http://arxiv.org/pdf/1312.3724.pdf

[13] Dyslexie Font and dyslexia:
http://www.dyslexiefont.com/download/files/DyslexieRegularResearch2012.pdf
http://dyslexiahelp.umich.edu/sites/default/files/good_fonts_for_dyslexia_study.pdf

[14] Studio geometrico di pittogrammi e icone. Manuale di utilizzo e applicazione:
http://www.tiragraffi.it/ispirazione/design/2013/06/studio-geometrico-e-realizzazione-di-100-pittogrammi-e-icone

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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A style between two centuries: the Great Hall of the Faculty of Architecture of Rome.

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Abstract
The proclamation of Rome as the capital of Italy marked the starting point for an impressive urban development. The city, included within the Aurelian Walls, seemed to turn into a shipyard for the construction of several buildings linked to the function of a capital while neighborhoods for new social classes were being made to crown around the Old Town. It was, therefore, to create a dichotomy in the architecture of Rome for which public buildings, full of symbols, were represented by an eclecticism sometimes oversized, while private houses absorbed the traits of the modern architecture that already had spread across the Alps and into Italy took the name of Liberty. Hampered by the cultural climate, extremely closed towards European art, the architects gradually introduced the new style that, however, in Rome never reached the inspiring models. The fusion of the new trends with the constructive tradition gave rise to a particular architectural language recognizable in several buildings of the time. Among them deserves attention, the restructuring carried out in the first thirty years of the '900, in what is now the Great Hall of the building of the Faculty of Architecture in Piazza Borghese: an interesting solution that, even in its small size, contains the own characters of the architecture of the period bringing out the contrast between the linearity of Art Nouveau and the character of fortress attributed to specific architectural elements.

Keywords: Great Hall of the Faculty of Architecture of Rome, Liberty, survey,

1. Introduction
When Rome was officially proclaimed capital of Italy February 3, 1871, the city found itself totally unprepared for the new role for which it was awarded. The capital of the Papal States, in the course of his last three centuries of life, was in fact remained almost unchanged from the urban point of view without that it was felt necessary to take any of those changes that had already affected many other European cities starting since the second half of the nineteenth century, such as Paris, Vienna and Barcelona. Included within the Aurelian Walls, which were now an anachronistic border, the city lacked the infrastructure that the new role of capital of Italy entailed. Thus was born the need to undertake a series of rapid urban transformations that comprise both the historic city and the necessary peripheral expansions. The whole city seems to turn into a shipyard for the construction of several buildings linked to the function of a capital city while districts for new social classes were being made to crown around the Old Town. In this fast-paced architectural climate it was therefore to create a dichotomy where the public buildings, full of symbols, were represented by an eclecticism sometimes oversized – we remember among others the Exhibition Palace by Pio Piacentini (1883), the Policlinico Umberto I by Giulio Podesti (1903), the headquarters of the Bank of Italy by Gaetano Koch (1888-1892), the Military Hospital of Celio (1885-1891), the Palace of Justice by Guglielmo Calderini (1888-1910), the National Gallery of Modern Art by Cesare Bazzani (1908-1911) and, not least, the Monument to Vittorio Emanuele II by Giuseppe Sacconi (inaugurated in 1911, but ended in 1925) – while private homes, especially for certain social classes, absorbed the traits of the modern architecture that already had spread beyond the Alps and into Italy took the name of Liberty. However, hampered by the cultural climate, extremely closed towards European art, the architects of this time gradually introduced the new style that, in any case, in Rome never reached the inspiring models. The combination of new trends with



Fig. 1: The fortitude character in the design of the portals: on the left the doorway inside the Great Hall of the Faculty of Architecture of Rome, on the right a doorway of the same period in Trastevere.

building tradition, gave rise to a peculiar architectural language found in numerous interventions of the time, characterized by the fusion of a particular character of fortitude, often seen in the design of portals (Fig.1), with its fluid linearity of the decorative elements. Among the many examples we want to present here the restructuring made in the twenties of the '900, in what is now the Great Hall of the building of the Faculty of Architecture in Piazza Borghese.

2. From the stables of Borghese to the seat of the Faculty of Business and Economics, then of Architecture

The building is located in the area where the existing structures were owned by the Borghese family, illustrious Roman family that had settled by the end of the sixteenth century. The Borghese family had his residence in the square of the same name, that before was named square Dezza. Cardinal Camillo Filippo Ludovico Borghese, who became Pope in 1605 under the name of Paul V, bought it at the end of 1500 a pre-existing artifact designed by Vignola as well as other neighboring properties and gardens. The residence was completed and expanded later by Martino Longhi the Elder and Flaminio Ponzio and, in the second half of the '600, again remodeled and enlarged by Carlo Maderno and Carlo Rainaldi. All the city blocks between via Ripetta and the current Piazza Borghese became, from the end of the '500, property of the Borghese family. In front of the secondary facade of the noble residence is a sixteenth-century building whose construction is due to Cardinal Scipione Borghese as a residence for the servants. Even the triangular block, where in the twenties of 1900 was built the palace for the Faculty of Business and Economics of “Sapienza” University, at the time was destined to stables pertaining to the residence of the noble family. A synchronic reading and a critical analysis of documentary material contributes greatly to the understanding of the evolution and transformation of architectures and their immediate context.

The plan of Rome by Leonardo Bufalini (1551) (Fig. 2) represents the area in question through a perimeter of buildings. Only the perimeter of the block, which a century later became the residence of the Borghese family, presents inside the perimeter a building plan. This would mean, in the hierarchy graphic adopted by Bufalini, that the blocks where was built the Palace - now headquarters of the Faculty of Architecture – at the time were not prestigious, contrary to what happens to the block that later will become the noble residence. The evolution of the area is also attested by the three-dimensional map made by Mario Cartaro (1576) (Fig. 2), designed some ten years after that Vignola designed his palace for Monsignor Tommaso Del Giglio.

In both maps is not present the open space that later is formed at the end of Via Borghese and that is well evidenced in the three-dimensional plan by Giovanni Maggi (1625) (Fig. 3).

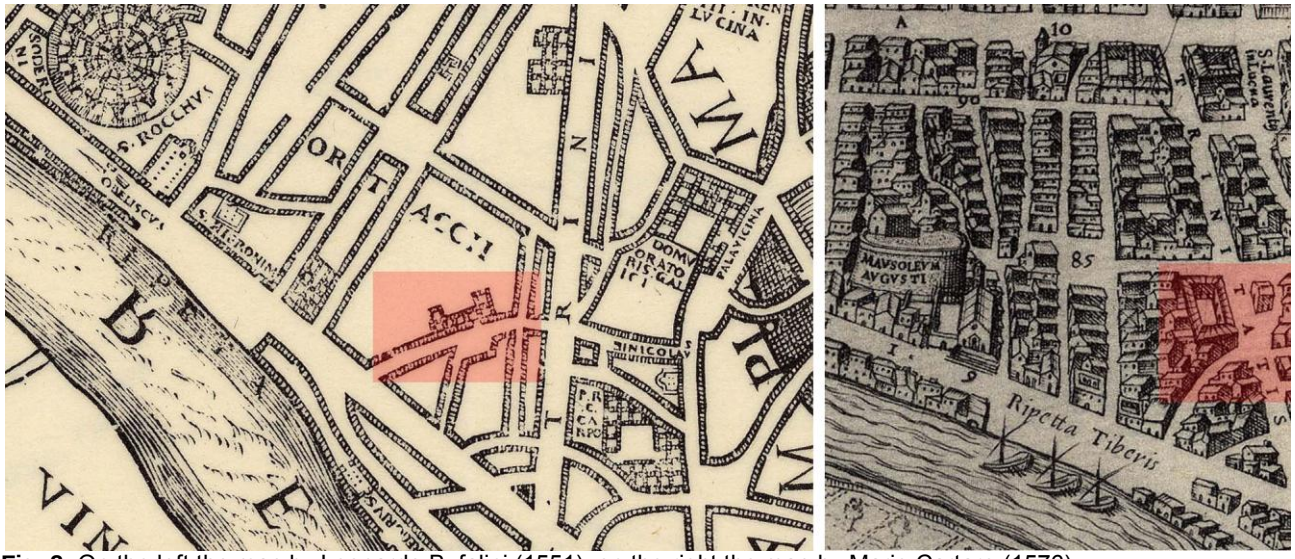

Fig. 2: On the left the map by Leonardo Bufalini (1551); on the right the map by Mario Cartaro (1576).

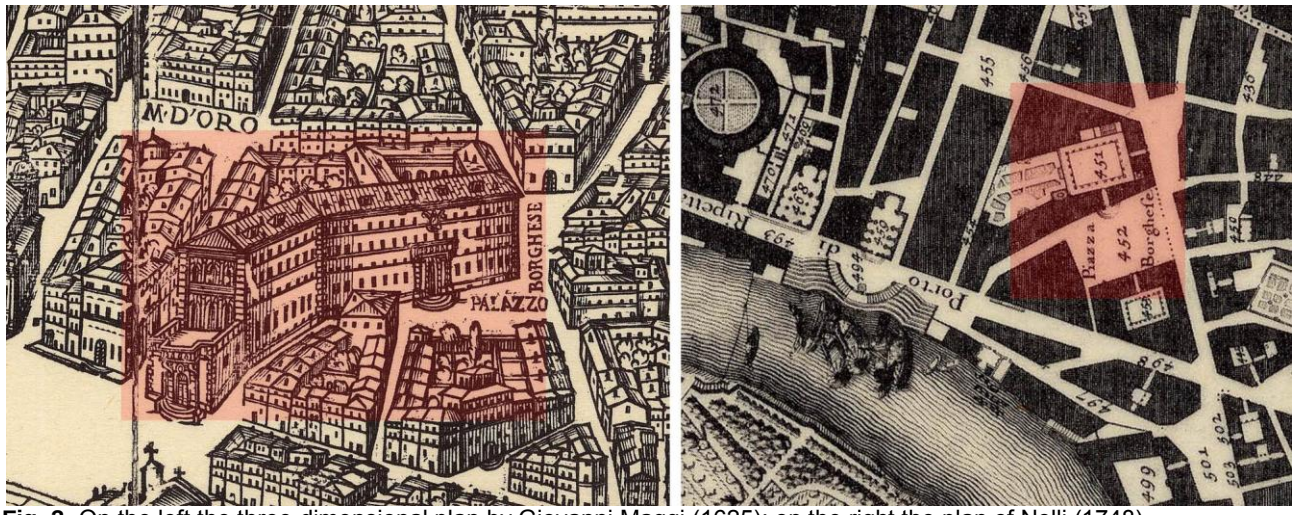

Fig. 3: On the left the three-dimensional plan by Giovanni Maggi (1625); on the right the plan of Nolli (1748).



Fig. 4: Giuseppe Vasi, *Palazzo Borghese*, 1745-1765.



Fig. 5: The Great Hall, view of one of the short walls and detail of stucco marble decoration.

The plan of Nolli, published in 1748 (Fig. 3), gives us a picture of the area in its present condition: the via Borghese that, starting from via Ripetta, presents on the left side, the secondary facade of the Palazzo Borghese and, on the right side, the triangular block dictated by the existing buildings pertaining to the Borghese family. In addition, also the front of the palace, designed by De Baptistis, looks the square. The engraving by Giuseppe Vasi (1745-65) (Fig. 4), coeval with the Nolli map, gives us a picture in which the square is presented as pertaining to the noble Palace. In the background are clearly visible the buildings on which, between 1923 and 1928, was built the first seat of the Faculty of Business and Economics of "Sapienza", commissioned by the Royal Institute by Economic and Commercial Sciences, which later became Faculty of Architecture.

3. The Great Hall

On the first floor of the building located between via Ripetta, via Borghese and Piazza Borghese, result of the restructuring made between 1923 and 1928, designed by Giuseppe Marmiroli to house the first seat of the Faculty of Business and Economics of "Sapienza ", there is the Great Hall subject of this paper. It is a room of limited size with an almost rectangular shape in which there are 7 doorways (the four lowest positioned, two by two, along the short walls, and the three highest, along the long wall); only three of them, however, allow the passage to the adjacent rooms of the building. On the long side, opposite the entrance are placed in perfect symmetry with doorways three windows that give light to the whole place. The Hall, especially interesting for the elements characterizing it, contains the characters proper of the architecture of the period and emerges clearly accentuated the contrast between the Liberty linearity (albeit limited and restricted to decorative elements) and the character of fortress attributed to specific architectural elements. The walls of the Hall, from the ground up to a height of 1.50 m are coated with a surface gray stucco marbled finished at the top by a strictly geometric series of grooves; doors and windows are framed with the same material too. (Fig.5). The fortress character of the Hall lies mainly in the features of the robust pseudo-medieval portals. Made of wood, some with two doors that open completely, others with sub-opening, the so-called "hatch", they have a rigid design with panels that have in the middle decorative diamond point studs. Both portals and frames contrast with the linearity and the elegance of the other decorative elements, sculptures and paintings inspired by nature. Doorways and windows have also overpanel where there are reliefs of lithe snakes - especially above the door frames of the short sides - or large feathered wings of birds, or even simple plates engraved with the two Latin phrases "DISCITE" and "ITE " (Fig. 6).



Fig. 6: The Great Hall, detail of the overpanel with snake and Latin phrases.

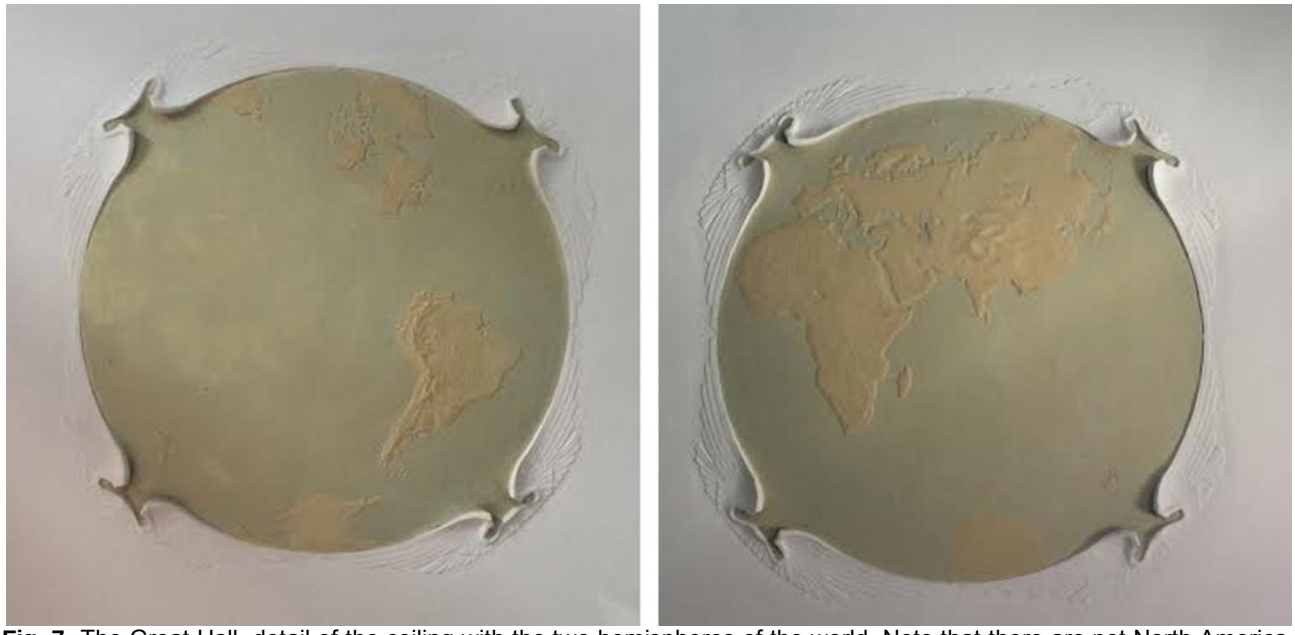

Fig. 7: The Great Hall, detail of the ceiling with the two hemispheres of the world. Note that there are not North America and Australia.

The decorative pattern of large feathered wings - perhaps a reference to the speed of commerce? - is often used in the entire Hall: we find it made in stone, approached the stucco marbled frames of the central door and window and, oversized, in wall paintings (Fig. 5). The surfaces of the walls are marked by gypsum bands framing simultaneously both the overpanel and the frescoes, made by Andrea Petroni of Venosa, painted on the four walls. Particularly interesting is the corner solution adopted, consisting of a vertical perforated strip with a strongly chiaroscuro, placed at 45° with respect to the adjoining walls, which rests at the bottom on a jagged surface which finishes trough a sort of flattened pyramid triangular base. (Fig.5). The same band, placed horizontally, runs along the upper end of a large part of the walls. Even the ceiling presents interesting elements: a plaster frame concave represents the connection between the end of the perforated walls and a broad perimetral band contouring the entire surface of the roof, on which are inscribed pseudo-strips which, approaching towards the angular zone, sag and become first portions of circles, then, at the corner, real circumferences. The resulting effect is that of a slight wave propagation (Fig. 7). Interesting then the decoration of the ceiling where there are the two hemispheres of the terrestrial globe enclosed in two circular stucco frames that are raised from the plane of the ceiling repeating the motif of the feathered wings and creating a decorative pattern, linear and sinuous. This decoration, evidently a reference to the universality of the trade, has the peculiarity that, in the representation of the world, is notably absent, for reasons not yet clarified, North America and Australia.

4. Survey and post-processing activities

Survey activities were carried out through the use of laser scanner Leica C10 supplemented by direct measurements. First has been prepared a project for digital detection carried out for the purpose, after a

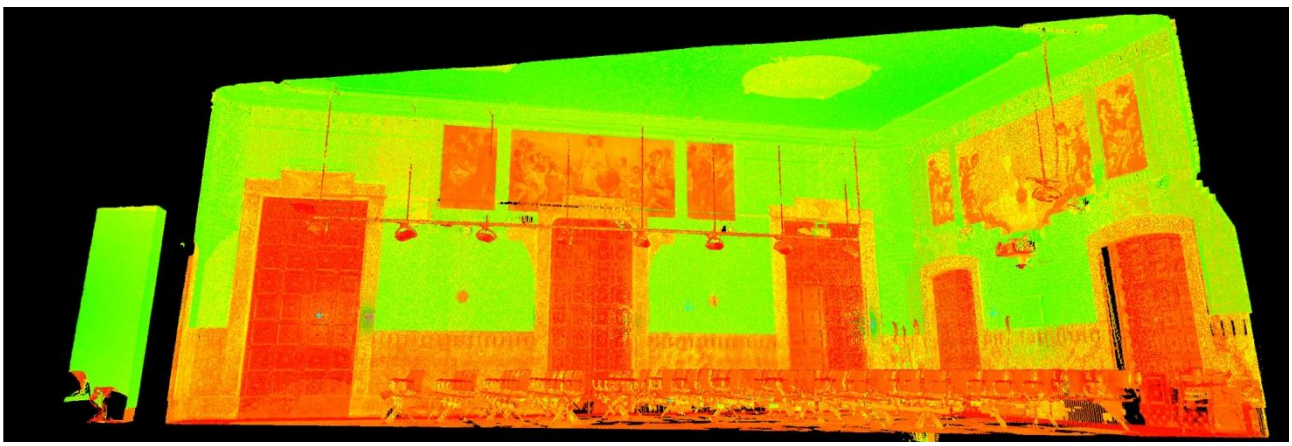

Fig. 8: Picture of the Great Hall from the point cloud.

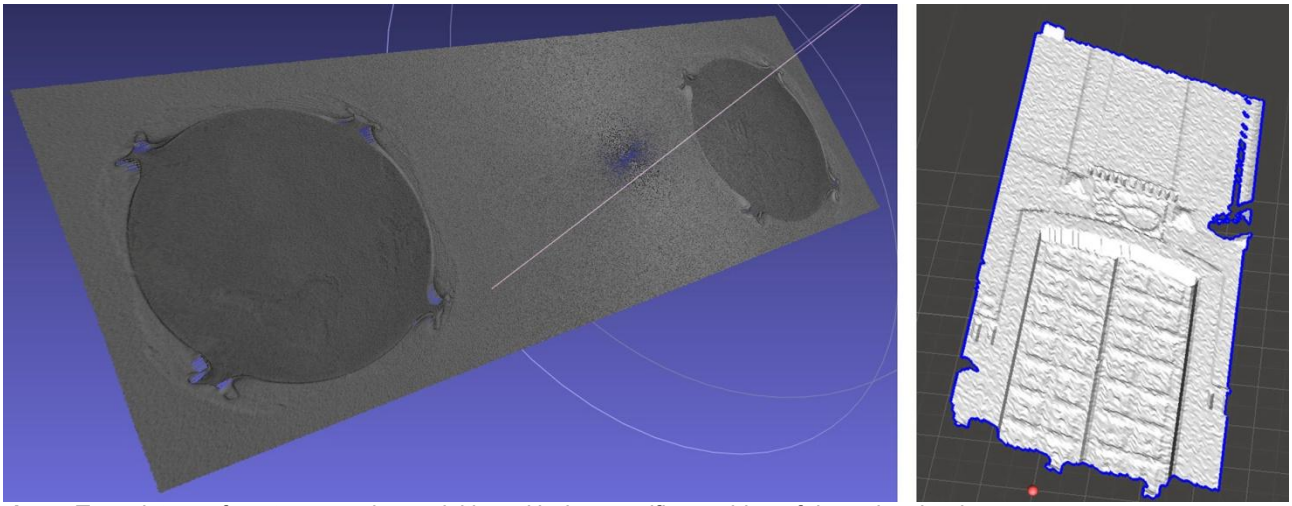

Fig. 9: Two picture of post-processing activities with the specific meshing of the point cloud.

several site inspection useful to examine the conditions of light (natural and artificial) and the practicality of the spaces for the best positioning of the instruments. For the metric control of the cloud unions resulting from successive scans there were acquired numerous direct measurements and also have been used a lot of two-dimensional white/black target. The use of target allowed to facilitate the activities of union of point clouds and ensure better control of the final result. Each scan was in fact done so that you could always see at least three targets referable to the next and previous scans. The overall activity was facilitated by the limited size of the architectonical place and by the possibility to directly measure many elements perfectly recognizable in laser scans. Scanning activity was constantly accompanied by a constant photographic documentation, done either with the integrated camera scanner with both external camera so you can rely on high-quality images. Post-processing activities, still in progress, began with the cleaning of individual scans in order of their union. From the union of point clouds are derived general drawings (plan, sections) as well as some details for which was made a specific meshing of the point cloud.

Sections 1 and 4 are by G.M. Bagordo; section 2 and 3 are by L. Carnevali.
Although the responsibilities of the individual sections, the authors want to emphasize how this paper - such as conducting the research - is the result of their full and constant cooperation.
The post-processing activities are also attended by arch. Maria Rosaria Cundari.

Bibliographical References

[1] BARDATI, Flaminia. *Piazza Borghese.* In CAGIANO DE AZEVEDO, Raimondo (edited by). *La Facoltà di Economia. Cento anni di storia: 1906-2006*. Soveria Mannelli (CZ): Rubbettino Editore, 2006.

HERITAGE and TECHNOLOGY
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The rehabilitation of the school building heritage in Potenza (Italy)

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Abstract

The European Directive 2012/27 on energy efficiency requires the Member States to reduce consumption and to adopt strategies for the rehabilitation of buildings. The Italian territory is characterized by the presence of a wide public and private building heritage characterized by low levels of quality and efficiency, where rehabilitation energy is a fundamental priority. Many buildings, including schools, made before the 70s, are responsible for a high energy consumption.
An adjustment to the standards required by the regulations is now necessary, but to improve the levels of performance of each building an adequate knowledge of the actual state and a careful examination of the energy characteristics of the system casing/plant cannot be ignored.
This paper proposes a method of analysis for the monitoring of energy performance using an expeditious model easily transferable to any urban reality and aimed at the evaluation, characterization and representation of the energy consumption of buildings. Everything was tested and applied to several schools of Potenza (Italy), realized during different periods and with different materials and construction techniques. We have performed comparisons between theoretical and experimental analysis on the system casing/plant, in addition to energy audits essential to define strategies of energy conversion of the entire complex, intervening on the casing and on the plant.

Keywords: Diagnosis, Rehabilitation, Intervention, School Buildings, Energy Consumptions

1. The problem of energy saving in the public building heritage

Expectations and lifestyles of today's world, environmental question and energy problem are at the origin of a new way of thinking about architecture and planning, which tends to integrate the technical-scientific research with social content and individual comfort, together with the context and values. Even following the implementation of the regulatory, procedural and programmatic provisions gained in the international political and scientific debate concerning sustainable development and energy conservation, new forms and multidisciplinary methods are declining, and they are forming important linkages to ensure consistency and synergy between new construction and urban regeneration, with particular attention to environmental connotations.
In the near future, therefore, one of the most difficult problems that the construction sector will face, is the recovery of existing buildings: recovery from the functional, energy, distribution, performance and architectural point of view.
The European Parliament, in view of the zero energy buildings target (Directive 2010/31/EU), reported to the member states that the situation of energy efficiency of existing assets is in a deplorable state, which has triggered a process of change without preceding in the energy sector, precisely linked to accrued needs to limit consumption in the civil and mobility sector, reduction of emissions of CO_2 in atmosphere and urgent need to ensure optimal levels of sustainability, especially in relation to the comfort of the occupants. The same European Directive 2012/27/EU [1] on Energy Efficiency aims precisely to increase the rate of building renovation and establishes a common framework of measures for the promotion of energy efficiency in the Union. For this reason finalizes rules aimed at removing obstacles in the energy market and overcome those deficiencies that hamper efficiency in the supply and use of energy and provides for the establishment of national indicative targets in energy efficiency for 2020 imposing an improvement of energy efficiency in

public buildings and public utility of + 1.5% per year. It is estimated that the share of the construction industry ensures a saving of 10-12% on the 20% total desired.
The result is thus the so-called “climate and energy package 20-20-20” which plans to reduce greenhouse gas emissions by 20%, raising to 20% the share of energy from renewable sources and a 20% the energy saving: all by 2020. With these operational measures, the EU confirms the will of the Member States to continue to engage themselves in the negotiation process for the fight against climate change for the post-Kyoto, after 2012. This portfolio fits in 'the field of the preliminary negotiations in the Conference of the United Nations Convention Framework on Climate Change (COP15) in Copenhagen, negotiations in which the EU reaffirmed the position of unilateral reduction in emissions of 20% by 2020 and, in the case of international agreement , to engage progressively to 2030 and 2050 to reduce of 30% and 50% its emissions compared to 1990 levels.
Going back to the requirements of Directive 2012/27/EU on energy efficiency these are minimum requirements and shall not prevent any Member State from maintaining or introducing more stringent measures. These measures are compatible with EU law. If the national legislation provides for stricter measures, Member States shall notify such rules to the Commission.
Each Member State shall ensure that from 1 January 2014, 3% of the total useful floor area of buildings heated and/or cooled owned by the central government and occupied by them is renovated each year to meet at least the minimum energy performance requirements set.
In our country, on 30 June 2014, the Council of Ministers approved the final text the Decree implementing Directive 2012/27 / EU on energy efficiency and amending Directives 2009/125 / EC and 2010/30 / EC and repealing Directives 2004/8/ EC and 2006/32 / EC. Since then, there is a program of energy upgrading in buildings of central government. Moreover, as part of the supply of products and services of the central government the norm strengthens the bond to purchase products and services with high energy efficiency.
The provision establishes also the “National Fund for Energy Efficiency”, an important financial support to the rehabilitation of buildings of the Public Administration and to the interventions for the reduction of energy consumption in industry and services sector. A specific section of the Fund will be dedicated to support investment in district heating and cooling network. The Fund will be supplied with approximately 70 million euro per year in the period 2014-2020.
In favor of the final consumers of energy provisions are designed to increase awareness of energy consumption in the citizens through the promotion of individual measurement systems and a more accurate billing and based on actual consumption. Also important standards are introduced for the dissemination of information and for the formation of companies, government, citizens and students.
Is therefore clear the urgent need to start from those works really useful to unlock Italy and give it a new future. Among these there are also Italian school buildings, many of which, more than 41 thousand, need requalification and safety interventions as is clear from the fifteenth edition of “Ecosistema Scuola”, the annual survey of Legambiente on the facilities and services of kindergarten, primary and secondary schools levels of 94 provincial capitals. This year the photograph taken by Legambiente is hardly reassuring: 58% of the schools was built before the entry into force of the seismic code of 1974; 32.5% need urgent maintenance; 9.8% of the buildings is in hydrogeological risk areas; 41.2% in areas of seismic risk and 8.4% in ones of volcanic risk.
Fall to 30.9% buildings with essential certificates as that of fire prevention, while only 22.2% are schools where it was carried out verification of seismic vulnerability. The economic crisis and the reduced availability of Commons to invest, also because of the constraints imposed by the Stability Pact, has also led to a decrease of the schools that have school bus services (22.5%) and walking bus (5.2%). Positive data come, instead, from sustainable practices such as recycling that records the positive trend of 2012.
The state of energy efficiency of school is critical because almost all born in the years 1950-1980 without regulations on energy saving in buildings. The schools built in the period from the 80s to the present day have been built according to the criteria defined by the law 373/76, perhaps sufficient at that time, but totally inadequate for the standards accrued over time. Starting in 1991 with the enactment of the Law 01/09/1991 n. 10, “Rules for the Implementation of the National Energy Plan in the field of rational use of energy, energy conservation and development of renewable sources of energy” the schools, like all public buildings of new constructions or in renovation, should integrate energy saving and renewable energy sources in buildings declared interventions of public utility and public interest.
The non-application of the rule throughout the country has led to a school building stock absolutely far from the average of the quality standards in Europe. A school building today in fact consumes more than 100 kWh/m^2 per year for space heating only. The total energy consumption of the Italian schools are around 1 million TOE per year of which about 70% for heating and 30% for electricity consumption, and particularly the secondary schools represent about 27% of total consumption. The high level of consumption for the functioning of school facilities is not opposed to an effective policy of sustainable energy management of buildings to ensure the improvement of the quality of indoor environments in terms of thermal and visual comfort, the reduction in energy demand with the rational use of the same, the reduction of pollutant emissions and the proper management of energy services.

2. Energy audit

Europe 2020 and the “Covenant of Mayors” have drastically renovated all the planning policy of the Member States in the energy field. Europe 2020 is a comprehensive global strategy that includes both energy efficiency objectives both those of growth in production of energy from renewable sources; the “Covenant of Mayors” is the standard and the benchmark to which all municipalities should aim on promoting alternative energy and energy conservation. Within the project ENER SUPPLY (Energy Efficiency and Renewables - Supporting Policies in Local level for Energy) funded by the Cooperation Programme “South East Europe” which saw the City of Potenza as a leader, in addition to the training, dissemination and sensitization activities, methods of energy audits are adopted and tested. The D.Lgs. 115/08 defines as Energy Diagnosis: “... a systematic procedure to obtain adequate knowledge of the energy consumption profile of a building or group of buildings, an activity and / or industrial facility or public or private services , to identify and quantify the opportunities for energy savings from a cost-benefit analysis and to report on the results”.

The energy audit is the systematic set of survey, collection and analysis of parameters related to specific consumption and operating conditions of the building and its facilities, which has the following objectives:

- define the energy balance;
- identify technological refurbishment;
- evaluate for each intervention technical and economic opportunities in order to reduce operating expenses;
- improve comfort conditions.

In fact, the energy audit identifies the health status of the building-plant system and, once identified the “diseased parts”, it provides remedies with targeted interventions. Especially for existing buildings on which maintenance must be planned, the energy audit is the first step to be performed to reduce fuel consumption and improve energy efficiency.

3. Energy diagnosis of Primary School “Pollicinia” in POTENZA

The main interest of all administrations, including the municipality of Potenza, is to have the diagnosis and energy certification of buildings owned by the city. For this reason the project ENER SUPPLY has established a partnership between the City of Potenza and University of Basilicata (specifically, the energy audit took place in collaboration with PhD and Adjunct Professors of the School of Engineering ingg. Ippolita Mecca and Gianluca Rospi), which was achieved with a methodological proposal of intervention, the preparation of a questionnaire for energy audits and in situ verification. The validation of the proposals was made by means of a campaign of audits on most of the municipal school buildings, located in different environmental contexts, made in different historical periods and with different construction techniques. The objective is to get: a picture of the energy performance of a building; the control of the proper operation of plants and systems; the control of costs; the proposal of energy saving measures. These objectives are obtained by successive steps which provide: the calculation of the energy consumption of the building; the comparison with the standards (e.g. certification classes and in situ investigations to discover any abnormalities (with the help of thermographic studies and environmental monitoring).

In fact the diary audit provides an accurate collection of information regarding: the geometry of the building (surfaces, volumes, intended use of the various rooms); orientation (with dimensioning of opaque parts and windows); the shading; the characteristics of the casing (with the identification and stratification of materials); the number of users present; the collection of all energy consumption in the last five years; the type of equipment present with relative power and hours of actual use; the heating/DHW used (type, capacity and operating hours); the lighting (type, number, hours of operation, installed capacity).

Defined the methodology and drafted a check in which were reported all the information listed in the diary audit, the energy diagnosis was conducted regarding several municipal buildings of Potenza through surveys and data collection (electricity and methane consumption) in the competent offices.

For in situ instrumental investigations various tools and techniques were used: infrared thermography to highlight the energy characteristics of the casing and, in particular, the heat losses due to thermal bridges; the Babuc data logger to calculate the transmittance of the casing and the microclimate inside; the flexible endoscope to identify the stratification of the materials that make up the external vertical closings; the thermo-hygrometer to measure temperature and humidity and the surface moisture meter to identify the walls with presence of condensation.

Below there are the main results of the energy audit done on the Primary School “Pollicinia” in the city of Potenza, in the Basilicata Region (South of Italy).

3.1 Description of the structure

The school is located in an area of connection between the old town and the new districts born immediately after the war, in a strategic point of intersection between several main roads, although this is rather an isolated building surrounded by a large green space.

The building was built in 1963, is on two levels, consists of eight sections, has a usable area of 2800 m^2, a covered area of 806 m^2 and a total volume of about 5310 m^3.

The building has a frame structure in reinforced concrete and hollow blocks of prefabricated concrete with interposition of a layer of rock wool, the roof is flat and is made by brick and concrete with bitumen, the ground connection is made with traditional crawl space while the intermediate floors are in brick. The windows are of the aluminum frame type with air space of small size.

3.2 In situ surveys

The main problem in performing an energy analysis of existing buildings is the lack of availability and reliability of essential parameters for the assessment, even more in buildings constructed before the 1970s; you can consider, for example, the transmittance and thermal inertia of the walls, the evaluation of parameters of comfort and performance of plants.

The adopted path of diagnosis has seen the combination of three different methods of analysis: the monitoring of indoor environmental parameters (air temperature, mean radiant temperature, relative humidity and air velocity), the monitoring of materials in situ (measures of thermal conductance), the analysis by endoscope and thermal camera.

3.2.1 Environmental monitoring

This analysis has seen the measurement of the thermo-hygrometric parameters that characterize the indoor microclimate, such as air temperature, mean radiant temperature, relative humidity and air velocity, in other words the complex of the environmental parameters that affect the thermal exchanges subject-environment.

The analysis of the microclimate of an indoor environment is characterized by certain values of some physical parameters, such as temperature, relative humidity and air velocity, which must remain within certain ranges depending on the considered season (temperature 20-26 °C; relative humidity 30% -60%; air speed of 0.2 m/s). In fact, if just one of those values goes out the characteristic range, this cause, without doubt, an alteration of the normal conditions of thermal comfort.

The evaluation of this subjective state can be objectified and quantified through the use of integrated indexes that take account of the environmental microclimatic parameters (air temperature, radiant temperature, humidity and air velocity), the energy expenditure (metabolic cost MET) related to physical activity, and the type of clothing (thermal insulation CLO) commonly used.

These measurements were made in an instant in different rooms of the school and not continuously, as should be done, because the main objective was the didactic one. The measurements have allowed to verify compliance with the indoor microclimate that was good in rooms where there is the heating system, while in the rooms with the system turned off such conditions remain well below the normal limits.

3.2.2 Materials monitoring

The materials monitoring campaign, carried out in situ, had as its goal the measurement of the thermal conductance of the building envelope of the opaque vertical structure of the school.

In situ measures on the casing were conducted according to European standard (ISO 9869: 1994 Thermal insulation - Building elements - In situ measurement of thermal resistance and thermal transmittance), and have aimed to derive the thermal conductance of the wall, that is a parameter really important also in the process of energy retrofit.

The methodology used was that based on the heat flow meter (HFM method) that has, as shown in the technical literature, good accuracy: the errors are around 5%, with a maximum value of 10% and a minimum of 1%. The error tends to the minimum values with increasing thermal conductance of the walls: the typical case of historic buildings, where high thermal inertia and the absence of specific heat insulation materials mean that the walls have a high thermal conductance value.

The acquired data were processed later with the typical methods of analysis for transition systems: the progressive average method and the method of identification “black box”.

The results obtained were: C_{mean} = 0.696 W/m^2K and $\lambda_{average}$ = 0.264 W/mK (= 0.696 W/m^2K 0.38 m).

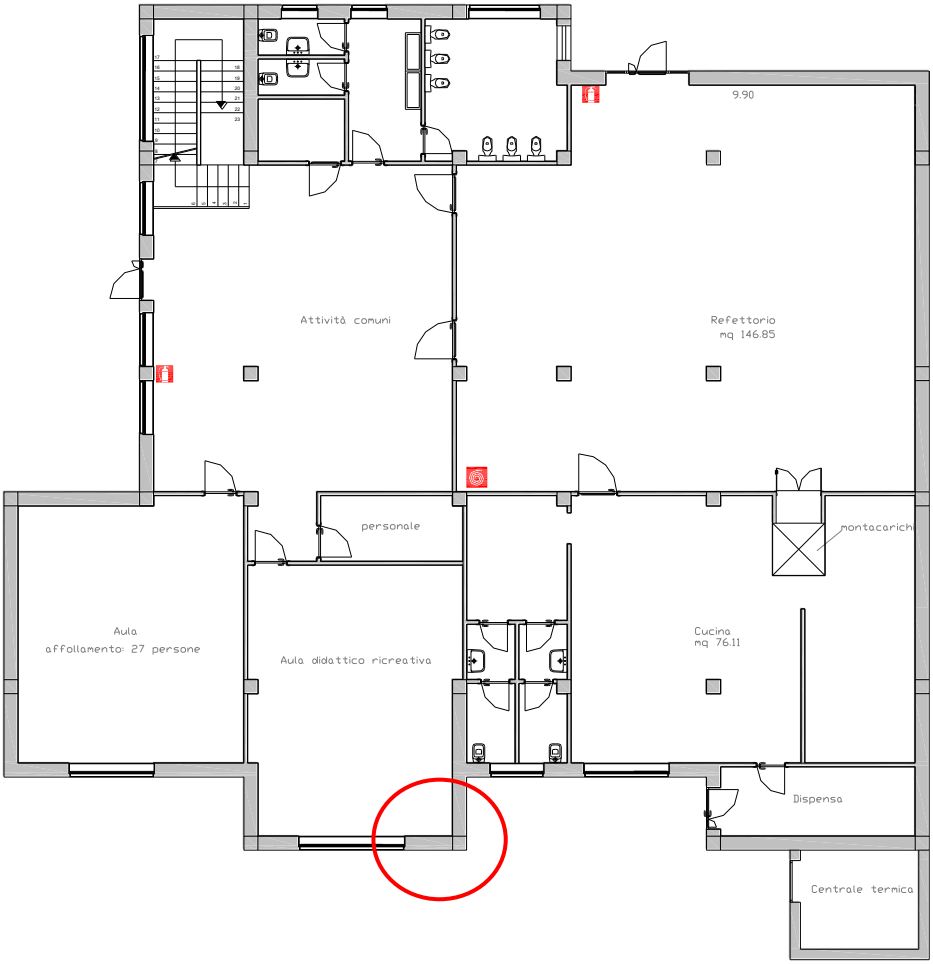

Fig. 1: Survey area of the wall.



Fig. 2: Babuc data logger with probes to measure the thermal conductance.

3.2.3 Endoscopic analysis

Through this analysis it was possible to verify the correct stratigraphy of the masonry. This analysis consists of making a hole in the wall where will subsequently be introduced a camera to inspect the various layers which make up the masonry that specifically has a thickness of 38 cm and is composed of number of 5 layers so composed from the inside to outside: plaster (1 cm), hollow concrete blocks (12 cm), rock wool (3 cm), hollow concrete blocks (20 cm) and plaster (2 cm).



Fig. 3: Endoscopic analysis: in situ surveys.

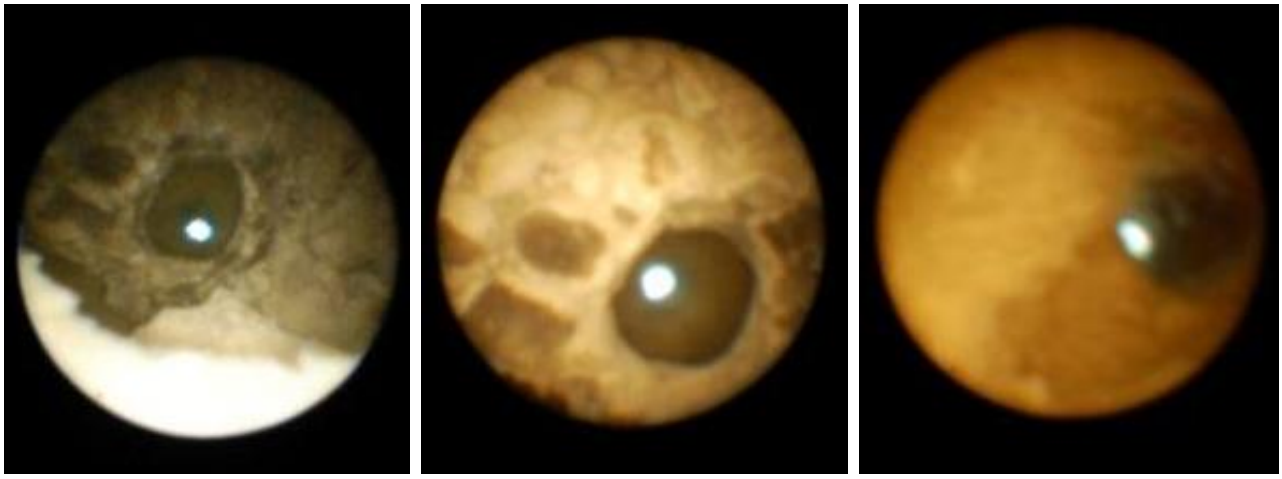

Fig. 4: Endoscopic analysis: stratigraphy of the wall.

3.2.4 Thermografic analysis

The thermography is a technique for detection of information, performed through the acquisition of images in the infrared range. Through the use of a thermal camera you can perform non-destructive and non-intrusive surveys. This instrument is able to detect the temperature of the analyzed bodies by measuring the intensity of the infrared radiation emitted from the body under examination. The radiant energy is a function of the surface temperature of the materials and this is in turn conditioned by the thermal conductivity and the specific heat. Thanks to the effect of different values of these parameters, specific for each material, the different components of an artifact, such as a masonry, assume different temperatures under the action of thermal stress. This characteristic is exploited by thermography to display, with suitable systems, the different thermal behaviour. With the thermographic survey campaign, radiations in the infrared range emitted by the buildings are recorded and, on the basis of these ones, temperatures are calculated and represented in a scale of "false colours". The final product of this processing performed by the camera depends on the distance between the object to detect and the camera itself and on the angle of the focal lens of the instrument. In outdoor thermographic survey, in most cases one must necessarily resort to multiple thermographic measures and then to different thermal images. Logically, this also affects the spatial resolution of the image (the shorter the distance, the greater the spatial resolution).

Through this type of analysis are shown the parts of the casing in which there are greater heat dispersion due to deficiencies of insulation, are identified the thermal bridges due to non-insulated structural elements, it is detected the presence of moisture in the walls due to capillary rise and the presence of non-insulated pipes in the walls or under the floor.

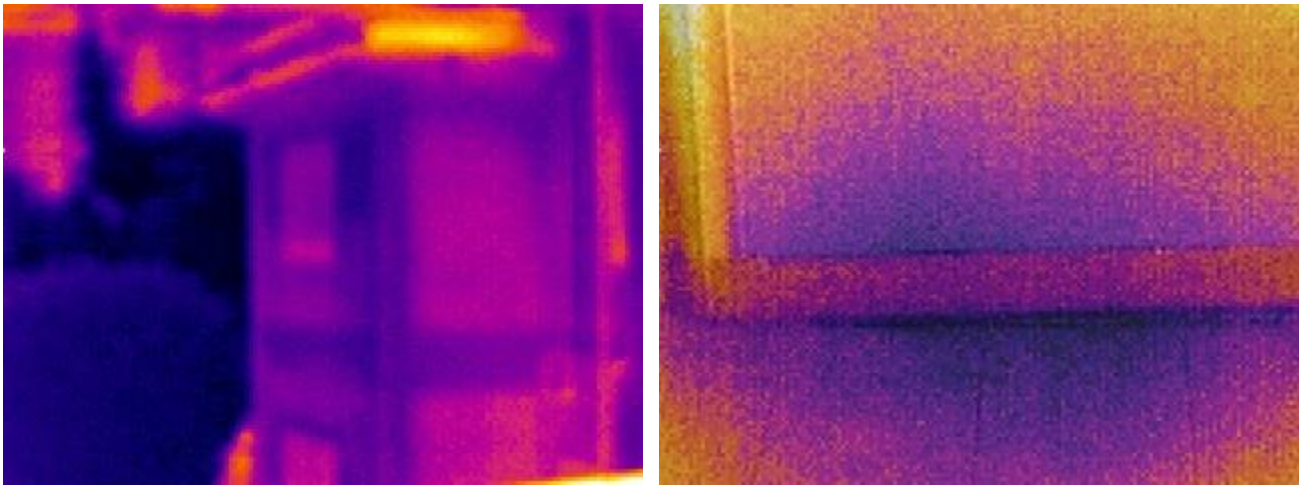

Fig. 5: Thermal bridges and rising damp.

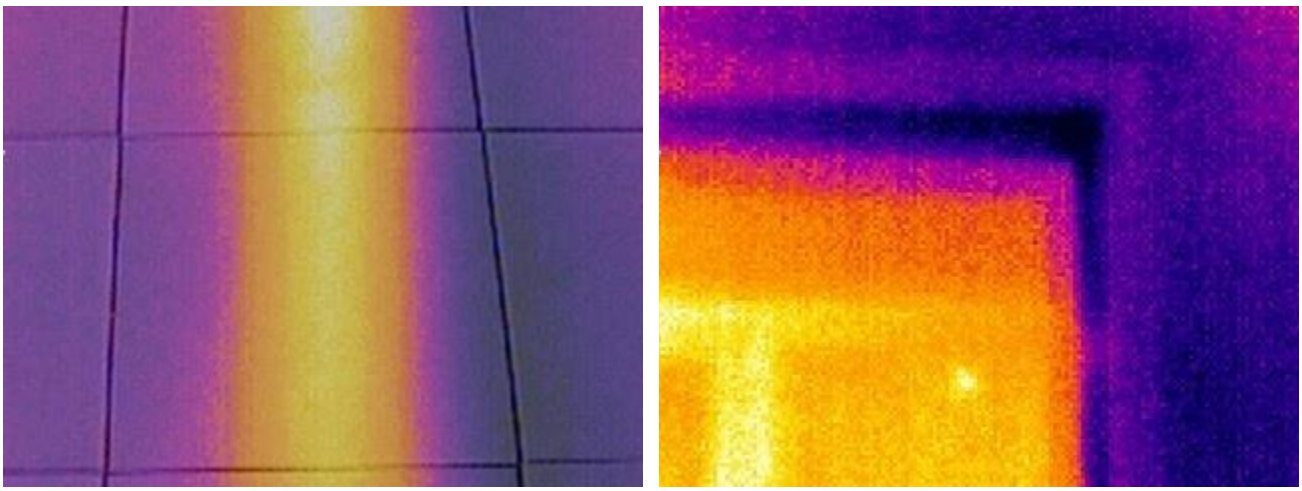

Fig. 6: Non-insulated pipes and leaking window frames.

4. Intervention hypothesis

The audit of the building allowed to make a first assessment of possible interventions for energy efficiency of the building such as:

- Replacement of frames;
- Insulation from the outside by means of coat;
- Thermal insulation of the roof from the outside;
- Verification of the slopes for the drainage of rainwater and replacement of gutters and downpipes;
- Reconstruction of the attack on the ground through ventilated crawl space.

These extraordinary maintenance works would allow the building to move from the energy class G with high annual consumption to energy class A +, as shown by the audit carried out with a commercial software in the current state and after the implementation of suggested retrofit interventions.

5. Conclusions

The collection of information on building techniques, plant technologies, all energy consumption and functional use of the structure allows a “data base” indispensable to the energy classification. In fact, a detailed energy audit, conducted with the help of simple tools, it is crucial to obtaining a proper energy simulation of existing buildings where the components that make up the casing can be various, not always known and certainly not easily detectable.

The conduction of an energy audit on the built heritage and the consequent energy classification allows local governments to monitor the existing building and program policies of energy and environmental sustainability.

It is so really apparent that the theme of renovation of school buildings should play a leading role in the current developments in European scientific research and in the field of architectural design, investing aspects related to an increase of the services offered by the building artifacts and the systems used, to the evolution technology options available to designers and to the introduction of new paradigms in terms of aesthetics and architectural language.

In conclusion this paper, starting from the identification of the features that characterize the Italian school building, has studied the issues related to the process of refurbishment of school buildings in the awareness that the social and educational objectives, and those of biocompatibility, that a modern school should meet, can be achieved through a project that controls the environmental requirements of space and technology requirements of the technical solutions to ensure alignment of new school facilities with new livability levels and new methodological addresses required for teaching and learning.

Bibliographical References

[1] European Parliament and Council, Directive 2002/91/EC of the European Parliament and Council of 16 December 2002 on the energy performance of buildings.

[2] European Parliament and Council, Directive 2010/31/EC of the European Parliament and Council of 19 May 2010 on the energy performance of buildings.

[3] European Parliament and Council, Directive 2012/27/EU of the European Parliament and Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance.

[4] Legislative Decree of 29 December 2006, 311, Corrective and integrative legislative decree 19 August 2005, n. 192, implementing Directive 2002/91 / EC on the energy performance of buildings (OJ No. 26 of 1-2-2007- Ordinary Supplement 26).

[5] UNI TS 11300 - Part 1: 2008. Energy performance of buildings. Determination of the thermal energy demand for air conditioning in summer and winter, May 2008 + EC1 / 2010.

[6] UNI TS 11300 - Part 2: 2008. Energy performance of buildings. Evaluation of primary energy need and of system efficiencies for space heating and domestic hot water.

[7] UNI TS 11300 - Part 3: 2010. Energy performance of buildings. Evaluation of primary energy need and of system efficiencies for space cooling.

[8] UNI TS 11300 – Part 4:2012. Renewable energy and other generation systems for space heating and domestic hot water.

[9] Norma UNI 10349:1994. Heating and cooling of buildings. Climatic data.

[10] UNI EN ISO 14683:2008. Thermal bridges in building construction. Linear thermal transmittance Simplified methods and default values.

[11] D.P.R. n. 59 of 2 April 2009: Calculation methods and general criteria and requirements of the energy performance of buildings and plants.

[12] ISO 9869: 1994 Thermal insulation - Building elements - In situ measurement of thermal resistance and thermal transmittance.

[13] Ecosistema Scuola 2014, XV Legambiente report on the quality, facilities and services of school buildings.

[14] Corgnati S. P., Corrado V., Filippi M. 2008. A method for heating consumption assessment in existing buildings: a field survey concerning 120 Italian schools. *Energy and buildings*, vol. 40, Issue 5, pp. 801-809.

[15] Filippin C. 2000, Benchmarking the energy efficiency and greenhouse gases emissions of school buildings in central Argentina. *Building and Environment*, vol. 35, p. 407-414.

[16] Hernandez P., Burke K., Lewis J. O. 2008. Development of energy performance benchmarks and building energy ratings for non-domestic buildings: An example for Irish primary schools. *Energy and Buildings*, vol. 40, pp. 249-254.

*** Note of the authors**

This paper was executed together but, for editorial purposes, paragraphs 1 and 2 are attributed to Tiziana Cardinale, paragraphs 3 and 4 to Ippolita Mecca, and paragraph 5 to both Ippolita Mecca and Tiziana Cardinale.

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Cultural Heritage communication between narrative and creativity. 3D Video Mapping Projection and new suggestions of Augmented Space.

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Abstract
In the Knowledge Society, Cultural Heritage plays a fundamental role in the development of structured communities. The rise of digital communication in everyday life has produced a deep effect on identities and cultures, transforming the shape of access and transmission of knowledge. In this effort, the application of digital innovative technologies to Cultural Heritage represents a new frontier of research, preservation, valorization and communication, as well as new experiences for the cultural tourism sector. Indeed, these technologies extend the possibilities to act on the visitor's experience, contributing to richer interpretations of the past, bringing new perspectives to questions of identity and culture and generating societal and economic benefits. Video mapping results from the interaction of video content (2D or 3D) projected on any surface, as historic buildings, monuments, archaeological sites. To obtain optimal results, it's necessary that the projected content is designed specifically for the selected surface. These projections can also be interactive and this feature reveals a huge communication potential, when projections are aimed at promoting the historical and archaeological heritage. The result is a very intense and involving performance, which becomes an attraction and an instrument of participation and information, which in turn influence people's perceptions of places.
3D *architectural mapping* harnesses the innate capacity of interactive multimedia design and digital technology to raise an awareness of cultural environments, in this effort the visual and the aural forms became a way to understand, express, search for and interrogate representations of contemporary culture.

Keywords: Cultural Heritage, Video Mapping Projection, Architectural Storytelling, Communication, Valorization.

Introduction *(I.D.N.)*
In the "Knowledge Society", Cultural Heritage plays a fundamental role in the development of structured communities. The rise of digital communication in everyday life has produced a deep effect on identities and on cultures, transforming the shape of access and transmission of knowledge.
In addition, the fully entrance of Cultural Heritage system in the "digital era" have opened new research questions and new complex methodological discussions. The strategies oriented to application of digital to Cultural Heritage represent a new frontier in many study sectors: preservation, conservation, valorization and communication. "Innovation" and "technology" have an even more crucial and potentially very huge role inside the research agenda. Today it is essential for cultural and creative sectors to seize the opportunities of the digital age and globalization and give to culture and media sectors access to new international opportunities, markets and audiences, contributing actively to sustainable growth, jobs, and social cohesion.
Extending to the very heart of structured communities and representing a pillar in their construction, Cultural Heritage plays a key role in providing a sense of belonging and social responsibility.
Around the concept of Cultural Heritage all a series of values, knowledge, belief, traditions and institutions has taken shape that are decisive both for the collective memories and for sociability of groups, but also for the individual development of citizen's conscience. They also serve as an inexhaustible source of inspiration

for the evolution of people's qualities and talents. In challenging times, it is always more important to promote knowledge and valorisation of Cultural Heritage in order to fortify cohesion, solidarity and to inspire modern visions and uses of the past.
The promotion is a necessary aspect in the correct management of artistic and historic patrimony: valorisation is a concept of extreme importance to embody the nation, the civilization's identity and, therefore, the national identity. A cultural object – whatever category it is, tangible or intangible – influences in our society a plurality of meanings, which impact on different educational, entertaining, social and economical spheres.
A correct promoting policy becomes an advantage for the user, for the community, and for the cultural object. An accurate valorisation is the key that a site of cultural interest can have to develop its resource in the always more crowded and competitive panorama of cultural and entertaining highlights.
In the field of promotion of Cultural Heritage, we don't always keep in mind the role of entertainment: a specific dimension of enjoyment whose purpose is to arouse that feeling of "*hilaritas*", as defined by the historian Paolo Giovio in the sixteenth century, and that we now translate with the word "pleasure". The linkage between heritage, culture and entertainment is one of the most important pillars for any society. However, the Cultural Heritage often needs to be translate into entertainment, it has an own language, methodology. Among the various fields, entertainment is becoming an important sector for revitalization and reinforcement of cultural and economic activities, especially for tourism. In fact, Heritage, Culture and Tourism are indissolubly linked to entertainment, by the quality and variety of specific plans, strategies and actions on which the revitalization of the potential use of various sites depends. Cultural Entertainment is an important resource for fascinating the tourists desire to discover and live authentic emotion: people visit countries and cities for sheer want of pleasure and in pursuit of appreciating and exploring cultural diversity and heritage.
It is an imperative today to develop them in order to promote a sector growth. Of course, the economic dimensions cannot be ignored: Cultural heritage is a pillar in the sector of Cultural and Creative Industry. It is an even more important economic and social component that is becoming increasingly important for modern post-industrial and knowledge-based societies. It is a vehicle of cultural identity and it plays an important role in fostering cultural diversity[1].
The UNESCO report defines cultural industries: «industries which combine the creation, production and commercialization of creative contents which are intangible and cultural in nature. […] The term creative industries encompasses a broader range of activities which include the cultural industries plus all cultural or artistic production, whether live or produced as an individual unit. The creative industries are those in which the product or service contains a substantial element of artistic or creative endeavour and include activities such as architecture and advertising. In this article, these terms are used precisely and are not synonymous nor interchangeable» [2]
Avoiding extreme positions such as the purist approach or an exclusively marketable commodity, the relationship between "conservation" and "public utilization" of the Cultural heritage represents the only possible way through to establish a long lasting and beneficial balance.
Information and CommunicationTechnologies (ICT) have made possible many important developments in the field of Cultural Heritage and they continue to provide dynamic and exciting changes through which new possibilities perpetually emerge [3]. Digital and new technologies represent a real resource to promoting the cultural heritage, especially for the digitally native generation, but the use we decide to do of their power is fundamental. It is important to develop new products and services that are able to put the visitor in the condition to discover, to approach and deal with Cultural Heritage by establishing an empathetic and emotional relationship.
The 3D Videomapping Projection (called also "Video Projection Mapping", "3D Projection Mapping", "Projection Mapping", "Digital Mapping", "Architectural Mapping", "Façade Projection" or "Spatial Augmented Reality") is an experimental and innovative form of multimedia art, that combines registered video animation files with a real architecture. It is not only a performative kind of audio-visual artefact, but it also represents a new form of visual art, strictly connected to the development of the cultural heritage, through the huge possibility of sophisticated technologies and through the contemporary audiences new perception of physical space and of moving images features: three dimensional, interactive, animated[4].

1. Augmented Space in Cultural Heritage *(I.D.N.)*

Understanding Cultural Heritage is essentially an interactive practice in which the possibility to learn and to perceive acts through information. New technologies of Virtual and Augmented Reality and of digital systems contribute to reconceptualise cultural patrimony, in a more dimensional way: as a simulation process that aims at recreating several different realities of the information, which increase the heritage in itself[5].
Indeed, these technologies extend the possibilities to act on the visitor's experience, contributing to richer interpretations of the past, bringing new perspectives to questions of identity and culture.

Lev Manovich illustrates this awareness in his research on “The poetics of Augmented Space”. In the article, he highlights that issues arising from the Augmented Space cannot be reduced to a simple technologics paradigm, but rather should involve a wider theoretical discourse, closely related to aesthetic and cultural practice of the perception and of the interaction, focused on mankind and on his relationship with space. In this regard, he explains: «Although historically built environments were almost always covered with ornament, texts (for instance, shop signs), and images (fresco paintings, icons, sculptures, etc. – think of churches in most cultures), the phenomenon of the dynamic multimedia information in these environments is new. […] If previously we thought of an architect, a fresco painter or a display designer working to combine architecture and images, or architecture and text, or to incorporate different symbolic systems into one spatial construction, we can now say that all of them were working on the problem of Augmented Space. […] Augmented space is the physical space overlaid with dynamically changing information […], it is the physical space which is “data dense” »[6].
These words clarify that the only real development factor is represented by the entry into the “augmented” system of a new form of information: digitally produced, multimedia, dynamic and interactive. Consequently, the symbolic re-interpretation of the space involves not only the perception, but also the way to act and interact in relation with the immediate environment, always more loaded with digital and dynamic information.
The representation of a new dimension to overlap existing ones with the subsequent concealment of perceived space is always a necessary challenge for artists of various periods and at the same time, deception and illusion to unsuspecting viewers. Humankind has always acted over the space "augmenting" the perception of it through a *surplus* of information. Art and Architecture are the best example of this predisposition: the prehistoric wall paintings, the windows of medieval cathedrals, the Renaissance prospective are all examples of how humans have intervened on space to convey messages and tell stories in the course of its history.
The new media technologies offer to the participants the chance to experience simultaneously the real, the virtual in a new intermediate space.
Lev Manovich underlines that the profound cultural change in computerized media revolution, concerns especially space and its systems of representation and organization. In addition, the space is becoming a media, just like the others (audio, video, image and text): it may be transmitted, stored and retrieved instantly; it may be compressed, reformatted, converted into a computerized stream of information, it may be planned and managed interactively [7].
In Augmented Space, the screen displays take up of the entire three-dimensional space of a building; it is the last appendix that separates the physical from the virtual. In the future, this barrier disappears in favor of a compositional effect of nuances, smoothness and continuity.
If Digital culture and new media framework represent its recent background, Video Mapping Projection has an older cultural tradition: the suggestion of light has always fascinated humanity with his evocative power. In this effort, it is impossible to separate history of visual shows from history of artificial light: the magical or religious rituals, the theatre performances, the baroque festivities are only some examples [8]. We can say that it is the contemporary version of *tromp l'oeil* effects or *son et lumière* shows, but the existence of contemporary digital projection methods marks a decisive step.

2. Video Mapping Projection *(A.P.)*
Video mapping results from the interaction of video content (2d or 3d) projected on any surface, as historic buildings, monuments, archaeological sites. To obtain optimal results, it’s necessary that the projected content is designed specifically for the selected surface. These projections can also be interactive and this feature reveals a huge communication potential, when projections are aimed at promoting the historical and archaeological heritage. The result is a very intense and involving performance, which becomes an attraction and an instrument of participation and information, which in turn influence people’s perceptions of places.
The main technologies that are used in a project of mapping are basically projectors and content creation software. Then, there is a creative part, in which the contents to propose are identified, and a technical part, to bring into practice through the projectors.
Video mapping is born from the utopia (utopia that can become real) that it’s possible to escape from the movie screen invading the space. After reaching, in the 90's, the idea that it had to be the viewer to enter a virtual space, but in the XXI century it was realized that it was simply necessary to expand the real space we inhabit daily. So virtuality had to integrate - through devices and vision of image- concrete reality, increasing it. [23]
Art has always set itself the aim to seduce and engage the viewer, even perceptually. In 1912, the *Futurists* wrote in the *technical Manifesto of painting* "we will put the viewer at the center of the picture", highlighting that the purpose that artists placed on themselves in the fifteenth century was not different from that which arises today. The only difference is that today we can put it into practice, thanks to new technologies.

2.1 Architectural Video Mapping *(A.P.)*

Video mapping applied to architecture allows to transform buildings and landscapes in complex screens on which to project video contents, animating and giving life to structures. The display becomes "hypersurface". Mentioning Anna Maria Monteverdi ("*Ipersuperfici e mediafacciate*"): "More than eliminated, the screens became bigger. One calls hypersurfaces or interactive media facades those architectural walls, permanent or temporary, designed to accommodate surfaces bright and colorful, mega video projections and plasma screens: gigantic screenings with images and writings are part of the landscape and the metropolitan interior". The heavy becomes light, the ancient modern, movable property.

Architectural elements of churches and monuments disintegrate, enriched by the lights, colors and geometric shapes, while the environment is changed to the rhythm of music. During the projection, the images are two-dimensional, but are perceived as 3d. The definition "*Augmented reality"* is, therefore, fitting, because it concerns visual perceptions altered and enhanced for the benefit of the observer's wonder. The music and lighting effects enhance the thrill, suspense and surprise. Architecture loses its static nature: the construction lines, arches and windows cause distortions showing parallel and visionary worlds with prospects, scenarios and scale completely changed. A facade of concrete can become a medieval stone wall, reproducing ancient situations, now lost, providing historical and artistic notions.

During the night, the architectures become active background for imaginative installations, showing, albeit virtually, a new aesthetic. The added value of these video installations, as in any art form, is not the technique. But it's the idea, the history or significance that you want to communicate. Video mapping should not simply be a display of technical virtuosity, but it can be a powerful tool for urban installations, reinterpretations and artistic representations. Virtual reality interacts with urban space and with real architecture. Beyond the limits of the screen, the installation becomes a collective experience, which actively involves the urban landscape. The participation of the spectator extends the concept of classical architecture, with its annexed spatial and planning configurations, particularly changing its use.

2.2 Creative "video-architectural" storytelling *(I.D.N.)*

Cultural Heritage represents a pillar element of our historical memory, with the advent of digital technologies the way in which we understand, collect and make it available is largely changed.

To reduce the gap between people and culture, it is necessary to find new ways of engaging in a digital world recalibrating the relationship between contemporary media and what is formally considered Cultural Heritage. This goal aims to develop a toolkit of approaches and strategies for living heritage, in order to preserve and pass it on to future generations and to maximize cultural creativity and ensure benefit from the social and economic potential of Cultural Heritage. As written by Neil Silbermann: «digital heritage has already begun to transform the process of re-creating and understanding the past as it is practice in the twenty-first century. […] the past has become an ever-present virtual reality that is simultaneously more real and more virtual than ever before. […] the past is now seen as a resource for economic development of local communities and regions, a medium for cultural identity and cross cultural communication, an edifying destination for cultural tourists, and a focus for educational enrichment. At the very same time, however, the essence of Heritage as a contemporary activity has also begun to be transformed. Both the nature of authenticity and the role of interpretation are being re-examined and redefined. The former exclusive emphasis on the conservation and presentation of architectural remains and physical artefacts is now supplemented by recognition of the value of intangible traditions and the social history they represent. The contrast between an older kind of presentation and a more inclusive concept of interpretation is increasingly recognized. While "presentation" denotes the carefully planned arrangement of information and physical access to a cultural heritage sites […] "interpretation", on the other hand, denotes the totally of activity, reflections, research, and creativity stimulated by a cultural heritage sites» [9].

Video Mapping Projection systems and their concept of "augmented-real space" interaction use digital narratives to invoke and promote new patterns of understanding the value of Cultural Heritage. Mixing such aesthetic ambiences with virtual augmentations and adding dramatic tension has developed very recently these narrative patterns into an exciting new edutainment medium. The narrative dimension, in fact, delivers an aesthetic, dramaturgical and emotional approach useful for the community engagement process.

Experiential narratives are a potent instrument to generate an emotional connection to a cultural subject, object or place [10].

The practices related to Storytelling, are always regarded as a powerful resource for the involvement of the people and for the enrichment of their educational experience. It was one of the earliest techniques of managing knowledge, and already is an effective natural technique of communication and transmission of culture. The term "Storytelling" characterizes a communicative methodology based on the use of narrative techniques for educational, cognitive and social purposes. Today, in the post-digital era, technology increases the possibility to tell stories in different ways, to share and create a "living experience". Especially Digital Storytelling represents an innovative border in the communication of Cultural Heritage.

Capturing and expressing experience of place, of community stakeholders and their perspectives, has opened new opportunities for Museums and Cultural Institutions to reuse and to promote their Cultural Heritage resources. In fact, its practices allow an experimental and creative approach to the interpretation of contents, with a strong emotional impact [11].

Nowadays, when defining heritage the idea of present-centeredness becomes relevant. As claimed by Graham and Howard "we adopt a constructionist perspective which regards the concept as referring to the ways in which very selective past material artefacts, natural landscapes, mythologies, memories and traditions become cultural, political and economic resources for the present" [12].

Nevertheless, the contemporary uses of the past, "as a means of linking people and places through heritage as the vehicle for the creation and transmission of place identities".

Many interesting examples of 3D Video Mapping Projections for cultural heritage have developed what can be defined as "Architectural Storytelling" for presenting an unfolding storyline or sequence displayed onto a monumental façade, using moving image projection.

The Architectural Storytelling concept aims to create a product that endures beyond the temporal dimension of the spectacle, to provide a cultural and emotional experience characterized by multiple levels of engagement and meaning. The historic building is the primary point of investigation and interpretation. The narrative thread of the story brings together the voices and the forms of the past with graphical solutions and illustrative animations playing upon the architecture.

This unique story craft process is the result of the collaboration between different creative skills coming from writing, editing, illustration and the theatre world: historians, storytellers, designers and artists work together to direct and to draw out stories and themes of scientific significance for audience.

The resulting Architectural projection narratives are a contemporary form of storytelling and heritage interpretation and re-creation. The events, usually presented as a large spectacle supported by sponsors and cultural funding over several nights, enjoy and share the stories, bringing a stronger sense of connection to architectural heritage as a historical document and repository of memory. At the same time, the interest concerning the use of AR has shifted from simply fascinating and entertaining audiences, to discovery suitable methods of providing contextually significant knowledge that can enrich visitor experiences. Projection, in fact, being part of a union between media and architecture gives space a meaning and forces it to speak a modern language in telling a past story.

These "Sound and Light" shows can be created to convey information in an entertaining yet spectacular way. Shows have been created to deliver historical messages and celebrate events.

It is the case of the 3D Video mapping Projection, created in 2012, for the 388 edition of the traditional religious Feast of "Saint Rosalia", main patron of Palermo, in Southern Italy.

Commissioned by *Mon Amour Film* [13] and by the Municipality of Palermo, realized with the collaboration of Sandro Tranchina, Matthias Schnabel [14], Roberto Rebaudengo [15], Pippo Montedoro and Franco Scaldati, the Video Mapping was a narrative of images celebrating the death and revival of the city, beyond the "holy contemporaries". It tells the story of the terrible spread of the plague in the city in the year 1624 and its miraculous healing through the intercession of the Saint [16].

The video was projeted on the four monumental façade of the main Baroque square of the city called "Quattro canti", officially known as Piazza Vigliena, an octagonal "theatre of sun". The near-identical facades contain fountains with statues of the allegory of four seasons, the four Spanish kings of Sicily, and of the patronesses of Palermo, (Cristina, Ninfa, Olivia, and Agata). The facades onto the interchange are curved, and rise to four floors; the fountains rise to the height of the second floor, the third and fourth floors contain the statues in niches. At the time the piazza was built, it was one of the first major examples of town planning in Europe.

3D Video Mapping reinterprets, with a contemporary aesthetic, most iconic Baroque buildings of the city, exploring the Sicilian iconography *tout court*. It evocates both popular references (glass painting, holy cards, ceramics) as the most educated (or baroque, coral, silver, besides the stucco and sculptures of the Serpotta family) [17].

Another example of 3D Video Mapping Projection used to relate and communicate to the public the history through a creative reinterpretation of cultural heritage, was created for the medieval citadel of the ancient Byblos-Jbail (Greek name of the Phoenician city Gebal, Jubayl or Jbail in its current Arabic name). The city of Lebanon is famous for being one of the oldest continuously inhabited cities in the world and, today, it is a UNESCO World Heritage Site.

I AM strategic project organized 3D Video Mapping, made possible by the Municipality of Jbail-Byblos and the support of The European Union; Minus5Architects[18] and Studio Mr. White[19] realized it, thanks to the Art Directors Hani Abyad and Daniel Georges; the Technical Direction of Omar Youssef[20], with the collaboration of 3D Artists Octave Ureche, Eftimie and Cezar Ionescu.

Video Mapping held in the ancient Byblos port in 2013, was projected during the annual *Byblos International Festival*. Each historical period of the city was depicted in a creative way, visually capturing the essence of

that time. A flow of sequences was carefully designed to take the audience into a series of unexpected visual cliffhangers, keeping their interest peaking throughout the whole show.



Fig. 1: 3D Video Mapping Projection "388° Festino di Santa Rosalia, Palermo 13-14-15 July, Palermo (Italy).
http://www.rebaudengo.com/?project=388-festino-di-santa-rosalia

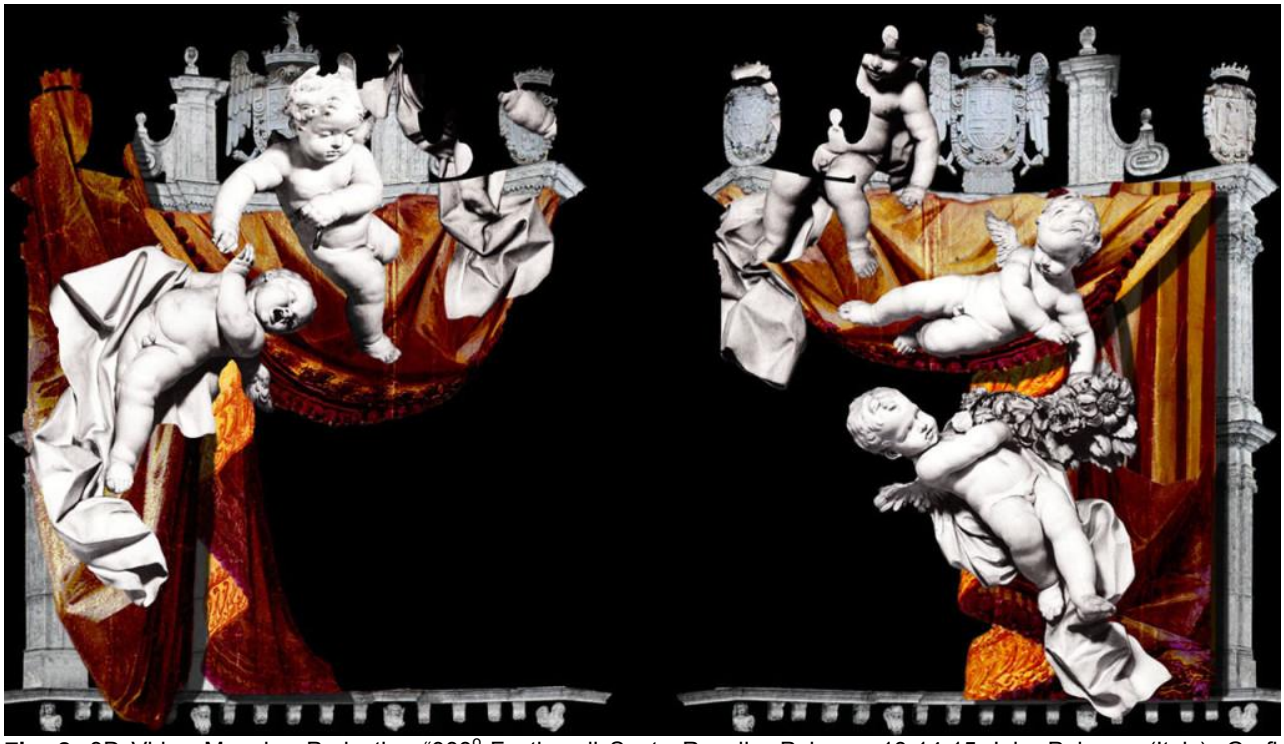

Fig. 2: 3D Video Mapping Projection "388° Festino di Santa Rosalia, Palermo 13-14-15 July, Palermo (Italy). Grafic passage with Serpotta stucco's sculptores.
http://www.rebaudengo.com/?project=388-festino-di-santa-rosalia

3. Video Mapping Experiences in Europe and Italy *(A.P.)*

3.1 *"Fêtes des lumières"*

In the last few years, the "Festival of lights" in Lyon, best known as "*Fêtes des lumières*", is becoming more and more popular. Although in recent times the number of visitors has been steadily increasing (about 3 million people in 2010 and 4 million in 2012), this celebration has very ancient origins, linked to the veneration of the Virgin Mary. Starting from 1643, the merchants and nobles of Lyon, vowed to pay homage to the Virgin every year, if she had delivered them from the plague afflicting the city at that time. Since then, a communal procession goes from Notre Dame de Fourvière to the Cathedral of St. John, on 8th September each year, day of the consecration of the city to the Virgin, the feast of her Nativity. In 1852, the celebration was moved to the 8th of December, the feast of the Immaculate Conception, to inaugurate the statue of the Virgin placed on the tower of the old chapel of Fourvière. The inauguration had to take place on the 8th of September, but was postponed because of the weather. Since then, the festival is held in December.
Since 1989, the celebration takes a new form and it is accompanied by beautiful light installations. These activities are carried out by the Municipality and by entertainment professionals. The sponsorship of EDF (*Electricité de France*) is essential for the new production, which obviously uses a lot of electricity. These animations have a contemporary character that resides both in the concept and in the ephemeral completion of the work, still starting from an ancient tradition. All this has made this festival an important tourist event, attracting millions of visitors each year. Popular participation is however very present.
The image proposed in this article relates to a performance of 2010 on the facade of the "Theatre of Celestine". The animation consists in deforming the construction lines of the theater, according to a voice command entrusted to the public, making it an interactive exhibition. This performance is particularly interesting because on the same façade different mode of action are proposed. On one side there is the close relationship with architecture, in fact many lightings enhance the proportions, deforming the central volume or playing with the hierarchies of the surfaces. Then suddenly the projection is transformed and a huge facial image is displayed. This creates correspondences between the mouth, eyes and openings of the building. This spectacular effect proposes an almost amorphous reading of the theater.



Fig.4 Architectural Projection Mapping – "Fete Des Lumieres" 2010

3.2 Italian application of video mapping

One of the most known applications of video mapping in Italy is the Glow Festival. It takes place in spring in Ostuni, a small ancient center of Puglia. The Glow Festival is an event of digital arts, specially focused on lighting and video mapping, with the intention to promote cultural heritage through new technologies applied to art. The last edition was really special, because UNESCO proclaimed 2015 as International Year of Light and Technology. Video mapping is a creative use of light. An open call invites artists from everywhere, to create and perform a video lasting about four minutes, created for one of the three locations made available. Addition to the wonder for the beauty of the performances, people give attention to the historical and architectural heritage, admiring the facades and altars on which the projections are made. From this

observation was born the intention of the organizers of the festival to expand the event to all the historical center of the city.
Another significant experience is one that takes place in Ravenna, where installations of 3D video mapping combine the historic architecture with visions created by the most modern digital technologies. In 2014 the work of the creative team of “Visioni di Eterno®” was admirable: they transformed the Neonian Baptistery through the power of imagination and technology. The team compares the monumental art to new forms of Video Digital Art, creating a union between past and future. People are involved in an active interpretation of historical monuments, transforming the places of memory in places of experience to form a new memory.



Fig.4 “Visioni di Eterno®” Neonian Baptistery, Ravenna



Fig.5 GLOW Festival 2014 - 3rd “Una Vicenda Epica” Antaless Visual Design/ Italy

4. Conclusions *(A.P.)*

The video mapping re-interprets the concept and the boundaries of Reality. Through lights, the physical world is manifested, and it could be hiding, turning or changing perception through colors, shapes, textures and lights. Through the three-dimensional effects the perception of a surface is altered. This surface is modelled, creating the movement and modification of something that is typically solid and rigid. However, these changes are temporary, ephemeral. When the projector is turned off, everything returns as before, without trace of what happened. The sound is another element, along with video, which is used to create effects of illusion, making the video mapping experience more complete and complex. In many cases music is what drives the performance. The most fascinating thing of video mapping is that it is a technique that expands the concept of the screen, allowing to turn any object or surface in support of audiovisual communication.

As we have seen, there are several possible relationships between the projections and the architectures that support them. Many images are strictly connected to the facades on which they will be projected; they resume the contours or shapes of the building and transform it, making dynamic a surface that normally is solid and static. The process helps the viewer to know this architecture, reading its styles, its overlaps and proportions. The projection becomes a “new eye” that allows to see details never noticed before.

Instead, other lighting effects that detach from a specific building, despite being designed for it, use it only as a screen. In such cases, colours, stage effects and the imagination of the operators win on the communication related to the architecture. These operators are distinguished between graphics, which process the data and turn it into performances, and those who are concerned with the content of the narrative (historians, artists, architects...) which choose the facts to tell to the public. These evaluations on the content, on the relationship with the architecture, on the exposure mode, are those that will produce an endless repertoire of possible beautiful installations of video mapping applied to cultural heritage.

Bibliographical References

[1] SANTAGA, Walter (Ed.). *Il libro Bianco sulla creatività. Per un modello italiano di sviluppo*. Milano: Università Bocconi, 2009.
http://www.beniculturali.it/mibac/export/UfficioStudi/sito-UfficioStudi/Contenuti/Pubblicazioni/Volumi/Volumi-pubblicati/visualizza_asset.html_1410871104.html

[2] UNESCO. *Understanding Creative Industries Cultural statistics for public-policy making*. Paris: UNESCO, Global alliance for Cultural diversity, 2006.
http://portal.unesco.org/culture/es/files/30297/11942616973cultural_stat_EN.pdf/cultural_stat_EN.pdf.

[3] Hardman, Lynda. Aroyo, Lora. van Ossenbruggen, Jacco. Hyv¨onen, Eero. Using AI to Access and Experience Cultural Heritage. In *IEEE Intelligent Systems*, vol. 24(2), March-April 2009, pp. 23–25.

[4] CATANESE, Rossella. *3D Architectural Videomapping*. In GRUSSENMEYER. Pierre, *Proceeding of the International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol. XL-5/W2, 2013 (XXIV International CIPA Symposium, 2–6 September 2013, Strasbourg, France). ISPRS Archives, pp.165-169.
Web: http://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XL-5-W2/

[5] MILGRAM, Paul. KISHINO, Fumio. A Taxonomy of Mixed Reality Visual Displays. *IEICE Transactions on Information Systems*, vol. E77-D, no. 12, 1994, pp. 1321-1329.

[6] MANOVICH, Lev. The poetics of augmented space. *Visual Communication*. London and New Delhi: SAGE Publications, 2006. Vol. 5(2), p. 219-240.

[7] MANOVICH, Lev. *The Language of New Media*. Cambridge, Mass.: MIT Press, 2001.

[8] VIRILIO, Paul. *Guerre et cinéma: logistique de la perception, Cahiers du cinéma*. Éditions de l'Étoile : Paris, 1984.

[9] SILBERMANN, Neil. *Chasing the unicorn? Toward a convergence of goals.* In KALAY, Yehuda - KVAN, Thomas. AFFLECK, Janice. *New Heritage: New Media and Cultural Heritage*. 2ª eds.New York: Routledge, 2008, pp. 89-90.

[10] BRUNER, Jerome. *Making stories: Law, literature, life*. Cambridge, MA: Harvard University Press, 2002.

[11] AMORETTI, Valeria. CIRAFICI, Alessandra. DI FRATTA, Valeria. DI NATALE, Iolanda. LALLONE, Daniela. MASCIA, Ludovico. *Tell me a story. New emotional and cognitive strategies to communicate and valorise the Cultural Heritage*. In CAMPANELLA, Luigi & PICCIOLI, Ciro (Eds.). *Proceeding V^th International Conference in Diagnosis for the Conservation and Valorization of Cultural Heritage (Naples, 11-12 December 2014).* Roma: Aracne editrice, 2014, pp. 67-77.

[12] GRAHAM, Brian. HOWARD, Peter (Eds). *The Ashgate Research Companion to Heritage and Identity*. Aldershot: Ashgate, 2008, p. 1.

[13] Web: http://www.monamourfilm.com/#!videomapping/cyuu

[14] Web: http://www.matthias-schnabel.de/cms/

[15] Web: http://www.rebaudengo.com/?project=388-festino-di-santa-rosalia

[16]Web: http://www.santarosaliapalermo.it/

[17] Web: www.minus5architects.com

[18] Web: http://studiomrwhite.com/filter/Byblos

[19] Web: http://www.omaryoussef.net/

[20] MCLUHAN, Marshall. *Understanding Media: The Extension of Man*. Corte Madera, CA: Gingko Press, 1964.

[21] MONTANI, Pietro. *Immaginazione intermediale*. Laterza: Roma-Bari, 2010.

[22] MUNARI, Bruno. *Fantasia: invenzione, creatività e immaginazione nelle comunicazioni visive*. Laterza: Roma-Bari, 2007.

[23] MANIELLO, Donato. *Realtà aumentata in spazi pubblici. Tecniche base di video mapping.* Ed. Le Penseur. Potenza, 2014

[24] Web: http://www.csl.unifi.it/dwl/riflessi/projection-mapping-riscrivere-larchitettura/

[25] Web: http://www.annamonteverdi.it/digital/

[26] Web: http://www.setup-web.it/category/tutte-le-uscite/page/5/

[27] Web: http://www.glowfestival.it

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Urban symbiotic architecture in Pavia
The origins of Giancarlo De Carlo's Building Development Plan for Pavia University

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Abstract
In 1970s many factors accelerated the development of Pavia University and affected its relationship with urban evolution, generating effects that persist to present days. Due to 1950s population boom and to general socio-economic growth, in the whole country university subscribers tripled between 1950 and '69, giving rise to the so-called mass university and causing a strong overload of universities. Since '67, Law 641 settled funds for university buildings and called for five-year development plans. However youth protests in late '60s produced a great cultural ferment that swept academia resulting in a rethinking of universities' structure and social role.
In this socio-economic and cultural climate, in Pavia a season of rethinking was inaugurated about the organization of university buildings and their relationship with the city. Following the L.641/67 the University instituted a Permanent Advisory Committee for Building, which in turn commissioned architect Giancarlo De Carlo to prepare a Building Development Plan (1970-74). In his plan De Carlo defined a multipolar model, by which – through the permeability and attractiveness of university buildings – he was trying to break through the both physical and psychological border separating the university from city life, giving birth to a form of urban symbiotic architecture.

Keywords: Building development plan, multipolar model for universities, University of Pavia, Giancarlo De Carlo, symbiotic architecture.

1. Introduction
In Pavia the tradition of higher education is very old: in 825 A.D. an important school of rhetoric was established by the Carolingian emperor Lothair I. In 11th century, a law school was joined to the school of rhetoric. In 1361 at the initiative of Galeazzo II Visconti, Duke of Milan, the Emperor Charles IV founded in Pavia a *Studium Generale* to which the same rights of the Universities of Bologna and Paris were recognized by Pope Boniface IX. In 1485, the *Studium Generale* was eventually transformed into *Università*.
In the second half of the 18th century, the Austrian emperors Maria Theresa and Joseph II promoted the development of the University of Pavia, the only then existing in Lombardy. The arrangement of the historical seat of the University, still in use today, dates back to 1772; later it was enlarged in 1821 (construction of the courtyard of the Rectory) and in 1851 (construction of the *Aula Magna*) [1]. In 1894 some institutes moved to *Palazzo Botta*, a palace owned by the *Demanio* – state property administration – and granted in use to the University, located in the historic centre of the city [2].
Between the late 19th and the first half of the 20th century the importance of the University gradually decreased due to the founding of other universities in the nearby Milan: the Royal Higher Technical Institute (later Polytechnic of Milan) in 1863 and the *Università Statale* in 1923. From nearly 2000 in 1923, the number of students fell rapidly to 1200-1400, remaining almost constant during all the 1930s.
In 1932 the new location of the *Policlinico San Matteo* was inaugurated in a peripheral area [3]; hence the hospital let free the four cloisters of its original fifteenth century location adjacent to the seat of the university, which were then assigned to the School for cadets of Military engineers [3] and after the World War II in

1951 became an integral part the university [2]. In 1933-35, close to the new Polyclinic, a new building complex for some of the scientific institutes (Chemistry and Physics) was built [4].
In the post war period the number of students at the University of Pavia grew to nearly 4000 units, then it stabilized at about 3000 students in the second half of the 1950s. By contrast, between 1958 and 1968 students rapidly increased and almost tripled, reaching the number of about 7000. This phenomenon was common to all Italian universities and was due to a number of demographic (e.g. the baby boom following the end of World War II) and socio-economic factors; it marked the transition from an elitist university to the so called mass university, causing a strong overload of university seats.

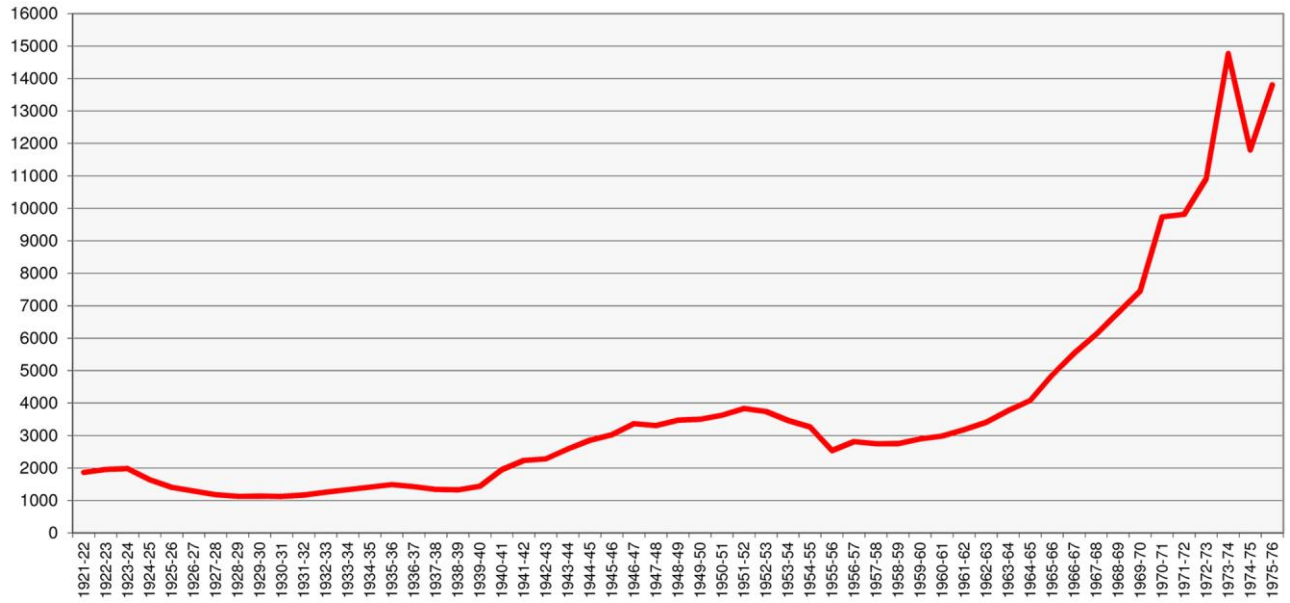

Fig. 1: Diagram of the number of students at the University of Pavia between 1921 and 1918 (source: University yearbooks).

2. Mass university (context, causes, goals)

Once the reconstruction phase was passed faster than expected – also thanks to international aid (Marshall Plan) – after World War II from 1953 in Italy a period of rapid economic expansion occurred (also known as *Miracolo economico*, Italian economic miracle). Economic and productive development were accompanied by the increase in mean household income and consumption. A large part of society took advantage of the growing disposable income by relying on education as a means for social advancement.
Schooling rate grew and as well as «the propensity of young people to continue their studies, once the initial selection, to the highest possible level» [5]; total students of Italian universities tripled between the academic years 1950-51 and 1969-70.
However, the exponential growth in the number of university students was accompanied neither by a national plan for the adaptation of university facilities nor by a rethinking of the social role of the university.
The works in the sector of university buildings were minimal and mostly confined to isolated cases (for example, the case of the University of Urbino); in addition the number of professors did not grow in proportion to that of students: university facilities thus reached a level of critical overload.
However, university teaching body was not only inadequate from the numerical point of view, it was also inadequate from a cultural perspective to address the problems of Italian society of the period. In particular, most of the professors had entered into service before the Second World War, in a cultural context where the loyalty to the regime – and to the social order represented by it – was often preferred to freedom of thought: Royal Decree Law no. 1127 of August 28th, 1931 demanded an oath of allegiance to the fascist regime on university professors. Moreover, professors were unable to establish a dialogue with a student population characterized both by a heterogeneous social extraction and by the desire to play an active role in a changing and socially open society, which asked therefore to better analyse social issues.
According to Giancarlo De Carlo, universities had been for centuries places of formation of the leadership elite with the aim of maintaining the *status quo*. Therefore they were characterized by the support of the principle of authority in order to exhaust student's autonomy of thought and ability to develop a radical and independent criticism to the system [6]. In his interpretation of the university situation, the increase in the number of students did not automatically transformed elite university in mass university, but only in "university of large numbers". Indeed De Carlo stated that «The goal of mass university was to supply a social demand that differed from that made to elite university. This is not to train managers for a ruling class,

but to prepare professionals for the whole social context, thus specialized for specific activities, but aware of the purpose and consequences implicit in their action» [6].
The crisis could not therefore be resolved by a simple expansion of classrooms and laboratories or by an increase in the number of professors; a thorough analysis and a radical rethinking of the multiple economic, cultural, and social implications of the role of university were necessary.

3. The student protests and criticism to social system and university

Since December 1963 the students of the Faculty of Architecture at the Polytechnic of Milan showed the first signs of discontent towards an academic/professional culture unprepared to deal with ongoing social phenomena: considering «anachronistic and abstract» the themes assigned for the design assignments, they asked professors to discuss all together the programmes [6]. Having received no adequate response by professors, in February 1964 they occupied the faculty (being followed later by the students of the faculties of Turin and Rome). They were able to get some small concessions, including the establishment of joint committees – composed of professors and students – which had the task of advising on teaching organisation, however final decisions remained in the hands of the faculty board, made up of full professors only [5] [6].
Nevertheless in January 1967 students occupied again the Faculty of Architecture in Milan, and in November they occupied also the Catholic University of Milan and the Faculty of Architecture at the Polytechnic of Torino. Within a few months the protest spread like wildfire involving all the universities across Italy. The crisis of the university system took on the deeper meaning of a general crisis of values, ideologies and role. Student masses claimed a transformation of the study organisation that would allow to establish a different relationship between university and society [7], in particular the student movement rejected the idea that the only purpose of education should be a training subservient to productivity and industry; instead they stated that the purpose of education should be the cultural progress of the individuals and the awareness of their role in society.
During 1968 in Italy – as in many other European countries and in the USA – the protest movement spread from the students' world to the entire society, giving rise to joint events for workers' rights [8].
In response to protests, in Italy Law no. 910 of December 11th, 1969 (*Provvedimenti urgenti per l'università*, Urgent measures for university) credited the right to access university faculties to students who have completed any five years high school and granted a partial liberalization of university curricula; moreover Law no. 300 of May 20th, 1970 (better known as *Statuto dei lavoratori*, the Workers' Statute) introduced instead a series of protections and rights for workers.

4. The Building Development Plan for Pavia University

In this complex context the University of Pavia began to address the issue of the development of its building structures. In 1967, the Law no. 641 defined new rules for school and university buildings and established that universities should adopt a development plan in order to get state funding for the period 1967-71. [9]
In 1968 the rector, prof. Mario Rolla, appointed a Permanent Advisory Commission for Building with the task of conducting an investigation into the logistical needs of different faculties and thus of defining the guidelines for the development plan. The commission was chaired by prof. Alberto Gigli Berzolari (later rector in 1976-83) and was composed of 25 people, almost all professors of the University of Pavia, representatives of different faculties and of the various academic ranks [10].

4.1 The role of the Permanent Advisory Commission for Building (1968-70)

The commission was active until 1970 and eventually came to identify a few key strategic objectives with the help of the Technical Office and of the staff of the Institute of Drawing of the University [3] with regard to building and urban aspects.
The first objective was to limit the number of students to 15000 (later raised to 18000) [11]. This number was called "critical threshold" because, according to its researches, the commission felt that a greater number of students would have altered in a negative way the relationship between university and city. However, this limit could be admissible only if the university had been equipped with a series of new spaces, services and facilities, so as not to burden the already existing urban fabric and services, but rather to provide new services available for the entire population [10].
The second objective was to find adequate space for technical-scientific faculties still present in the historic town. For this purpose the Commission planned out the design of new buildings outside the city centre in order not to have typological or dimensional constraints for laboratories. For the new buildings the commission chose an agricultural area close to the *Cascina Cravino* and adjacent to the Polyclinic and to the Institutes of Chemistry and Physics. Once they had identified the building development area, the University arranged to purchase a quantity of land sufficient to build not only University Institutes, but also additional services and facilities for a mixed university and city use. In the idea of Commissioners, the new settlement had not to be a closed-in-itself campus, isolated from the urban context, but a system strictly connected with

the city [10]. In order to emphasize the need for complete integration between University and city, prof. Gigli Berzolari – President of the Commission – coined the slogan “the campus for the University is the city of Pavia” [3].
The third objective was to further expand the space devoted to the humanities faculties in the historic centre, with the reuse of the buildings vacated by the science faculties and the acquisition of new buildings [3].
The commission also decided that the contract for drafting the plan had to be entrusted to a professional specialized in the design of university buildings [10].
In October 1970, the task was given to Giancarlo De Carlo – since 1969 a full professor of Urban Planning at the University Institute of Architecture in Venice – which in previous years already expressed radical critics to Italian academic organization [6]. As an architect, he had designed some university buildings in Urbino and participated in the competition for the new seat of the University of Dublin [12]; moreover he had coordinated a research on university building types in Italy and in the world and on how they influenced the relationship between universities and cities [13].
At the end of its work, the Commission was replaced by a Planning Committee for Buildings whose role was to maintain continuous contact between the designer and the University. Indeed the Planning Committee was chaired by the rector prof. Antonio Fornari, and composed by four members: the architect Giancarlo De Carlo and three professors of the University of Pavia, Ugo Maione (full professor of Hydrology and dean of Engineering Faculty), Gianpaolo Calvi (adjunct professor of Building technology), Alfredo Ruffo (full professor of Biochemistry), later substituted by Marco Fraccaro (full professor of Medical genetics) [10].

4.2 The Building Development Plan for Pavia University. The general approach

In Giancarlo De Carlo’s theoretical reflection, traditionally to the closed and authoritarian cultural system typical of universities corresponded a similarly closed architectural system. In the Anglo-Saxon tradition, the closure and the autonomy of university structure is total: the university campus (often isolated in the countryside) is a world apart with its own residences and services, which depends on the outside world only for the supply of materials goods and unskilled labour [13]. In small or medium-sized university towns typical of the central and southern Europe tradition the university is concentrated in a single building block, or broken up into multiple locations (typically corresponding to different faculties) dispersed in the urban fabric. In both cases the seat or seats university, although physically integrated into the fabric, are substantially impenetrable by the population of the city and the university tends to cannibalize the city, making it a mere instrument in his service [13]; for this university model De Carlo suggested the analogy of the hermit crab (*Pagurus bernhardus L.*): only the shell of the city remains (i.e. the apparatus of spaces and services), and the hermit crab-university appropriates it expelling all non-academic functions [14].
The city of Pavia ran this risk because its student population had increased from 6,3% of the total population in 1945-46 [15] to about 15% at the beginning of the Seventies [5]. To overcome the opposition between academia and civil society, De Carlo proposed a new model called “multipolar”. This model takes the form of a constellation in which at the same time three hierarchically distinct elements are present: central, intermediate and peripheral poles. These poles should give life to the alternation of situations of concentration and dispersion of university building in the urban fabric [10].
To draft the project, De Carlo reread and reinterpreted the urban structure and the relationship between university building and public space [14]. Historically the checkerboard system of the oldest part of Pavia University – made up by quadrilaterals courtyards with sides of about 25 m – «is inserted with continuity in the orthogonal urban fabric, deriving from the Roman *castrum* underlying the city» and forms a sort of «university-city» [16]. The ideas behind the organization of the new buildings are therefore permeability, attractiveness and flexibility [10]; the aim is to break down the both physical and psychological impassable border that separates the university from city life [17]. The multipolar model is designed to assign a new role to university in city fabric creating «an uninterrupted network, a continuous flow of interdisciplinary and multifunctional relationships between the different poles» [12] which aimed to create a complete fusion between academia and urban reality: the *universicittà* (i.e. the univercity) [18].

4.3 The Building Development Plan for Pavia University. The operational choices

Since the Plan De Carlo arose from the need for transformation of the role of university in society, it resulted in the hybridization of the urban fabric with a network of widespread services in partnership between city and university, which allowed to establish what we might call a symbiotic relationship between the two, with positive effects on both. The basic idea is that a number of university services are typically underutilized and therefore they can be made available for the use of different social groups and conversely a number of civic services can be exploited for university use [11] [20].
Indeed, the three expected categories of pole were thought to be equally open to people use: peripheral poles were designed exactly to ensure contact between academic world and urban peripheral districts and to create structures that could compensate for the shortcomings of public services [19]; intermediate poles had to contain a number of (residential, sport, commercial, cultural, etc.) spaces in the service of university, but also available for public use; central poles were finally intended to house the main teaching and research

activities and therefore they contained complex equipments and spaces that citizens could not find in other facilities, but they also had to «contain fragments of other types of pole» [10] [14] [19].
The real success of multipolar model had to be based on the circulation of knowledge and experience between different poles: the knowledge of territorial and social reality experienced in peripheral poles should flow into central poles and theorizations developed in central poles had to provide a guide to the activities of peripheral poles [14]. To achieve this ambitious goal, De Carlo tried to involve in the decision-making process of the Building Development Plan both students and academic staff, both citizens and local authorities in charge of territorial government [9] [11].
At the urban level the project included both the expansion of the university to the northwest, and the widespread inclusion of university facilities in the urban fabric, with new acquisitions and with the refurbishment of buildings already in the possession of the University.
Central poles were two: the first was the whole of all university buildings in the historic centre (the historic seat, *Palazzo Botta*, the former San Felice orphanage, the former Calchi barracks, the former barracks of Military Engineers at *San Pietro in Ciel d'Oro*); the second was made of the existing or designed buildings in the Cravino area.
Three types of intermediate pole were defined: structures serving central poles; existing colleges and new residential facilities (in which a mix of both students and citizens was expected as users) made in new buildings or refurbishing blocks of the historic centre; university collective services also open to public use.
Two types of peripheral poles were defined: a system of services located in various suburbs of the city to which the role of «hinge elements between university and local problems» was attributed [20]; detachments in the main centres of the province (for example, a new Department of Agriculture planned in Voghera, about 30 km south of Pavia) [10].
To understand the general ideas of the plan relating to the problem of the historical city, the proposal to build two intermediate poles in two groups of blocks in the historic centre has great interest. These blocks were heavily degraded – both in terms of construction, and from the social point of view – and they required urgent renewal [7]. As already said, the idea was to obtain – inside the historic building fabric – a series of spaces for integrated residences, assigned partly to colleges, partly to social housing.

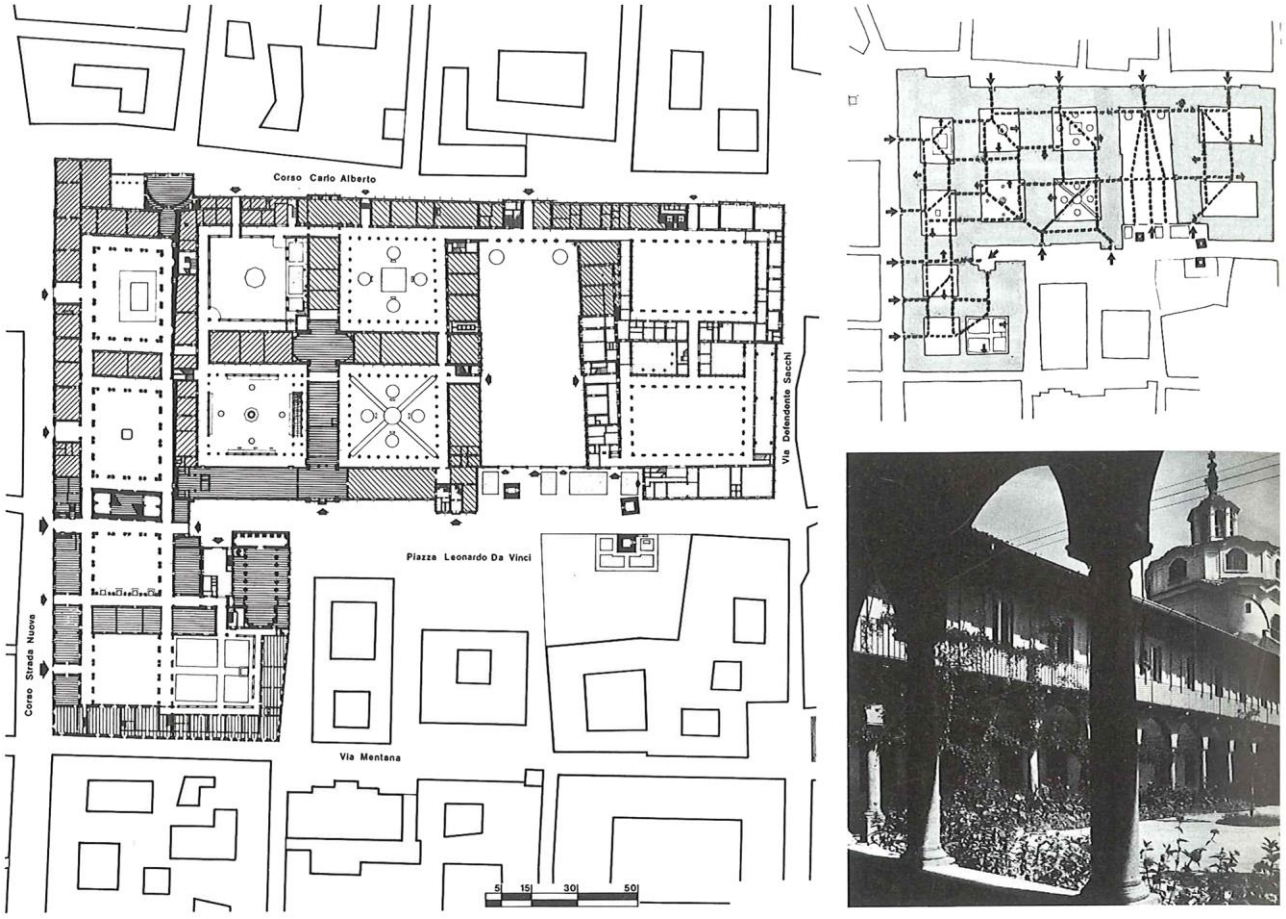

Fig. 2: Plan of the historical seat of the University of Pavia. The building complex is built around nine courtyards (the two to the east belong to a university college). In the top right: scheme of diagram of possible paths for pedestrians to cross the building [11].

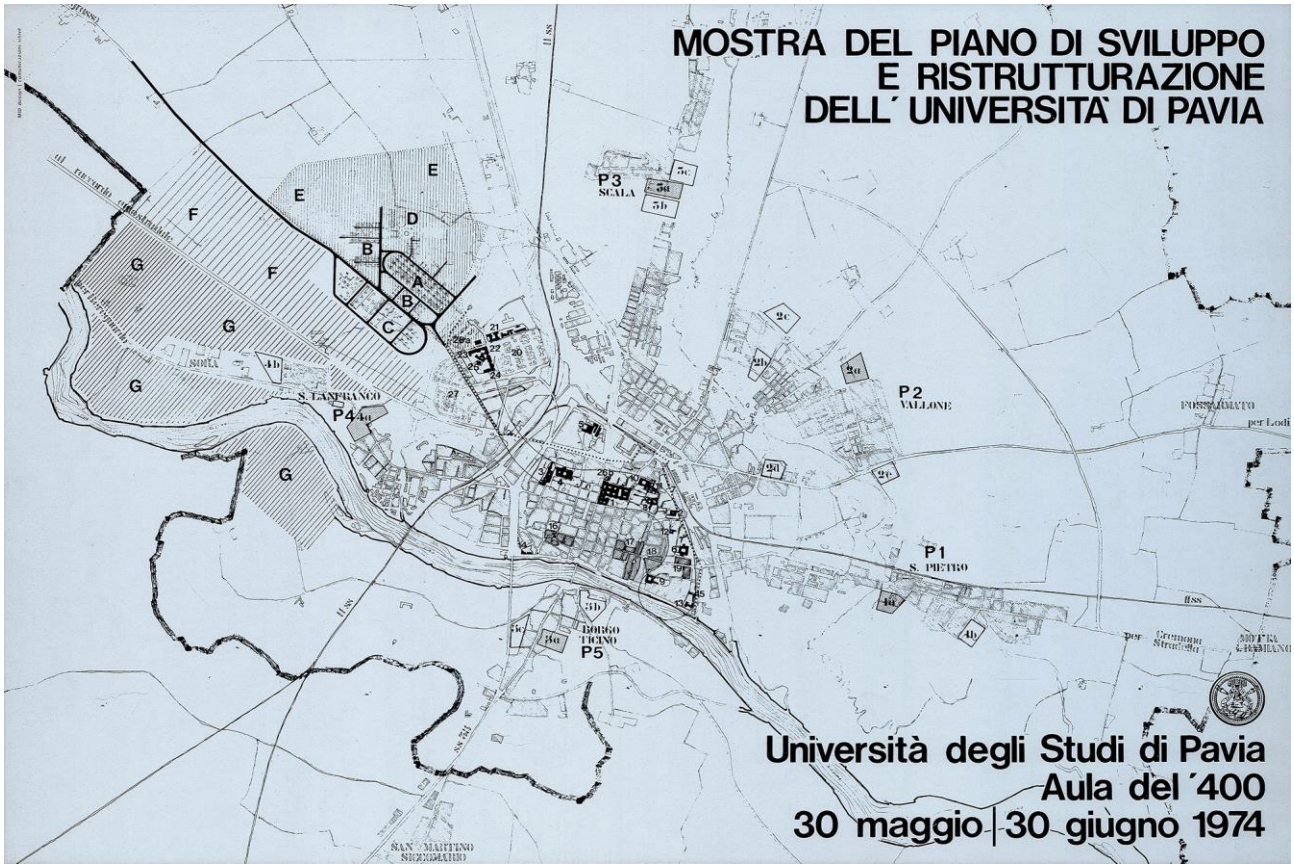

Fig. 3: Negative image of the illustrative poster distributed during the exhibition of the Building Development Plan for Pavia University held in the historical seat of the university in June 1974 [10].

The symbiosis between university and city (conceived both as building fabric and as a system of human relations) in this case take two basic shapes: on the one hand the joint intervention of university and municipality was thought to enable preservation and refurbishment of building complexes that private enterprise would let fall into disrepair [5] [7] [11] or alter in order to foster forms of speculation; on the other hand the joint settlement of students and lower class people would have favoured cultural exchanges between the two social realities and it would have prevented the ghetto effect typical both of many social housing estates, and of colleges, especially those built within campuses isolated from the rest of the city [20].
To the urban level, De Carlo's Plan coupled a level of preliminary architectural design characterised by drawings (scale 1:200) of all the new buildings of the central and intermediate poles. Particular attention was given to the design of the new structure for scientific faculties constituent the expansion of the central pole of Cravino; it became the design *manifesto* of the attempt to create the symbiosis (envisaged by the plan) between university buildings and city: «a continuous, flexible, growing, open, porous organism» [10].
In this area, the architectural translation of the idea of "univercity" (the fruitful permeability and fusion between universities and city, characteristic of the historic centre of Pavia) was characterized by a large linearly developed building complex (with main axis from north-east to south-west), characterized by a modular grid (43,2 m x 57,60 m, at the vertex of which the towers of vertical connections are located) intended for classrooms and teaching laboratories, offices and research laboratories, museums, a theatre, a cinema, bars and retail spaces. In particular, museums and commercial/leisure spaces, were placed along the central pedestrian distribution spine, which was connected through numerous cross walkways to the areas of botanical gardens and greenhouses (north-east), of sports facilities indoor and outdoor (north) and of university residences (west and south) [10] [12]. To the south of the complex a settlement of social housing was also planned [21]. The alternation of bands which are open to the public (in the north, along the central spine and in the south) with other bands reserved for educational activities (in the intermediate bands on either side of the central spine) was precisely aimed at stimulating the crossing of the university complex, promoting the symbiosis between university and city due to the appropriation of these spaces by the population and to the creation of moments of meeting and opportunities for cultural exchange.
A critical aspect of the expansion in the central pole of Cravino was connected to the potential impact on mobility and on transport links to the historic centre and to the rest of the city. Crossing the limited boundary of the university project, De Carlo proposed the creation of a new infrastructure linking the two poles at the service of the entire city; it was a monorail characterized by silent electric-driven wagons with rubber wheels,

that run on a thin reinforced concrete or steel beam 4,50 m high from the ground. The expected impact of the Monorail was low; indeed, the overall dimensions of the pillars – placed at 25 m from each other – was minimal and «The small size of the wagons allows very small radii of curvature, thus making possible the passage also in the vicinity of compact building fabrics, without requiring demolition». On the whole De Carlo thought that the impact was «much less than that produced by large parking lots for cars that will fully cover the visual of the spaces in which they are located» [21]. However, although the designers emphasised on the benefits of the new infrastructure that would allow the reduction, if not elimination of vehicular traffic in the historic centre, the full realization of the path between the pole of Cravino and the south east of historic centre would entail huge costs and the felling of trees of ring boulevards [22].

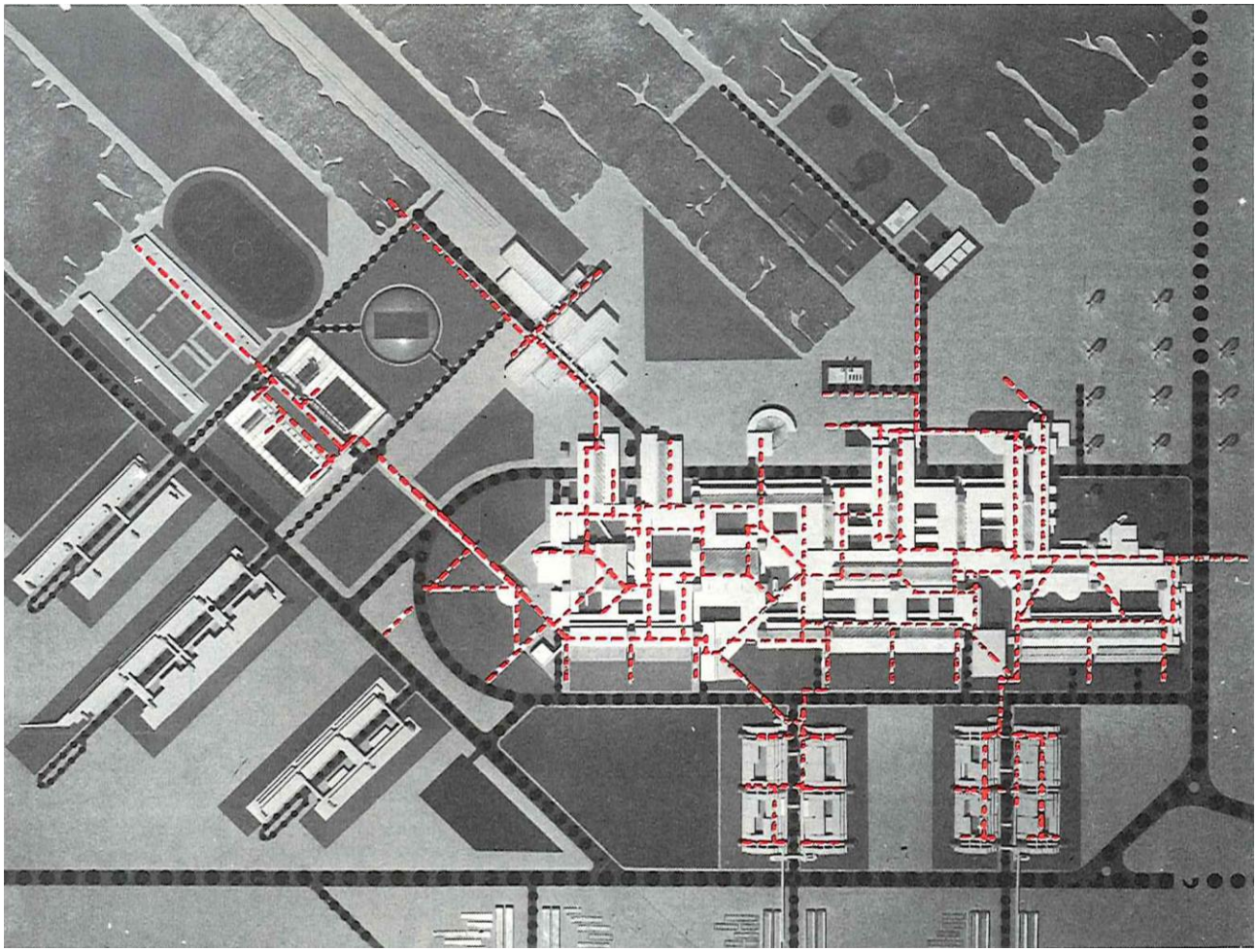

Fig. 4: Plan of the new structure for scientific faculties constituting the expansion of Cravino central pole. The building complex is built around many courtyards. To the north of the complex (in the upper left in the figure) there are indoor and outdoor sports facilities; to the north-east of the complex (at the top of the figure) there is the area for botanical gardens and greenhouses; to the east of the complex (at the bottom of the figure) there are the university student residences. The red dotted lines identify many possible paths for pedestrians to cross the building in all the directions [11].

4.4. Transposition in the municipal planning instruments

In 1970, when the University of Pavia charged De Carlo of drafting its Building Development Plan for some time a debate was ongoing about the need to update the planning regulations of the city, which seemed outdated and incoherent, and totally inadequate to deal with the strong changes of that period.

Indeed, the current PRG (*Piano Regolatore Generale*, General Urban Plan) – prepared by the Municipal Technical Office with the advice of professor Luigi Dodi – had entered into force only a few years earlier (1963), but with a delay of almost ten years after its drafting and approval (1956); it was especially obsolete as general conception (e.g. it foresaw a huge expansion from about 75˙000 inhabitants in 1961 to 120˙000 in 1990) and inadequate to deal with the changes that were occurring in the city [4].

Moreover, until 1963 the development of Pavia was governed by the previous PRG approved in 1938 and entered into force in 1941 (more than twenty years before), and by the Reconstruction Plan (1950).

Just this strongly inhomogeneous and – in many respects – poorly defined regulation, together with «the inability of the then dominant political forces, to organically solve the urban problems of Pavia» [23], had led to a serious political and administrative crisis that lasted from 1968 to 1973, causing even a compulsory

administration of the municipality (1971-73). In this situation building speculation had proliferated, altering large sections of the historic centre, and giving rise to phenomena of social expulsion of lower classes.
As mentioned, De Carlo addressed university issues trying not to divide them from those of the city; on the contrary he tried to create a symbiosis between the two entities, taking advantage of the opportunity provided by the necessity of university building renewal to solve some problems of the city, and exploiting the potential of the municipal services network to promote the contact between university research and population. To achieve this result it was essential that university choices were fully accepted as their own from local politics, therefore De Carlo tried to promote a dialogue between University and City Administration.

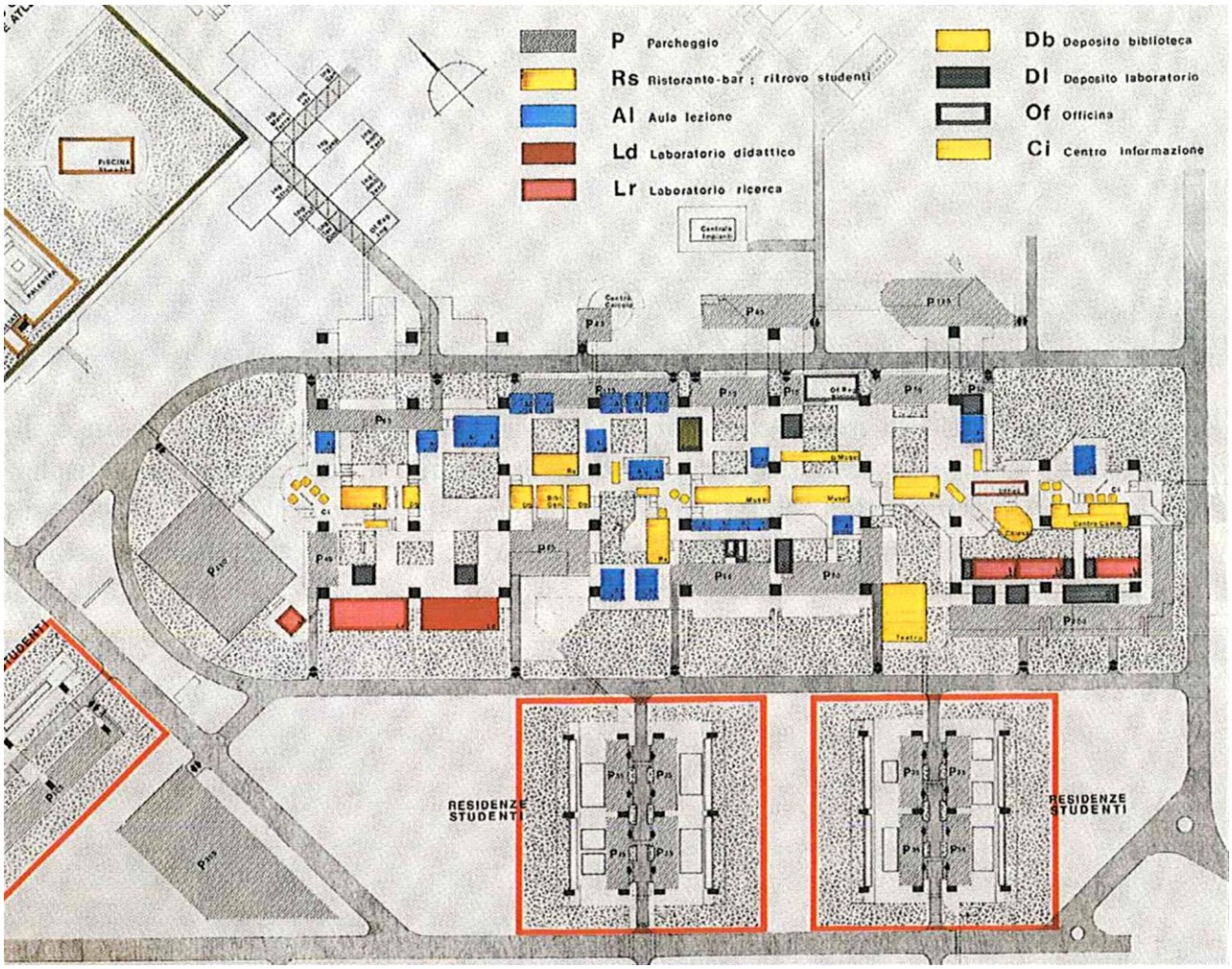

Fig. 5: Layout of the new structure for scientific faculties in Cravino central pole. Yellow areas are those intended for public use (bars, commercial areas, libraries, museums, a theatre, a cinema, a church); blue areas are those for classrooms; red areas are those for teaching and research laboratories; areas enclosed in red rectangles are those intended for university student residences; areas enclosed in brown rectangles are those devoted to sports [12].

In July 1972 professor Antonio Fornari – Rector of the University – summoned provincial representatives of parties to review the first draft of the plan, and «the meeting ended with a general motion favourable to the discussed plan» [9]. In March 1973 the new Municipal council and the mayor Elio Veltri (PSI, Italian Socialist Party) were elected; they immediately legitimized De Carlo's Plan by making some variants to the current PRG, in particular: the inclusion of a new university area in the Cravino zone as well as the restriction to agricultural use of a large adjacent area to prevent building speculation, arising from the intensive urbanization of the district; the destination to university use of the former Calchi Barracks (also former convent of Santa Chiara) and the prohibition to build in the surroundings; the destination to university residence of the buildings adjacent to the Borromeo College [9].
On November 11th, 1975 the "Framework Convention" between the City and University was approved. The Convention represented a key step in the implementation of De Carlo's Plan, because – through «an accurate coordination of the two public bodies» – it had the fundamental function of ensuring the establishment of an equilibrium condition between Municipality and University, whose development (in the

era of mass university and of access liberalization) «is strictly conditioned by the actual and potential resources of the whole municipal territory» [23].
A further fundamental evolution of the urban framework occurred in 1976, when the new PRG was adopted. It was drawn up by a technical office specially organized by the municipality, with the advice of the architects Giovanni Astengo and Giuseppe Campos Venuti. The PRG adopted almost all of the instructions contained in De Carlo's Plan; in particular it confirmed the possibility of university expansion to northwest (related to the decentralization of scientific disciplines), for whom «the new plan could not develop original proposals, but had to take account of already ongoing programs» [9] [24].
The hypothesis of a significant university expansion in the north west of the city (it was planned that a total of about 12˙500 students would have weighed on the area of Cravino [21]) was one of the most problematic aspects of the urban plan. In fact, the municipal administration wanted to protect the large green area to the north of the city, along the course of the *roggia* Vernavola (an artificial channel with high naturalistic value) and the PRG was therefore bound to plan the expansion of production activities at the opposite end of the city, creating a form of bipolarity in urban development [9] [24]. The plan attempted to balance this bipolarity favouring residential settlements in the Cravino: about 20% of new residential areas expected by the PRG was in this district, while in 1977 the Plan for Economic Social Housing (PEEP) stipulated that about 60% of new social housing had to be built in the area [24]. However, a part of public opinion strongly criticized the decision to separate the two lines of development [22]. The PRG by Astengo and Campos Venuti also confirmed the plan of peripheral poles – though decreasing their number from 5 to 4 and eliminating the one closest to the Cravino pole – since they «will tend to favour a greater integration between the city and the university» [24].
Instead a point of divergence between Building Development Plan for the university and PRG was the missed implementation of the idea of integrating student housing in the rehabilitation of historic centre building fabric: since the capacity of settlement of the historic centre was considered «just enough for the resident population» [9], the areas were almost entirely destined for reuse as social housing on the initiative of the municipality itself [25].
In March 1977 the City Council accepts with a deliberation a few remarks to the new PRG regarding the Cravino area, made by the University of Pavia, finally «the bureaucratic process of the two plans can be considered successfully completed, registering a significant and useful convergence of their projects in the interest of both the involved bodies» [9].

5. Conclusions

The period of drafting of Building Development Plan for Pavia University coincided with a phase of complex socio-cultural and economic changes in Western society, which was expected to be an opportunity for radical renewal. In this perspective De Carlo assigned a key role in the design process to the establishment of a dialogue between University, public administration and citizens, which were also involved in "participatory planning". Starting from the idea – especially rooted in the student movement – that it was necessary to rethink the role of university in society and in territory, De Carlo made a series of architectural and urban choices – both in the design of new buildings, and in the refurbishment of the existing ones – conceived to create a social and cultural symbiosis between academia and city population.
Years later De Carlo's choices may seem utopian, however – if seen in the context of economic expansion and great cultural ferment of the time when the plan was drawn up – they assume greater realisticity. The subsequent economic downturn, along with the reluctance to change that characterized part of the academic world, prevented the full realization of the plan, especially with regard to Cravino central pole and to peripheral poles. However, although the incomplete implementation has partly distorted the overall vision underlying the Plan, even today its flexibility and the farsightedness of the design choices at the urban scale positively influence the city land use decisions and the evolution of Pavia urban fabric, so that the current university development plans are still debtors to the ideas elaborated in those years.

Bibliographical References

[1] FAGNANI, Flavio. Università degli Studi. In ID. *Guida storico artistica di Pavia*. Pavia: Ponzio, 1985, p. 123-126.

[2] ERBA, Luisa. L'Università. In *Pavia. Ambiente storia cultura*. Novara: De Agostini, 1988.

[3] CALVI, Gianpaolo; IANNELLI, Giovanni. Il campus del Cravino e il Centro di ricerca sulle acque. In CANTONI, Virginio; FERRARESI, Alessandra (eds). *Ingegneri a Pavia tra formazione e professione. Per una storia della Facoltà di Ingegneria nel quarantesimo della rifondazione*. Milano: Cisalpino, 2007, p. 569-575.

[4] BRUSCHI, Sergio; PALESTRA, Giovanni Walter. Edilizia a Pavia 1945-2005. Pavia: Ce.St.Edil., 2007.

[5] CALVI, Gianpaolo; ARECCHI, Alberto; MAZZUCCHI, Sergio; TURRI, Francesca (eds). *Sistema universitario, società e territorio.* Pavia: Industria Grafica Pavese, 1974.

[6] DE CARLO, Giancarlo. *La piramide rovesciata*. Bari: De Donato, 1968.

[7] OTTOLENGHI, Roberto. Introduzione agli attuali problemi di crescita dell'Università di Pavia. In CALVI, Gianpaolo; ARECCHI, Alberto; MAZZUCCHI, Sergio; TURRI, Francesca (eds). *Sistema universitario, società e territorio.* Pavia: Industria Grafica Pavese, 1974, p. 62-64.

[8] CAPANNA, Mario. Formidabili quegli anni. Milano: Rizzoli, 1988.

[9] CALVI, Gianpaolo; OLIVA, Federico. Aspetti urbanistici ed edilizi del Piano in rapporto al Piano Regolatore Generale della Città di Pavia. In *Università degli studi di Pavia. Conferenza di ateneo. Realtà e prospettive del sistema universitario pavese. Atti*. Pavia: M. Ponzio, 1981, p. 45-53.

[10] Illustrative poster distributed during the *Mostra del Piano di sviluppo e ristrutturazione dell'Università di Pavia*. Università degli studi di Pavia. Aula del '400. 30 maggio/30 giugno 1974.

[11] DE CARLO, Giancarlo. Pavie: la ville et le modèle multipolaire. In *L'Architecture d'Aujourd'hui*. n. 183, January-February 1976, p. 52-62.

[12] TURRI, Francesca. La "nave" di Giancarlo De Carlo e il piano di sviluppo dell'Università di Pavia al Cravino. In CANTONI, Virginio; FERRARESI, Alessandra (eds). *Ingegneri a Pavia tra formazione e professione. Per una storia della Facoltà di Ingegneria nel quarantesimo della rifondazione*. Milano: Cisalpino, 2007, p. 577-594.

[13] DE CARLO, Giancarlo. Pianificazione e disegno delle università. In ID. (ed). *Pianificazione e disegno delle università*. Roma: Edizioni universitarie italiane, 1968, p. 9-34.

[14] DE CARLO, Giancarlo. Piano generale di sviluppo dell'Università di Pavia. In *Università degli studi di Pavia. Conferenza di ateneo. Realtà e prospettive del sistema universitario pavese. Atti*. Pavia: M. Ponzio, 1981, p. 33-44.

[15] TURRI, Francesca. Abitare da studente. Indagine sulla situazione abitativa degli studenti universitari a Pavia. Pavia: ISU, 1989.

[16] COPPOLA D'ANNA PIGNATELLI, Paola. L'università in espansione. Orientamenti dell'edilizia universitaria. Milano: ETAS Kompass, 1969.

[17] DE CARLO, Giancarlo. Evoluzione della concezione e dei modelli territoriali dell'università. In CALVI, Gianpaolo; ARECCHI, Alberto; MAZZUCCHI, Sergio; TURRI, Francesca (eds). *Sistema universitario, società e territorio.* Pavia: Industria Grafica Pavese, 1974, p. 52-61.

[18] DE CARLO, Giancarlo. Un caso di studio: l'«universicittà» di Pavia. In *Parametro*. n. 44, 1976, p. 20-23.

[19] DE CARLO, Giancarlo. Piano di sviluppo e ristrutturazione dell'Università di Pavia. In *Casabella*. n. 423, March 1977, vol. XLI, p. 56-57.

[20] ARECCHI, Alberto. Distaccamenti universitari e residenza integrata. In CALVI, Gianpaolo; ARECCHI, Alberto; MAZZUCCHI, Sergio; TURRI, Francesca (eds). *Sistema universitario, società e territorio.* Pavia: Industria Grafica Pavese, 1974, p. 68-69.

[21] DE CARLO, Giancarlo. Appunti sul progetto per la nuova Università di Pavia. In CALVI, Gianpaolo; ARECCHI, Alberto; MAZZUCCHI, Sergio; TURRI, Francesca (eds). *Sistema universitario, società e territorio.* Pavia: Industria Grafica Pavese, 1974, p. 65-67.

[22] STABILE, Ignazio. La città disintegrata. Un documento sulla partecipazione tradita. Pavia: Il Cerchio Edizioni, 1981.

[23] VELTRI, Elio. La convenzione quadro Università-Comune. In *Università degli studi di Pavia. Conferenza di ateneo. Realtà e prospettive del sistema universitario pavese. Atti*. Pavia: M. Ponzio, 1981, p. 65-67.

[24] CAMPOS VENUTI, Giuseppe; OLIVA, Federico (eds). *Urbanistica alternativa a Pavia.* Venezia: Marsilio, 1978.

[25] TURRI, Francesca; PERNETTI, Roberta; ZAMPERINI, Emanuele; CAPPELLETTI, Viola. Retraining of social housing in Pavia. In AA.VV. *R+S=F 2010. Rehabilitation and Sustainability. The Future is Possible*. Barcellona: CAATEEB, 2010.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Different futures in the labyrinth of the carto-iconographical heritage of Milan.

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Abstract
In one of his short stories Jorge Luis Borges tells about a mysterious labyrinth, bequeathed from an erudite Chinese writer to his grandson. He find that the legacy is none other than a weird manuscript, apparently senseless, in which the time lines intertwine and all the several development of the events and the possible futures of the characters coexist at the same time.
The same labyrinthine and contradictory nature seems to mark the development of Milan through the time. The city was always divided between, on one hand, the ambition of a territorial dimension and civil magniloquence, and on the other hand the inclination to development as an amount of places closed in themselves, in which are organized little worlds with an own recognizable identity. That duality between intimistic localism and metropolitan dimension has often compromised the organic development of the urban transformation. This study -expounded through the photographic and graphics analysis, together with the GIS technology for integrated navigation in the archive of Milano, including cartography, iconography and projects documents- allows instead to show the coexistence of both the way in the development/definition of the *Forma Urbis*, recognizing even in the most apparently *tranchant* of the Rettifili the function to organized the urban perspectives through sequences of places and monuments in the historical city.

Keywords: *Urban representation, Cartographic heritage, Iconographic heritage, Milan*

1. Female cities and male cities. Milan, a hermaphroditic city?
In a slightly humorous conference held in 1926 at the *Kunstbibliothek* Heinrich Tessenow stated: «*Young cultures are "roady", animated by growth and what they are becoming, immature. When the culture gains stability the roads start to cross, a point of tranquillity is formed and the culture develops itself in height and depth, tall buildings dominate, quiet gains ground, femininity, intimacy and squares take over (...). Contemporary man is "roady", and yet he carries within him the nostalgia for the outlined space of squares, for femininity. Conservatives are the opposite of this.*»[1]
The urban identity of Milan, during the entire process of its development, seems to swing in a contraddictory way between the two opposite paradigms described by the prussian architect.
On one hand the city presents itself like a system of central places designed by the monocentric structure of the walls, which are crossed, like in a spiderweb, by the radial structure of the *Corsi*, the streets that connect the gates, and consequently, the surrounding area, to the barycentric heart of the city. This latter, coinciding with the monumental centre of the *Duomo* and its square, sorts out the places of the city life: the *Brolo* with its arcade for trade and the *Piazza dei Tribunali*, the archbioshop's see and the fortress of the visconteo-sforzesco castle. In the historical Milan, the walls mark indeed not the boundary between an interior organized world and the external chaos, rather than the particular connotation of an unique reality, in which the urban interiority assumes the significance of a holy enclosure whom a bigger area is connected to; in a manner to speaking the city, id est that part of a territory enclosed by walls, represents the acropolis of the land.
This is the feature described by all the perspective and planimetric cartography of the sixteenth and seventeenth century, which passed down the scheme of Milan made by enclosures and central areas,inscribed one inside another, as well as a matryoshka doll.



Fig. 1: In order from left, "*Piazza San Fedele durante l'assalto al palazzo del Ministro Prina"* by Giovanni Migliara (1814), Piazza San Fedele today (Photo M.Introini).

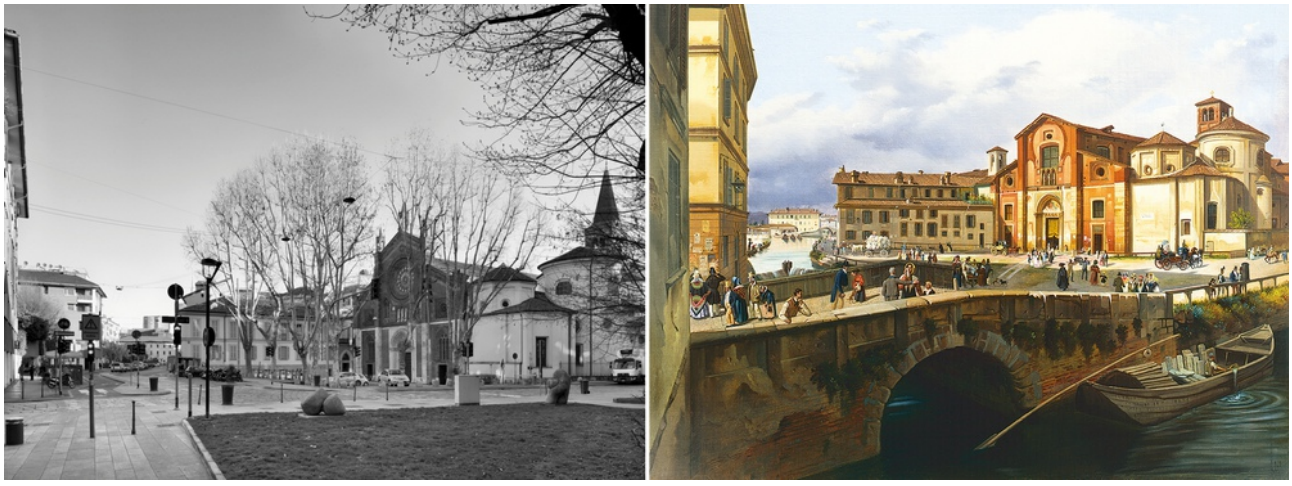

Fig. 2: In order from left, San Marco today (Photo M.Introini), "*Veduta della facciata della chiesa di San Marco"* by Luigi Premazzi (1837).

This design was largely confirmed also by Teresian and in Lombardo Veneto Cadaster maps,[2] which tell the development of the urban space – composed by houses, shops, noble houses, factories, churches, convents and gardens – organized in a hierarchical way and divided in urban jurisdiction, each of them referring at one of the six gates, by which the Spanish walls are divided, and further organized in internal parish.

It's a complex system of places, around them are organized small world with an own recongnazible identity, given by the relation with a particular parish and by the handcrafted production of its inhabitants. In this way was the district of *Perfumieri* coexisting near the ones of *Spadari*, *Venditori d'Oro* and *Fustagnari* (people make swords, gold sellers and tinsmiths).

The urban views [3] of the sixteenth century, from the portrayal of the military parades in Piazza Duomo painted by Sebastianone, to the description of squares and *sciostre* (the areas where the *comballi*, barges trasporting goods by *Navigli*, landed) crowded in Giuseppe Migliara's and Luigi Premazzi's painting or nostalgically snow-covered in Angelo Inganni's ones, confirm the description of an urban image.

To this type of city made by small worlds seems to oppose Milano during the age of the Enlightenment.

The city is described by the *Piano dei Rettifili*, drawn up by the architects of *Commissione d'Ornato* and basing itself on Giacomo Pinchetti's map in 1807 and on its different versions published between 1810 and 1812 of the survey carried out since 1806 to 1807 by the Astromers of the Brera Astronomic Observatory.

They picture a city redrawn with the *grandeur* proper to its new role of capital of the *Regno d'Italia* and to its destiny to be the one guiding the expansion beyond the city walls, which were a physical obstacle against the open shape that the city would have had.



Fig. 3: Extract from *"Piano dei Rettifili"* drawing by *Commissione d'Ornato* on Pinchetti map's edition (1801).

To express this "roady" character, during the age of the Enlightenment, Milan resumes and increases the ancient *cardo-decumano* structure on which was built *Mediolanum* in Massimianus' age. The Roman structure is still visible through the radial medieval scheme thanks to the north-west traking of R*ettifilo,* that connects piazza Cordusio and the Castle, to its territorial extension in corso Sempione and to the construction of Arco della Pace, a closed reference to *les arcs* wanted in Paris by Napoleon.
A sign of "civic magnificence" that the historians pointed out [4] also in the entire iconography of Milano aimed to better illustrate the various projects about the realisation of the new places of the civic life or of the temporary structures celebrating the glory of Napoleon.

2. In the labyrinth of history

The development of the urbanistic image of Milan is signed, through the ages, by the conflict between two souls, in which the "roady" and male one wants to express the idea of a city open by wide urban perspective, like it wants to restore a more domestic and feminine structure made of square and closed places.
In the same way a tendency in historiography wanted to give an interpretation about the architectonic development in the XX century following the idea of a manichaeistic contrapposition between the ones looking back to the past, guardian to the souls of the historic core of the cities (like for example Saverio Muratori and Giovannoni) and the followers of the Modern Movement, who suggest a more salubrious and rational city through the new *extra-moenia* districts.
A dualism between localism and metropolitan dimension which often compromised the organic fulfilment of the the urban depelovement processes.
Nevertheless it's exactly the peculiarity of Milan, meaning the necessaty to always connect the new to the known characters of the city and of the architecture (claimed by both BBPR and Terragni in one hand and Aldo Rossi and Guido Canella on the other) that reveal how this kind of interpretation is rough and simplistic.
The complexity and richness of the historical bequest is truly clear in the coexistence and in the twine, incomprehensible at the first sight like in a labyrinth, of different lines of research and tendencies apparently opposed to each other.
In a famous short story edited in 1941 [5] Jorge Louis Borges tells about a chinese erudite notable, who bequethed a mysterious labyrinth to his grandson.
The latter push himself to action to "*imponerse un porvenir que sea irrevocable come el pasado*" [to impose upon himself a future as irrevocable as the past].
Finding a note in which it was written "*Dejo a los varios porvenires (no a todos) mi jardín de los senderos que se bifurcan*" [I leave to the various futures (not to all) my garden of forking paths.], he finds out that the bequeth is a bizarre manuscript at which the ancestor dedicated the last ten years of his life. The manuscript is an



Fig. 4: In order from left, Porta Nuova today (Photo M.Introini), extract from google Maps (2015) in which is signed the point of view of the previous image, "*Milano. Porta Nuova"* engraver Bramati (1833), document combined with the "*Pianta città Regia di Milano"* (1807/10) with the *"Mappa del Catasto Teresiano sez. Corpi Santi di Porta Comasina e Porta Nova" (1722)* in which is signed the point of view of the engraving.

apparently senseless narration, in which the time lines intertwine and all the several development of the events and the possible futures of the characters coexist at the same time.
In this way Borges seems to suggest that to the supposed continuity of history as linear narration it needed to replace a research that is able to find out in history plots of possible continuities, adopting a hermeneutic approach towards a past in which the molteplicity is able to take place of the irrevocability.

3. The Ariadne's thread of representation

As in the temporal aspects of the manuscript described by Borges, the navigation with GIS-technology in the carto-iconographical heritage of Milan – available on line and consisting in maps and topographical plans, paintings, drawings, endgravings and project documents [6] – allows to read them not only as documents but also as representation.
That involves to not consider them undisputed statements of an assertive truth, but as results of a well-

defined statute of the communication, to which contributed the adoption of a point of view looking at the reality and a graphic code to transcribe it.
This imposes the necessity to employ comparative procedures between different images of the same object or physical context. In this way it is possible to identify surely the graphic code used and possible aberrations or deformations caused by it.
The analysis of the cartographical documents aimed at this revealed, for example, that the seemingly *tranchant* approach used by P*iano dei Rettifili* to the lively space of the city it's above all a graphic effect deriving from the high factor of the scale (1/6200) in the cartographical map adopted by the architects of *Commissione d'Ornato*, in order to be able to show to Napoleon the new plan, during his visit in Milan at December 1807. The graphical representation of Milan's survey in scale 1/1000 executed by the Brera's astronomers was not finished at that time and it would have been, in the early intentions, the cartographical base for the new urban project.
This is really clear when one compares, using an experimented method in some recent analytical studies, the representation of a certain place in *Piano dei Rettifili* with the representation of the same one took from the architectonic executive projects, for example those designed for the city gates.
A more difficult situation occurs when, in lack of representation on architectonic scale, one needs to presume from the analysis of the existing reality the way the previsions of the plan are claryfied in the intervention with the architectural scale.
For example in *Piano dei Rettifili* the correspondent route of the present via Dante is marked out with high determination. It was destined to connect the new tringle-shaped square named Cordusio with Castello Sforzesco, that was the fulcrum of the new Napoleonic order, around it Antolini's project considers the building of Foro Bonaparte.



Fig. 5: Today's image of via Dante connecting Piazza Cordusio with Castello Sforzesco as a resoult of the application of *Piano dei Rettifili* (Photo M.Introini). The photographs are made using a camera equipped with a tilt-shift lens, which allows to move the position of the recording medium from the center alignment with the axis of the optical assembly. When the photo camera is parallel to horizon, this displacement allows to take a picture having the vertical lines of the architecture parallel to perspective framework (vertical decentralisation) and to move the main points of prospective, maintaining the line of the horizon parallel to perspective framework.

Foro Bonaparte would have been the magnificent laical and civic centre of the city, aimed to be a countermeasure to the inner city of piazza Duomo. The fulfillment of this axis seems to be never specified in an executive project or in a more detailed one. It's needed the use of the instruments of representation to sound out the physical aspects of the spaces and to recognize in them the ways in which the plan has been realized.
The planimetric survey reveals how, from the beginning in piazza Cordusio to the arrival in piazza Castello, the street front slides ahead closing the optical telescope towards the castle in 1.60 linear meter on a global length of 363 lm. It's a too small size to be visibly comprehensible on a cartographical scale, and, otherwise, it's too big to be considered as an imprecision in the building accomplishment.
If one analyses a picture took in piazza Cordusio of today's perspectival axis, will be comprehensible those little planimetric gaps done during the realisation of the building front.
Each of these differences reveals that the optical telescope of via Dante is the result of a refined geometry, which organized every fragment like a sequences of perspectives, structured to progressively move the main point of view in North-Wester direction "closing in" towards the Castle.
This persuades to consider the axis of the *Rettifilo* of via Dante like an indication of the idea of the urban structure, aimed to find a more precise dimension in the physical relationship with the places of the inherited city and its fragile proportions.

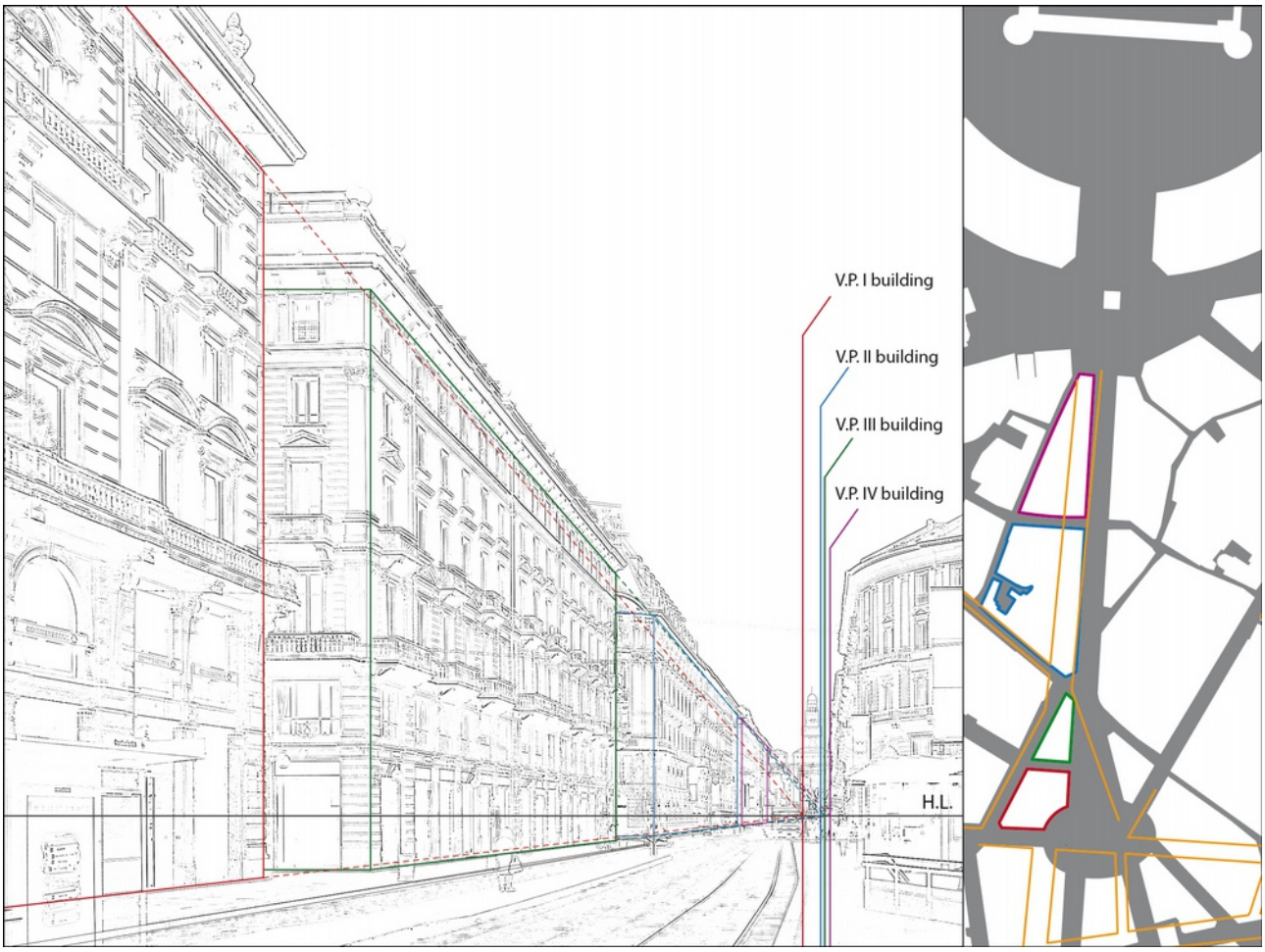

Fig. 6: Sketch of the street front and returning the horizon line and the slippage of the main points of the perspective. Next image: the figure ground of the area between Piazza Cordusio and Castello Sforzesco, where are underlined the buildings slipping forward; in orange is represented the *"Piano dei Rettifili"* designed by *Commissione d'Ornato*.

4. Milan between chorographic map and topographic resewing

The analysis made on the *Rettifilo* of via Dante demonstrates that is wrong to confer to the drawing express from the Neapoleonic plan the presumptuous will to proceed with hard an summery cuts of the urban space.
In the general process of the development of Milano instead, the contrast between the ideas of cities, facetiously exemplified by Tessenow as a conflict of gender, seems to find a recomposition in terms of

difference of scales, giving to the imperativeness of the tracing the worth proper to the carto-chorographyc drawing, aimed by its nature to fix, through a process of abstraction and simplification, the relationships between the actions and the urban elements.
It's interesting at this point to understand how this approach is diversified in relation with the parts of the city which have a strong architectural identity, that is in those cases in which the drawing of the tracing or the chorographic one had to confront with places which for ages kept in themselves the meaning and the coagulative points of the collective life, being in this way the connection of the expression of the urban space.Surely in the city of Milan a place with these features it's the complex of the today's via and piazza Mercanti, deriving from significant restorations and demolitions during the nineteenth century made in the place, where the earlier medieval square of the fourteenth century was.
Until the second half of the twentieth century, piazza Mercanti was a quadrangular space, enclosed by a building front, which opened towards the dense weave, of the surrounding alleys, through six doors, big vault with rounded arches, each of them allowed the entrance to one of the six districts of the city, the *Sestrieri*, named from the handcrafted activities done there.
The square, for some century indicated as *piazza dei Tribunali*, was the physical and geometrical centre of the city and also the business,civic and social one, complementary to the religious centre in Piazza Duomo.
There was placed important public buildings, like *Palazzo dei Giureconsulti*, which occupied a whole side of the quadrangular enclosure, *Casa dei Panigarola* (or *Ufficio degli Statuti Notarili*) , *Scuole Palatine* and *Loggia degli Osii*, from which the sentence were communicated to the citizenery in front of which was situated a black rock where were forced to sit, exposed to the shaming, those who went in bankrupt.
In the middle of the quadrangular enclosure was the today's *Palazzo della Ragione*, in the past named *Broletto*: a rectangular space, open and hypostyle, on which was a solid building volume in brick , seat of the city assemblies. Maria Teresa decides to elevate it and to appointed it as notarial archive.
Being a space closed in itself, like a fortress that fences in the Broletto, makes this part of the city immediately recognazible in the historical maps, where it remains the same until 1865, when Mengoni proposes the construction of *Galleria Vittorio Emanuele* and a new order of the whole area near to piazza Duomo, extending it with demolitions.
Actually, referring to the surrounding area of today's piazza Mercanti, Mengoni's idea is quite faithful to the planning of *Piano Napoleonico*. This latter, imaging the partial demolition of the building that was orthogonal to *Palazzo dei Giureconsulti* as well as of *Rebecchino* and of *Coperto dei Figini*, traced a Rettifilo that was parallel to today's via Mercanti, a link between piazza Cordusio and piazza Duomo, removing in this way every diaphragm.
Developed at a distance of more than 150 years each other, both the Napoleonic project and after the Post-Unitarian one have the same idea about the street tracing, with the effect to transform a part of urban space, that was closed in an enclosure, in a open and perspectival one.



Fig. 7: In order from left: extract from "*Mappa del Catasto Teresiano, Carta delle Porte" (*1751); extract from *"Piano dei Rettifili" drawn in 1807 by Commissione d'Ornato on the Pinchetti map's edition dating back to 1801.*

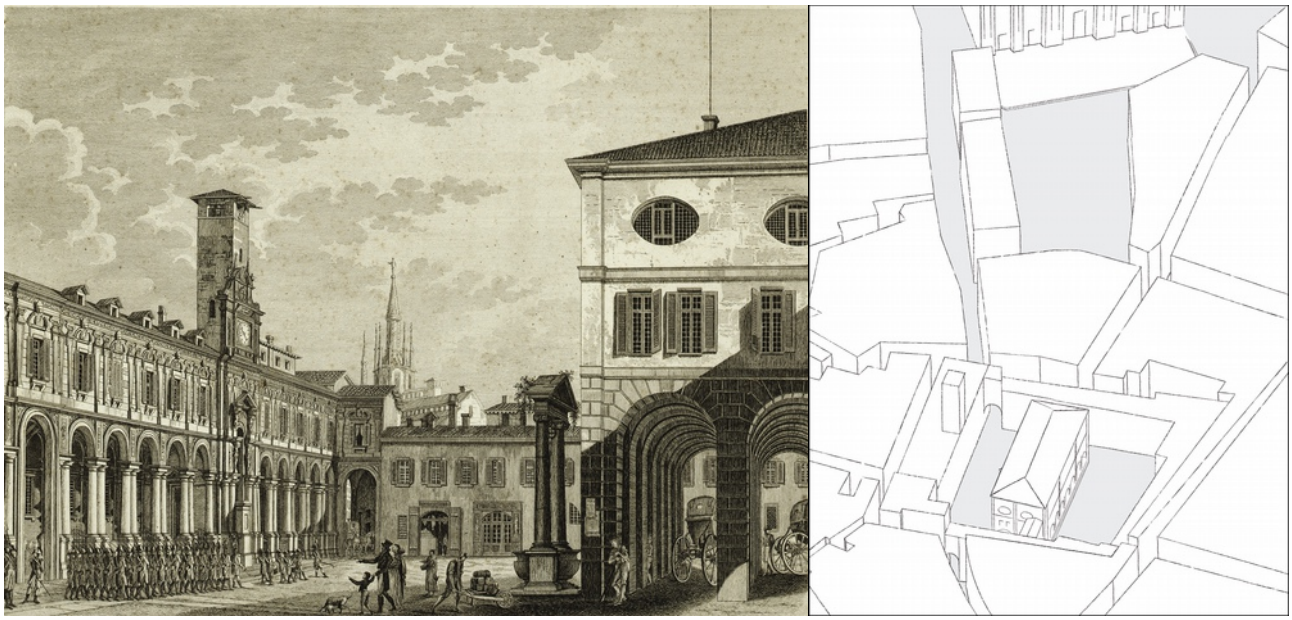

Fig. 8: *"Veduta della P.za dei Tribunali"* by Gasparo Galliari (1807), three dimensional sketch of the enclosed squared space of the *Piazza dei Tribunali*. The connection with the surrounding was through the city gates, like the rounded vault one in the background of the image, that connected *Piazza dei Tribunali* with *Piazza del Duomo*.



Fig. 9: *Via dei Mercanti* today (Photo M.Introini), three dimensional sketch of the opened space of *Via dei Mercanti*. In the photo can see on the left the *Palazzo dei Giureconsulti*, on the right *Palazzo della Ragione*, in background in the middle of image the wide view of *Piazza del Duomo*.

In this case, the analysis through the visual comparison between the representation of the place in a Galliari's engraving of the nineteenth century and a today's one, photographically described with a point of view the most similar to the one of the historical representation, reveals a kind of revolution of the open/close relationship between the *Broletto* and the surrounding areas.
This revolution is pointed out by moving the sixteenth-century well, that in Galliari's engraving was still in the area opposite the *Palazzo dei Giureconsulti*, corresponding nowadays to via Mercanti, in the space behind the *Broletto*, today's via Mercanti in the toponymy, in the exact point where was the *Pietra dei falliti* [bankrupts stone], to mask with heraldic nostalgia the memory of the shaming and the infamy.
The revolution of the spacial relationship is based on also those elements that today are defined as street furniture, involved in a resewing operation able to save the topographical memory, recomposing the urban aporia enunciated by Tessenow between the male act of tracing and the feminine one of enclosing, between an idea of city that found itself on a street drawing as a sign of command and the one that unified the urban

space around the places which symbolize the sense and the ritual of the collective life.
Even the progressive and “roady” Mengoni declared in this way to carry “within him the nostalgia for the outlined space of squares, for femininity”.

Bibliographical References

[1] TESSENOW, Heinrich, *Die Deutsche Zeitung* 2.3.1926, in: DE MICHELIS, Mario. *Heirich Tessenow 1876-1950*. Milano: Electa 1991, p. 113 and n. 71 p.123.
[2] SIGNORI, Mario. L’immagine cartografica della città di Milano nelle mappe dei catasti sette-ottocenteschi e nel rilievo degli astronomi dell’Osservatorio milanese di Brera. La documentazione archivistica. The cartographic image of the city of Milan in 18-19th century land register maps and in the survey cariied out by the astronomers of Milan’s Brera Observatory. In: IAROSSI, Maria Pompeiana. *Ritratti di città in un interno.* Bologna: BUP-Bononia University Press, 2014, p. 49-54 and 171-173.
[3] SANGION, Silvia. Il volto della città alle soglie della contemporaneità. Milano attraverso l’occhio dei vedutisti e le parole degli scrittori. The city facet at the doorway of contemporary. Milan trough the landscapee painters’ eye and the writers’ words. In: IAROSSI, Maria Pompeiana. *Op.cit., p. 71-75 and 181-183*
[4] PATETTA, Luciano (a cura di). *L’idea della magnificenza civile. Architettura a Milano 1770-1848.* Milano: Electa editrice, 1978.
[5] BORGES, Jorge Luis. El jardín de los senderos que se bifurcan. In: *Ficciones.* Barcelona: Penguin Random House, 1995, p. 101-117.
[6] http://www.ritrattidicittà.it/
[7] ROSSI Michela, RUSSO Michele. L’immagine della città: frammenti e percorsi nell’iconografia urbana. The image of the city: tiles and paths in urban iconography. In: IAROSSI, Maria Pompeiana. *Op.cit.*, p. 151-156 and 210-212
[8] IAROSSI, Maria Pompeiana, RUSSO, Michele. Il rilievo urbano per la comunicazione via web. Un’esperienza milanese. The urban survey for web communication. A Milanese experience. In GIANDEBIAGGI Paolo, VERNIZZI, Chiara. *Proceedings of “Italian Survey & International Experience. XI Congresso Internazionale UID-Unione Italiana del Disegno.* Parma 18-20.10.2014”. Rome: Gangemi 2014, p.333-340.

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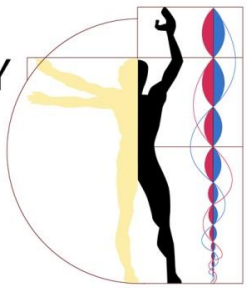

Ancient villages: the Eco-museums to Eno-museums

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Abstract
Tourism is a substantial factor on economic development processes. In fact it is an integrated component into territorial dimension as it expresses itself trough multidimensional and cooperation processes, both socially and politically.
Contemporary requirements, for developing and consolidating together economic and social wellness with environmental resources, are more and more moving into the territory from the global scale to the local scale. In this perspective the idea of Eco-museum can today be revisited in order to launch experimentation of a new sustainable tourism. Focusing on existing relations between human habits and natural eco system, Eco-museum moves towards an integrated system rediscovering cultural identities of local communities.
And it is the historical memory, even before the character of places and architectures, to direct tourists to a fruition of the territories more rooted to the contexts and less hasty.
The semi-abandoned villages open, for example, interesting recovery prospects; on the one hand must be reconfigured perceptual identity of the built town, on the other, it could be possible to start testing innovative multimedia connections on a global scale. One possible perspective can be represented by Eno-museums, which, in spite of a Wine-museum, recall from Eco-museum experimentation both the urban extent and the strong interconnection with productive activities.

Keywords: Wine-Landscape, Landscape-Perception, Local Production, Ecomuseum, Enomuseum

1. A more conscious tourism[1]
The idea of ecomuseum can still today be the basis for promoting a more conscious tourism that meets the needs of the area, while it is adequate to been revisited in order to move experimentation of a new sustainable tourism. Focusing on existing relations between human habits and natural ecosystem, the ecomuseum moves again towards an integrated structure rediscovering cultural identities of local communities. And in this perspective the fundamental aspects of ecomuseum should be revisited in order to launch experimentations, especially if the experiments led to results from which testing more specific contexts, with relevance onto the economic plane.
In this paper the idea of Ecomuseum is connected to that one of Enomuseum, identifying peculiar differences and concordances according to sample case studies. There are original correspondences as the ecomuseum idea was born in France, and it is also true that France is the first place in Europe for the success of enotourism. So both these kind of territorial organizations

[1] Francesca Muzzillo

share the goal of investigating about people, heritage, local culture and integrity of different environmental contexts, while people is experimenting them firsthand.
Even in wine places in which enotourism and ecomuseum practices seem to be more separated than in France, there is the opportunity of bringing these two ideas together. It is in fact an opportunity to connect habits of the community and agriculture economy in the future as many ecomuseum experiences have linked winery spaces inside wide landscapes, respecting the identity of places. An example is the ecomuseum of Rocche del Roero.
Also the "Musée des Traditions Paysannes de Bourgogne Nivernaise" is a case study apt to let understand how daily life - in this museum - is an opportunity for a new rural society.
The rural landscape is part of a complex system, which combines aspects of production, culture and environment. It is a basic interconnection between human activity and environmental system, in which man's ability to affect the territory is expressed in different ways, in relation to different environmental conditions and different production techniques; but in any case they are based on the need to find a balance with the environment in which it operates.
These characteristics make it particularly suitable for an ecomuseum to promote sustainable and conscious tourism that funds its future on recognition of identity. Particularly the connotation that makes it possible is the reorganization of diversity: diversity in space, in time, in seasons. It is the integration of history and nature that compounds a variable diagram of diversity. And the wine experience might push towards a more conscious experience of place, as it opens a wealth of knowledge in a direct way, with the occasion of being involved in a particular moment that is always temporal. Landscapes so produce history memory, together with perspectives and there is the fundamental base for a sociopolitical productive landscape.
The seasonal variability of enoturism is a factor that influences strategies that are apt to have different fluxes during year and variability of experiences. The involvement in a natural place encompasses respect for the environment and for people. It make us understand that each place is distinctive, and so, in view of a more sustainable approach for promoting enotourism, we should formulize not only considerations for the single vineyard or even for a group of vineyards, but also the connection which bounds vineyards to the landscape and to the human habits.
It is true that wine cultivation has sometimes a relative impact from the perception point of view, with the consequent homogenization of local identity, but, if a mixture of different element were well disposed, it would influence the latent opportunities of territories to take advantage of sustainable tourism. There is a way for reducing visual impact, realizing at the same time an integrated component into territorial dimension as it expresses itself through multidimensional and cooperation processes, both socially and politically.
How to work in an innovative way? There is a way of compounding natural and artificial resources, inspiring to the traditional way of working in a natural asset of people during time. In that way the central concepts of sustainability are applied to ecomuseum, looking at a local approach, especially if a grade of community consensus is reached. So the contrast between different areas should convergence in coherent perspective, which is apt to realize process of cohesion among people living in the place and tourists.
According to sustainable Agro-ecology processes in agricultural production systems, tourism is a significant factor for increasing qualities of rural areas, with both benefits on the landscape and on the economy of the places. An agreement between social needs and landscape quality may help in promoting new quality of life, both for people living in town, only sometimes moving to country, and for people living in the country. In fact the focal point to have a better standard of quality is the collaboration of local communities, in order to have an intrinsic factor on economic processes, which balances natural and cultural dimension. In a coordinated way it is possible to organize successive working progress in a place to which communities are attached with an alternative governance organization for identity in landscape organization.
A mosaic of vineyards into a landscape is essentially opened to tourism if in a first stop a visitor may gather information on the process of vine making, as commonly it happens in ecomuseum organization. It is the idea of “living heritage” that in fact is at the basis of ecomuseum that is strictly bounded to working processes and in France ecomuseum were born just for making livable again traditional way of working, which were typically of a zone.
The ecomuseum is a result of the coming together of different factors, identity, heritage, economy. The last factor is fundamental as it is not always possible to sustain it, especially if it is possible to

obtain only local funds. But experience teaches us that, without taking into account each specific environmental situation and its own particular constraint, there is no homogeneous disposition for sustainable recovery of rural environments. An appropriate relationship between ecomuseum and a vaster environment is difficult to define even in a specific site. It could only be verified by elaborate simulations of different touristic effects and compare them with comparative strategies.
Moreover a conscious tourism may help in reducing poverty, it can enhance landscape productivity and it constitutes a wide range perspective. With a system of project methodologies, it is possible to recreate a situation similar to historic presence of human activity into a landscape, with continuous emotional participation.
Particularly a possible solution to integrate ecomuseum and enomuseum is the case of the agricultural hamlet, in which it is possible to have at the same time natural and artificial traditional bounded together.

2. The new concept of Enomuseo in the redevelopment of the ancient village Il Borro[2]

Today, increasingly, the term "innovation" means learning through the continuous evolution of technological systems that operates locally, based on the interdependence between the concepts of process, production and consumption, as well as between people, culture and natural resources. It follows a new vision of what agriculture produces (typical, landscape, short distribution chain) and the development of new ways to manage relationships in distribution chains and local systems.
According to B. Joseph Pine and James H. Gilmore, the experience is a new type of offer that is in addition to commodities (fungible materials), assets (tangible artefacts) and services (intangible assets). The experiences can then be classified according to the participation active or passive by individuals and their type of connection with the event. Businesses are increasingly interested in finding innovative solutions, both regarding the products, both in the use of technology and machines, but to move successfully in the post-crisis world, in tune with the great changes taking place in the world trade, is no longer enough to follow the demands of change. The way forward is not easy, especially for companies in a sector such as agriculture, yet now even agricultural enterprises have come to this showdown for survival. Positive examples are important if the rest of the system is able to learn from the past, obtaining a model of innovation.
In the concept of Enoturismo, we can find an innovative way to act methodically, following rules and formats prepared, and coordinated with the help of all the energies and resources available; this term that expresses the knowledge of an area through the exploration of flavours, the discovery of the traditions and customs of the places of wine. The idea of being able to discover, enjoy excellent we find the concept of tourism, a term that expresses the knowledge of an area through the exploration of taste, the discovery of the traditions and customs of the places of wine. The idea of being able to discover, enjoy fine wines and admiring landscapes and tourist trail is one of the prerogatives that affects the wine, which can produce the possibility of an experiential approach to the discovery of the rural, the "terroir" represented as one fundamental values of food tourism through the close relationship between planning, agriculture and tourism.
A good example of this is represented by the Tuscan village of Borro[1]. This village placed in the green hills of Tuscany and today recognizable as medieval village, was already present in the twelfth century. The remains of the ancient walls and the bridge, make presumes that it was a fortress located on a cliff, a spur of rock. However it should be emphasized that the Borro has had over the centuries a great importance from the standpoint of political strategy, its road system (presumably of Etruscan origin), linking Fiesole with Arezzo and even the ancient Roman routes - such as Clodia and Cassia - passed near the ancient fortress. From the first documents available it seems that the fortress was purchased by Borro de Borris of Medulano (Podesta of Arezzo which took its name from the castle) (Fig.1).
For the Borro village, the 1900 was a century of renovations and handovers; in fact, in 1904, around the farm passed to the Princes Germans of Savoy-Aosta, that were: the Duke of Aosta

[2] Fosca Tortorelli

Emanuele Filiberto, The Count of Turin Vittorio Emanuele and the Duke of Abruzzi Luigi Amedeo; them, in the mid-fifties, handed-in the entire estate to the Duke Amedeo of Savoy-Aosta which included about 1,000 hectares, besides to the village. In early '90, the same Duke sold all his property to Ferruccio Ferragamo's family that has transformed and shaped this ancient village giving it back a meaning. In fact in 1993 Ferruccio Ferragamo, with the help of his son Salvatore, made an important recovery of restoration and installation of this ancient town. It started with the desire to bring life back to this place carrying on its traditions and its history, with the primary intent to operate in harmony with nature, trying to create a perfect continuum between past, present and future.

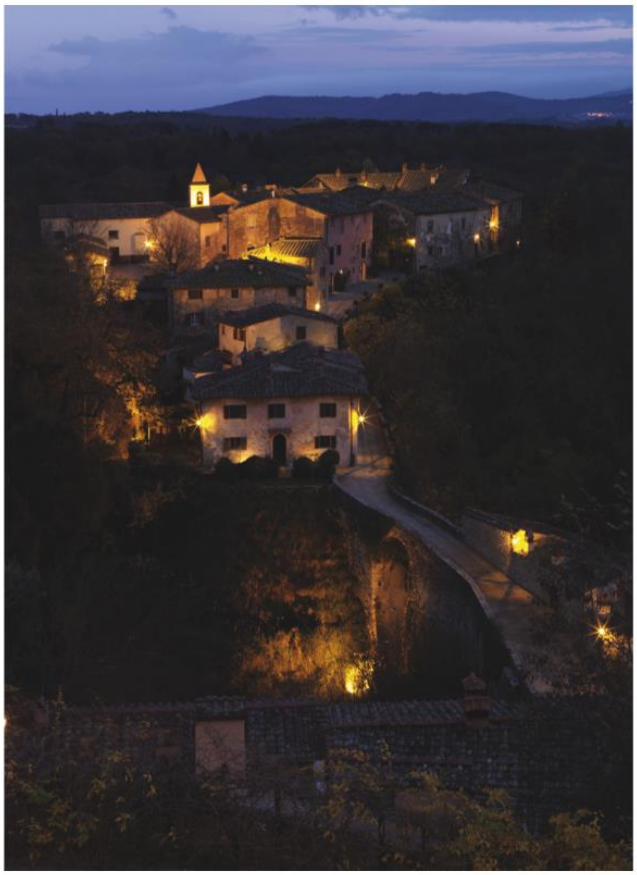

Fig. 1: Il Borro (@Photo received from the main Winery)

During the restoration it was decided to bring almost everything to its original state, it has been chosen to use the old paved road and bring back the old cellars. Have been used as much as possible local workers who have worked with knowledge and passion.
The respect for nature is expressed through many projects and trade choices introduced in 2011, like homes to zero energy consumption, photovoltaic systems; but is especially its special blend of the Borro village with the history and traditions in wine production, that reinforce this connection.
Since ancient times this area resulted in the suitable areas for the production of wine; indeed the Borro, whom extension insists on the hills of Valdarno, at the foot of Mount Pratomagno, guarantees unique climatic conditions, which give a perfect terroir for growing grapes.
It is still in 1993 that the Ferragamo's family begins the restoration of the first vineyards and today wine production is a very important part of their business.
All agricultural productions of Il Borro utilize the natural fertility of the soil and from 2012 the vineyards were converted to the dictates of biodynamic agriculture. Today the estate winery Borro is connected harmoniously to the old underground cellar and it is divided into a first structure, partially underground, used for the fermentation and the bottling of the wine (Fig.2).

The drawing is characterized by a curved profile that conforms itself to the profile of the side of the access road in order to reduce significantly the horizontal development.



Fig. 2: The Winery (@Photo received from the main Winery)

Moreover in the cellar was thought a combined area dedicated both to exhibitions and cultural events, as the attention of the owners for art led to the creation of an interesting collection of incision related to the theme of wine (Figure 3).
The complex is conceived no longer only as a place of work, but as a multifunctional space closely connected to the entire estate.



Fig. 3: The area dedicated to exhibitions (@Photo received from the main Winery)

It follows, then, that in the case of Borro, it has been aimed to highlight the links with the territory, as heritage of natural, cultural, tourist and social values .
This is just one possible example of the new concept of Enomuseo that should be extended to the wider concept of Network Enomuseale, such as to encompass the possibility of spreading new models of relationship between territory and enterprise users, in order to improve the competitiveness of businesses and the territory itself.
The Enomusei may constitute thus a strength of a new and different model of cultural heritage protection.

Bibliographical References

Icaro M., Sull'identità meridionale. Forme di una cultura mediterranea, Bollati Boringhieri Torino 1999

Brun, J. P. Le vin et l'huile dans la Méditerranée antique. Viticulture, oléculture et procédés de transformation. Paris 2003

Brunori G., Marangon F., Reho M. La gestione del paesaggio rurale tra governo e governance territoriale. Continuità e innovazione. Franco Angeli, 2007

Fregoni M.,Schuster D., Paoletti A. - Terroir e qualità eccelsa del vino, ovvero la qualità del terroir . Terroir Zonazione Viticoltura. Phytoline editore, 2003

Muzzillo F., a cura di, La progettazione degli ecomusei. Ricerche ed esperienze a confronto, ESI, Napoli 1998

Muzzillo F , Tortorelli F, Vitigni del sud tra storia e architettura, Natan Edizioni, 2012

Pastore R. Il marketing del vino e del territorio: istruzioni per l'uso. Franco Angeli, 2004

Percy H. Dougherty a cura di, The geography of Wine, Regions, Terroir and Techniques, Springer, London New York 2012.

World Heritage Status of the Cultural Itinerary of the Vine and Wine Among the Peoples of the Mediterranean, World Heritage Expert Meeting on Vineyard Cultural Landscapes, 11-14 Luglio 2001, Tokaj, Hungaryoptional. References will be indicated with a number in brackets.

[1] Il termine toscano Borro sta a indicare un burrone formatosi dal letto di un torrente che rendeva la postazione una rocca inespugnabile.

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Pompei between Archaeology and "Agritecture"

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Abstract
The idea of "Agritecture" concerns the implementation of an integrated and systemic approach to plans and projects of rural heritage and the agricultural landscape. Should therefore be understood as the recovery of urban spaces for agriculture, the return of nature within the urban place whose main features are proposed to overcome the contradictions between the issues of protection and conservation of existing assets, such as to initiate processes enhancement and socio-economic promotion.
Seemingly idea of today, which had its realization two thousand years ago and that has his real acknowledgment in ancient Pompei.
In fact, through the study of the green archaeological resource, through in-depth investigations into the orchards and gardens that were part of the reality of Pompeii, you have a tangible example of the nature of the organization in a town of two thousand years ago.
In ancient Pompeii were green spaces both public and private, and every house had both his garden that his garden.
Some crops were particularly important in the daily life of ancient Pompeii, like the wine, while others were the basis of special handicrafts, such as the preparation of ointments and perfumes, and others were the subject of family consumption or sales.
In this paper we establish a close correlation between the current theories of agritecture and domus, which contained within them spaces dedicated to physical well being, productivity and economic development.

Keywords: Agritecture, Hortus, Archaeology

1. Agricultura: la cultura del verde dialoga con l'archeologia.
The idea of the research is linked to the theme of the ancient world, and inspired by the guidelines of the Expo 2015 in Milan: " Nutrire il Pianeta. Energia per la Vita".
Aspects of quality and authenticity of the food go to catch up with the established tradition in the farming activities of the people and as a result of age-old experiences with which today strongly connect both scientific and technological innovations. The food, as in the past, is one of the main factors that define a civilization and is strongly linked to the social and cultural sphere and contributes to the creation of a sense of belonging, to the roots, "cultural identity".
If we look at the various paintings and texts surviving on life and on the most significant products (oil, wine and wheat) of ancient Rome, is instantaneous recognize a complete picture of the eating and productive habits of the greatest ancient civilizations and the link to the needs and demands of today. An innovative approach that is based on a meeting of archaeology and technology where the reconstruction of the spatial design of the areas given over to crop and then the eating habits of the Romans focus, from time to time, situations peculiar relative to the other major civilizations that have developed on the Italian territory: from the Greeks to the Etruscans.
The orchards and the gardens of ancient Pompeii are one of the key document for understanding the organization of the green in a city of two thousand years ago. If we reread the urban and

architectural aspect of ancient Pompeii, we note that there were green spaces both public and private, every house had its own vegetable garden and its garden. This data provides us with food for thought on the close correlation between the current theories of Agritecture[1] and Domus Antique.
In particular the districts that were developed around the Amphitheatre, as suburbs who lived the inevitable transformations own urban expansion, contained numerous green areas with different uses.
In these kitchen garden and gardens were cultivated both ornamental plants, sowing plants and fruit, such as peaches and lemons, for this reason through the remains of excavation and using modern investigation techniques, it was possible to recognize them.
Some crops were particularly important in the daily life of ancient Pompeii, like the wine, while others were necessary as the basis of handicrafts and others were for family consumption (Fig.1).

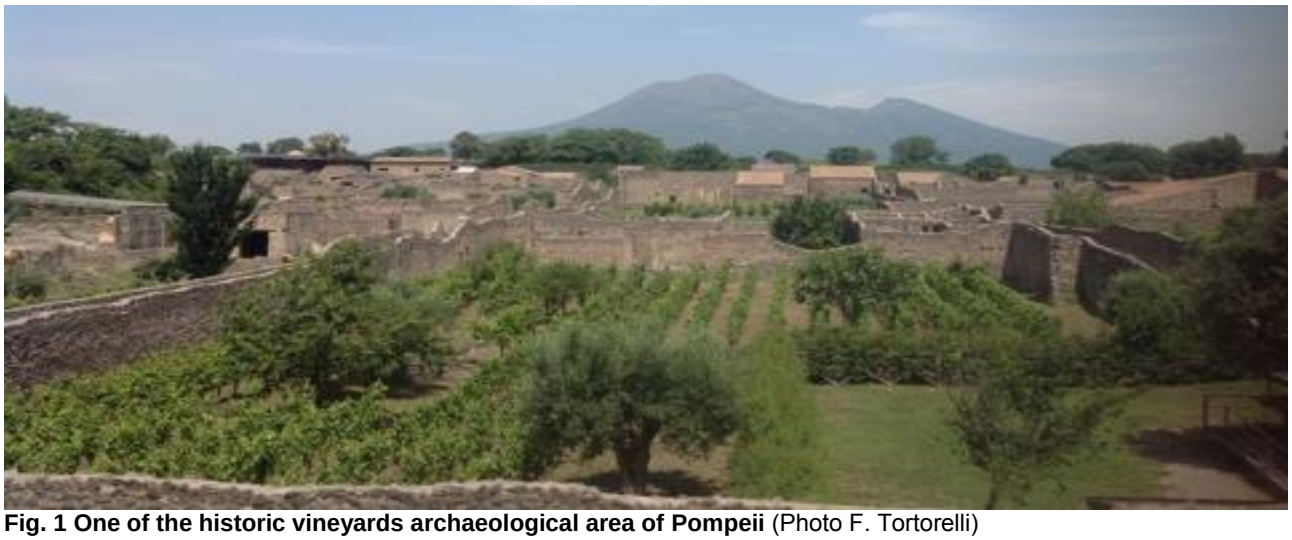

Fig. 1 One of the historic vineyards archaeological area of Pompeii (Photo F. Tortorelli)

In this regard the discovery of a green area used as a nursery of trees has been of considerable importance, which has enabled us to define the species most commonly grown in the gardens of Pompeii.
The species cultivated in the nursery therefore clearly indicate what were the plants most popular on the market, also plants grown in "viridaria" that is, those small gardens that had mainly an aesthetic value in the architecture of the house, were used differently in everyday life; often the garden became the pharmacy home, because most of the plants used for ornamental purposes had medicinal properties, indications that we find in the text of Columella.
Further confirmation comes from the study of the *Casa dei Casti amanti* (Fig.1)., along the *Via dell'Abbondanza*, where a few years ago was brought to light a viridarium of which was perfectly readable the design of the flower beds, was the first example of green space reconstructed in all its parts, architectural and vegetation. In cities not missing then the "public green", linked to common areas such as spas, gyms, temples and, just outside the city, the funerary enclosures.

[1] The Agritecture, is the synthesis of the two main disciplines: Architecture and Agriculture. Through an intervention of Agritecture we propose to overcome the contradictions between the issues of protection and heritage conservation with those of enhancing and socio-economic promoting. Within this overall vision should be examined, however, the lines of the evolution of rural areas: environmental protection and its enhancement must be accompanied in parallel protection and promotion of productive functions of business units, agricultural and related activities agriculture (crafts, small industry, trade).

But back to the organization of the Domus is important to note that, outside of the Domus itself, is the Hortus, a space with the characteristics of a vegetable garden that, in large villas of imperial Rome becomes wider and more.



Fig. 2 Pompei: a fresco depicting Pompeii at the table found in the Casa dei Casti amanti

The Hortus area, into the Domus space, was a small stretch of land, crossed by a central drain (Euripos) the sides of which were cultivated plants, mostly evergreens, such as laurel and strawberry trees, interspersed with herbs such as acanthus and flowers. The fence is often made up of plane trees, a symbol of strength and tenacity, and cypress trees, able to repair the garden from the wind.
The Vesuvius archaeological areas, in particular Pompei, offer the opportunity to use a unique documentation offered by several other factors such as, for example, the decorations of the houses in which appear representations of plant elements, documents excavation, the artefacts or organic finds discovered on the ancient surface level, elements that, taken individually, seems sometimes partial, but that together provide an overall picture almost exhaustive.
From here it is clear the actualization of a lifestyle of our ancestors, who, albeit unwittingly, has turned the strong attention to the connection with the land and natural resources.

2. New identity for the contemporary city

The integration of agricultural areas in urban areas is a topic of great interest in view of the transformation of our city in the most sustainable.
Within the debate on sustainable development, one of the central issues is the question of the territories of the margin, and in particular, the redefinition of relations of reciprocity between agricultural land and city, between environmental systems and urban systems.
The contemporary city has expanded dramatically, leaving almost always protected areas and neighbouring farm as a reserve for urban growth; throughout the twentieth century has been characterized by a clear separation between agriculture and cities. Some recent experiences,

however, show that a possible rebalancing of the urban ecosystem can take place right through the hybridization of the two systems, and the design of this hybridization is one of the challenges of contemporary design. Technological aspects, landscape, environmental co-exist together in this hybridization. An architectural culture, then, that renews completely its reference models, facing the challenge of a liquid modernity and establishing new relationships with a culture like that farm, which is not a constructive culture in traditional terms, but in terms of enzyme production, and following logical bio-compatible and uses technology support highly evolved. Architecture is returning to nature and especially towards agriculture and its technologies.
Agriculture, interpreted in terms sustainable, certainly plays a central role in the protection of the territory, together forming a productive activity but also environmentally friendly, founded, therefore, rule-biological and natural. Agriculture, therefore, designed to restore identity to a place, to protect the beauty of our rural landscapes, to conserve natural resources, to meet a secular vocation of our area, to provide numerous benefits to the urban system (micro-climatic variations, purification air, productivity, noise attenuation, soil conservation, biodiversity conservation). Agriculture can provide a model of self-regulated industrial production based on natural and renewable resources, agriculture which no longer represents the site of the pre-industrial technologies but, on the contrary, occupies a new space, extreme sophistication of management and production, an agriculture that makes use of appropriate technologies to regain the role of engine of sustainable development of an area. The technology is becoming natural, therefore, the more sophisticated constructive model, in which the industrial technology view trying to imitate the cycles and performance. The world of the artificial, created to replace an inadequate nature, is rediscovering nature as a realm of technology unattainable, as extraordinary ability to produce materials, products, environmentally friendly performance, feeding technologies weak and diffuse nature of entire regions. Until now the architecture has always focused on the construction of the city, without considering that the agricultural landscape needs a design. This design should aim at enhancing their own signs of the agricultural landscape as elements of identity of a place, to the promotion of traditional cultivation techniques, the use of alternative energies, the establishment of models and features reversible as crop rotation. In short, the agricultural landscape as an inexhaustible source from which to draw for the design of an artificial landscape that uses technologies such as natural building systems.
Further sign of the new way of reading the architecture and is continuing interdisciplinary project, called "Making Agriculture and maintenance of green within the Archaeological"
A project of great value both academically and is aimed at fostering the rediscovery and preservation of the territory and its biodiversity (fig.3).



Fig. 3 Teaching garden of an experimental project on public space and biodiversity

This exciting project with the involvement of students and teachers who, under the careful guidance of the researchers of the laboratories of the Superintendent, will be operating at the Garden Didactic, the nursery and the Botanical Garden inside the archaeological Pompeian.
Participants will prepare the soil and will start the crops using the techniques of the time; they will produce a photographic documentation of the various stages of the crop. Horticultural products that will be collected at the end of the project will be donated to charities working in the area.
A clever combination of Architecture, Archaeology and Agriculture to rediscover and revive the ancient concepts in a modern, timeless.
So the Archaeological Landscape becomes alive, turns, triggers new relationships dialoguing with what constitutes itself, in order to recover the sense and the quality combined with the practices and needs of the contemporary city. The use of archaeological heritage can be seen also for purposes of economic growth and as a tool for the development of the territory, according the socio-cultural growth in the combined logic of efficient management of the site in a well defined local context.
The heritage, through a rational management, can indeed produce income and promote the growth of local economies. From the traditional logic of management of cultural heritage on the basis of the objectives of protection, preservation and usability, we move to a vision that does not consider the cultural property as a constraint, but a resource for the benefit of the employment and local income.

Bibliographical References

Battisti A., Tucci F. Ambiente e cultura dell'abitare. Innovazione Tecnologica e sostenibilità del costruito nella sperimentazione del progetto ambientale, in De Grandi L. Teoria e uso del colore, Mondadori, Milano. 2000,

Borgongino M., "Archeobotanica - Reperti vegetali da Pompei e dintorni", L'erma di Bretschneider, Roma 2006

Bekker-Nielsen, T. (2005) 'The Technology and Productivity of Ancient Sea Fishing' in Bekker-Nielsen, T. (ed.) Ancient Fishing and Fish Processing in the Black Sea Region. Aarhus University Press. 83-97.

Ciarallo A., Giordano C. Gli spazi verdi dell'antica Pompei, Aracne 2012

Guzzo P. G., Guidobaldi M.P., Nuove ricerche archeologiche a Pompei ed Ercolano: atti del convegno internazionale, Roma, 28-30 novembre 2002 Volume 10 di Studi della Soprintendenza archeologica di Pompei Editore Electa Napoli, 2005

Plinio, in "Dedicatoria" della "Naturalis Historia".

Vittoria E. 1976-77, Premessa comune al programma coordinato dei corsi biennali di Tecnologia dell'Architettura, in Guida dello studente, Facoltà di Architettura di Napoli. Dedicatoria" della "Naturalis Historia".

Amedick, R., "Stibadia in Herculaneum und Pompeji", Ercolano 1738-1988. 250 anni di ricerca archeologica, (L. Franchi dell'Orto ed.), Roma, 1993

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Conservation Practices in Turkey in Last Decade, Two Monuments from Two Eras: the 4th-Century Laodikeia Church and the 16th-Century Rabi Madrasa*

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Abstract
Over the last ten years, many concepts have been introduced to the area of conservation in Turkey. "Management of historic sites", a much-discussed topic, has been an area of integration for specialists from different disciplines. "Tourism" and "cultural heritage" have become two issues that are discussed together to obtain sustainability in both tourism and cultural heritage conservation. As a result of increasing urbanization and the rapid loss, the values and conservation of "historic rural sites" and "industrial heritage" have become important issues.
Even though, conservation works have been done on large numbers of historic buildings in Turkey in last ten years, most of these works do not meet international criteria for conservation of cultural heritage. Most of the conservation works causes the loss of authenticity, information of building technology, original materials and aesthetic values of historic buildings.
The aim of this paper is to focus on good conservation practices in Turkey in last decade. For better discussion possibilities, two buildings, where different conservation problems occurred and different conservation practices applied have been chosen. Considering these selection criteria, restoration works on a Late Antiquity building, a lately excavated building at earth level and a Classical Ottoman Period building, still providing opportunities for reuse, will be analyzed and various conservation problems and appropriate conservation approaches will be discussed.

Keywords: Conservation Practices, Turkey, Laodikeia Church, Rabi Madrasa

1. A short history of conservation in Turkey
Since the 19th century, as a result of industrialisation and dramatic changes in building technology and materials, as well as comprehensive changes to historic buildings, the emphasis on the links between heritage and locality as well as between locality and identity [1] has become more and more important. Furthermore, owing to the extraordinary losses at historic sites in European cities during the Second World War, the eagerness for the preservation of historic sites comprising residential buildings and monuments has increased. The Convention for the Protection of Cultural Property in the Event of Armed Conflict of 1954 was a revision and adoption of the so-called Hague Protocol. [2] In this convention the classification of cultural heritage was carried out by identifying cultural property as monuments of architecture, art or history, archaeological sites, groups of buildings, and works of art and collections [3]. There has been increasing concern for conservation of "historic monuments and sites", and many important international charters and conventions on this issue have been complemented and signed by a large group of countries over the years. Among the most noteworthy were the Venice Charter in 1964, the Declaration of Amsterdam in 1975, the Washington Charter in 1987, and the Nara Document on Authenticity in 1994. The Burra Charter in 1979

* Instructor Çağrı Murat Tarhan, Prof. Dr. Celal Şimşek, and architect Ayşe Orbay have contributed information and resources to this article. The author would like to express her sincere gratitude for their collaboration, as this paper could not have been written in its current form without their contribution.

concluded that the “best conservation often involves the least work and can be inexpensive”, a concept that is widely accepted by professionals and authorities on conservation today [4].
Turkey has signed most of the international charters mentioned above, resulting in developments in the legal aspects in the country. The first legal attempt at ensuring the conservation of monuments and sites was developed in 1951, and Law No. 5805, known as “Real Estate Law on the Establishment and Duties of Supreme Council of Antiquities and Monuments (GEEAYK)”, was published on 2 July 1951. The Supreme Council of Antiquities and Monuments of Turkey, which has a very important role in the history of conservation in Turkey, was established according to this law. The Supreme Council was given the duties of developing the principles and programmes for the conservation of historic monuments, following up and auditing these principles and programmes, and declaring its scientific opinions on any kind of case or dispute related to conservation issues [5]. GEEAYK has been the most important institution with authorised power since it was established. The council has declared its decisions on important subjects, such as: re-functioning historic buildings for their longevity (10.08.1953, No. 155); a preference for the restoration of historic monuments, even if there is a risk of collapse, instead of demolishing them (19.03.1956, No. 466); submission of detailed documentation of traditional buildings which are not listed by the council before demolishing them (06.08.1957, No.707) [6].
During the 1960s, the effects of the Venice Charter were felt in Turkey, and the term “site” began to be included in legislation related to conservation. However, while these practices were in progress, the registration of historic monuments only took place after the 1970s [7]. In 1972 there was an attempt to get closer to integrated conservation by including the streets, squares, and fountains together with historic monuments and civic buildings [8]. In 1973, for the first time Law No. 1710 introduced detailed definitions of monuments, building complexes, historic sites, archaeological sites, and natural sites. The change in the definition of historic site from ‘single parcels’ scale to ‘zone’ scale, and the overlapping of the concepts of planning, tourism, and development with conservation caused other governmental bodies to be involved in this issue [9]. Law No. 1710, insufficient in meeting the needs for conservation of sites, was replaced with Law No. 2863 in 1983 [10]. In 2004, Law No. 5226 came into force, and besides some changes in definitions in Law No. 2863, there was an attempt at solving the problem of integrity both between “development plans” and “conservation plans” and among the governmental and local bodies [11]. Law No. 5226, introduced in 2004, introduced the terms “management area” and “participatory management plan”, provided new financial resources and models of organisations, and introduced definitions of planning stages and stakeholder responsibilities.
In the last 10 years, after Law No. 5226 came into force, conservation and restoration work in Turkey has progressively continued in parallel with a significant increase in construction work in the country. Although it is not possible to state that most of this restoration work has been particularly in good qualities and properly done, it is obvious that the experiences gained and the increasing interest in the area have led to advances in conservation practices.

2. A Current conservation issues and research fields of conservation in Turkey

Over the last 10 years, many new concepts have been introduced to the area of conservation in Turkey. “Management of historic sites”, a much-discussed topic in the last 10 years, has been an area of integration for specialists from different disciplines such as conservation specialists, archaeologists, art historians, tourism managers, tourism investors, and local communities and local/governmental bodies. “Management” has been a more emphasızed issue of world monument sites, archaeological sites, and urban historic sites especially in last five years.
The concepts of “tourism” and “cultural heritage” have become two issues that should be discussed and planned together to obtain sustainability in both tourism and cultural heritage conservation. In particular, the promotion of “archaeological sites” for tourism possibilities has become more widespread.
The conservation of “historic rural sites” and “industrial heritage” has been discussed more over the last ten years in Turkey. As a result of increasing urbanisation in Turkey, historic rural areas turned out to be at greater risk, and following the loss of these sites, the values and conservation of historic villages have become an important issue in Turkey. Similarly, after the massive numbers of industrial sites lost in the late 19th and early 20th centuries, industrial buildings became rarer, and some of the remaining industrial heritage buildings have been restored and converted for new usage possibilities.

3. Selected Case Studies

Two different historic buildings from Turkey have been selected for this study as two examples of praiseworthy conservation works in the last 10 years. It was aimed to discuss the conservation works on two buildings from Late Antiquity and the classical Ottoman period and the necessıty for different approaches towards an excavated building at earth level and a building, which still provides opportunities for reuse. The Late Antiquity building was to be handled almost as an art object to be exhibited, besides being an element of cultural heritage, while the classical Ottoman building had to be planned as a building to meet the needs

of its users, such as heating, lighting, plumbing, besides being part a cultural heritage asset to be valued. Furthermore, the building from Late Antiquity, which collapsed during an earthquake, had to be excavated and a proper anastylosis for its re-integration carried out, while the main problem of the classical Ottoman building was the inappropriate restoration work done over time, as a result of efforts to use it continuously. The differences between these two buildings made it possible to discuss the various problems and appropriate approaches in this conservation work.

4.1. Laodikeia Church in Denizli (4th century BC)

Excavations of Laodikeia Church have started and mostly completed in 2010 (Fig. 1). The church, which measures 40.85 m by 37.5 m, was settled on a whole peninsula and has an atypical plan scheme for a church. It has a single eastern apse, five northern and five southern apses [12]. This church is very important for Christianity as it was mentioned in the Bible and was one of the earliest sacred places, built just after the Edict of Milan in 313 between Emperor Constantine I and Licinius. The excavations revealed that the church had two different construction phases in the first half of the 4th century and after the earthquake in 494, which allowed continued use of the building until the earthquake in circa 602–610 [13].

Even though most of its stone blocks were found in situ, only a couple of the stone block rows of the church's outer walls existed when it was excavated in 2010, under the management of excavation team manager Prof. Dr. Celal Şimşek and conservation manager Instructor Çağrı Murat Tarhan. The conservation work was continued following a conservation programme planned for completion in 2015. The documentation and conservation of the building have continued concurrently during this period [14].

The principles of the conservation team followed international conservation principles. First of all, the aim was not to harm the building's authentic identity and the landscape of the archaeological site through the conservation work. The anastylosis was planned to be carried out by using only the in situ blocks, with very few exceptions (Fig. 2). The original mortar and plaster were analysed in laboratories, with the aim that new mortar and plaster would be very similar to the analysed materials. Contemporary materials such as epoxy resins were also studied, in order to have compatible mechanical and physical properties with the authentic building materials. The anastylosis of the building was carried out by using the original buildings found in situ, and a layer of brick was placed between the existing parts and the parts rebuilt using in situ blocks to differentiate the reconstructed parts. Excessive completion of authentic materials and the use of new materials were avoided, with the aim of the maximum benefit for the continuity of the building with minimum intervention. Different construction phases were left exposed, in order to give visitors an insight into the various periods of the building.



Fig. 1: Laodikeia Church after the excavations in 2010 (Laodikeia Excavations Archives).



Fig. 2: Laodikeia Church after anastylosis of the main building parts (Laodikeia Excavations Archives).

The conservation work started after the construction of temporary roofs for conservation of the more fragile parts of the building, such as frescoes, mosaics, and opus sectiles (Fig. 3). For the conservation of the mosaic and opus sectile pavements, which were very much damaged during the earthquakes, the principle followed was one of “keeping the originals as found in situ and completion only with authentic materials found on site”. As a result, earthquake damage such as sags and hollows was kept and not refined. The frescoes, stuccos, marble claddings on walls, mosaics, and opus sectiles on the floors were restored by using mortar prepared by utilising ancient techniques, according to characterisation analyses of the original materials. The open sides of the frescoes, mosaics, and stucco plasters were fixed using lime-based mortar (Fig. 4). No painted or imitation additions to lost parts were used; instead, lime-based mortar filled the gap to 1 cm beneath the existing level of covering. The gaps below the tesserae and plaster were filled by injection and were not dismantled for conservation.

Lime-based solutions, instead of acrylic resins and silicates, were used for the consolidation of load-bearing building parts. The cleaning work was done using non-destructive mechanical methods, distilled water, clay and paper pulps, mostly for removal of salts from the stone blocks.

The collapsed stone blocks, belonging to exterior walls and pillars, were resettled into their original locations by the use of mortars very similar to the original ones. New marble blocks were used only for the completion of missing parts of the main apse by using the pantograph technique, and new stone blocks or coverings were left 1 cm below the original wall or floor levels to provide visitors with a better understanding.

A roof project is planned for the church in the future, with the aim of not obscuring its authenticity and advancing the perception of the building, and thus a modest and simple design was preferred. The roof will be constructed using high-strength steel, will have the minimum amount of elements, and will provide heat insulation by use of polycarbonate hollow sheets with UV protection.



Fig. 3: “Opus Sectile” conservation under the temporary roof structure (Laodikeia Excavations Archives).



Fig. 4: Mosaics and opus sectiles after conservation (Laodikeia Excavations Archives).

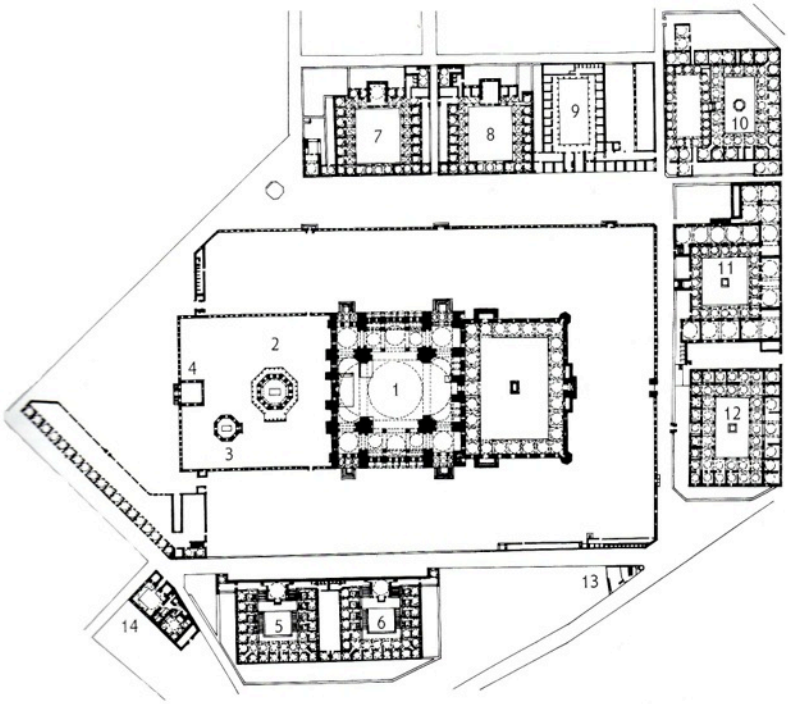

Fig. 5: Suleimaniye Kulliyesi and Rabi Madrasa (building no. 5)

Rabi Madrasa in Istanbul (16th century)

Rabi Madrasa, a higher education building, is part of Istanbul's most important building complex from the Ottoman Period, Suleimaniye Kulliyesi. This complex was designed by Ottoman master architect Sinan for Suleiman the Magnificent and completed in 1557. It was constructed using one of the most intricate construction site organisations in the history of architecture [15]. The Suleimaniye Complex was built on the top and Golden Horn side of one of the hills of Istanbul (Fig. 5). Besides the famous Suleimaniye Mosque, it features three madrasa and hospital buildings on the south-western side, a refectory, hospital, guesthouse, stables, and caravanserai on the north-western side, a bath and three madrasa buildings, one of which is Rabi Madrasa, on the north-eastern side, and the tombs of Sultan Suleiman and his family on the eastern side. All this constituted the largest religious, educational, and health complex of the Classical Ottoman period [16].



Fig. 6: The courtyard of Rabi Madrasa and small terraces of cells under the arcades.

Rabi Madrasa is one of the twin madrasas on the slope down to the Golden Horn. These madrasa buildings are excellent examples of Sinan's architecture, showing the superiority of his spatial organisation, considering the geographical conditions of the site. The sharp slope of the site was used in the design by stepping the site, and the cells of students were placed on the platforms together with the small terraces of each unit (Fig. 6) [17].

Rabi Madrasa was subjected to restoration on various occasions during the Republican period in the 1950s and 1990s. In the 1990s, the madrasa building was intended for use as a dormitory, but the conservation work could not be completed. In 2003, Rabi Madrasa was given to TUBA (the Turkish Academy of Sciences), and the architect and conservation specialist Ayşe Orbay was hired for preparation of the restoration project of the building in 2004. After the bureaucratic processes, the conservation work started in autumn 2005. The first phase took place from 2005 to 2007, and covered the conservation work on the upper structure. In 2008, Sayka Construction took over the conservation work of the building and completed the upper structure restoration and other conservation work by 2010, under the control of Ayşe Orbay [18].

The main principles of the conservation work were as follows: the removal of harmful additions to the building, minimum intervention and maximum benefits, keeping the authentic materials in their place as much as possible, simple and modest architectural element additions when necessary for comfortable conditions, utilising the original and existing plumbing systems in order to avoid further comprehensive intervention, and utilising new materials/mixtures which had the closest components and characteristics of the original materials.

The conservation work in the building mostly consisted of the removal of harmful interventions carried out on the buildings during 20th-century restoration, as these intrusions mostly caused structural and material decay to the building. There was a concrete layer and steel mesh on the domes, causing excessive weight, a flow of salts to the original materials from cement, and continuous water flow due to insufficient insulation. The concrete layer was removed and the brickwork was coated with khorasan (lime and ground brick) mortar. The domes were then cladded with lead sheets, as was originally the case. The missing end ornaments were reproduced and placed on top of the domes (Fig. 7).



Fig. 7: The domes after removal of a harmful concrete layer and lead cladding.



Fig. 8: Reproduced architectural elements and new bath fixtures in Rabi Madrasa.

The cement-based plasters were removed from the walls, the salts in the masonry caused by the cement plaster were removed as much as possible, and re-plastering was carried out using lime-based plaster, prepared according to the recipes of the original plaster, on the inner faces of the domes and inner walls. The salt and black crusts on the unplastered cut-stone surfaces were cleaned using distilled water and paper pulp. In addition, AB57, a chemical paste, was used to clean the marble surfaces.
The cement screed and cement-based tiles on the floors were removed, and hexagon brick tiles – the form of the original floor tiles – were paved on the floors in the inner spaces. Architectural elements such as windows, shutters, cupboards, and doors were designed by following the typology of the buildings' period, but also chosen as the simplest type of the period, instead of elaborative motifs and ornamentations, as there was no evidence of the original ones in the building (Fig. 8). The exterior wooden door was repaired and the missing parts completed. The lighting and heating equipment, not originally part of the building, were also chosen to be as modest as possible (Fig. 9).
The original drainage system in the courtyard was cleaned and re-utilised; the courtyard between the two twin madrasas, where the earth was uncovered in the 1990s to build a kitchen and toilet, was refilled with earth. The building is not yet being fully used, but it is ready for use as the head office of TUBA. There are plans to repoint and change/complete the broken/missing parts on the floors of the colonnades.



Fig. 9: New heating and lighting equipment, and reproduced hexagon floor tiles.

4. Evaluation of the conservation work completed in the studied examples

The conservation of the two buildings in Turkey mentioned above has some very important superior features compared to many other ongoing restoration projects in Turkey. Firstly, there were some major principles for this conservation work, which have been accepted in many contemporary international documents and charters. Secondly, in both projects, the goal was to keep to the minimum intervention and retain as many of the original materials as possible. There was no over-cleaning, over-building, or excessive use of new materials in either case. Thirdly, it was planned that the interventions should be carried out after comprehensive analyses of the original materials and with similar materials with similar components, physical, and mechanical properties. Finally, in both cases, new additions to the buildings were planned as very simple and modest, in order not to overshadow the original values of the heritage. As a result, the restoration work in both Laodikeia Church and Rabi Madrasa deserves to be appreciated and mentioned as two of the most praiseworthy conservation practices in Turkey.

Bibliographical References

[1] ASHWORTH, Gregory J. *From history to heritage – from heritage to history: in search of concepts and models, in Building a New Heritage: Tourism, Culture, and Identity in the New Europe*, (Edited by ASHWORTH, Gregory J. and LARKHAM, Peter J.), London–New York: Routledge,1994, p. 14.

[2] Referring Web Pages Web: http://portal.unesco.org/en/ev.php-URL_ID=13637&URL_DO=DO_TOPIC&URL_SECTION=201.html (Access: 3.22014)

[3] JOKILEHTO, Jukka, *History of Architectural Conservation*, Oxford: Butterworth-Heinemann, 2002. p. 25.

[4] RODWELL, Dennis, Conservation and Sustainability in Historic Cities, Oxford: Wiley-Blackwell, 2007p. 5.

[5] KEJANLI, Turkan, AKıN, Can Tuncay, YıLMAZ, Aysel, Türkiye'de Koruma Yasalarının Tarihsel Gelişimi üzerine bir İnceleme, *Elektronik Sosyal Bilimler Dergisi,* Kış -2007 v.6, i.19, 179–196, ISSN:1304-0278, p. 185.

[6] ZEREN, Nuran, *Kentsel Alanlarda Alınan Koruma Kararlarının Uygulanabilirliği*, unpublished PhD thesis, İ.T.Ü., İstanbul 1981, p. 6.

[7] KEJANLI, Turkan, AKıN, Can Tuncay, YıLMAZ, Aysel, *Ibid.,* 2007. p. 188.

[8] DINÇER, İclal AKIN, Oya, "Kültür ve Tabiat Varlıklarını Koruma Kapsamında Koruma Planı ve İdari Yapısı", *2. Kentsel Koruma Yenileme ve Uygulama Kollokyumu*, İstanbul, 1994, p. 129.

[9] AVCI, Nabi, Kültürel ve Doğal Mirasımızın Korunmasında Örgütlenme ve Koruma Sorunları, in: Türkiye'de Risk Altındaki Doğal ve Kültürel Miras, *TAÇ Vakfının 25. Yılı Anı Kitabı*, İstanbul: TAÇ Vakfı Yayını, 2001, p. 26.

[10] KEJANLI, Turkan, AKıN, Can Tuncay, YıLMAZ, Aysel, *Ibid.,* 2007. p. 192.

[11] TEKELI, İlhan "Kentsel Korumada Değişik Yaklaşımlar Üzerine Düşünceler", *Şehir Dergisi*, Ocak, 1988, 21/1. p. 21.

[12] ŞIMŞEK, Celal, *"Laodikeia: Laodicea ad Lycum", Laodikeia Çalışmaları 2*, Istanbul: Ege Yayınları, 2013. p. 345.

[13] ŞIMŞEK, Celal, *Ibid.,* 2013. p. 360.

[14] The verbal information on the principles and details of the completed conservation works on Laodikeia Church has been given by Inst. Çağrı Murat Tarhan and Prof. Dr. Celal Şimşek in January 2014.

[15] KUBAN, *Doğan Sinan'ın Sanatı ve Selimiye*, Istanbul: Tarih Vakfı Yurt Yayınları, 1998. p. 75.

[16] KUBAN, Doğan, *Ibid,* 1998. p. 82.

[17] Kuban, Doğan, *Kent ve Mimarlık Üzerine İstanbul Yazıları,* Yapı Endüstri Merkezi Yayınları, Istanbul 1998, p. 120.

[18] The verbal information on the principles and details of the completed conservation works on Rabi Madrasa has been given by architect and conservation specialist Ayşe Orbay in January 2014.

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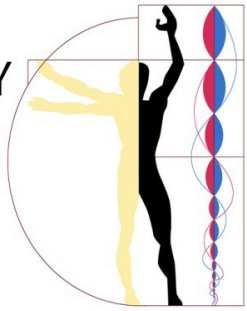

Intersecting lives: Giovanni Battista Naldini and Giovanni Antonio Dosio

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Abstract

The lives and works of Giovan Battista Naldini [1] (b. Florence 1593, d. Florence 1591) and Giovan Antonio Dosio [2] (b. San Gimignano 1533, d. Caserta 1611) crossover during the time they spent in Rome and Florence until 1591, the year of Naldini's death and the start of Dosio's new career in Naples and Caserta. Despite recent in-depth studies of Dosio's work, the analysis of his drawings still presents some gray areas, including works which were the result of a collaborations between Dosio and Naldini, and the effect this had on their graphic production, a situation that is not helped by a lack of documentary evidence. Indeed, because the annotations to the drawings show the handwriting of both men, it is difficult to distinguish between the different contributions of the two men.
Moreover, the relationship between the two men has been previously been seen as a subordinate one because Naldini is best known for copying Dosio's drawings, rather than the other way around, despite the fact that the two artists were of the same age.
The focus of this paper is therefore the study of the nature of the collaboration between Dosio and Naldini in the drawing of the ancient and the modern, through information provided by some particular drawings and documents that we know were produced in a set time frame.

Keywords: Giovan Battista Naldini, Giovan Antonio Dosio, drawings.

Giovanni Antonio Dosio, the florentine architect, began working when he was just fifteen years old in the Roman workshop of Raffaello da Montelupo [3], draftsman, sculptor and restorer of marbles. It was through Montelupo that Dosio came into contact with the work of the great Michelangelo, who had a deep influence on his whole artistic career, which took him first to Rome and Florence, and then to Naples and Caserta where he worked for the Prince of Caserta, Andrea Matteo Aquaviva D'Aragona. In his formative years, Dosio focused on drawing from antiquity, filling his notes with epigraphs, tombstones, and the great monuments of the past, as well as buildings that were under construction at that time. Through conversation with his Florentine patron, the collector Niccolò Gaddi [4], the idea was born of compiling a true treatise on architecture, for which Dosio produced elegant and precise survey drawings of the antique.
Naldini, also known as Battista degli Innocenti because he was brought up in the hospital of the same name, is also cited in some contemporary documents as Battista di Matteo di Naldino [5], a reference to his natural father, Matteo, who he met as an adolescent. It was in the hospital that Naldini took his first step towards a promising career thanks to his mentor Vincenzio Borghini [6], the prior of the hospital, who as soon as Naldini was twelve years old sent him to the workshop of Jacopo Carucci, also known as Pontormo [7]. Like Dosio and other artists of the time, Naldini tried his hand first at drawing figures, before moving on to copying from others artists, particularly Pontormo and Andrea del Sarto, drawing the antique from life and panoramas. Some of these drawings can be found in Florence, in the Gabinetto Disegni e Stampe degli Uffizi and in the Biblioteca Nazionale Centrale (MS. N.A. 1159), in Paris in the Cabinet des Dessins of the Louvre, in the Fogg Art Museum, Cambridge Massachusetts, in Berlin in the Staatliche Museen, Kupferstichkabinett, Oxford in Christ Church Picture Gallery and also in London, in the British Museum and Victoria and Albert Museum.

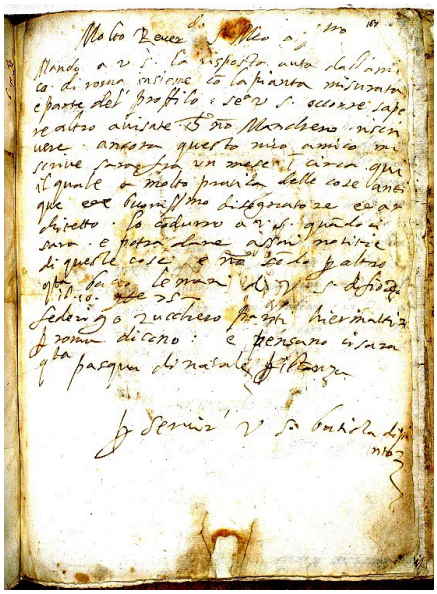
Vincenzio Borghini was a constant presence for the young artist [8]. The exchange of ideas with one another, Borghini's encouragement of Naldini in his drawing, the love that the cultured mentor had for the art of drawing in which he himself engaged with excellent results, establishes an interesting analogy with Niccolò Gaddi who was also an amateur draftsman. It was Borghini who introduced Naldini to the powerful Giorgio Vasari, artist to Cosimo I, Grand Duke of Tuscany, who facilitated Naldini's visit to Rome in the Autumn of 1560, during his apprenticeship, so that he could study the antique from life. This is attested to by a letter written by Borghini to Vasari, in which he asked the artist to show Naldini the most important Roman monuments [9]: "[...] *I desire from you two favours for the aforementioned Giovambattista (who departs tomorrow for Rome in the company of master Alexandro Pucci): the first is that you write four lines to him, advising him on all the best things in Rome related to your profession, so that he can stay there for a few months and gain some benefit and produce some good things. Of this I am sure, he does not have that much knowledge, I would therefore be grateful if you could give to him the most detailed advice as is possible. The other thing that I would like is for you to introduce him to some friends and recommend him most highly to them, as if he were your responsibility and that he receives all the favours that are fitting for a young virtuoso* [...]" [10]. We know from Vasari that the young Naldini stayed in Rome with Marco da Faenza: "I *received your letter and with this there is a letter [...] for G. Battista, painter, and one [...] for Marcho da Ravenna [that is, Marco da Faenza] [11] painter, raised by me, who guides him around many places and I recommend him to anyone who can help* [...]"[12].

It was at this time that the lives of Dosio from San Gimignano and Naldini from Florence crossed over, united by antiquarian interests and the exercise of drawing from surveys and from life [13]. Naldini in particular copied drawings of statues in general and of figurative cycles from the early sixteenth century, prolonging his Roman sojourn until at least 1563 according to Borghini, when he designed the decorations for the wedding of the Prince of Massa, Alberico I Cybo Malaspina, to the Neapolitan, Isabella di Capua. On his return to Florence on the 16th of July 1564, he was admitted into the Academia del Disegno, continuing his professional development, under the protection of Borghini and Vasari. It was thanks to these two that Naldini was involved in the project for the preparation of the decoration of the *Salone dei Cinquecento*.

Following their shared journey through the early part of their artistic careers, linked by their production of drawings and early patronage in Rome, the careers of Dosio and Naldini diverged in part. One worked as an architect, while the other was promoted to consul of the Accademia del Disegno and admired as an inventor of religious scenes. We find Naldini in 1577 in Santa Maria Novella, working on a *Purification of the Virgin* [14], and in 1576 in Santa Croce painting a *Stigmatisation of Saint Francis*, continually crossing paths with his friend Dosio in the worksites of Florence. Both are recorded as present at the Archbishop's palace, which was undergoing a full restoration after the terrible fire of 1533, Naldini working on painting the old church of San Salvatore, which was incorporated within the palace [15].

Both were also working at the site of Santa Trinità dei Monti, together with Gugliemo Della Porta and Cesare Nebbia. The chapel to the right of the base of one of the two bell towers, added to that church in 1570, was given to the Altoviti in 1573 and frescoed by Naldini with scenes from the Life of John the Baptist, which must have been finished before 1584 when the frescoes were described by Raffaello Borghini [16].

With the exception a short stay in Rome between 1577 and 1580, Naldini concentrated his work in Florence, where undertook some work for his Medici patrons. For example, the decoration of the *Studiolo* of Francesco I, installed between 1570 and 1572 by Giorgio Vasari following an iconographic programme devised with Vincenzio Borghini, which is attested to by correspondence sent between the two men. Borghini continued to feature in the artistic life of Naldini, sometimes as the promoter of his work, and at other times acting as his patron. In relation to this there is a letter [17], edited by Lorenzoni [18] (fig. 1) and identified by Eliana Carrara, written from "the painter Battista" to the prior and dated the 10th November 1975. In it he writes "*the reply received from a friend in Rome together with the measured plan and part of the side elevation*", announcing the forthcoming visit to Florence by the friend "*who is very skilled in antique things and a very good draftsmen and architect*" [19]. It has not been possible to identify who this friend was, but we can deduce that the architect was "*very skilled in antique things"*, was unknown to Borghini, and enjoyed the respect of his patron, who was acting as a go between and arranging a meeting with the prior, in advance of some drawings. Even if we do not have documents to verify contact between Dosio and Borghini, it can be revealed that there is a certain correspondence between the dates, as Dosio returned to Florence from his long sojourn to Rome in 1575, and from that year he started work on the Gaddi Chapel. In November 1575 he was elected to the Accademia del Disegno in Florence. From that moment he continued to move between Florence and Rome, and on the 28th October 1575 he wrote to Niccolò Gaddi to inform him of his work at the chapel of Giovan Battista Altoviti in the Sanctuary of Loreto. During the same period, Naldini was also engaged in work outside of Florence, working in Rome between 1577 and 1580, at San Giovanni dei Fiorentini, among other sites.



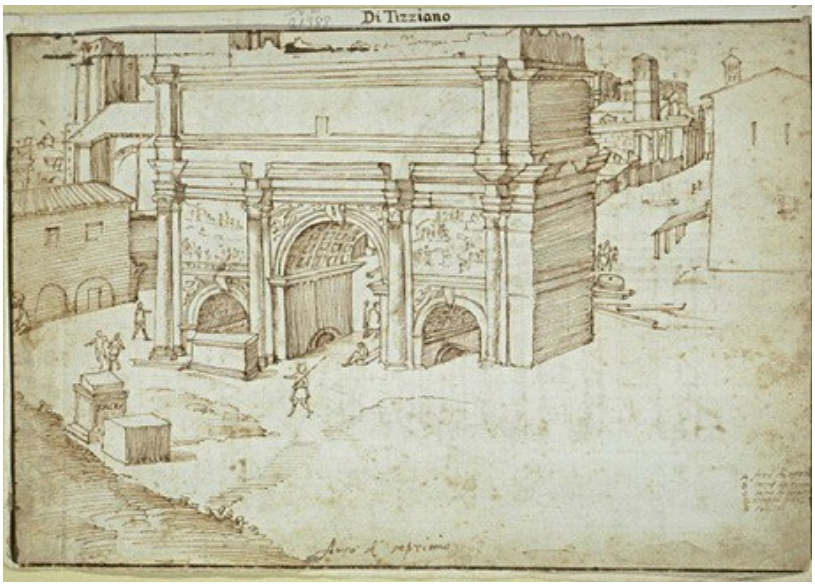


Fig. 1: Giovanni Battista Naldini: *Letter to don Vincenzo Borghini,* Biblioteca Nazionale Centrale, Florence, MS Magliabechiano XXV 551 c. 167r e v.).
Fig. 2: Giovanni Battista Naldini, *Arco di Settimio Severo,* Musée du Louvre, Département des Arts graphiques, Cabinet des Dessins, INV 11031.

From these brief biographical notes, we can trace a professional relationship which went beyond the end of Naldini's first trip to Rome. The more difficult aspect of all of this comes when you try to establish the nature of the collaboration between the two young artists, the architect and the painter. In particular there is the issue of those who have read the relationship between the two as being a subordinate one, because Naldini is known to have copied drawings by Dosio rather than the other way around, despite the fact that they were in fact the same age. Among the examples there is a drawing by Dosio G.D.S.U 2567/Ar [20] of the Arch of Septimius Severus and Naldini's copy of it, held in the Cabinet de Dessins, Louvre, inv. 11031 [21] (Fig. 2) . This second drawing contains the note "*Arco de septimio*", the handwriting of which resembles that of Naldini. The subject of the Arch of Septimius Severo is based on one of the plates in *Antichità* by Gamucci [22]. The drawing G.D.S.U. 4354/Av (fig. 3), already attributed to Dosio [23], contains an annotation written in a hand that is certainly not Dosio's: "t*his building is close to the Theatre of Marcellus on the side of the Campidoglio and at the foot of Mount Vulgo known as Piazza Montanara*". This annotation also suggests the presence of Naldini, especially in the way in which some of the letters are formed, such as the "g" which is very rounded and sloping, and the "z" with its final bottom stroke which is characteristic of Naldini.

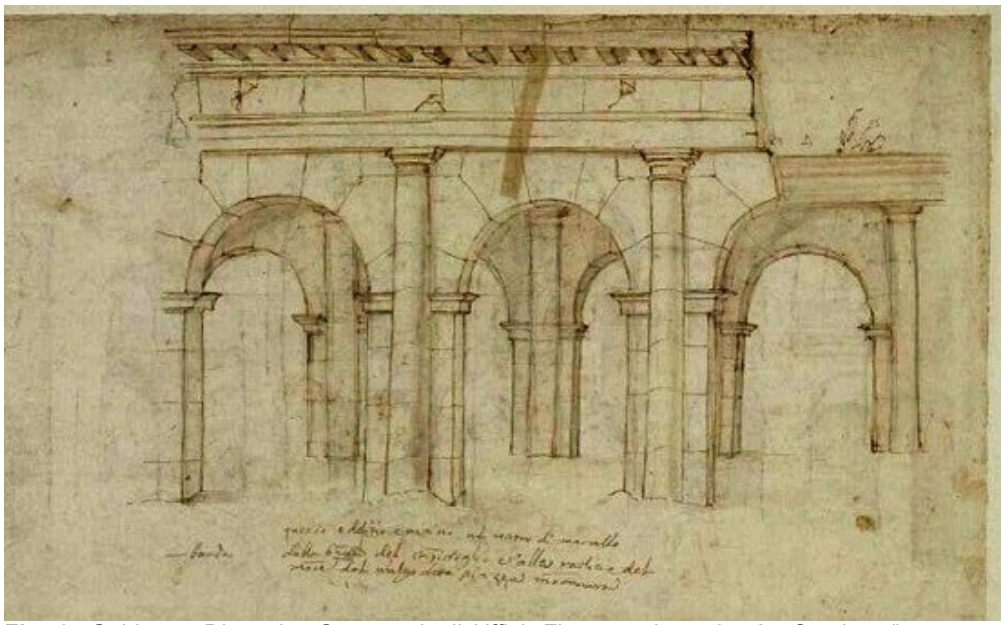


Fig. 3: Gabinetto Disegni e Stampe degli Uffici, Florence, inv. 4354Av Caption: "*questo edefitio e uicino al teatro di marcello dalla ba[n]da del ca[m]pidoglio et alla radicie del mo[n]te dal vulgo detto piazza mo[n]tanara*". This drawing was attributed to Giovanni Antonio Dosio.

The drawing represents a perspectival view of the arch supported by pilasters, in front of which are placed half columns of the Tuscan order. It was once identified as the Porticus Minuci, today it is thought to be of the Forum Holitorium, a subject that was proposed again in the Dosio drawing at Windsor Castle, RL 19247, ex portfolio 5, folio 40 [24].

Crucial in the context of this brief examination is the collection of sixteenth-century drawings contained within the manuscript N.A. 1159, acquired by the Biblioteca Nazionale of Florence in 1968 from the director Emanuele Casamassima [25], who was responsible for the research and cataloguing of the collection (fig. 4)

These drawings explore various themes of an antiquarian nature, from funerary altars to inscriptions, some marble groups, copies of drawings by Dosio and drawings done from life, possibly produced to enrich a private collection, and focused on the period of the pontificate of Pius IV (1559-1565), as can be deduced from references to collections or to classifications of the time [26]. Among the drawings there are examples that are close in style to that of Dosio, as well as sheets which an analysis of the handwriting suggests could be the work of Naldini. For example, c. 68r. and c. 50r, in which Eliana Carrara and Ruth Rubinstein have both identified Naldini's letter "z", "finished with a long flourish"[27]. There is no shortage of documents in Naldini's hand which we can use for the purpose of comparison. In addition to the letter sent to Borghini, there are also other documents that have been known for some time, such as the request for payment which Naldini sent to the superintendent of the Grand Duke's fortresses, Girolamo Seriacopi [28].



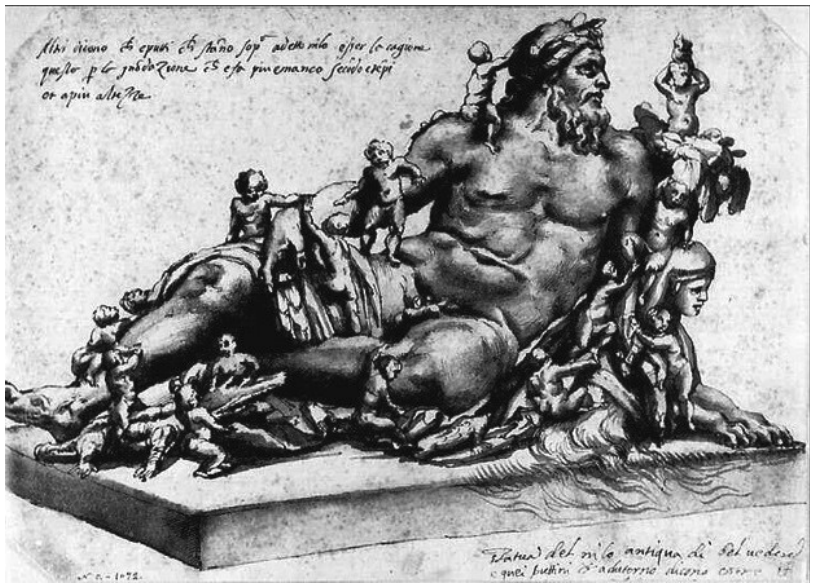


Fig. 4: Giovanni Battista Naldini, Talamone figure in Egyptian style, Biblioteca Nazionale Centrale, Florence, MS N.A. 1159 c64r. Caption: "*il presente termine e a tivoli dicesi che si domandano acomici e quali erano popoli soggiogati dai Romani"*

Fig. 5: *"Statua del Nilo antiqua di belvedere e quei puttini ch[e] adatorno dicono essere il…", "Altri dicono ch[e] e putti ch[e] stan[n]o sopra adetto nilo esser la ragione questo [e] lo inddozione ch[e] e fa piu e manco seco[n]do ese[m]pio et a piu altezze".* Lisbona, Museu Nacional de Arte Antiga. Attributed to Giovanni Battista Naldini by Matthias Winner e Arnold Nesselrath.

In the manuscript there is epigraphical evidence of the antique world which have been examined more for their documentary value than for their decorative aspects, an interest that was perhaps inspired by Borghini, who was already engaged in compiling an inventory of antique epigraphs from the Florentine area, and who may have suggested to the artists in his circle that they do the same. Like Dosio, Naldini was also interested in the city as a complex, as is testified to by his panoramas which contain contemporary palaces and buildings under construction. From the collaboration between the two artists there grew a corpus of drawings in which it is difficult to discern the individual contributions, and the written notes which can often be found on the sheets do not seem to help, because the notes often contain the handwriting of both men. For example, the drawing held in the Museu Nacional de Arte Antiga in Lisbon (n. inv. 1072) which depicts the Nilo Vaticano [29] (fig. 5) has two separate annotations, one in the hand of Dosio and the other probably in the hand of Naldini. The drawing shows a soft but broad use of a colourwash on top of brown pen, and the dimensions are analogous with those of the pages in the manuscript NA 1159, previously cited, and with some drawings held in the Biblioteca Comunale of Fermo (Fondo Carlucci, Disegni inv. 224-241) [30]. The drawing by Dosio in the Biblioteca Centrale of Florence, MS. 618 c.32. (fig. 6), serves as a useful comparison with other graphic works. Ruth Rubinstein, in relation to the Manuscript NA 1159, summarised it like this: "*In 1986 at the conclusion of my talk on this codex at a colloquium at Coburg, Nesselrath proposed that the young Florentine painter, Battista Naldini (1537-1591) might well be our artist, for three reasons:*

first, that Naldini was in Rome between 1560 and c. 1562; second that Naldini was known to have copied drawings by Dosio, particularly views of antique ruins; and third, that the handwriting of Naldini and that of our artist seem to be identical" [31].

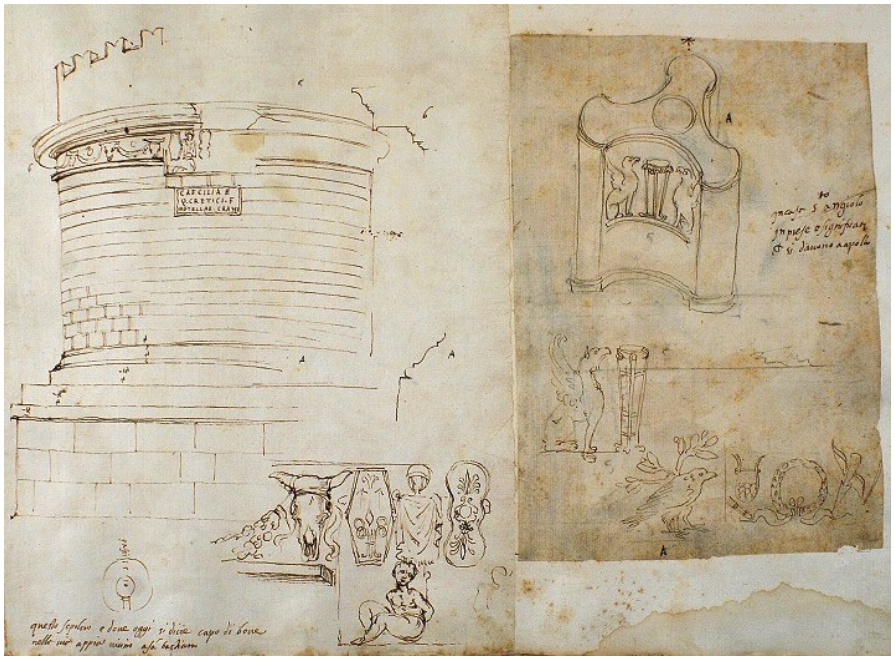


Fig. 6: Giovanni Antonio Dosio, Biblioteca Nazionale Centrale, Florence, MS. 618 c. 32. Caption at the bottom written by Dosio: "*questo sepolcro è dove oggi si dice capo di bove/nella via appia vicino a san sebastiano*". It represents the Cecilia Metella's cylindrical mausoleum, down there is a small sketch of the plan and some decorative details. At the right, a small piece dating back to the early imperial age and perhaps kept in the Farnese palace, whose wall envisaged Via Giulia, at right the note: "*in casa s angiolo/in piese(?) significan/che si davano ad apollo".*

To complicate things further there is also the issue of Naldini's versatility as an artist, which sees him sometimes working in the style of Dosio, whilst at other times he moves from "a childish clumsiness to a spirited and delicate "maniera" placing him in a Vasarian context" [32]. In imitating Dosian subjects, Naldini embraced the same linearity and lightness of touch, with a *chiaroscuro* achieved through a close lattice of verticals and horizontals, which is replaced in his more autonomous drawings by a greater fullness and sharpness in the outlines and a dusting of inspiration from Vasari.

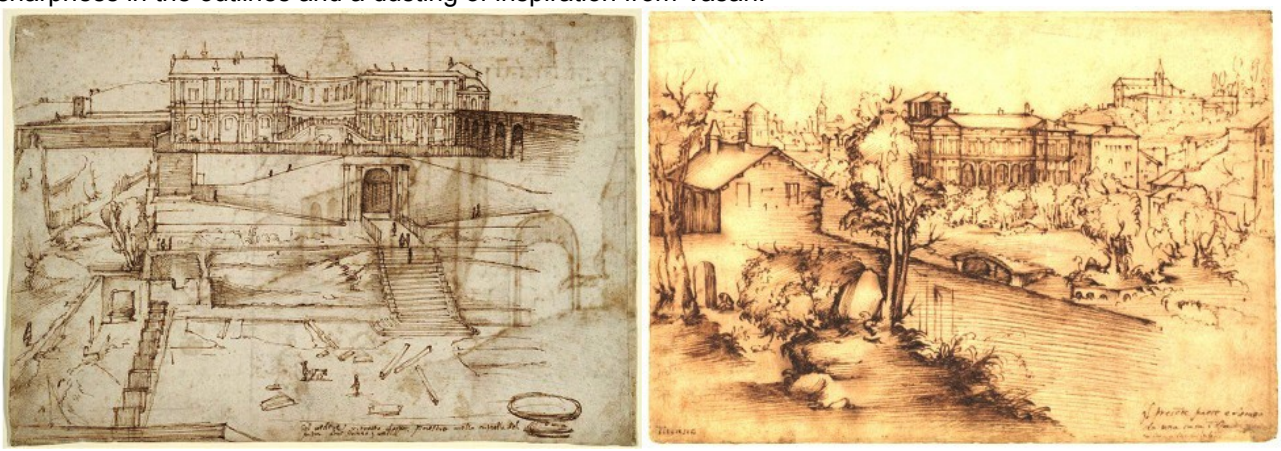


Fig. 7: Giovanni Battista Naldini, Fogg Art Museum, Cambridge, Mass. 1934.214r. The Cortile del Belvedere; verso: *The Pyramid of Cestius and the Porta San Paolo,* c.1552-1553.
Fig. 8: Giovanni Battista Naldini, View of Rome with Villa Farnesina (recto), circa 1555, Courtauld Gallery, Witt Collection, Witt Drawings 4642r. In the lower right: "*Il presente paese e ritratto da una casa in strada nuova vicino a strada iulia*"

Suggestive in that sense are two panoramas which show the same style of drawing with explanatory notes that are written in hands that could be superimposed on top of one another. We are talking about the view of the Belvedere Courtyard (Fogg Art Museum, Cambridge, Mass. 1934.214r) (fig. 7) [33], on the verso of

which we find the pyramids at Cestio and Porta San Paolo, and a view of the Villa Farnesina (*Veduta di Roma con Villa Farnesina*, recto, circa 1555, Giovanni Battista Naldini, ink, 22.9 cm x 33.4 cm) (fig. 8). These views were popular with artists of the time, and were drawn by both Dosio, whose presence at the Belvedere is attested to by documents which record him as busy at work in the Casino of Pius IV, and by Naldini, who can be linked to "Decorating in stucco the vault of the atrium of the Belvedere Torso" [34].
The subject of the first view is the same as that in the celebrated drawing of the Belvedere by Bramante (G.D.S.U. 2559A) [35]. It has been attributed to Dosio and dated to between 1558 and 1561 because of the presence of the new staircase with its two ramps and central landing, modelled on Michelangelo's staircase for the Palazzo Senatorio, and which replaced Bramante's original circular staircase. The work had been completed in 1552 when "...the whole wing had already been covered with roofs" [36]. A few years later work began on excavating the foundations for the western wing, work on which was effectively underway by October 1560 [37], and was entrusted to Pirro Ligorio and Sallustio Peruzzi. According to Vasari, by then there remained only a trace of Bramante's foundations. This period of work coincides with the commencement of work on the Casino for Pius IV in 1557, located to the west of the courtyard, which explains the communication door which was left in the perimeter wall of the courtyard, as well as the tracks of the path made by the masters who transported construction materials towards the Casino. The analysis of the two drawings allows us to date the page held in the Fogg Art Museum to just after this, based on the presence on the right of the drawing of the foundations for the west wing in place of the simple excavation. Work proceeded quickly, according to a view of 1565, which depicts the joust held on the 5th March 1565 for the celebrations of the marriage between Annibale Altemps and Ortensia Borromeo: "Demonstration of the joust held in the theatre of the palace reduced in this form by his Holiness of Our Lord Pius IV as you can see in the reproduction of the plan with its measurements".

In both the compositions the architecture is captured with efficacious and light lines, leaving as the protagonist the huge courtyard, with its differences in height, creating the effect of a landscape, while on the first floor there are the boulders and tree trunks of the building site, as well as men who are focused on their work. To the left of both the views there is the stepped profile of the perimeter wall which follows the different levels of the land. However there are also some differences, in the Uffizi view the perspective is solid and architectural, perfectly central, with a vanishing point that is higher up. Whereas in the Fogg Museum drawing the vanishing point is set at an oblique angle, with the result that it is less rigorous in the proportions and relationship between elements, and the central area of the courtyard looks like it has been flattened into the background. From a graphic point of view, the style is the same as the view with the Villa Farnesina, held in the Courtauld Institute of Art, both in terms of the drawing of the architecture, and the way in which the details have been drawn, such as the foliage on the trees and vegetation. To my mind it is in these minor elements that you can observe the will and free interpretation of the author. In this case the details seem to hide a different hand to that found drawing the same view in G.D.S.U. 2559. Finally, the handwriting of the annotations is very similar in both drawings which suggests that they were written by Naldini.

Another controversial drawing is the view of the crossing of St Peter's drawn from the western side of the nave (fig.9), held in the Hamburger Kunsthalle-Kupferstichkabinett, a well-known drawing that has been published in a volume dedicated to Renaissance Rome [38]. The drawings shows the new St Peter's under construction, looking towards the east, where the old structure used to house the main altar had been built in the sixteenth century. On the left of the drawing is an altar covered by an aedicule placed up against the pilaster of the dome. At the top of the drawing the drum of the dome is shown under construction, with the pedimented windows and paired pilasters which already have their capitals. The view G.D.S.U. 91Ar.[39], which is roughly contemporary, shows the construction site of the dome from the opposite side to the other drawing. At the bottom right of the Uffizi drawing there is a hint of the block of wall which appears in the left hand side of the Hamburg drawing. At the top towers the drum of the dome, drawn from a side that was perhaps less complete, open towards the machine used for hoisting up loads, operated by an external wheel [40]; a true cogwheel transmission which moved the ropes which are visible in both drawings.

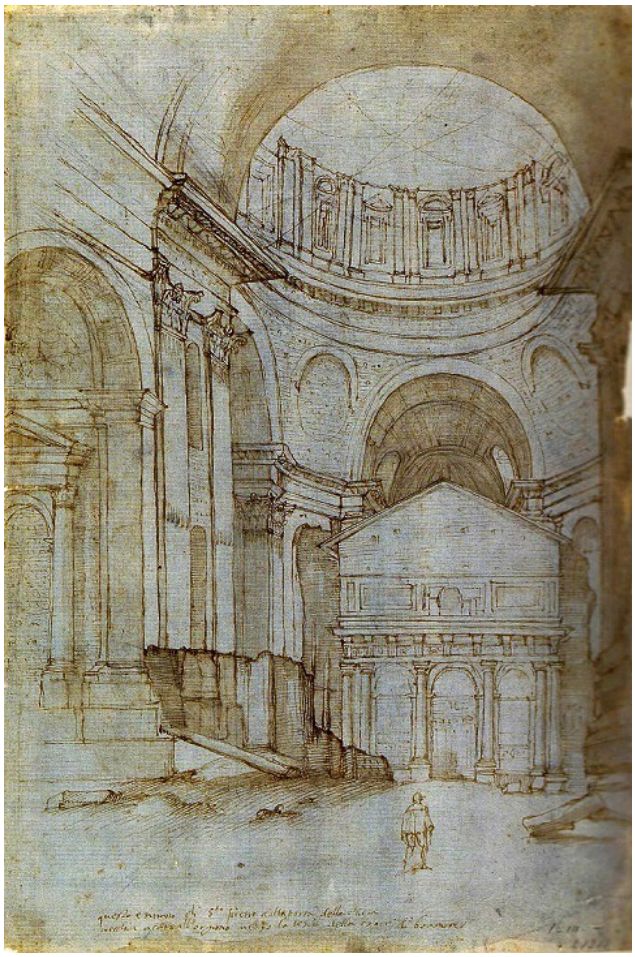




Fig. 9: View of the cruise of Saint Peter from the western part of the nave. Caption: "*questo e ritrato di S^to^ Pietro dalla porta della chiesa vecchia ac[n]to allorgano verso la testa della croce di Bram[n]te*" Hamburger Kunsthalle, Kupferstichkabinett, inv. 21311
Fig. 10: View of the cruise of Saint Peter. Gabinetto Disegni e Stampe degli Uffizi, Florence, 91Ar.

The two views are of a different character, style and were produced for different objectives, but both aim to record the same subject, the interior of San Peter's under construction shown from its most impressive angle, where the building opens up into the emptiness that is full of anticipation and curiosity about Michelangelo's future dome. It is this emptiness that the view of G.D.S.U. 91Ar. (fig. 10) seems to address, with the interior shown as if in shadow. On the second floor there are many decorative details, such as the capitals of the great pilasters in the crossing, the bases, the aedicule roughly sketched on the right, while at the centre of the drawing there is a section of the column of the drum suspended in midair, an aspect which gives the drawing life and movement. The Hamburg drawing has a more pictorial quality, with the figure stood on the ground floor that seems to observe with detachment the scene of the colossal building evolving, while the past is destined to withdraw.
The graphic style of the drawings is markedly different, which makes it unlikely that the two views could be by the same hand. In the Hamburg drawing there is an annotation which recalls that: "*this image of Saint Peters from the door of the old church next to the organ towards the head of Bramante's cross*". According to the chronology of work established by Vitale Zanchettin and based on documents for the site, "*The construction of the interior body of the drum, begun in 1554 with the first supply of Fiano stone, must have been virtually finished in the summer of 1561, when they commissioned the remaining internal capitals which had not been realised in the first contract of 1555 as well as those for the external columns and half pilasters of the radial buttresses, defined in the jargon as "impost block capitals" [imposte dei capitelli]* [41]. From this examination comes a dating for both the drawings to the years just after 1560, which coincides with the presence of both Dosio and Naldini at St Peters. However, the handwriting of the annotation in the Hamburg drawing is without doubt not that of Dosio, nor is the style of the drawing, but to some extent it is comparable with the manner and style of Naldini.
If these drawings have been considered to be by an artist who had the opportunity to attend Dosio's workshop, only during his time in Rome, and if it is likely that he was given the task of copying drawings to send to other passionate students of the antique, at times copying drawings as a pure exercise, then the thesis that Naldini was a simple copyist can be contradicted by the fact that he was also inspired to draw the

same subjects in which he showed the signs of autonomous draftsmanship and a different sensibility. Another valid example of this is the comparison of Naldini's drawing of *Tombstone of the Roman legionary Marcus Aurelius Luciano* (fig. 11), with the drawing by Dosio in the Biblioteca Nazionale of Florence M.S. N.A. 618, c.44v, which is a simple rough version of the former, taken from the tombstone in the house of Bishop Ferrantino di Amelia. Again, the Florentine drawing in the Marucelliana c.161v is certainly by Dosio and shows, among others, a funerary altar, the first sketch for which is probably folio c.53v in manuscript 618 [42]. At the top of this page there is the note "on the back there is nothing" which suggests a hand other than Dosio's. If there is a connection between the two drawings, then we can say that Dosio



Fig. 11: Giovanni Battista Naldini, Memorial stone of the Roman legionary Marco Aurelio Luciano, Biblioteca Nazionale Centrale, Florence, MS. N.A. 1159 c. 53r. Caption *"In casa di Mo.s ferratino vescovo di amelia*".

could have drawn inspiration from the former, one sketched from life where the molding of the altar has been rapidly outlined and only part of the figurative elements of the three faces have been decorated.
The theme of collaboration between Dosio and Naldini in drawing the antique and the modern, with its intricate tangle of overlapping copies and completions, remains to be examined. However it is possible to illuminate this journey with some certainties which are provided by drawings and documents which were produced over a well-defined period of time.

Bibliographical References

[1] PILLIOD Elizabeth, *Pontormo Bronzino Allori. A Genealogy of Florentine Art,* New Haven-London, Yale University Press 2001

[2] BARLETTI Emanuele (edited by) *Giovan Antonio Dosio da San Gimignano*, Edifir Florence 2011.

[3] GATTESCHI Riccardo, *Vita di Raffaello da Montelupo*, Florence Polistampa 1998

[4] PLODER Josef, *Bramante e gli altri. Storia di tre codici e di un collezionista*, Exhibit Catalogue, Florence, Olschki 2006

[5] GAYE Johann Wilhelm, *Carteggio inedito d'artisti dei secoli XIV, XV, XVI* tomo III presso Giuseppe Molini, Florence 1840 Letter sent from Borghini to Giorgio Vasari, march 10, 1569 da Borghini a Giorgio Vasari in pp. 264- 265

[6] CARRARA Eliana, *Su alcuni disegni di Naldini presenti in un manoscritto di Vincenzio Borghini*, in *Fontes* anno VI, 11-12/2003 , pub. Agorà, p. 138- 139.

[7] BAROCCHI Paola, *Itinerario di Giambattista Naldini*, in “Arte Antica e moderna”, XXXI-XXXII, 1965, p. 244-288

[8] BELLONI Gino, DRUSI Riccardo *(*edited by*) Vincenzio Borghini. Filologia e invenzione nella Firenze di Cosimo I*, Exhibit Catalogue, Florence, Bibl. Naz. Centrale, 21.3/20.4.2002, Olschki, Florence 2002.

[9] FREY Karl, *Der Literarische Nachlass Giorgio Vasaris*, München, 1923-1930, I, n. CCCXX, pp. 582-83.

[10] CASAMASSIMA Emanuele, RUBINSTEIN Ruth, *Antiquarian Drawings from Dosio’s Roman Workshop. Biblioteca Nazionale Centrale di Firenze. N.A. 1159*, Florence, Giunta Regionale Toscana, Milano, Editrice Bibliografica 1993, nota p. XXII

[11] *CECCHI* Alessandro, *Per la ricostruzione dell’attività romana di Marco Da Faenza*, in «Paragone (arte)» XLV, 44-46 March - July 1994.

[12] FREY Karl, *Der Literarische Nachlass Giorgio Vasaris*, München, 1923-1930, I, n. CCCXX, pp. 582-83.

[13] CARRARA Eliana, *Giovanni Antonio Dosio e Giovanni Battista Naldini: pratica del disegno e studio dell’antico nella Roma del settimo decennio del Cinquecento*, in *Saggi di letteratura architettonica da Vitruvio a Winckelmann*, Florence, Olschki, voll. II, vol. 1°, pp. 151-159.

[14] THIEM Christel, *«Invenzione» e «pratica»: Zur Entwurfspraxis des Florentiners Giovanni Battista Naldini*, in STAUFFER Christine E. (edited by), *Festschrift für Eberhard W. Kornfeld zum 8*0, Geburstag, Bern 2003, pp. 49-55.

[15] BARLETTI Emanuele, *Il Palazzo Arcivescovile di Firenze, vicende architettoniche dal 1533 al 1895*, Arti Grafiche il Torchio, Florence 1989, p. 29.

[16] ROMEI Francesca, Antonietta Dell’Agli, *Santissima Trinità dei Monti*, in «Roma Sacra» II, 6, april 1996, De Rosa, pp. 5-17

[17] CARRARA Eliana, *Su alcuni disegni di Naldini presenti in un manoscritto di Vincenzio Borghini*, in *Fontes* anno VI, 11-12/2003, Agorà, p. 138- 139.

[18] LORENZONI Antonio, *Carteggio artistico inedito di D. Vincenzio Borghini*, Vol. I, Florence succ. B. Seeber 1912.

[19] CARRARA Eliana, *Su alcuni disegni di Naldini presenti in un manoscritto di Vincenzio Borghini*, in «Fontes» anno VI, 11-12/2003 , p. 138- 139.

[20] ACIDINI LUCHINAT Cristina, *Roma antica*, in BORSI Franco (edited by) *Roma antica e i disegni di architettura agli Uffizi: Giovanni Antonio Dosio,* Officina Edizioni, Rome, 1976 p. 30.

[21] CAMPBELL Ian, *Ancient Roman Topography and Architecture. Drawings by Francesco di Giorgio, Ligorio, Dosio and Four Anonymous Sixteenth-Century Draughtsmen*, London, Royal Collection Enterprises, vol. I, p. 242.

[22] MARCIANO Antonella, *Disegno e rappresentazione tra antico e moderno*, in BARLETTI Emanuele (edited by) *Giovan Antonio Dosio da San Gimignano*, Edifir Florence 2011, pp. 75-113.

[23] ACIDINI LUCHINAT Cristina, *Roma antica*, in BORSI Franco (edited by) *Roma antica e i disegni di architettura agli Uffizi: Giovanni Antonio Dosio,* Officina Edizioni, Rome, 1976 , pp. 91-92.

[24] CAMPBELL Ian, *Ancient Roman Topography and Architecture. Drawings by Francesco di Giorgio, Ligorio, Dosio and Four Anonymous Sixteenth-Century Draughtsmen*, London, Royal Collection Enterprises, vol. I, pp. 292-294.

[25] CASAMASSIMA Emanuele, RUBINSTEIN Ruth, *Antiquarian Drawings from Dosio’s Roman Workshop. Biblioteca Nazionale Centrale di Firenze. N.A. 1159*, Florence, Giunta Regionale Toscana, Milano, Editrice Bibliografica 1993.

[26] CASAMASSIMA Emanuele, RUBINSTEIN Ruth, *Antiquarian Drawings from Dosio’s Roman Workshop. Biblioteca Nazionale Centrale di Firenze. N.A. 1159*, Florence, Giunta Regionale Toscana, Milano, Editrice Bibliografica 1993, p. XIX.

[27] CARRARA Eliana, *Su alcuni disegni di Naldini presenti in un manoscritto di Vincenzio Borghini*, in «Fontes» anno VI, 11-12/2003, p. 142.

[28] POGGI Giuseppe, *Regia galleria degli Uffizi. Di alcuni ritratti dei Medici*, in «Rivista D'Arte», VI, 1909, pp. 321-332.

[29] CARRARA Eliana, *Su alcuni disegni di Naldini presenti in un manoscritto di Vincenzio Borghini*, in «Fontes» anno VI, 11-12/2003, p. 146.

[30] MONBEIG GOGUEL Catherine, *Trois dessins d'après l'antique autour Giovanni Antonio Dosio par Marco da Faenza* (?), entre Lisbonne, Fermo et Firenze, in TERRAROLI Valerio, VARALLO Franca, DE FANTI Laura, ed. by *L'arte nella storia. Contributi di critica e storia dell'arte per Gianni Carlo Sciolla*, Milano Skira 2000, p. 388.

[31] CASAMASSIMA Emanuele, RUBINSTEIN Ruth, *Antiquarian Drawings from Dosio's Roman Workshop. Biblioteca Nazionale Centrale di Firenze. N.A. 1159*, Florence, Giunta Regionale Toscana, Milano, Editrice Bibliografica 1993, p. XX.

[32] CASAMASSIMA Emanuele, RUBINSTEIN Ruth, *Antiquarian Drawings from Dosio's Roman Workshop. Biblioteca Nazionale Centrale di Firenze. N.A. 1159*, Florence, Giunta Regionale Toscana, Milano, Editrice Bibliografica 1993, p. XXII.

[33] CECCHI Alessandro, *Alcuni disegni del soggiorno romano di Battista Naldini*, in *Gedenkschrift für Richard Harprath*, edited by LIEBENWIEN Wolfgang, TEMPESTINI Anchise München-Berlin, Deutscher kunstverlag 1998, pp. 53-58.

[34] THIEM Christel, *"Das" römische Reiseskizzenbuch des Florentiners Giovanni Battista Naldini: 1560/61,* Deutscher Kunst Verlag, 2002.

[35] FROMMEL Christof Liutpold, in BERNARDINI Maria Grazia, BUSSAGLI Marco (edited by) *Il Rinascimento a Roma nel segno di Michelangelo e Raffaello*, Mondadori Electa, Verona 2011, p. 269.

[36] MUSSOLIN Mauro (edited by) , *Michelangelo architetto a Roma*, Silvana Editoriale, Cinisello Balsamo, 2009*,* p. 49.

[37] BERNARDINI Maria Grazia, BUSSAGLI Marco (edited by) *Il Rinascimento a Roma nel segno di Michelangelo e Raffaello*, Mondadori Electa, Verona 2011, p. 269.

[38] MILLON Henry e MAGNAGO LAMPUGNANI Vittorio (edited by) *Rinascimento da Brunelleschi a Michelangelo: la rappresentazione dell'architettura,* Catalogo della Mostra di Venezia, Milano, Bompiani 1994.

[39] ACIDINI LUCHINAT Cristina, *Roma del '500, vedute e rilievi della cupola di San Pietro,* in BORSI Franco (edited by) *Roma antica e i disegni di architettura agli Uffizi: Giovanni Antonio Dosio,* Officina Edizioni, Rome, 1976 , pp. 132- 146.

[40] MARTINES Giangiacomo, *Macchine da cantiere per il sollevamento dei pesi, nell'antichità nel Medioevo, nei secoli XV e X*VI, in «Annali di architettura» n. 10, 1998-1999

[41] ZANCHETTIN Vitale, *Il I tamburo della cupola di San Pietro,* in *Michelangelo architetto a Roma,* Silvana Editoriale, Cinisello Balsamo, *2009,* p. 186.

[42] TEDESCHI GRISANTI Giovanna, SOLIN Heikki, "*Dis Manibus, pili epitaffi et altre cose antiche" di Giovannantonio Dosio*, *il codice N.A. 618 della Biblioteca Nazionale di Firenze,* Edizioni ETS, Pisa 2011, p.20 and p. 35.

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The Augustan Bridge at Narni: Documentation and Analysis by Laser Survey and 3D Modeling

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Abstract
The Augustan Bridge at Narni, so-called following its renovation under Augustus in 27 BCE, is an important point on the Via Flaminia (220 BCE) connecting Rome to Rimini, and embodies all the characteristics of an imposing military structure. Though having collapsed several times it retains its arches on the south side, as well as part of the central and northern pillars.
Mentioned in classical sources, and described by many artists and travelers, the bridge became the subject of numerous studies from the second half of the Seventeenth century. Following an earthquake in 2000, the surviving arch was the subject of restoration work completed in 2005.
However, many technical aspects of the structure are still not fully understood: the number of arches - three or four, though most scholars argue four -, the absence of a breakwater, the shape of the collapsed arches, its slope and physical connection with the Via Flaminia at both mountain and valley level, as well as the causes of its collapse.
Laser scanning techniques created a 3D digital clone of the bridge, providing comprehensive measurements for reconstructing the bridge's original form and overall size. Today, such precise quantitative data programs along with their resulting point cloud of 3D measurements, combined with CAD technology and the possibility of three-dimensional printing, significantly improve the virtual reconstruction of surfaces and their textures. These techniques can be utilised by both the scientific and academic communities.

Keywords: Narni, Augustan Bridge, survey, laser scanning, 3D modeling

1. The Via Flaminia, the Augustan Bridge and the Madonna del Ponte Sanctuary
The restoration work of the Via Flaminia, done by Caio Flaminio, took place in the III century BCE (220 BCE) and was carried out mainly through the rationalization of preexisting routes. This work finds its roots in the Romanization of the central and northern Adriatic regions of the peninsula: the route had military purpose and represented the main communication axis toward north-est. The Roman colony of Narnia (Narni), established in 299 BCE, acquired a strategic role inasmuch geographically positioned in a key area for the military control of the route. After the restoration by Consul Flaminio (Flaminia vetus), the road reached Narnia from the south and continued north crossing the Nera River at a lower altitude, probably where the medieval bridge was built, which was destroyed during World War 2. Afterward, running along the western edge of the Ternan basin and avoiding Carsulae (Sam Gemini), the route moved toward Vicus ad Martis (Massa Martana) and through Fulginium (Foligno). From there it continued toward Arminium (Rimini), ensuring a safe, advantageous and fast route leaving Rome. In the I century BCE, Augustus, within his policy of oversight over the eastern Transalpine regions, personally took upon himself the care of the route and, in addition to the restoration work of the eastern branch (Flaminia nova) toward Interamna (Terni), he built the Bridge that crosses the Nera River at a higher altitude, in order to create a better and faster connection of the Flamina vetus to the north-east of the peninsula, and with the main axis toward Ameria (Amelia), which reached the via Amerina and the central Tyrrhenian regions. The strategic value of the intervention was sealed with the honorary arch dedicated to Augustus, built in Rimini at the end of the route restoration in 27 BCE.



Fig. 1: Zenithal view of the area.

The city, the route and the bridge kept their strategic military role in the late Middle Ages and in the later centuries, being the obligatory transit for soldiers and troops moving from North to Rome.
Between the XVII and XIX century, the Grand Tour's travelers in search of picturesque and sublime, illustrated and reproduced many times (Carot, among others) on prints the Augustan Bridge, the most appreciated structure of the classic age by the new pilgrims [1].

1.1 The Augustan Bridge

The Nera Clefts north of Narni, for their topographic and orographic characteristics, have kept over time the role of an essential crossroad: figure 1 shows the zenithal view of the Nera River area, on the left side there is the bridge built in the 1940s, in the center the remains of the Augustan Bridge and the railway that goes through the right abutment from north (further on, on the upper side there is the Madonna del Ponte Sanctuary), and on the right side the current pedestrian boardwalk that follows the layout of the medieval bridge destroyed during World War 2. The Augustan Bridge represents one of the greatest transit infrastructure realized by the Romans, which design was probably commissioned to a definitely non-local architect, whereas the travertine blocks with which it was built probably came from a local quarry (Catafosse). Built with big squared travertine bossage blocks and concrete conglomerate layers on the inside, today it presents itself mostly collapsed, with its southern head arch intact, figure 2, from which several meters of stonework have been removed between the arch extrados and the driveway plane, the head joint to the rocks on the northern side and the remains of two piers, one of which collapsed, in the central section. From a typology point of view it is a "…bridge-viaduct, with abutments on its sides that lean against the rocks, and piers grounded on emerging rock banks. It consists of a majestic engineering structure connecting the land sides with a 180 meters viaducts, which dominates in that stretch an impetuous Nera River." [2].



Fig. 2: Upstream view of the first arch from the left abutment to the firs pier.

It grows 30 meters high with an arches length of 160 meters for a total length of 180 meters: the preserved arch has a 19,5 meters span, the second arch measured approximately 32 meters and corresponded with the higher water flow section. The piers, with a square section, do not have the breakwater spurs and probably were grounded on emerging rocks. All the nineteenth-century representations suggest the driveway plane being above the bridge with a south-north incline. Already during the classic age the bridge was subjected to partial collapses that involved the reconstruction of the third pier and the last arch, resulting in a much different appearance from the other three. The sources furnish proof of transit in 537 AD. In 847 a major earthquake disrupted central Italy and probably affected the bridge too. In 1053 [3] the collapse of the Velino Lake embankment above Marmore resulted in a flood that caused the subsidence of part of the bridge, thereafter named ruptum or dirutus. Until the construction of the medieval “ponte novo” (new bridge), upstream to the Augustan Bridge, before 1217, the transit had to happen thanks to wooden scaffoldings, of which are proof the struts housing holes on the right side of the first pier, on the left side of the second and on the right side of the third one. The pons novus was in use until World War 2. In the municipal charters of 1371 the bridge is called both pons novus and pons maiorem montis Narnie, with the prohibition of extracting stones for the construction of other buildings. From the XIX century numerous studies and surveys have been conducted on the structure, in the attempt to gather elements for a restoration model, however, the limited tools, even though accurate, of that time, have generated several reconstructions, some of which are very much different. In 1819 the engineer Giuseppe RICCARDI, after the collapse of part of the medieval bridge, proposed to restore the old bridge. For that occasion he drafted, figure 3, a reconstruction of the probable original design. In 1847 the remains were stabilized by building a brick wall on the left abutment of the bridge. Within the “Cronistoria Narnese” (Narni’s Chronicle) [4] the historian Edoardo MARTINORI remembers the collapse of the third pier in 1885: “the 14th of July, at nightfall, with a great din the central pier of the Augustan bridge fell”. The collapse of the second pier, figure 4 [5], is supported also by Eroli [6]. Researchers instead agree on the subsidence of the second pier as cause of the collapse of the bridge. In this regard Eroli supply a difference in height of 2,77 meters between the cornice grade plane of the second arch on the first pier and its counterpart on the second pier.

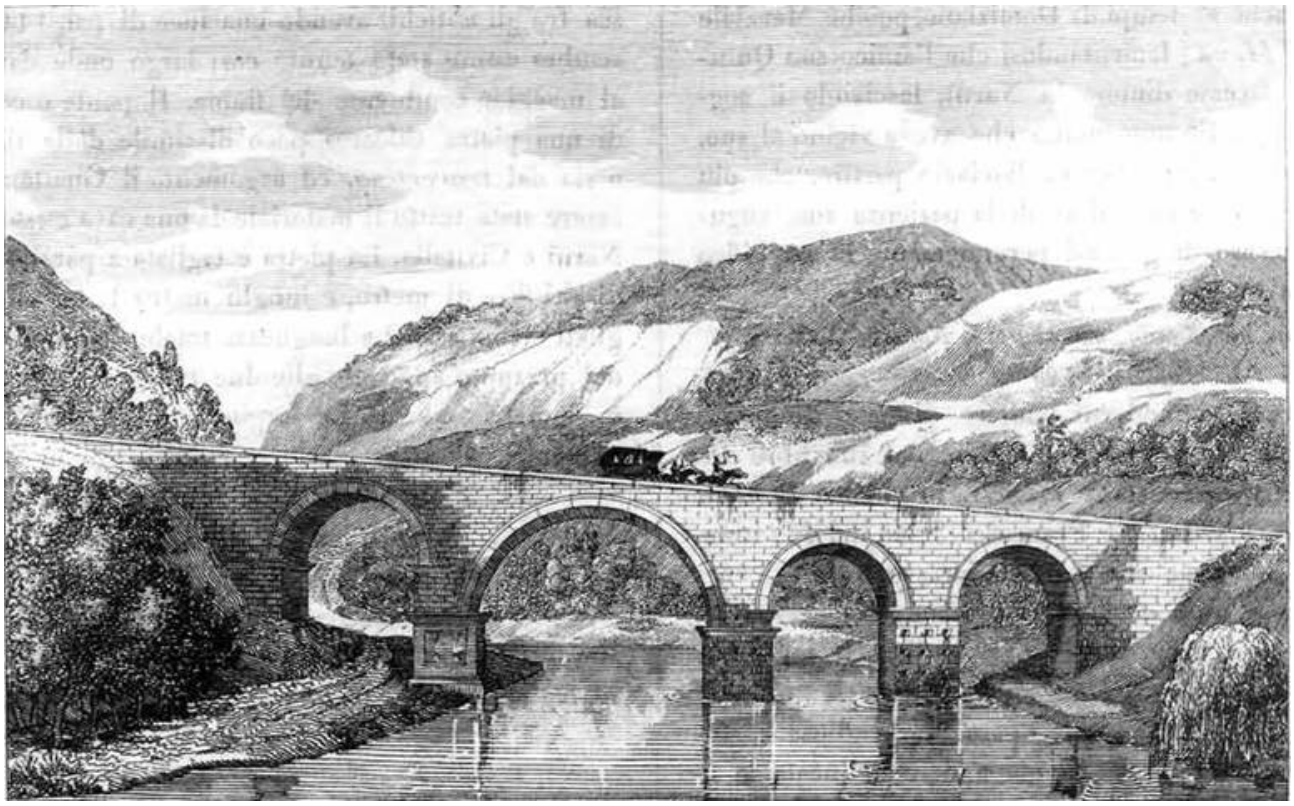

Fig. 3: Upstream view of the bridge from the ideal reconstruction of RICCARDI (1828).



Fig. 4: Downstream photograph of the bridge taken by Anderson prior to 1885.

1.2 The Madonna del Ponte Sanctuary

An unresolved issue is embodied by the shape of the northern bridge head: the remains of the fourth arch do not allow to understand how the bridge was connected to the outbound driveway moving north.

The layout of the route is easily recognizable within the residential are of Narni Scalo, whereas today the orography near the bridge has completely changed: in the XVIII century a sanctuary devoted to the cult of Mary rose, the Madonna del Ponte Sanctuary, figure 5 shows a picture of the bridge (with the second pier collapsed) and the church. The sanctuary was built around a cave that houses a sacred image.

Tradition wants that, during the month of March, 1714, a youngster form the Fanelli family of Narni, while hunting in that area, crawled through the bushes and randomly discovered the entrance to a cave.

On the back wall it was painted the image of Mary and his benedictory son holding in his left hand a scroll which read “Ego sum via”.

Around the sacred images grew a strong devotion, nourished by miraculous events that brought many believers to give generous money offerings, then used to build the church. The commission was given to the Milanese architect Giambattista Giovannini, known as ‘il Battistini’.

The church was consecrated in 1728.

The construction of the church enveloped the cave and other preexistences of the area, obstructing still today a clear analysis of the ancient backdrop: the cave could be either a substructure of the outbound viaduct of the bridge, or an artificial opening obtained from the limestone bank, intended as a burial place accessible from the driveway of the viaduct.

In addition to the construction of the sanctuary, the realization in recent times of a tunnel that connects the outbound road of the 1940s new bridge with the ‘via Tuderte’ (via Flamina vetus) toward north, has completely changed the profile of the small high ground on which the bridge lean against, erasing the traces of the old pathway; the very incoherent nature of the limestone bank has also caused over time significant landslides (figure 5): for this reason the bridge now seems to end against the rocks, with no continuation.

In correspondence to the southern head, the opening in the 1950s of the SS 3 ter (state highway 3 ter) has cut out the traces of the bridge connection with the overhead incline from which descended the via Flaminia; in correspondence of the head a tower surrounded by an nineteenth-century mansion could probably have been part of the fortification system of the bridge.



Fig. 5: Photograph taken from the left bank of the Nera River.

2. Laser scanning technology survey

Having successfully used the laser scanning technology in other analysis experiences [7], it has been decided to use it also for the Augustan Bridge, in order to obtain more extensive metric data and recreate a tridimensional model of it, in addition to better study the relation with the old road network.
The survey has been carried out over two working days and in addition to the laser equipment, supplied for the occasion by the company 3D-Target Srl from Brescia, it has also been used the traditional topographic equipment, supplied by SIAT snc from Narni.

2.1 The laser equipment used

For the new survey has been used a laser scanner produced by Z+F (Zoller & Fröhlich company) [8]: the model Z+F IMAGER 5006i [9]. The Zoller & Fröhlich company works in collaboration with other companies, such as Leica Geosystems (who sell a version of the IMAGER 5006 as the HDS 6000 and the IMAGER 5006i as the HDS 6100). The IMAGER 5006 was the first true "stand alone" laser scanner, worldwide. The integrated hard disk and power supply and operating methods enable a completely wireless operation. This technology has been carried over into the improved IMAGER 5006i.
The Z+F IMAGER 5006i is a phase-based laser scanner. It is suited for capturing objects in a range of 0.4m (15.75 in) to 79m (3110.24 in). The 3D laser scanner is characterized by a maximum measuring speed of 508.000 points/second and the quality of the point cloud data allows for reduced post-processing. It has a maximum field of view of 310° (vertical) x 360° (horizontal). The stand-alone solution is operated via a control panel and a display. The scan results (point clouds) are saved on an internal hard disk and can be transferred to another device, such as a PDA or PC, by means of USB ports. The data exchange via WLAN is possible, too. The internal rechargeable battery of the scanner provides a duration of at least 2.5 hours, the external battery provides at least 4 hours. The Z+F IMAGER 5006i can be powered additionally via a power supply unit. In order to obtain, in addition to the spatial coordinates and reflectivity, also the RGB data it has been used the IMAGER 5006i with the Z+F M-CAM Camera [10], thus obtaining colored point clouds. The fully automated panorama camera. The fully automated panorama camera M-Cam provides a solution of an exceptionally high quality to the demand for coloured laser scan data.

2.2 The survey operations

The laser survey operations have been carried out over two working days at the beginning of June (the presence of a dense vegetation has considerably obstructed the operations, causing unavoidable shadow zones). Two series of scans have been carried out: one, without RGB data, in a “super high” format with a 20.000 pixel/360° resolution (both vertically and horizontally) and the other in “high” format with a 10.000 pixel/360° resolution using a M-CAM to obtain the color data. As an example, for the station 5 the two format have produced respectively 98,28 and 26,62 million points. Four scanning stations have been put into place on the left side of the Nera River, two upstream and two downstream of the first intact arch and eight on the right side, the railway side, from the last arch to the collapsed pier, from where the first pier has been hooked. Each points cloud is of “leveled” type and they have been at a later stage recorded in one distinct set. The recording has given great results for the individual groups of the two sides, while the combination of the two groups involved a slight reduction in accuracy, in the connection area, due to the overlapping difficulties linked to the presence of the dense vegetation.
In order to improve the accuracy of the recording operations of the point cloud, 19 targets have been implemented, which have been measured with the SIAT’s topographic equipment, needed also for the subsequent survey georeferentiation.
The software Cyclon by Leica Geosystems [11] and, recently, ReCap PRO by Autodesk [12] have been used to manage the point clouds.

3. Data process and virtual modelling

The recent evolution of software for processing point clouds obtained with laser technology (such as ReCap by Autodesk in its PRO and 360 version) allows an ever greater autonomy from the proprietary software of the laser equipment producers and distributors, with the consequent reduction of costs and learning period. Moreover, it facilitates the exportation and direct processing of the point clouds in CAD environments, typically AutoCAD by Autodesk [13], with a greater simplification of the 2D output of all the technical composition for documentation, analysis and planning. An additional advantage is the possibility to return the surfaces 3D shapes, complete with textures, in a cloud environment, freeing oneself from the necessity of owning powerful processing hardware. Lastly, the possibility to obtain 3D prints of the survey point cloud has become easier, thus opening new horizons in the field of documentation and publishing.
After the recording of all the point clouds related to the various scanning stations, it has been obtained a global set of points, with and without the color data, with which is possible to represent the reality through what is to all intents and purposes a tridimensional virtual clone of the bridge, see figure 6 and 7, useful, even at this stage, for a large series of measurement operations, from linear, singular or continuous to

angular, and with the possibility to visualize tangent or secant planes to the point cloud. A large series of functions then allow to select portions of points and to highlight their characteristics such as reflection, altitude, planarity etc.



Fig. 6: Downstream elevation of the entire bridge from the whole point cloud.

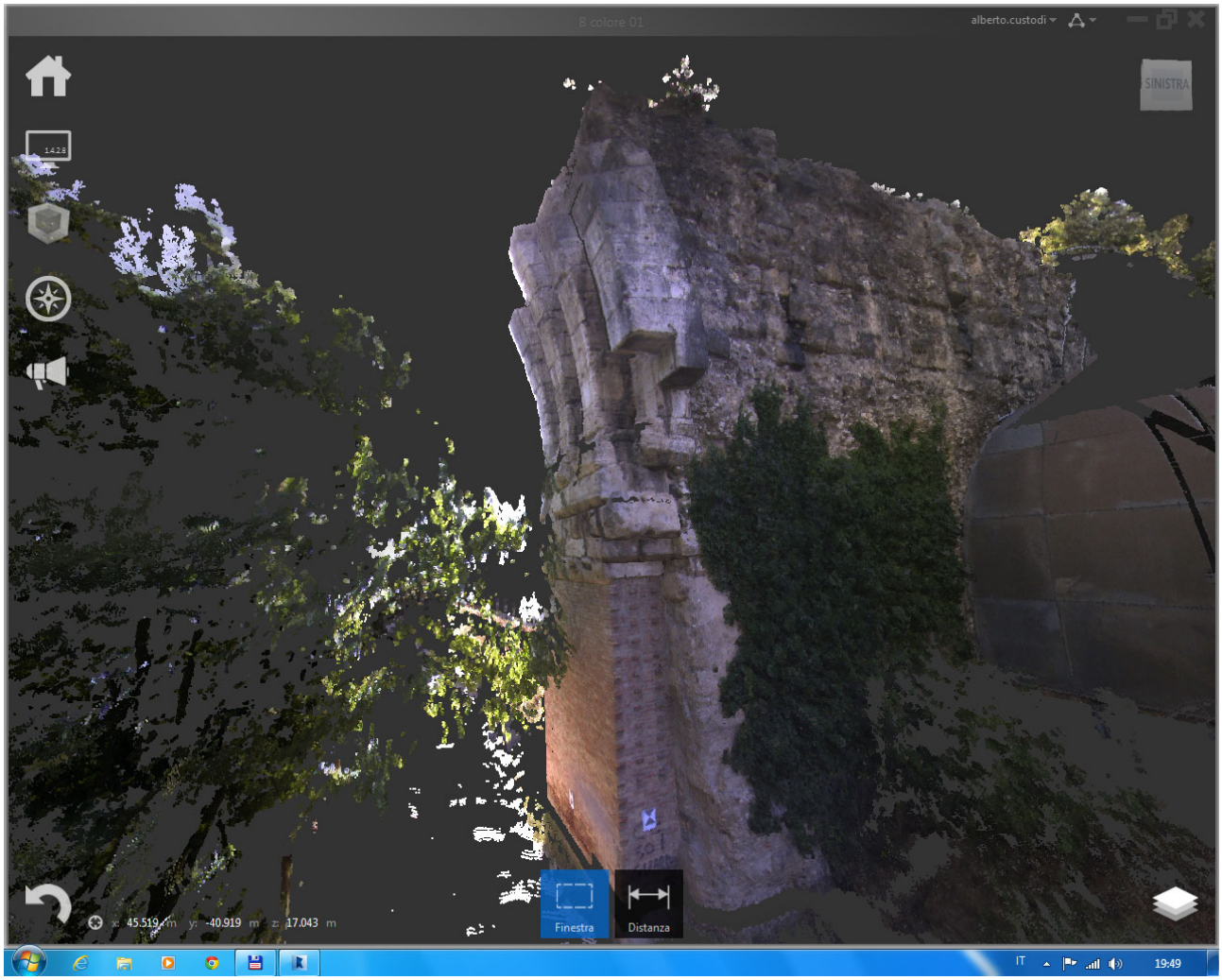

Fig. 7: Upstream view of the point cloud of the fourth arch and the right abutment, in ReCap by Autodesk.

4. Data analysis and processing

After acquiring and recording the point clouds, it was possible to examine in depth the bridge metric characteristics, thus obtaining additional data which can contribute to its study. With reference to Cecchi et al. [14], table 1 below shows the main measurements of the bridge arches and piers. Refer to the four arches diagram illustrated in figure 3.

	Augustan Bridge dimensions (in meters)							
Author	**1st Arch**	**1st Pier**	**2nd Arch**	**2nd Pier**	**3rd Arch**	**3rd Pier**	**4th Arch**	**Notes**
A. Choisy	19,5		32,1		17		16	
Cesanelli	19,5		32,1		43			three arches
Eroli	19,65	10	32,1	10	17	10	16	
Riccardi	19,5	9,5	32,4	10	16,92	10,48	15,6	
Ashby, Fell	19,6		32,1		18		16	
Ballance	19,5		32				16	
Cecchi et Alii	20,05	9,65	31,95	10,1	18,03	10,1	15,58	
current study	19,55	9,52-9,67	32,05-32,11	9,94-10,04	18,18	9,85-9,98	15,60-15,73	
	p=7,41	p=7,71	p=7,41			p=8,10		

Tab. 1: Comparison of the bridge measurements supplied by various researchers.

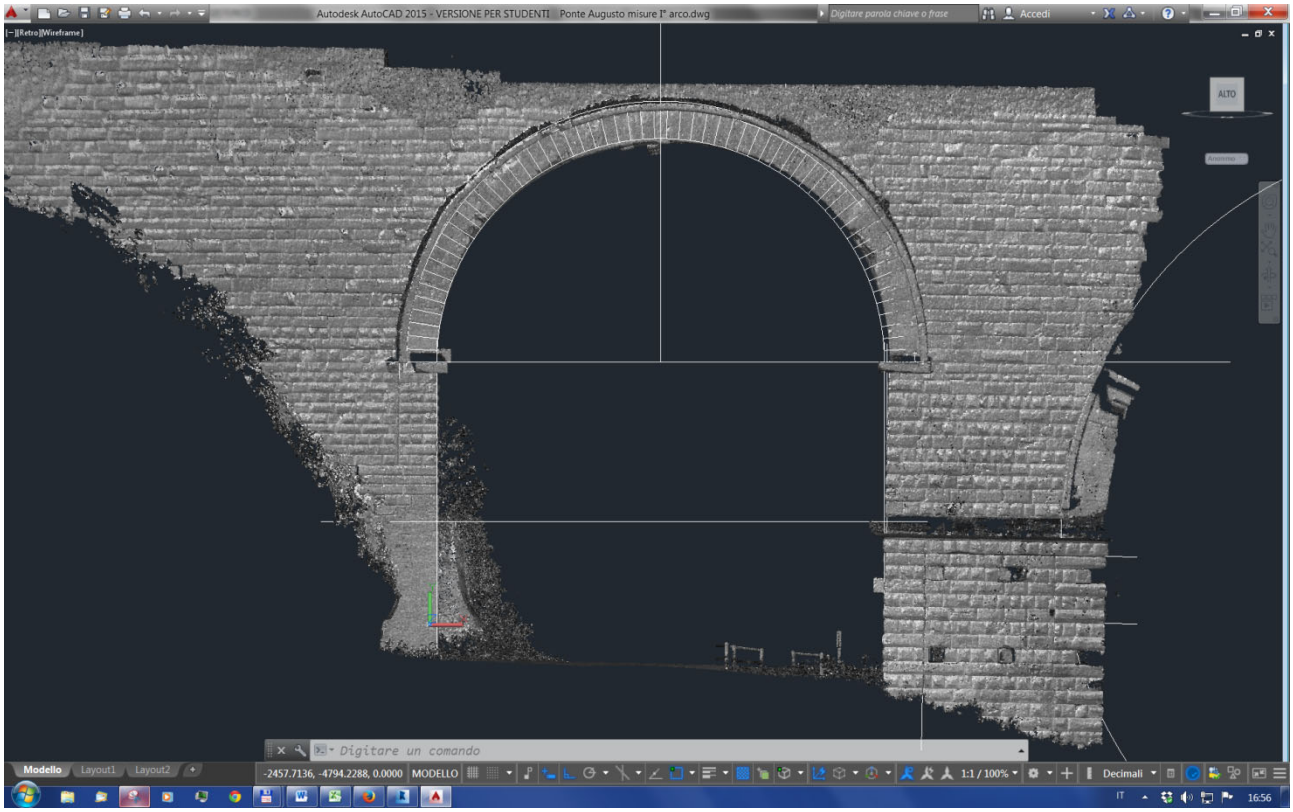

Fig. 8: Upstream elevation of the point cloud of the first arch and pier, AutoCAD environment by Autodesk.

After transferring the point cloud in AutoCAD environment, it has been possible to create some orthogonal projections such as the one in figure 8. From the examination of the first arch, which was built as a round arch with the springers at the same height, it is immediately evident the rotation, of about 1° (in accordance with Cecchi [14]), of the first pier toward the second arch and the consequent shift of the right springer of approximately 22.4 cm. Such shift caused the compression fracture of the inner edge of the voussoirs in correspondence of 30° angles on the horizontal axis, resulting in an outward compression and push of the cornice and lastly the vertical subsidence of the central section of the arch. Following the shift generated, some voussoirs have slid downward and one has completely came out, resulting in a gap later closed with bricks. The first arch turns out to have 59 voussoirs (see figure 8) and considering the development of the semicircle, of a 19,55 meters diameter (approximately 66 Roman feet), we obtain an average value of the internal gauge of approximately 52 cm. In respect of the radial direction, the length of the voussoirs is approximately 133 cm and the outer gauge is about 59 cm. The voussoirs radial length (the travertine arch gauge) is constant only on the downstream and upstream facades of the arch, while in the arch depth (going

from upstream to downstream, with a value of approximately 7.41 meters, equal to 25 Roman feet) some variations of length seem usual, as is possible to see in correspondence of the second collapsed pier, imposed by the necessity of amortization with a concrete casting. Moreover, from the analysis of the second pier is noticeable how the radial delimitation cornice of the voussoirs doesn't continue inside the arch.
For the first pier it has been shown how the length slightly vary by height according to the craftsmanship of the blocks and especially to the measurement position, taken in the bossage cleft rather than at the interface of two block rows or at its outer edge, thus obtaining the average values showed in table 1, with a depth (the upstream-downstream length) greater underneath the grade plane cornice of the second arch and equal to approximately 7.71 meters. In regard to the second arch it has been possible to measure in situ the gauge of the first four row of voussoirs on the downstream side, in correspondence of the second collapsed pier, and has been possible to observe again the value of 52 cm in accordance with the one of the first arch. The radial length of the upstream and downstream cladding voussoirs of the second arch resulted equal to 166 cm, measured on the point cloud. With these measurements, assuming that also the second arch was a round one and therefore with the springer initially at the same height, we obtain, as a more probable value for the diameter, the one supplied by the marquis Eroli, with a corresponding overall number of 97 voussoirs.
To verify the measurement of the diameter it has been arranged the orthorectification of old photographs, such as the one in figure 4, using the measurements obtained directly from the point clouds. For this purpose it has been seen how, within the point cloud, generated a plane tangent to the downstream façade of the first arch, this resulted, with great approximation, also tangent to the same façade of the third pier, thus allowing the identification of the plane on which to perform the perspectival straightening and the scaling of the old picture. A similar plane for the downstream façade of the first arch showed how the third pier wasn't aligned downstream, resulting having in the upstream-downstream direction an average length of 8.10 meters.
Once positioned the second pier, as already stated collapsed in 1885 and still laying on site for the most part, it is possible to identify the spans of the third and fourth arch, given the position of the existing portion of the third pier. In regard to the issue of the three or four arches it appears to be possible to exclude the hypothesis of the three arches, inasmuch the third arch, with a span of more than 43 meters, would have had a voussoirs radial length lower than the second arch, as it is shown in the orthophotographs.
The third pier shows, as reported also by other researchers, an undeniable different craftsmanship both for the global dimensions, with the missed alignment of the downstream plane with the same plane of the first arch, and for the dimensions of the voussoirs, and even for the disposition of the voussoirs, which do not present anymore the accuracy and modularity of the first and second piers.

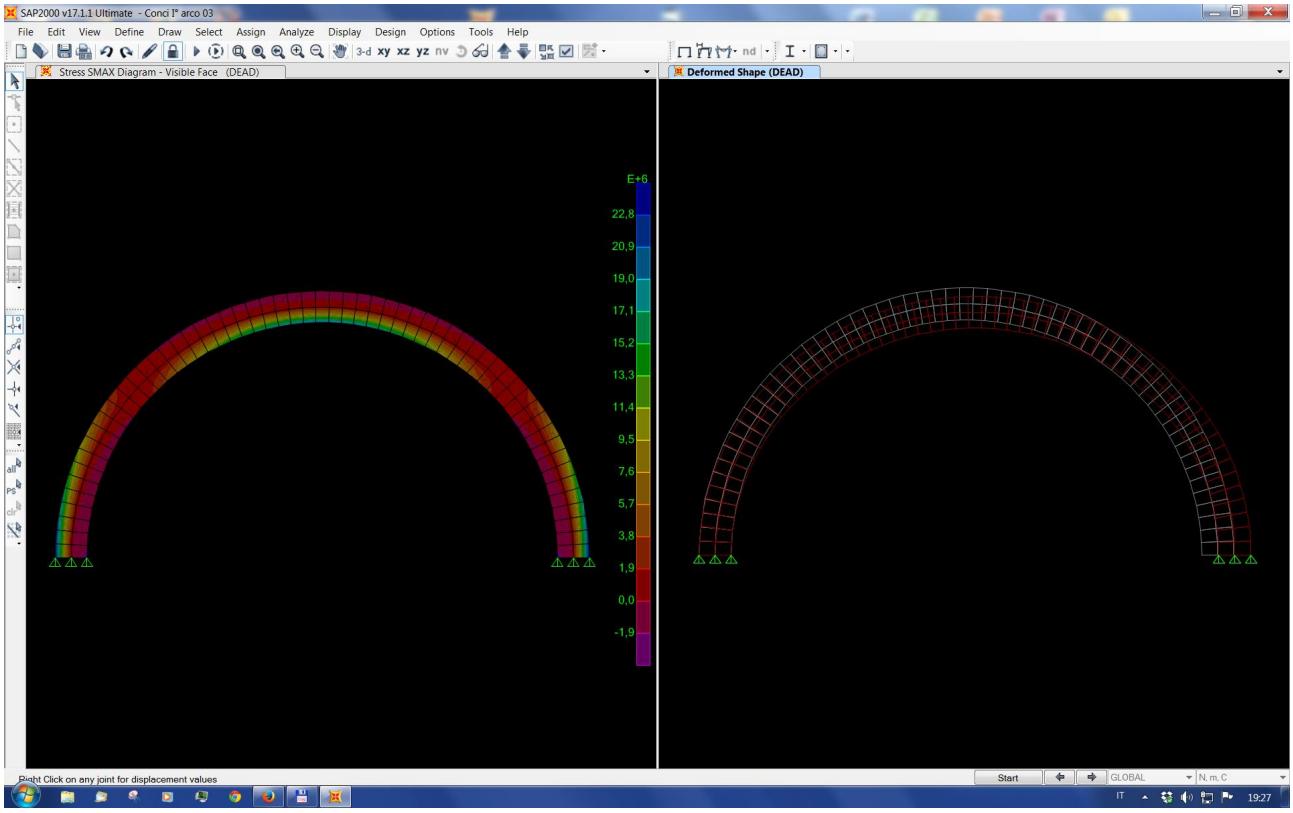

Fig. 9: Finite elements model of the first arch with strain due to the horizontal shift.

On the third pier it is not visible the springer of the third and fourth arch, not even in the older pictures and illustrations.
Of the fourth arch it still exists a small portion on the right abutment, see figure 7, which shows its completely different craftsmanship in comparison to the other three. On the right abutment has been recently realized the tunnel for the transit of the Roma Ancona railway.
Further applications, see figure 9, concerned the creation of finite elements models on which have been measured the strain produced after the subsidence suffered by the structure.

5. Future developments

In addition to what has been already highlighted, the finite elements modeling will be expanded and, since during the realization of the laser recording it wasn't possible to scan neither the upper section of the bridge nor the are of the Madonna del Ponte Sanctuary, it came up the need to complete the work with a new campaign of laser survey, currently in progress, with the collaboration of the Department of History, Art and Architectural Restoration of University Roma La Sapienza..

6. Acknowledgements

We wish to thank Superintendence for Archaeological Heritage of Umbria. A special thanks goes to 3D Target Srl of Brescia and especially to Dr. Paolo Girardi for making available the equipment and tangibly contributing to the laser recordings and the subsequent initial data process. We thank the Vallicelliana Library, represented by Dr. Gabriella Romani of the Photographic Archive, for making available the high definition copy of the Anderson's company photograph in their possession.

Bibliographical References

[1] CITTÀ DI NARNI. *Narni, un ponte nella storia degli antichi viaggiatori - Raccolta di incisioni - (1676/1927)*. Narni, 2000.

[2] ANGELETTI, Vincenzo. Le vicende costruttive. SALVATORE, Mariarosaria (a cura di). Il ponte di Augusto a Narni. Quadro archeologico, vicende costruttive, restauro. Soprintendenza per i Beni Archeologici dell'Umbria, 2005, p. 23-32.

[3] Hermanni Contratti Chronicon. De sex aetatibus mundi, in "M.G.H.S.", Hannoverae, 1844, sec. XI, vol. I, p. 131.

[4] MARTINORI, Edoardo. *Cronistoria Narnese*. Comune di Narni, Terni, 1987.

[5] Ditta Anderson, Roma, Biblioteca Vallicelliana, n.i. 108024(119).

[6] EROLI, Giovanni. Notizie del celebre ponte rotto di Augusto presso Narni. Roma, 1900.

[7] CUSTODI, Alberto. SCIORTINO, Lino. *Il Rilievo Laser Scanning nell'insula del Centenario [IX, 8] a Pompei*, in GUELI A., proceedings of V° Congresso Nazionale di Archeometria "Scienza e Beni Culturali", Siracusa, 26-29 febbraio 2008. Siracusa, Morrone Editore, 2008, pp. 379-387.

[8] Website of the Z+F company: www.zf-laser.com.

[9] Technical data IMAGER 5006i: http://www.geodis.cz/doc_product/datasheet/datenblatt_imager_5006i.pdf

[10] Technical data M-Cam (motorized camera): http://www.zf-uk.com/downloads/Z+F%20M-Cam.pdf

[11] Website: http://www.leica-geosystems.it/it/Leica-Cyclone_6515.htm

[12] Website: http://www.autodesk.com/products/recap/features/recap-pro/all/gallery-view

[13] Website: http://www.autodesk.it/products/autocad/overview

[14] CECCHI, Alberto (coord.). *Il Ponte di Augusto a Narni: metodi informatici per il rilievo delle rovine, la ricostruzione virtuale, la modellazione solida con il metodo degli elementi finiti*. Quaderni di Leonardo, n. 2, 2003.

HERITAGE and TECHNOLOGY
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Morpho-architectural analysis, constructive modalities and structural diagnostics for the restoration of the Church of SS Bartholomew and Stephen in Bergamo

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Abstract
Today, the final purpose of historical buildings' conservation seems having lost importance in the common consciousness, to lead at times to the point of not remember the reason for undertaking such activities. As a result, the instruments offered by technological progress are often undervalued in terms of the beneficial contribution that they can provide to the comprehension, preservation and enhancement of architecture. In the case study of the Church of SS Bartholomew and Stephen in Bergamo, 3D laser scanning combined with traditional techniques of investigation and diagnosis has allowed achieving a new monument's awareness, under the morphological and constructive point of views. In particular, it has helped the understanding of the precarious conditions of stability of the roofing. In addition to a widespread state of degradation and failure of some timber elements, the roof presents problems related to the linking between the individual components of the first and second array, the connections and support on the pillars and to the backing to the perimeter masonry cornices. Multi-levels analysis facilitated the comprehension of the overall behavior of coverage structure as well as of other technical parts, in order to prefigure timely restoration of the wooden elements. Finally yet importantly, they highlighted exceptional architectural and decorative characteristics, which are already, themselves, cultural values that deserve protection and transmission to future generation.

Keywords: Restoration, Structural diagnostics, Technological innovation, Knowledge, Bergamo

1. Notes on the building of the Church
The edification of the church of SS Bartholomew and Stephen is consequent to the establishment, in the 16th century, of the Venetian walls: an imposing defensive structure created by the Republic of Venice to protect its domains in the western mainland. The former Dominican monastery of St. Stephen, located in the upper town, was in fact demolished following the construction of the armed outpost named "*Il Fortino*" and of the bulwark put in defense of the port of St. James [1]. As a result, in 1571 Pope Pius V granted to the Dominican fathers to settle at the monastery of the suppressed religious community of the Benedictine Order of the *Umiliati de Rasulo* whose church, located in the county fair of St. Alexander, between the villages of San Antonio and San Leonardo, was already dedicated to St. Bartholomew. An important witness to the presence of the ancient Benedictine monastery is the perspective view by the painter Alvise Cima dated to 1693 (Fig. 1). It portrays the city of Bergamo both in its oldest nucleus situated on top of the hill and in its whole extent, including the villages grew along the roads towards Milan and Brescia [2]. The church of the *Umiliati de Rasulo* is depicted with three naves. Along the façade, are evident a rose and two large windows and, at the upper side of the nave, other openings that allowed the home lighting. The ancient temple was much more restrained in its longitudinal extent; it ended at the level of the still existing bell tower.



Fig. 1: Perspective view of the city of Bergamo before the construction of the "Venetian walls" by the painter Alvise Cima (1693) and detail of the ancient convent of the *Umiliati de Rasulo*.

The new church of the Dominican fathers had to rise majestic and impressive because the seat of the court of the Holy Inquisition and of a vast library [3]. It was planned by Antonio Maria Caneva with a single wide nave covered by a barrel vault, side chapels and a deep presbytery (Fig. 2).
On 11 June 1603, its foundation stone was laid and on 5 June 1633, it was offered to the "brothers of the Rosary" the possibility of establishing a small central-plan chapel with a dome, placed against the primary structure, and consecrated to Our Lady of the Rosary.
For the first time, restoration work was done following the collapse of the "*volto del coro*" in the month of July 1640. The refurbishment of the roofing was accomplished many years later as evidenced by a document dated 21 August 1655 stating that "*fu fatta scrittura per fare stuccare il coro*" [4].
The construction of the building structure, probably completed in the second half of 17th century, was however, still missing of the decorations. Only in the middle of the 18th century, thanks to a climate of renewed artistic interest and cultural openness of the city and to the generosity of nobles, merchants and intellectuals, the church was adorned [5]. On 25 June 1747, the Council of the Dominicans deliberated, in fact, to paint the whole church and on 2 March 1749, the realization of the frescoes on the vaults and side chapels started. The temple of SS Stephen and Bartholomew was definitely achieved only in 1897 with the erection of the main façade, the scenic backdrop of the leading road called *Sentierone*, designed by the architect Giovanni Cuminetti (Fig. 3).
A precise dating of the various construction phases is now possible thanks to the extensive archive catalogued in 1728 by Father Clemente Zillioli, a Dominican master of sacred theology. The convent, full of important bequests and with numerous properties, possessed a valuable documentary heritage - partly dispersed following the suppression of religious orders during the Cisalpine Republic - preserved, since 1971, at the State Archive of Bergamo. The records regarding the demolition of the convent of St. Stephen (1561-1570) and the new foundation of the monastery of St. Bartholomew (1571-1791) are of great interest.
They also include a remarkable graphic documentation, such as a plan of the Dominican temple, unfortunately undated, in which a folding part that overlaps the drawing below, reproduces the building with and without the



Fig. 2: Letter that orders that the design of the church and the convent should be completed (cc. 2, 2 seals, 1598); document filed within the State Archive of Bergamo.



Fig. 3: The Church of SS Stephen and Bartholomew in the late '800 and after the construction of the main façade planned by arch. Giovanni Cuminetti (the roof “alla Lombarda” and the amendment of the buttresses are visible).

presence of the apse [6]. The drawing, although catalogued for many years, is little known because it undergone a painstaking restoration that for a long time did not allow consultation by scholars and researchers. The first hypothesis is that it represents a variant form of a first draft, drawn perhaps after the start of construction work, which proposes the extension of the church with the addition of a new octagonal apse. This also in order to find a suitable placement to marquetry wood that decorated the choir stalls - a work of the Dominican father Damiano Zambelli - and to the winged altarpiece, called "*Pala Martinengo*", painted between 1513 and 1516 by Lorenzo Lotto, already stored in the old church in the upper town. The drawing presents a very detailed representation and is accurate in the geometric configuration as shown by the measurement scale stated on it, as well as by the clear indication of the construction of the octagon inscribed in the circle. Some alphanumeric symbols would even let one to suppose the past existence of a legend, today no more visible (Fig. 4). The drawing also shows the fence of the churchyard and a side door with a few steps, where there is now the Chapel of the Rosary, enhanced by the presence of a portal supported by two small columns. This would allow dating the representation to a time prior to 1633.
A stratigraphic study, still underway, has already permitted to identify the existence of some joints (both in the hall and between the buttresses and the oldest masonry of the building against on which they evidently rested. It has also gave the opportunity to contextualize the different masonry bonds, which could suggest that the new church of SS Stephen and Bartholomew would be built by integrating part of an earlier building, probably the same church of the *Umiliati de Rasulo*.
The monastery does not appear in the engravings that, between the later 700s and early 900s, will be the instrument to diffuse the "*Imago Urbis Bergomensis*". However, in the first half of 800s is shown, in a very detailed manner, in the "*Panorama*", an engraving done by the local architect Giuseppe Berlendis [7]. In 1816, the temple is also reproduced in its plan, with the surrounding urban context, in the "*Planimetria della città e dei borghi esterni*" of the engineer and architect Giuseppe Manzini but the representation is not very loyal, as evidenced by the Chapel of the Rosary, depicted as if belonged to a single building, and incorrect in metric sizes (Fig. 5).
Here are the motivation and the need to proceed with a reorganization of existing information and the formulation of a register of restoration work undertaken on the edifice, based on precise archival documentation, seen as an invaluable instrument for the monument’s comprehension and precious guide to the diagnostic and detailed analytical activities.
New studies have then carried out by the authors of this paper by combining traditional direct observations with modern 3D laser scanning with thermographic technologies. The speed and accuracy of the instruments have been associated with the direct reading of the operators, at the same time "designers" and "restorers". Their reflections have enabled to decode the data mechanically acquired by the sensors, so allowing to fill the gap represented by the absence of an adequate geometric and technical knowledge of the building and consequently to start a process of interpretation for a greater understanding, in terms of geometric ratios, construction methods, materials and their degradation phenomena identification.

2. The facade overlooking the *Sentierone*

Therefore, the analysis carried out at multiple levels primarily concerned the decorations of the main façade facing the "*Sentierone*". A system characterized by architectural and decorative features of capital value, but seismically very vulnerable. The accurate 3D survey has allowed, in this case, knowing the volume of each building element and their exact location in space; these indications have permitted to obtain a first quantitative

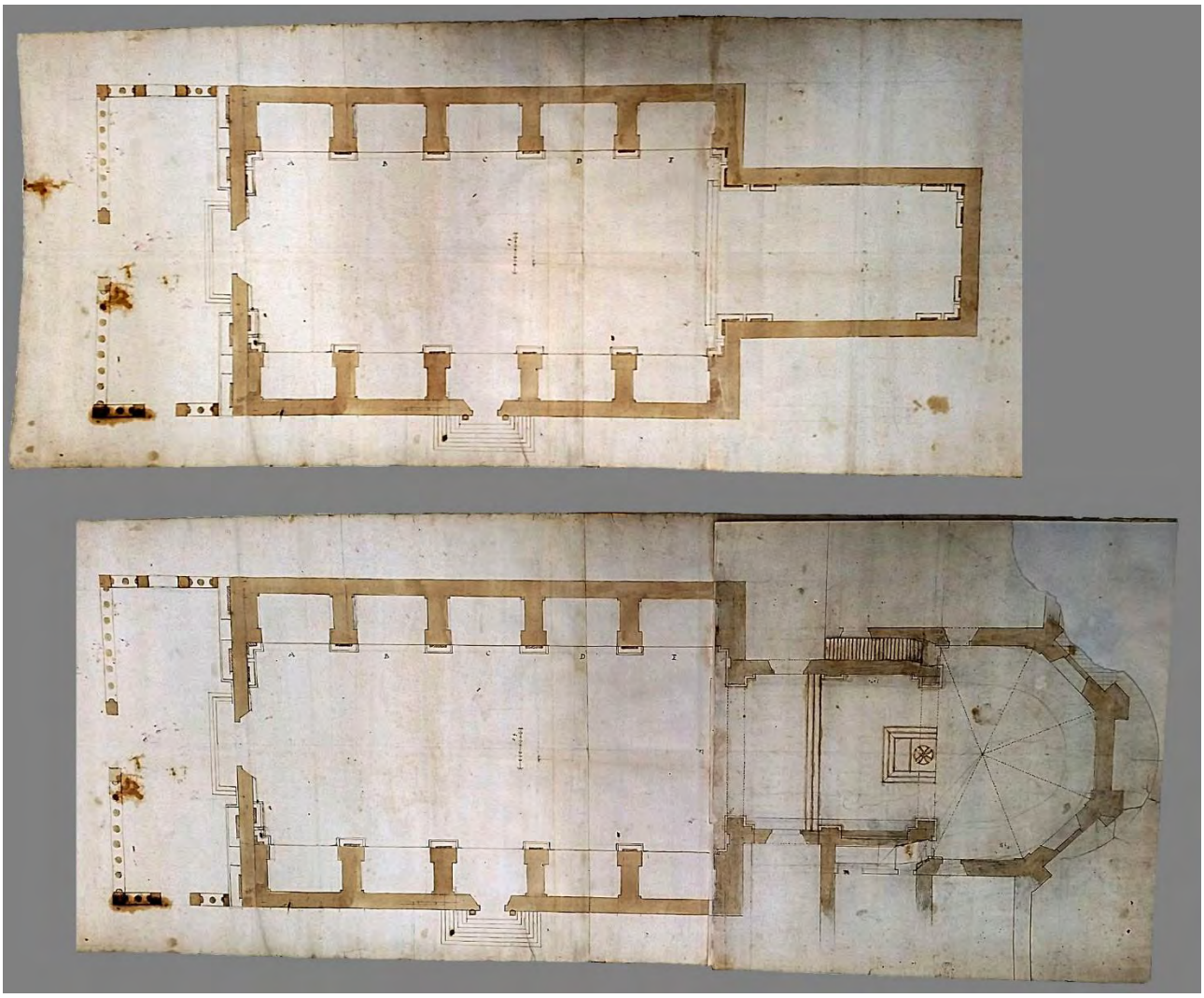

Fig. 4: Drawing of the Church of SS Stephen and Bartholomew (a plan of mm. 1040 x 420 with element in relief and the superimposed plan of the new apse - s.d., about 1630?); document filed within the State Archive of Bergamo.

estimate of the masses and to formulate hypotheses about possible failures and any collapse mechanisms, which may arise.

The analysis shows how the historical and iconographic previous statement was provided on two levels: the first was characterized by two pairs of giant pilasters that supported an entablature crowning while the second, never finished, was in masonry with a large central window. A small portal, slightly protruding, with two side columns holding a decorated pediment, enhanced the entrance; above and at the two sides, were located three empty niches.

The current prospectus incorporates many of the elements that characterized the old century design (like the lateral aediculae and the large central window), but it is much more slender thanks to a little rigorous use of the architectural orders, a clear sign of the late period of construction. The first level meets, albeit with some variations in the proportions, the encoding of the Ionic order of "Vignola" [8], whereas the second, vaguely attributable to Tuscan order, reveals a very free use of architectural elements, both in the relations between base and column and in the capitals that even present anthropomorphic decorations. A staircase and a majestic portal, very advanced compared to the façade plane, embellished with massive fluted columns that hold massive gable, announce the entrance to the temple. The architect Giovanni Cuminetti anyhow managed to give the facade a unity of style by maintaining a geometric continuity between the pilasters of the first and second order, by creating a high frame with friezes (which stood higher and hid the roof covering) and by elevating the prospectus through two thin pinnacles placed to the sides of many, small volutes (Fig. 6).

An important series of sculptures was designed together with the elements of the architecture to embellish the church also in function of the important role of backdrop that it had to fulfill in the urban context of the emerging "smoke-filled room of the Lower City" [9].

At the end of the pilasters on the first crowning were placed four statues of female figures, symbols of the four cardinal virtues made by the sculptor Andrea Paleni (Bergamo 1878-1905). Above them, in two high tabernacles, were located two bas-reliefs of the sculptor Luigi Pagani (Bergamo, 1829-1904) depicting the

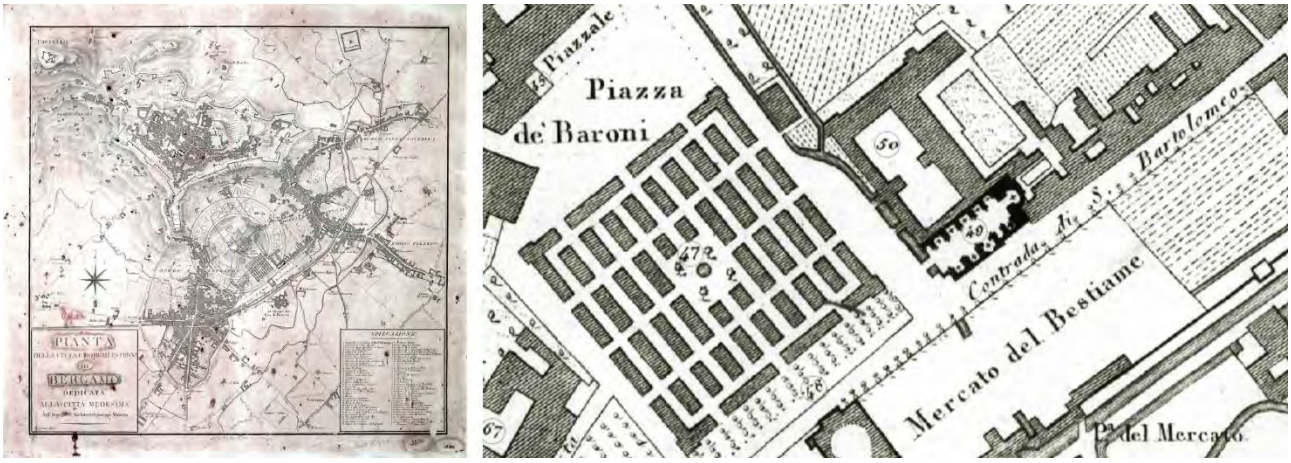

Fig. 5: The Church of SS Stephen and Bartholomew in "Planimetria della città e dei borghi esterni" of Bergamo (Arch. Giuseppe Manzini, 1816).

martyrdom of St. Bartholomew and St. Stephen. In the early 20th century, within the two niches at the side of the portal, were placed two marble statues of St. Francis and St. Dominic, the work of Giovanni Avogadri (Bergamo, 1885- 1971). These sculptures, if added important monumental value to the church, counter represent a high risk factor as high consistency masses, simply supported and not properly clamped, to the wall hangings.

3. Analysis and criticalities of the roofing/vault system

The new interpretation of the church building phases, based on the combined reading of both the historical sources and surveying data, has allowed evaluating the most important critical issues, in particular with regard to the vaulted systems and the roofing. The outstanding artistic value of the 18th century frescoes actually required a thorough survey of the attic, and to monitor the "health" of the wooden components of the trusses and of the *in folio* brick vaults [10, 11], in order to evaluate potential damages during catastrophic events. The diagnostic analysis was led up by means of an accurate geometric survey to understand the static behavior of both the wooden retaining structures (trusses, rafters, purlins and planks) and the masonry support systems (vaults extrados, ribs and clear spans). It continued by thermographic analysis and *in situ* strength tests on the materials (Fig. 7).

Photographic images of the end of 800s highlight, prior to the implementation of the current façade, a roof "*alla lombarda*", characterised by bearing elements resting on the walls and transversal buttresses gable-shaped, but lacking of closing partitions between the beams and the perimeter walls.

This meant that for a long time, wooden support structures and the external surface of the vaults were exposed to weather and climatic variations, in addition to not being protected from attack by rodents and birds.

The construction of the new front has helped to more safeguard these spaces (today still open on the presbytery side, even if protected from the animals by wire mesh) but the changes to adapt previous bundles to the new intervention, resulted in a messy complex of structures which often load on vaulted systems.

The original pitch of the roof and the hip roof height was probably modified, as it results from the comparison between the historical images and the present state, which shows that the first lateral buttresses have been raised. Furthermore, the need to ensure over the entire church a geometric continuity of the slopes in the presence of a variability of both the distance between the transverse support walls and the higher quota of the barrel vaults, has imposed different constructive solutions, not always carried out in the optimal way. The current situation is due to three different typologies, a first adopted in the area over the hall, another at the presbytery and, finally, a last for the covering of the apse (Fig. 8).

a) **Hall area**: the roof is shaped by a system of inclined beams arranged according to the slope of the pitch and supported by five props, which discharge on one brick arch that rests directly on the vault. A quick stratigraphic analysis has allowed to observe how this arc of discharge was built later; still subsequent are the props. The rise of the buttresses, well reported by the change of masonry, also has the function of crimping and containing the horizontal thrusts. The vault has a very small thickness and is made of solid bricks set "on edge" and covered with mortar; it is deformed but no cracks are visible on it;
b) **Area of the presbytery**: here, the roof is supported by simple trusses resting on perimeter wall (raised on a previous installation plan) and not chucked. On the struts are badly arranged inclined beams that hold the same slope of the ceiling. This suggests that the existing truss system was designed for a previous coverage, and then reused. The vault equipment in this area is sometimes visible because of the lack of small pieces of plaster and there are two holes (perhaps meant for candle holders, one of

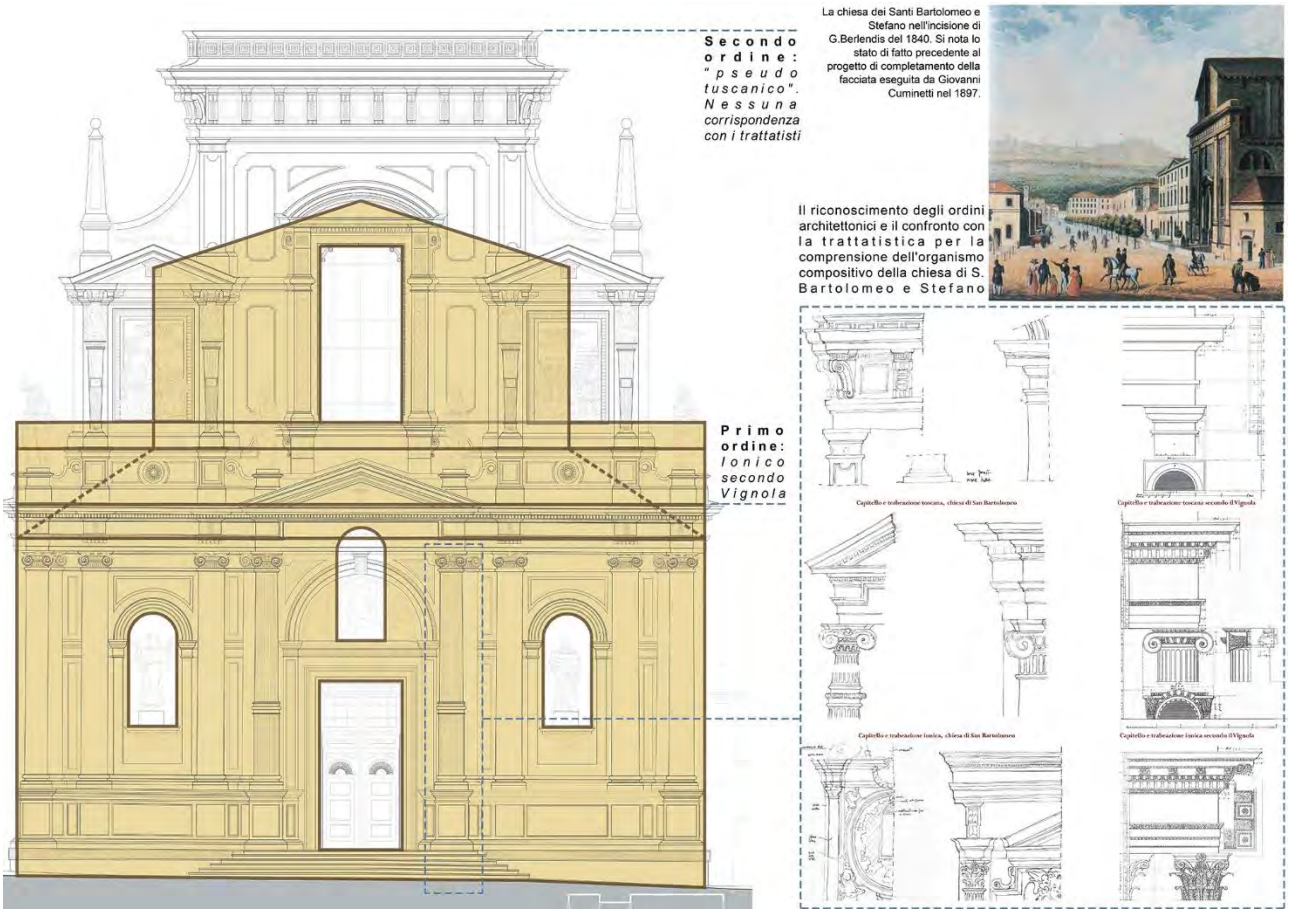

Fig. 6: The comparison between the current façade and the elements that characterized the old century design. Analysis of the architectural orders and paragon with the rules of the classic Treaties.

which occluded) whose existence, initially detected by thermographic surveys, was subsequently confirmed by a more thorough direct reconnaissance. This vault too presents an accentuated deformation; small superficial lesions are also visible on the mortar at a point where a chain, which is much lowered, pushes on it.

c) **Zone apse**: the roof above the octagonal apse is supported by a system of struts, which discharge the cover weight on both a series of brick pillars and some wooden beams, resting directly on the reinforcement of the vault. Wooden spacers, not stuck, are disorderly arranged between the struts and the framework to adapt the slope. This area, perhaps because of a greater geometric complexity, presents very precarious constructive solutions.

The survey, conducted on the basis the most rigorous approach and with high instrumental precision, allowed to go back to the real geometry of the vaults, so highlighting areas with the greatest deformation and subjected to the higher risk. The plan of the vault viewed from the underside (*pianta iposcopica*) showing the cycle of frescoes has been overlapped with equidistant contour lines, following a praxis frequently used by the drawing discipline when in the presence of curved elements not regularizable [12]. This has allowed identifying the portions of the paintings where the risk of small lesions due to an earthquake is greater (fig. 9). In addition, the act of geo-referencing in a single system, the point cloud of the attic with that acquired internally to the church, has allowed to obtain a series of longitudinal sections, and a sequence of transverse profiles (with a very dense pitch of 25 cm) that relate the deformed of the vault with the roof frame. As previously noted, the vaults have been the subject of a thermographic survey aimed at verifying a possible crack pattern; no visible lesions were detected by thermal infrared sensor nor fracturing of the plaster surface observable from below with digital cameras equipped with a telephoto lens. This, if at the time allowed to exclude a damage in place of the cover/vault system does not guarantee peace for the future. Some critical, constructive features make, in fact, the structure vulnerable from a seismic point of view, as well as the deterioration of the materials for the effect of time, in particular of the wood, has imposed a monitoring to test their static efficiency.

4. The diagnosis of wooden structures

The diagnosis of the timber structures has been based on the analysis of the following factors: an historical study of the roof, an accurate geometric survey, the recognition of the characteristics of the wood and the

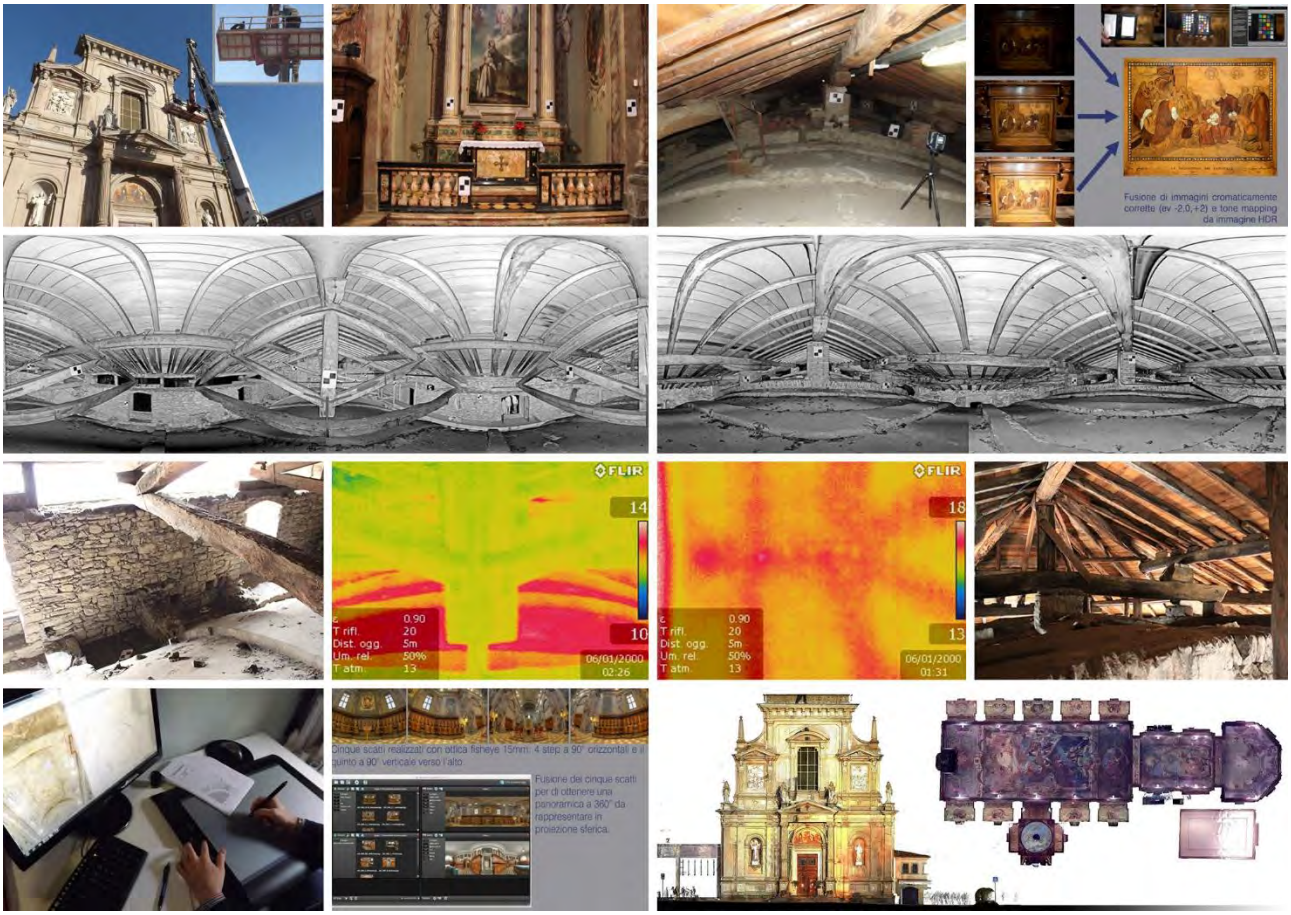

Fig. 7: The vault/roofing system: photographic survey with details of the criticalities, thermographic analysis of the trusses and of the vaults, 3D laser scanning, longitudinal section with thickness and deformation of the vault/roofing system.

evaluation of material and mechanical decay by means of an *in situ* investigation. The knowledge of the "past history" of the elements (only by knowing the past the present can be understood, even from a static point of view) was founded on the observation of the changes that have interested the original frames: subsequent additions, which was recognized through the difference in material, manufacturing, color and/or type of nails and metal connections [13].
The phase of the survey, assumed not as a simple data acquisition, but as a moment of “direct” contact with the artifact, allowed the in-depth understanding of the structure, its logic and constructive relationships between the individual parts. The measurements have been conducted by laser scanning instrumentation: a device small in size, light in weight and fast in acquisitions that has allowed recording for all resistant structures the numerical information of surfaces. The instrument has been placed on each side of the beams and, when possible, even under them to more rigorously evaluate structural abnormalities, excessive deformation and troughs.
For each frame has been rendered the orthographic projection of the fronts. They were then reproduced in thematic tables in which the structure was designed both in the general lines - with an indication of degradation, injuries and deformations in relation to a condition of ideal linear beams - through plans and cross-section at 1: 100 and 1:50 scales, as well as in its construction details by the means of exploded axonometric views at 1:20, 1:10 and 1: 5 scales [14].
The diagnosis of the built wooden elements was instead undertaken by visual inspections and simple and non-destructive methodologies. The tests were intended to investigate the essence, any eventual moisture, the class of biological risk and, finally, to empirically estimate the strength of any element [15]. The identification of the wood species was made possible thanks to the direct recognition and, in some doubtful cases, with the withdrawal of small fragments of damaged parts, when already detached. The presence of moisture in the inner timber has been verified by thermographic analysis.
Actually, the infrared thermal inspection, if properly conducted, can detect not only "wet" areas but also those characterised by inhomogeneous temperatures (due to the presence of water/air in the fibres) which are, in general, an index of possible fractures or show the presence of damaged parts [16]. The conditions of the environment in which the frames are placed, are an important data to assess the natural durability of wood, or

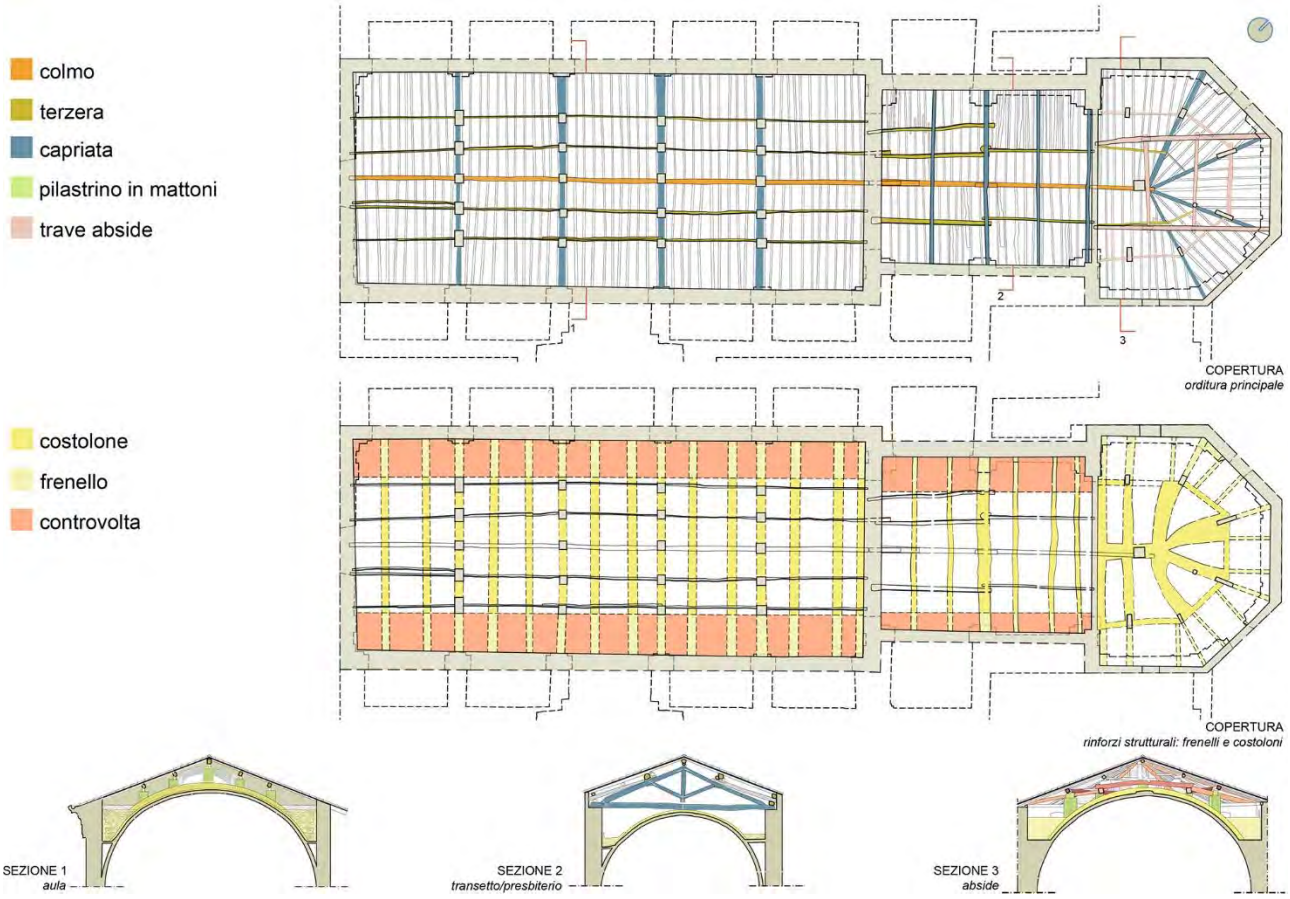

Fig. 8: Plan of the roofing: the resistant system, the reinforcement structures for the thrusts containment and to stiffen the vaults, the sections of the three different types of roof construction.

its ability to resist to the degradation produced by climate change and by the attacks of biological agents such as fungi and insects. The category of "biohazard" was evaluated in relation to the provisions of the UNI EN335 that, based on environmental considerations and simple tests, assumes an average time of life before proceeding with conservative treatments.
Lastly, it has been considered the mechanical degradation through the detection of lesions and their causes, due to intrinsic (effect of the withdrawal) or to external stress factors. Analyses of the resistant sections and deformations of the individual bars were conducted, as well as the verification of the unions and the joints subsidence. The estimation of mechanical strength has therefore been based on tables and empirical methods such as, for example, the so-called "Giordano Method" [17].
The wood in fact has a low modulus of elasticity and a marked plastic behavior that produces strong deformities (also hardly affected by thermo-hygrometric changes of the environment) unfortunately permanent. The knowledge of the actual geometry is therefore an important requirement for the verification of resistant sections that, strictly speaking, should be carried out with non-linear analysis.
Operating procedures established for the verification of structural wood elements, also adopted in this study, foresee an estimate of the operating loads and a theoretical check of the deformations according to the static schema of the resistant element and to the strength estimate of the material previously said. As the measured strains were lower than those calculated, so excluding a strength of the fibres, more complex tests aimed at determining the true mechanical resistance of the beam via a non-linear calculation were not considered necessary [18].

5. Conclusions

The tools provided by scientific progress, combined with other conventional investigation and diagnosis techniques, have allowed to reach a high level of knowledge of the church, both in morphology and constructive aspects, and facilitated the understanding of structural problems, in order to prevent any damage in the future. Despite the presence of local deformations on the vaults and of various types of material deterioration on the façade and in the attic, the analyses have shown that the building is in good state. The church does not require

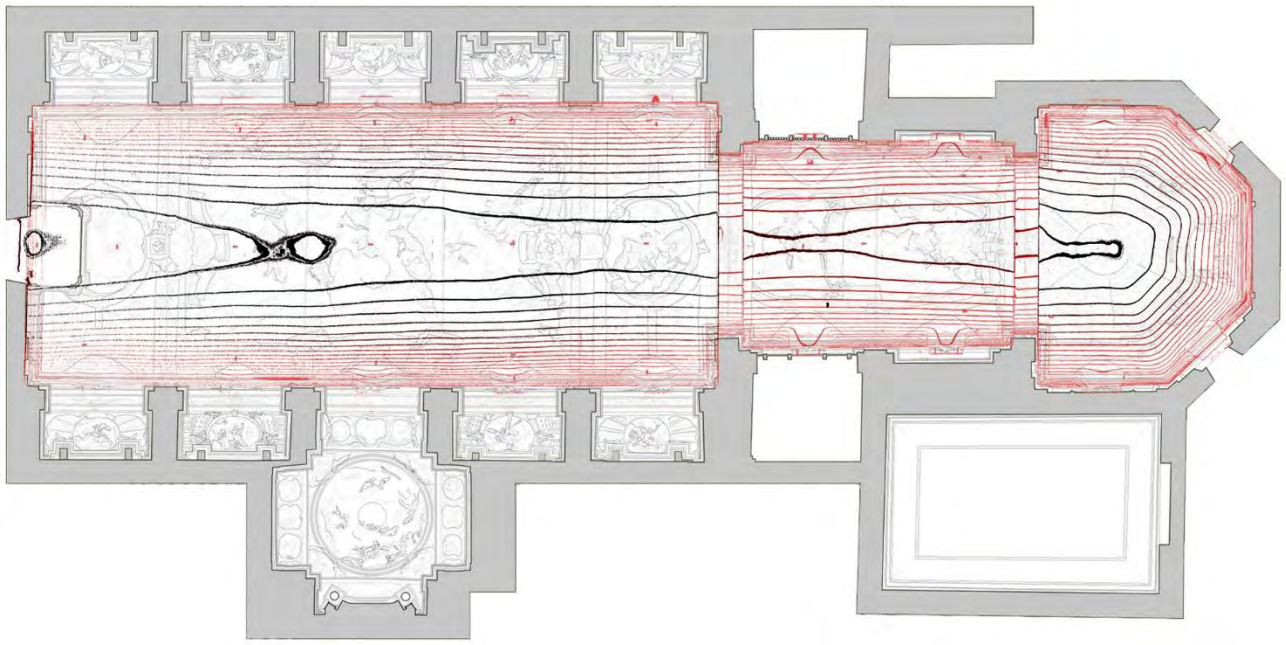

Fig. 8: The ceiling plan with indication of the vault deformation.

urgent and immediate interventions, but it is important to plan conservation actions to avoid any structural collapses that may arise in the long term, because of the wooden deterioration and/or the action of weathering on joints and external stone parts.
However, a more careful consideration concerns the risk related to a possible seismic event since many parts are not structurally connected to each other and have been designed only to respond to static and not dynamic concerns. In this case, it is mandatory wondering whether to replace the unsuitable structures (such as roof trusses, or some of the decorative elements at risk) or to decide for their full maintenance, so guaranteeing safety even against higher costs, because, they are, in any case, the syncretic witness of a human activity.
The choice is ordered by the sensitivity of the architect who needs to constantly operate on the basis of a multidisciplinary approach, not conditioned by a narrow vision aimed exclusively at the law compliance. It is important to look for a resolution, which could meet both operational and static requirements in a proportionate and balanced ratio of relationships between parts [19], as well as sustainable also from economic point of view.
This is a constant and irresolvable dilemma for restorers, often torn between the chance to uphold the "document" and the need to secure its preservation. A problem which is not easy to solve as the solution must ensure the overall maintenance of the monument, safeguarding and highlighting the architectural and decorative features that are already themselves, cultural values that deserve to be protected and transmitted to future generations.

Credits
This work has been coordinated and implemented by Antonella Versaci for historiographical and restorative issues and by Alessio Cardaci for 3D geometric survey and interpretative aspects. The editorial responsibility for the paragraphs is attributed to: 3 and conclusions - Alessio Cardaci, 1 and 4 – Antonella Versaci, 2 – Davide Indelicato.

Bibliographical References

[1] BERBERO, Walter. *Bergamo.* 1ª ed. Milano: Electa, 2012. 226 p. ISBN 8843512366.

[2] ROSSI, Tosca. *A volo d'uccello: Bergamo nelle vedute di Alvise Cima. Analisi della rappresentazione della citta tra XVI e XVIII. Secolo.* 1ª ed. Bergamo: Litostampa istituto grafico, 2012. 244 p. ISBN 8890095776.

[3] DE PAOLI GIBELLI, Silvana. *La chiesa dei santi Bartolomeo e Stefano in Bergamo: itinerario storico-artistico.* 1ª ed. Bergamo: Ikonos s.r.l., 2000. 47 p.

[4] TELLINI PERINA, Chiara. "Notizie relative alla chiesa di San Bartolomeo di Bergamo tratte da una cronaca settecentesca". In *Arte lombarda: rivista di storia dell'arte.* 1979, N. 51. Cesano Maderno: Alfieri. 79-83 pp.

[5] BIANCHI, Federica. San Bartolomeo a Bergamo [scheda]. In COPPA, Simonetta. *L'arte lombarda: dai Visconti ai Borromeo. Lombardia Barocca.* 1ª ed. Milano: Jaca Book, 2010, vol. 3, 181-191 pp. ISBN 978-88-16-60423-0.

[6] ALESSANDRETTI, Gianfranco. L'archivio del convento di S. Bartolomeo in Bergamo. In *Archivio Storico Bergamasco: Rassegna semestrale di storia e cultura*. Anno III, Novembre 1983, N. 5. Bergamo: Ed. Lubrina. 347-368 pp.

[7] MESSINA, Valeria. Per una costituzione di un regesto visivo del patrimonio architettonico locale: indagine sull'imago urbis bergomensis nelle stampe dell'ottocento. In *Museo & Storia: rivista della fondazione Bergamo nella storia*. 2006, n. 5. Web: http://www.bergamoestoria.it/rivista.aspx

[8] DE PAOLI, Massimo, *Il disegno degli ordini architettonici. Letture degli elementi connotativi*. Brescia: Acherdo Edizioni, 2011, 352 p. ISBN 8890415339.

[9] FRATTINI, Pilade; RAVANELLI, Renato. *Il Novecento a Bergamo*. UTET, 2013, 2 voll., 2000. 512 p. ISBN 9788890337468.

[10] BALLETTI, Caterina; GUERRA, Francesco. "Laser scanner e Beni Culturali: il rilievo della copertura lignea della Sala del Maggior Consiglio di Palazzo Ducale a Venezia". In *Rivista dell'Agenzia del Territorio*. 2003, Anno III, N. 3, 45-53 pp. ISSN 1593-2192.

[11] CARDACI, Alessio; MIRABELLA ROBERTI, Giulio; VERSACI, Antonella. "From the continuous to the discrete model: a laser scanning application to conservation projects". In: *The International Archives Of The Photogrammetry, Remote Sensing And Spatial Information Sciences*. 2011, vol. XXXVIII, 5/W16, 1-8 pp. ISSN: 1682-1777.

[12] DOCCI, Mario, MAESTRI, Diego. *Manuale di rilevamento architettonico e urbano*. 2ª ed. Bari: Laterza, 2009. 110-117 pp. ISBN 9788842090687.

[13] NATTERER, Julius; HERZOG, Thomas; VOLZ, Michael. *Atlante del legno*. 1ª ed. Torino: Utet. 1999. 360 p. ISBN 8802053707.

[14] TAMPONE, Gennaro. Rilevazione delle strutture in legno. In TAMPONE, Gennaro, MANNUCCI, Massimo, MACCHIONI, Nicola. *Strutture di legno. Cultura conservazione restauro*. Milano: De Lettera Editore. 2002. p. 168-179.

[15] TAMPONE, Gennaro. *Il restauro delle strutture in legno*. 1ª ed. Milano: Hoepli. 1996. 401 p. ISBN 8820322730.

[16] ROCHE, Guido. *La termografia per l'edilizia e l'industria. Manuale operativo per le verifiche termografiche*. Santarcangelo di Romagna: Maggioli Editore. 2012. 450 p. ISBN 8838768870.

[17] GIORDANO, Guglielmo. *Tecnica delle costruzioni in legno*. 5ª ed. Milano: Hoepli. 1999. 856 p. ISBN 8820325497.

[18] MARZO, Anna. Analisi e recupero di strutture lignee *antiche (Tesi di Dottorato – XIX Ciclo)*. Napoli: Università degli Studi di Napoli Federico II - Facoltà di Ingegneria. 2006. 320 p. Web: http://www.dist.unina.it/doc/tesidott/PhD2006.Marzo.pdf

[19] VERY, Françoise; ASSENNATO, Marco. *Architettura, Teoria, Venustas*. In "Architecture Marché Démocratie: EURAU10". Napoli: Dipartimento di Progettazione Urbana e di Urbanistica. 2010. 1-6 pp. Web: https://hal.archives-ouvertes.fr/hal-00981030

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The twenty-seven buildings of the Littorio rural hamlet in Candiana, Italy. Hypotheses of recomposition

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Abstract
The paper refers to the current state of a rural hamlet built in 1938 in the Municipality of Candiana, under the political context of the time of improving living conditions in the countryside. Located in the low Padua region, the Littorio hamlet comprised of twenty-seven buildings in which lived fifty-one families. The buildings, equal in size but different in the lay-outs of their façades, were built on the sides of a specially-designed road, 630 metres long and 7 wide. The houses, with a rectangular layout, looked out at one another on both sides of the new road, hosting two families each one behind the symmetrical facades.
The building complex can still be visited today, but little remains of its original appearance that may be gleaned from photographic evidence of the time. Many of the houses, having each been developed consistently, are now unrecognizable, and at least one has been demolished and been replaced by a featureless villa.
The main issue addressed here is how the systematic tampering of these houses can be stopped, and how to promote compensatory operations that might take into account their original general order and particular form.

Keywords: Italian Fascism, Rural Community, Memory, History as a tool for the project, Classicism

1. Introduction
Candiana is a village found in the province of Padova, a city which is located in the Veneto region in Northeastern Italy. It is situated in the southern section of the province, in the center of a vast countryside that was once a swamp; it receives its waters from two rivers, the Adige and the Bacchiglione. Over the course of the centuries the population has been occupied in constructing the river banks, excavating canals, revamping and cultivating the lands reclaimed from the swamps. The Benedictine monks who founded St. Michael's monastery in Candiana in 1097 led the initiatives to liberate the land from the water. They were followed, beginning in 1462, by the Regular Canons of San Salvatore (of the Holy Saviour) of Venice and, beginning in 1783, by the noble Venetian Albrizzi family.
The farmers lived in buildings called *casoni*, constructions that were widespread in ancient times in the lagoons of the nearby Adratic Sea and on the sand-dunes emerging from the marshes which were inhabited by fishermen and nomads [1]. These are shelters with a rectangular or square layout usually characterized by a single room. Laid on shallow or inexisting foundations, the walls were constructed in mudbricks or in reeds that were coated with mud on both sides. Roofs with steep slopes consisted in irregular wood beams upon which a network of poles supporting a covering of straw or marshland grass was laid (Figures 1 and 2). The *casoni* typically had dirt floors and the furniture was exceedingly poor. The fireplace was the only element that was constructed with burnt bricks used to protect the habitation from the danger of fire. It also served to identify the family that lived in the "casone." In fact, just as every family was different and distinguished itself from the neighboring ones, in the same way, each fireplace was different from all the others in the area [2].
According to an investigation carried out in 1933, there were 2,644 *casoni* at that time that were distributed in 25 townships or municipalities [3]. Of these, nearly 50 could be found within the limits of the municipality of Candiana. The progressive disappearance of the traditional *casoniere*, that is the person who practiced the profession of constructing or repairing *casoni,* contributed to the deterioration of the state of maintenance of those habitations.





Fig. 1: A photo of a family living in the Padova countryside: four generations standing in front of their house. Scene from the '30s.
Fig. 2: Scene of an interior of a *casone*. Photograph dating to the '30s.

2. Fascism and the *Casoni*

During the Fascist period the government's efforts to improve the living conditions of the population living in the countryside intensified. Mussolini opposed immigration from the countryside to the towns and cities, a policy chosen to avoid overpopulation of the cities which would have made the control of the population and the maintenance of social order more difficult [4]. In 1934 he thus synthesized his policy during the 15th anniversary of the foundation of the "Fascio di Combattimento" (a Fascist Party organization) in the following way: "Within a few decades all Italians living in the country must have large, healthy habitations where the farming generations can live and persist over the centuries" [5].

According to the head of fascism in Padova, Umberto Lovo, the work of renovating the rural habitations in the area around Padova initiated at the beginning of 1936 amid numerous difficulties due, for the most part, to legal complications in the event the user, the owner of the *casone*, and the owner of the land were three different individuals. Nevertheless, on May 2nd, 1937 fifty-two new houses were inaugurated and the same number of old *casoni* were set on fire (Figure 3). After a few months, in November of that same year, the Luigi Ruzza hamlet in Codevigo, which was not far from Candiana, was inaugurated. On December 13th of 1939 local newspapers published the news that 1,003 casoni had been gutted, 809 houses had been built including the ones located in the three rural villages referred to as: the Luigi Ruzza hamlet in Codevigo, the Fratelli Grinzato hamlet in Vigonza and the Littorio hamlet in Candiana; 6,645 persons had been moved and 325,000 work days had been registered [6] (Figure 4).



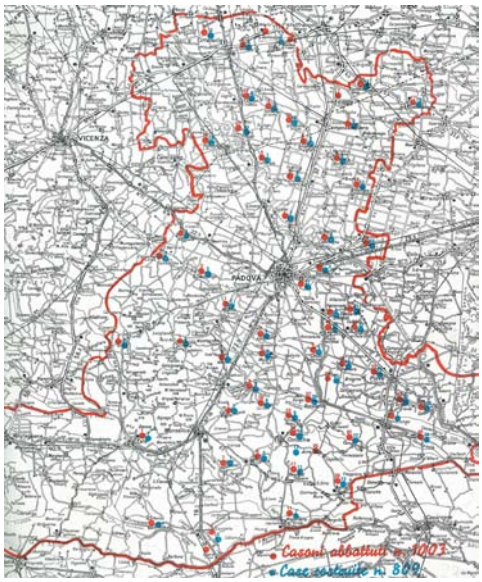

Fig. 3: Scene of a *casone* in flames; the image is from an ad publicizing the government's politics to improve the living conditions of persons living in the countryside. Photo dating to the end of the '30s.
Fig. 4: Map of the province of Padova in which demolished *casoni* are indicated in red and rural houses in blue, 1940.



Fig. 5: The Littorio rural hamlet. The plan of the project as designed by Quirino De Giorgio (1938).
Fig. 6: Candiana, extracted from the Regional Technical Map, a particular of the the Littorio rural hamlet. as it is seen today.
Fig. 7: Candiana, air view. St. Michael's monastery can be made out at the bottom right of the photo.

3. The rural Littorio hamlet project

The rural Littorio hamlet was designed by Quirino De Giorgio (1907-1997) a young collaborator of Umberto Lovo and at that time an undergraduate architecture student [7]. On the whole, 81 *casoni* per gutted in the village of Candiana and 88 houses that could accommodate almost 800 persons were built. Of these, twenty-seven made up the Littorio hamlet, a settlement that extended for more than half of a kilometre along a specially constructed straight road.

The hamlet was made up of 27 buildings for a total of 51 habitations; 24 edifices were built on the two sides of the new road constructed to connect the hamlet to the town of Candiana to the south and with a fork to the north. The 24 two-story constructions were arranged facing one other with each containing two habitations grouped in a symmetrical manner (Figures 5, 6, 7 and 8). With the sole exception of two cases in which the pair of habitations were separated by the course of a ditch but architecturally linked by an arch, these buildings all had the same plan but different facades so that every family could have a house that was different from all the others.

The hamlet, equipped with electricity and artesian wells, was composed of three other buildings: the House of Fascism, where Fascist party members met, the headquarters of the "Opera Nazionale Dopolavoro" (a Fascist leisure and recreational organization for adults) and the Embroidery, Sewing and Weaving Laboratory.



Fig. 8: The Littorio rural hamlet in Candiana. A general view of its southern side, photo dating to 1938.

4. The inauguration

The rural hamlet, the highlight of Fascist Padovan initiatives to rehabilitate rural housing, was completed by September 24, 1938 when Mussolini, who was visiting Padova on that day, “left the city shortly and travelled to the countryside to Candiana for the inauguration of the Littorio hamlet, that magnificent complex of healthy, rational habitations donated by Padovan fascism to those rural populations who despaired in cramped, unhealthy casoni” [8]. If that event is viewed within the wider perspective of Italian and European affairs, it can be said that Mussolini’s visit to Padova and Candiana took place at the very height of the European crisis with Hitler on the Sudeten problem which would lead to the Conference in Munich on September 28 and 29 and to the German annexation of wide areas of Czechoslovakia. Mussolini was continuously updated on the international crisis throughout the day’s activities. On that same day, news arrived that the French had sent fifteen divisions to the border as a warning to the Germans. The speech that Mussoni delivered that day when he returned to Padova and spoke to the crowd at the “Prato della Valle” square focused on the crisis and on the possibility of an imminent conflict between European countries. Among other things, he confirmed his alliance with Germany: “In these days more or less influential parties and tendencies are declaring that this is the opportune moment to face totalitarian states. In that case, those parties and tendencies will not find themselves facing two countries, but two countries forming a single unit. If in Italy there are those who I call men who constantly stand at the window, those who I call morally the middle class, I declare that they will be knocked out of the fight.”

5. The houses of the hamlet

The 24 paired houses were originally characterized by a single facet pitched roof sloping towards the rear of the house making the constructions seem taller when they are seen from the road. The thing that distinguished the blocks from one another were the openings in the façade and occasional particular features such as porches, upstairs loggias, projecting roofs, larger rooms containing the fireplace (Figures 11-28). In some cases, other variations of the façade further distinguished the single buildings. Some of the houses were not, for example, plastered but had exposed brick walls.

Openings in the façade were of various forms and dimensions but always arranged symmetrically with respect to the vertical axis of the layout. A fundamental distinction should to be made between arched and architrave windows and another with regard to how these were grouped. The window openings were generally arranged along two horizontal lines corresponding to the two floors and four vertical alignments identifying the window openings of 4 rooms, two for each of the paired habitations. None of the houses were equipped with external shutters. Light was shut out using wood elements attached to the window frame on the inside.

The habitation was composed of two floors (Figure 9). On the ground floor there was an entrance which is some cases was made up of single room; in others there was a gallery with arched or retangular openings. From there one could reach the kitchen from which it was possible to gain access to the second and last room on that floor. At times the entrance door was not found in the façade looking on the road but to the side. From the kitchen, a staircase led to the second floor in which three rooms were found: two bedrooms and a smaller room, a closet or a terrace. The bathroom was detached from the principal part of the house and postioned within the area of 1000 square meters of land that the familes were given to cultivate for their subsistence. Part of the land was to be used as a vegetable garden and part for the cultivation of fruit trees and a vineyard. No fencing separated the yard from the road.

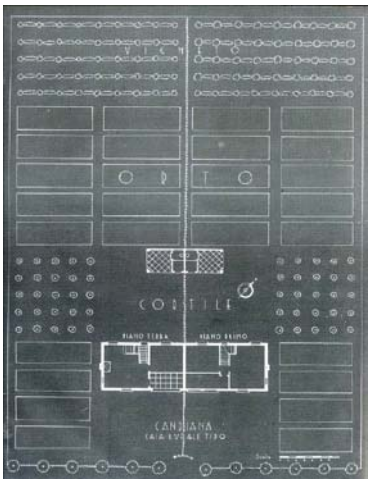



Fig. 9: The Littorio rural hamlet in Candiana. The floor plan of a typical rural house (to the left the ground floor, to the right the second floor) A view of the land. Author Quirino De Giorgio (1938)

Fig. 10: The Littorio rural hamlet in Candiana. A general view of the southern edge, photo dating to the post-war period.



Fig. 11, 12, 13: The Littorio rural hamlet in Candiana. The first house, west side, the second house, west side, the second house, east side. The photos to and including Figure 28 are of 18 out of the original 24 houses, those about which we have the greatest amount of information. The houses, 12 on each side of the road, were all equal-sized, only the facades were different. The sequence begins from the south side and moves to the north. The settlement was designed by Quirino De Giorgio.

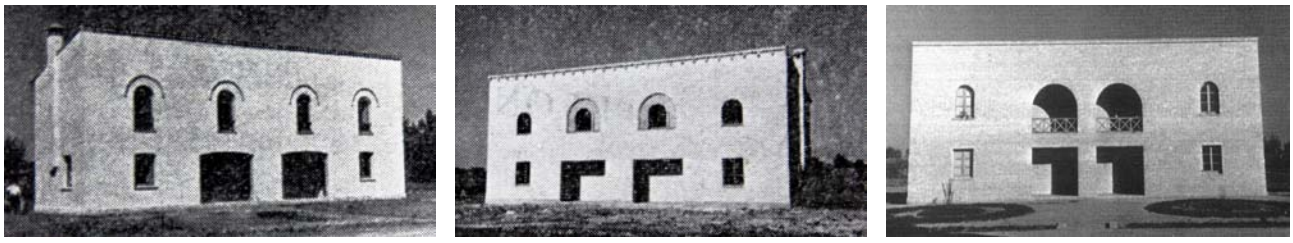

Fig. 14, 15, 16: The Littorio rural hamlet in Candiana. The third house, west side, the third house, east side, the fifth house, east side.

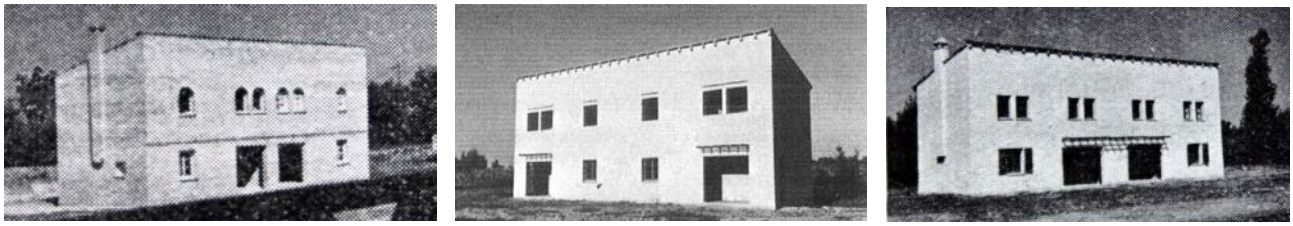

Fig. 17, 18, 19: The Littorio rural hamlet in Candiana. The sixth house, west side, the sixth house, east side, the seventh house, west side.



Fig. 20, 21, 22: The Littorio rural hamlet in Candiana. The seventh house, east side, the eighth house, west side, the eighth house, east side.

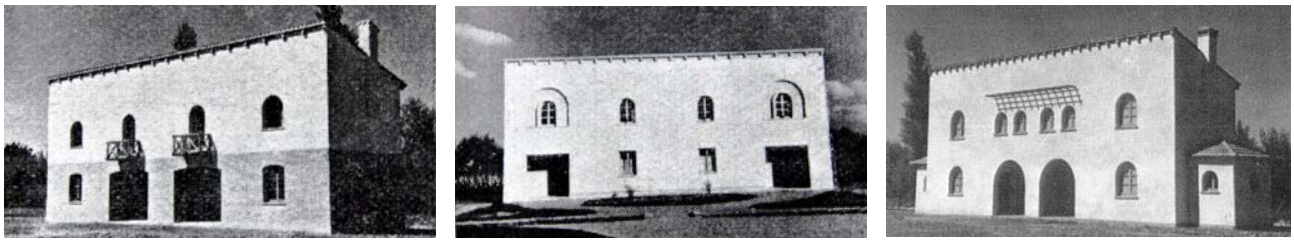

Fig. 23, 24, 25: The Littorio rural hamlet in Candiana. The nineth house, west side, the nineth house, east side, the tenth house, west side.

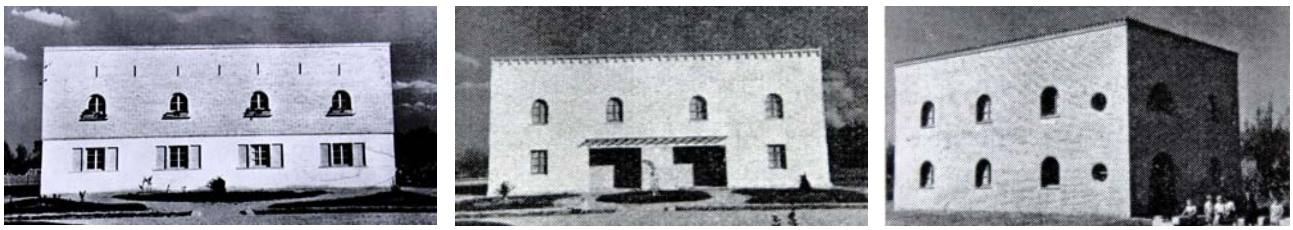

Fig. 26, 27, 28: The Littorio rural hamlet in Candiana. The tenth house, east side, the eleventh house, east house, the twelfth house, west side.



Fig. 29, 30, 31: The Littorio rural hamlet in Candiana. The first house, west side, the second house, west side, the third house, east side. Present state. Up to and including Figure 37 are views of the present condition of nine of the houses shown in Figures 11-28. Despite variations that were introduced to these houses, it is still possible to discern the original building plan by De Giorgio.



Fig. 32, 33, 34: The Littorio rural hamlet in Candiana. The sixth house, east side, the eighth house, west side, the eighth house, east side.



Fig. 35, 36, 37: The Littorio rural hamlet in Candiana. The tenth house, west side, the tenth house, east side, the eleventh house, west side.

As far as internal finishings are concerned, on the basis of data deduced from houses in the rural hamlet of the town of Vigonza, it is reasonable to conclude that the houses on the ground floor had square terracotto floor tiles laid on a bed of cementitious mortar over which one or more layers were superimposed with the passing of time. Wooden planks were laid on irregular wooden beams as flooring on the second floor.
The bricks were carefully laid. The wall sections corresponding to the attic space were laid using a single line of bricks reinforced by pilasters in the points of support of the beams of the covering. The undersides of the roof space were never left exposed but shielded by plastered ceilings. Each habitation's kitchen was equipped with a fireplace.

6. Deterioration and transformations

The group of buildings still exists in Candiana but little remains of its original appearance which can be gleaned from photographs of that epoch. The land, originally donated by the noble Venetian Albrizzi family which owned most of the neighboring countryside, was not ceded to the National Fascist Party. If it had been, following the regime's fall, it would have become property of the state and the integrity of the entire complex would have been preserved, as it was in the case of another rural hamlet designed by De Giorgio located nearby in Vigonza. Through the township government, it became, instead, property of the inhabitants who began to make modifications bringing the complex to its present condition. The competent authorities must face the challenge of limiting interventions to the buildings and yards attached to them and of finding the way and means to bringing those already made to a respectful harmony with the original plan conceived for a socially cohesive rural community.
The prefabricated fencing in either concrete or iron have markedly contaminated the perception of the whole, in view also of the fact that only a channel was originally intended to separate the road from the yards. The buildings appeared at that time to be laid out on a green carpet which enhanced the surreal appearance of equal-sized houses having different facades.
Not only were modifications carried out in different architectural styles, but in some cases the houses were completely demolished and new buildings were built following current housing standards at complete odds with their surroundings.




Fig. 38: The Littorio rural hamlet in Candiana. The fifth house, east side. The left side of the building has been demolished and reconstructed following a larger floorplan and using and mediocre finishings; the right side has probably undergone hefty renovations.
Fig. 39: The Littorio rural hamlet in Candiana. The seventh house, east side. The left side appears completely renovated; the right side, which has also been enlarged, conserves signs of the original openings.

6.1 Modifications of the volume

This manuscript is concerned with the 24 houses composing the hamlet, as the other three constructions not built for habitation have their own characteristics and should be examined separately. Of the 24 houses in the hamlet, three present aspects indicating that they have been entirely rebuilt (Figures 38, 39, 41). In other cases, the most frequent modification was replacement of the single to double roof facets, which was obviously carried out to increase the building's height. This type of intervention was probably chosen in view of the owner's decision to increase the height of rooms or to respect modern hygiene regulations.
With regard to their appearance, it can be said that the addition of a framed drainpipe also on the buildings' principal facade has burdened the upper part of the constructions with a heavy shadow as well as adding vertical signs of rainwater, messy elements in the context of clean houses as they appear in photographs taken in 1938. Originally, only the openings cast shadows against the façade's rectangular form illuminated by the sun and hemmed above by the waved line of tiles that descended towards the back of the houses.
In numerous cases the buildings were enlarged on one or the other side of the groundfloor to create a garage (Figure 40). These additions have undermined the perception of isolated although sequenced, autonomous blocks and give, instead, an impression of a continuous architectural form of variable heights. Other additions were made at the back of the buildings, attached to them or to their boundaries (Figure 42). Only a few of the hamlet's buildings have maintained the original relationship between isolated building volumes and the pieces of land attached to them.

6.2 Alterations in exterior finishes

The fact that interventions over time were not coordinated is more than apparent from the lack of homogeneity noted in the buildings' appearances. The most important and common modification was the systematic alteration of openings, originally distinctive elements used by the designer to characterize the hamlet. Variations were made both in the width of the openings of the porches and of the upstairs loggias as well as in the smaller windows. In the former case, these spaces were closed and transformed into rooms and the openings were reduced to usual size (Figures 43 and 44). In the latter case, several small windows, often matching in the original plan, were absorbed (Figures 45 and 48) or altered in form or reduced to rectangles because of the difficulty of respecting the conclusion of the full or lowered arch with new frames.





Fig. 40: The Littorio rural hamlet in Candiana. The sixth house, east side: an addition of the ground floor to the side of the building.
Fig. 41: The Littorio rural hamlet in Candiana. The seventh house, west side: the right side has been rebuilt and enlarged; the left side maintains its original outline.
Fig. 42: The Littorio rural hamlet in Candiana. The third house, west side: an addition at the back of the building.



Fig. 43: The Littorio rural hamlet in Candiana. The first house, west side, ground floor. The portico has been closed, the opening reduced to usual door, and aluminum window frames have been installed.
Fig. 44: The Littorio rural hamlet in Candiana. The first house, west side, first floor. The loggia has been transformed into a living area, with partial closure of the semicircular opening and installation of wood shutters.
Fig. 45: The Littorio rural hamlet in Candiana. The second house, west side. Closure of one of the two matched arched windows, anteposition of wooden shutters of a rectangular form to the other.

The adoption of wood shutters stained brown strikingly counters the absence of that element in the designer's original plan who never foresaw using external closures despite the inconvenience that the choice could cause.
Among new materials that have been used but that clash with those utilized in the rural community buildings of that time, concrete and, in particular, gilded anodised aluminum (Figures 43 and 47). have been widely used with regard to the former for prefabricated fencing and in the structural parts of new additions and for fixtures added to the buildings' outside edges with regard to the latter.
Every element projecting in cantilever fashion from the outline of the original volume can be considered a sharp contradiction of the designer's intent who aimed to construct buildings characterized by a geometrical purity (Figure 46). Projecting terraces belonging to the era of concrete floor slab in an urban context and not to wood structures in a rural one and new cornices can all be considered contradictions that are incompatible with the spirit of the original houses.
The manner in which the buildings are painted is another relevant aspect deserving mention. The buildings were in a large part originally plastered and painted, even if few traces of the initial coloration have been found. As the houses are two-family side by side dwellings, in some cases each of the owners have chosen to paint their property in a different color. To remain in harmony with the original plan, it would seem reasonable that every building should be painted in the same color, which should be adopted by the entire hamlet alternatively to exposed brickwork which was also a solution, less frequent, adopted by the designer. It is, nevertheless, difficult to establish what the original color was as the wealth of documentation that exists is almost entirely in black and white.
The vegetation is, finally, another element that hinders a view of the hamlet as a whole. Some of the inhabitants have grown tall hedges to create privacy in their garden, but this has had the effect of hiding most of the buildings from view. Others have planted different types of trees which have contributed to hindering the view of the hamlet, designed, instead, to be seen in its entirety without visual obstacles.



Fig. 46: The Littorio rural hamlet in Candiana. The sixth house, east side. Two square window openings have been transformed into a door opening with wood shutters and a small terrace with part of the parapet in galvanized steel has been added.
Fig. 47: The Littorio rural hamlet in Candiana. The seventh house, west side, first floor. One of two windows has been closed, the other window is in yellow colored anodized aluminum.
Fig. 48: The Littorio rural hamlet in Candiana. The tenth house, east side, first floor, lateral view: a circular window has been closed.

7. Proposals to restore the hamlet

We have, fortunately, many photographs of the entire hamlet and of almost every single house dating to the time they were inaugurated. The photographs were found in part in a booklet published by De Giorgio in 1940 [6], and in part they were taken from the designer's personal files. It is thus possible to find information about the initial condition of the buildings and to formulate strategies for future interventions that can bring the buildings closer to their original aspect or at least to remove those elements that most conspicuously contrast with its original plan.

Another positive element consists in the designing system adapted at that time to coordinate autonomous building systems according to a principle outlined by Emil Kaufmann in his writings [9]. That system made it possible to analyze independent autonomous units, in this case 27. The sum of the parts is, moreover, immediately apparent and the modalities by which the units are related to one another is likewise clearly apparent.

Returning to the original covering that has been preserved only in some cases could be a concrete objective. That would imply renovating the roof using a single facet inclined toward the back of the building and rebuilding the frieze in bricks as the building's upper boundary. Removing the rainwater drainage system would also contribute to restoring the minimalist original geometry of the buildings.

It would be opportune to keep the total volume as nearly as possible to the original one. Added elements should, for the most part, be prohibited. Existing additions between the houses and the road including porches external to the body of the house should be limited to the rear sides or to the lateral sides if their dimensions are small and they are clearly discernible additions.

Particular attention should be dedicated to the choice of materials used in all interventions to the houses including windows and TV antennas. Plastic, for example, should be prohibited in every architectural element to be utilized in these interventions. The same holds true for concrete which was never let in view in the works designed by De Giorgio prior to the war. Removing extraneous material used in recent times should not prove to be particulary difficult.

The naturalness of the materials originally used corresponds to the natural world in which the houses were immersed. While the hamlet's integration was originally total, with the passing of time it was reduced or lost. Clay in the bricks and in the roof tiles, lime, wood in the beams and windows reflect building materials belonging to that context, a direct evolution of the antique art of transforming natural resources into shelters.

With regard to window structures, windows without shutters would be the most opportune choice. Installed directly following the inner line of the wall, they originally originated marked shadows on the façade provoked by the shoulders of the holes. Choosing not to use external shutters and window grilles could lead, however, to a security problem making it necessary to use safety windows even if it is true that those living in that neighborhood have a greater sense of security and of neighborliness with respect to that in other areas. The problem of blocking the light could, moreover, be solved by positioning boards internally behind the windows as was planned originally or by using curtains.

Coordinating the colors for painting the plastered surfaces is another important detail. Although we are unable to infer the original color from photographic documents, the plastered parts preserved from the time of the original construction make it possible to hypothesize that the color adopted at that time could have been between sand color and light army green that harmonize well with those houses in exposed brick that were part of the composition. Dual colors corresponding to thedifferent properties present in a building, which distinguish the greater part of the plastered houses, is a clear indication of the deterioration of the architect's original plan and could easily and economically be rectified.

With regard to the outside parts of the houses, it would be particularly important to minimize the hedges and fences to a few dozens of centimeters of height so that the buildings in their entirety can be seen. Fencing, which should have a limited visual impact, should be in any case constructed in wood or stainless steel, not in cement. The hamlet was conceived of as a complex composition to be appreciated in the combination of its volumes. For that same reason, no trees should be positioned between the buildings and the road in areas that were from the very beginning conceived as family garden space.

With regard to the interiors, it is to be hoped that their original characteristics are confirmed and of course improved. The reintroduction of plaster ceilings would reinforce the conservation of the buildings' coherence more than the view of new floors reconstructed with regular beams substituting irregular ones dating to the buildings construction. Terracotto floor tiles for the ground floor and wooden planks on the second floor, conforming to the style at the end of the '30s, are among the best solutions available even today. The skirting boards were probably painted because laying floors perfectly was not yet a lost art.

8. Conclusions

How can what remains be preserved and protected? How to promote compensatory operations that might take into account their original general order and particular form?

No protection is contemplated or provided by the Superintendence of Architectural Heritage and Landscape Elements for the provinces of Venice, Belluno, Padova and Treviso, a peripheral branch with headquarters in

Venice at the Ministero per I Beni e le Attività Culturali (MIBAC - Ministry for Heritage and Cultural Activities). The Superintendence has general tasks within the territory with regard to cultural heritage and landscape, but the hamlet is not classified among assets deserving protection.
Its protection is thus entrusted exclusively to the municipality administration of Candiana. At present, this foresees “direct concession to enlargements (…) conditioned to the fact of conserving or restoring the original appearance from the perspective of the road of the existing buildings. These additions must be realized increasing the depth of the body of the building but without reducing its distance from the road.” Protection for future interventions is inferred obligating owners to extend the volume at the back but no provisional measure has been implemented to induce owners to modify superfluous invasive additions realized in the past even solely by incentivating it by a reduction in taxes.
The fact that the municipality of Candiana is merging with other bordering municipalities due the low number of inhabitants, slightly more than 2000, does not enhance prospects for reinforced efforts to conserve its architectural assets. In conclusion, unfortunately, it is probably that only the currently underway changing of inhabitants, the gradual transfer of the property to people with a higher cultural level, able to take decisions appropriately to the artistic more than commercial value of goods, will permit a substantial improvement of the hamlet condition.

Bibliographical References

[1] BANDELLONI, Enzo, ZECCHIN, Fabio, *I Benedettini di Santa Giustina nel Basso Padovano*, Padova: La Garangola, 1979, p. 94.

[2] TIETO, Paolo, *I casoni veneti*, Padova: Panda Edizioni, 1994, p. 54.

[3] TIVARONI, Carlo, *La casa rurale in Italia*, Roma: Usila, 1940, pag. 29.

[4] PENNACCHI, Antonio, *Fascio e martello. Viaggio per le città del Duce*, Roma-Bari: Editori Laterza, 2011.

[5] *Verso il popolo*, in ”Padova”, gennaio 1937, pag. 13.

[6] DE GIORGIO, Quirino, *Tre anni di marcia del fascismo padovano*, Padova: Società Cooperativa Tipografica, 1940.

[7] PIETROGRANDE, Enrico, *L’opera di Quirino De Giorgio (1937-1940). Architettura e classicismo nell’Italia dell’impero*, Milano: Franco Angeli editore, 2011.

[8] LONGHI, Sergio, *Quirino De Giorgio a Candiana. Il Borgo del “Littorio*, in “Quaderni di storia Candianese”, n. 5, 2009, p. 9-35.

[9] KAUFMANN, Emil, *Von Ledoux bis Le Corbusier: Ursprung und Entwicklung der autonomen Architektur*, Leipzig-Wien: Verlag Dr. Rolf Passer, 1933.

HERITAGE and TECHNOLOGY
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Survey and Representation of the complexity of ancient theaters and amphitheatres.

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Abstract

The survey and the representation of ancient theatres and amphitheatres introduce some interesting specificities. Their geometric conformation, trunk conic with circular directrix for the theaters and with directrix planned on the polycentric arc for the amphitheatres, gives the idea for some observations. On the onehand the relief needs a special approach for their spatial conformation, on the other hand their representation does not allow to project on an only plan the restored parts, especially for the raised parts. So the representation of the elevation, with the orthogonal traditional projections, does not permit to have restorations in the real form and size. The only solutionis that everything happens in 3D. It is completely possible to talk about reliefs and restoration processed and finished in 3D. If anything the two-dimensional projection is a necessity for the visualization. Consequently, covered ambulatories placed below the cave, superior ambulatories, barrelvaults with inclined generatrices, projecting wings of the building- “versure” surmounted by vaulte droofs, are detected and returned in their spatiality. In the following part there are the results of some studies carried out on some ancient places of performance in the eastern Sicily, such as the theater of Taormina, the amphitheater and the theater of Syracuse, and others.

Keywords: Representation complexity ancient theaters

1. – Introduction[1]



Fig. 1: the Greecktheater of Syracuse

The last decades of the survey methodology led to a gradual change from the past. Already with the stereo photogrammetry it was possible to get a graphic restitution in three dimensions. The limit was due to the computing power of the period, which did not allow three-dimensional elaborations with considerable amount of data, while the three-dimensional models generated by a pair of photo didn’t furnish information comparable to the complexity of the current numerical models. The stereo-photogrammetric renderer’s mental approach was a progressive adaptation of the results in three-dimensional, from a pair of two-dimensional photographic information. With the advent of 3D laser scanner, there has been a further step in the direction of three-dimensional models and results. The numerical model of the acquisition of the information is already three-dimensional, the operator inspects and browses in the cloud acquired in three-dimensional mode. Processes made by software aim at the three-dimensionality. The entire process starts from a three-dimensional acquisition, a three-dimensional navigation, union of three-dimensional models, processing through vectorization, mesh, three-dimensional

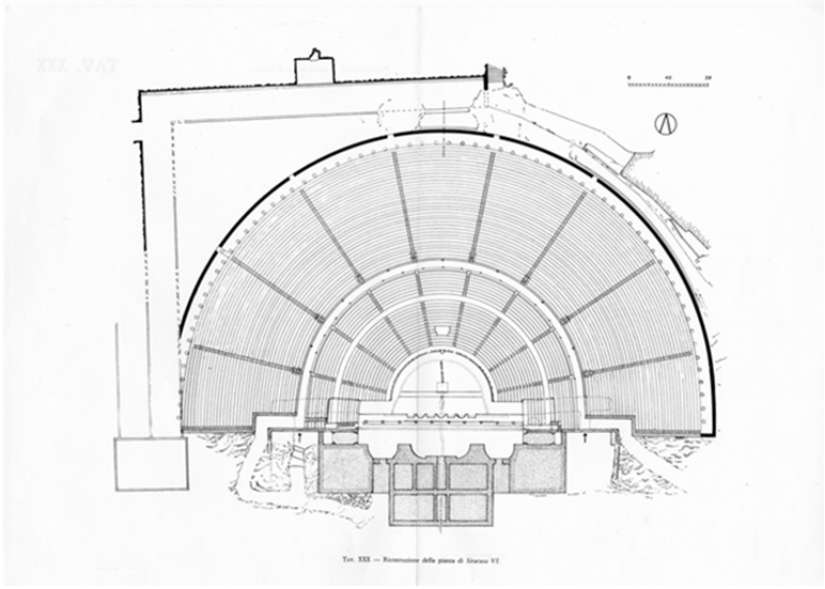

Fig.2:The Greek Theater of Syracuse, revival according L. Polacco C. Anti, (tav. XXX)

images. Therefore the mental process of extrapolation of traditional two-dimensional models which plants, elevations and sections, is revisited. Only on-screen images and prints on paper are flat, but originated from 3D models. After the capture of significant and descriptive views of plants and elevations, the development process starts and continues in three dimensions. This method involves a new approach, different from the two-dimensional models. And this is all the more significant as the object of the relief has a spatial conformation. So relief and representation in three dimensions entail a different way of proceeding, a revolution compared to an academic education based on the restitution, formulation and interpretation of two-dimensional models.

In the following notes you want to give the results of some works carried out on archaeological architectures, such as ancient theaters and an amphitheater of eastern Sicily, particularly on the theaters of Syracuse and Taormina, the amphitheater of Syracuse. The choice is not random, because each of them has some special characteristics: the theater of Syracuse is the most emblematic example of Greek theater as it hasn't undergone transformations. The theater of Taormina is an example of Greek theater turned into a Roman theater, while the Roman amphitheater of Syracuse is the best preserved in eastern Sicily, considering that the amphitheater of Catania was completely covered by layers of later centuries, and today only a small part is visible and accessible.

2. The Greek Theater of Syracuse[1].

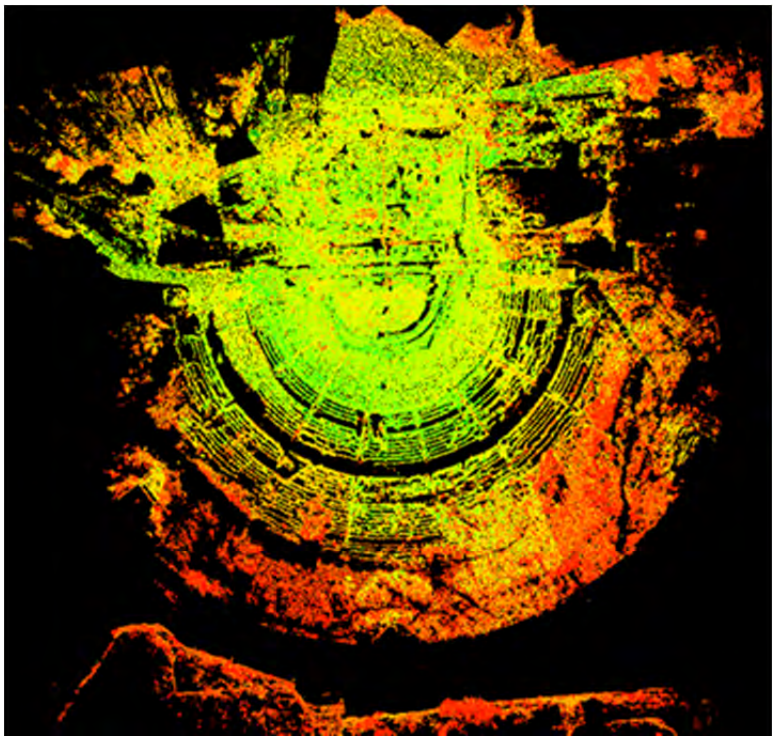

Fig. 3:TheGreek Theatre ofSyracuse, the point cloud

It dates back to the fifth century BC, and thank to the Greek mimographer Sofrone we know the name of the architect: Damokopos. Considered the most ancient Greek theater today existing, testimony of Ancient Greece, it has been recognized as a "World Heritage Site" by UNESCO in July 2005 [1]. The importance of the city was remarkable considering that in the fifth century BC no Greek polis, in Italian territory, could compete with Syracuse culturally or militarily [2]. We know that in theage of Hieroage the theater was totally remade. While the confirmation of the existence of a theater prior to that of Hiero II is reported by a Diodorus' passage, who recalls that Dionysius from Gela arrived at Syracuse in 400 BC, while the citizens were coming out from the theater. The theater was built in square work with blocks of local limestone. The cavea is largely dug into the slope. It was one of the largest in the Greek world and it could accommodate up to 17,000 spectators.

The total number of terraced steps was 67, more than those are still visible today. No certain signs remain of the scenic building of the Greek period, while cuts in the rock of the foundations of the Roman period are preserved.

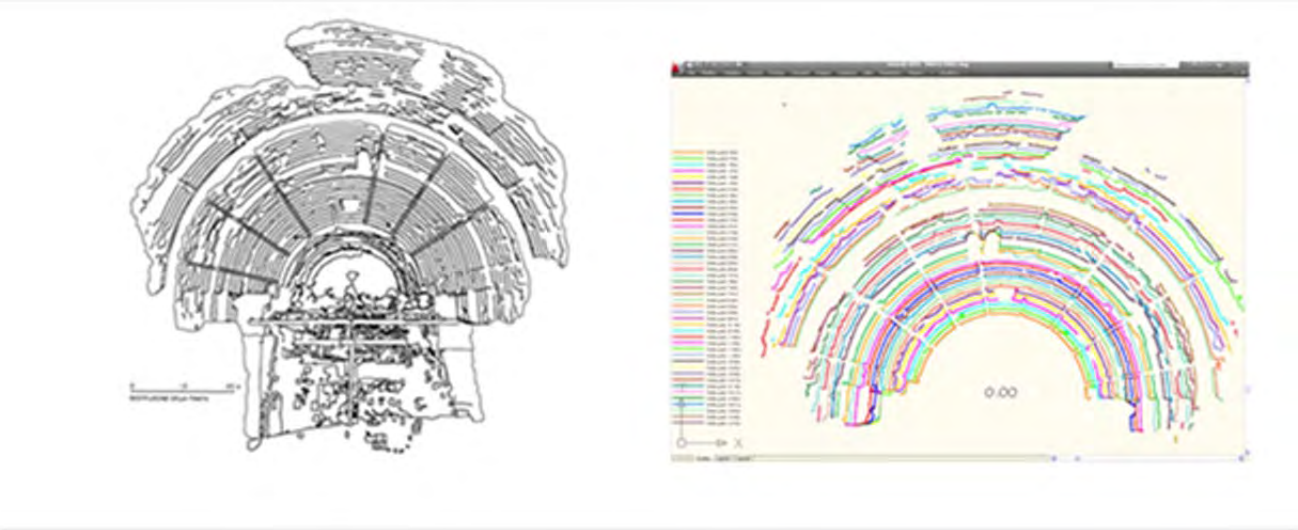

Fig. 4: The floor plans of the Greek theater in Syracuse, restitution with two-dimensional and elevations

2.1 Laser scanning data acquisition and restitution[1]

The survey campaign was divided into two phases at a distance of about ten months. The first involved the scanning of the cavea, the scene and the orchestra [3]. In the second phase it was surveyed the importance of the upper part, also known as temenite, where it is believed that there were more orders of the cavea [4]. The first phase was carried out in four days, appropriately at a distance of a few weeks, in order to obtain the way of verifying and processing the quality of the results obtained. The first acquisition was executed from the center of the orchestra, where a single station performed several scans, plotting the entire cavea, and the part above the greater diazoma. During the second day was made a single station from the scene, which covered the paradodos, the skene, the proscene and the orchestra, with the koilon. The third acquisition was performed in proximity of the greater diazoma, in order to detect the sessions of the terraced steps. The last battue required two stations that allowed surveying the orchestra and the entire cavea. In the second phase, during three different days, it was carried out the survey of the top, i.e. that of temenite. The scanning resolution of the clouds, for the relief of the cavea, was on an average a mesh of points with density of approximately cm 1 x 1. For the cavea it has chosen to work on six clouds, joined by the manual procedure, which provides the identification at least of six corresponding points for each pair of clouds to merge. In conclusion of the phase of union, there were returned the plant and the elevation, i.e. the front view, the two representative graphs.



Fig: 5: The Greek Theater of Syracuse, the area of the Temenite

The relief and the knowledge of the architectural artifacts through the use of laser scanner technology, has attained significant levels. The restoration of the superficial and volumetric characters is by now a particularly precise operation, increasingly interpretative of the complexity of the real. The restitution must consider dimensional, formal and figurative aspects, and in the case of archaeological artefacts, any transformation, using orthogonal projections, axonometric and perspective, all operations that need a schematization. Till when is helpful translating the model of point clouds, completely in the two projections traditional? The plant is a flat projection of the theater in true shape and size, from which you can extract metric

information. The restitution of the theater was pushed over and maintaining the elevation information of for each order of steps, we obtained a "dimensioned" projection. And in this type of representation, it finds its reason for being, as dimensioned projection, being a graph that gives us the three-dimensional object.

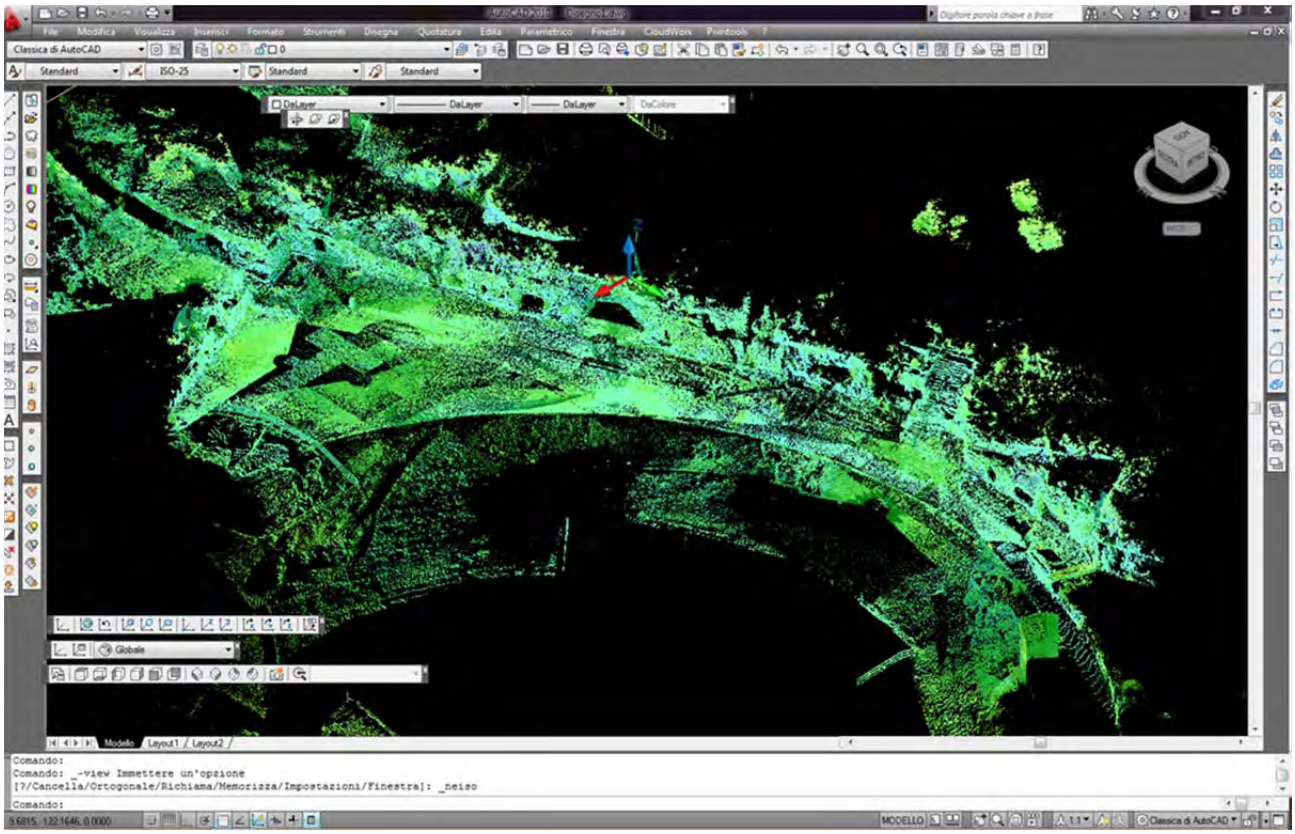

Fig. 6: The Greek Theatre in Syracuse, the point cloud of Temenite

For the profile of the auditorium of an ancient theater it is necessary to make some observations: the graph that you get from the elevation, nowhere is true in shape and size, although it is representative of the object, does not allow to take measures or to perform metric and graphic operations. While in the old times analysis and studies took plants and two-dimensional tables as a starting point, today this process is obsolete. The continuation of the graphic investigation whenever restarts and continues from the point cloud, which is our primal source of information: the numerical model. In this case the executed elaborations were: checking of the profiles, the subtended geometry, the relations with the old unit of measurement, the Vitruvian studies etc. The second phase had great importance, it consisted in the union of the scans of the temenite, and then in their union with the point cloud of the cavea. Thus in addition to having a unitary model of the entire archaeological site, starting from the vertical profiles it was possible to verify if the order of the steps was that theorized by some experts, or rather, if in the side above the temenite the scene was visible. This type of survey is only possible with the design, which in this type of studies, becomes an irreplaceable tool to verify, to investigate, to learn.

3. THE GREEK ROMAN THEATRE OF TAORMINA[1]

The most famous building in the city is absolutely the theater, thanks to his height on the sea and its panoramic views over the Volcano Etna. According to the most credible hypothesis at first the theater was Greek type, dating back to the Hellenistic age (about the third century BC), and then during the Augustan age it was transformed in Roman type. The little it remains of the Greek theater is a part of the wall of the stage, and many elements of steps reused for the Roman auditorium. The testimony of his Greek origin is given by the stone blocks of Taormina, still present underneath the scene, typical technique of the Greek production. Thanks to its 10,000 seats, 50 meters in width, 120 metersin length and a height of 20 meters, it is the second largest theater in Sicily, then the theater of Syracuse [5]. According to the most reliable sources, the theater was built around in the Hellenistic age, in the third century. B.C., at will of Hiero II of Syracuse. The **first theatre installation** probably was smaller than the current one, enriched in the top of the auditorium with a small temple [6], and a rotated scene (*skené*) a few degrees to the Roman structures. The **second plant** is traced back to the first Roman phase and introduces: the new front scene (*scaenae*

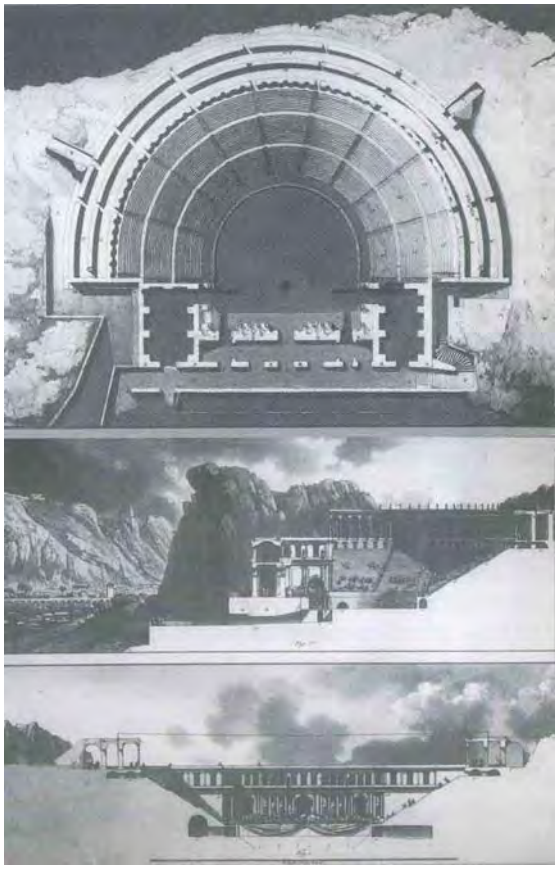

Fig. 7: The theater of Taormina, revival according J. Houel

frons), the two side walls that intersecting the *analemma* walls, delimit the two *parascaeni*, and the expansion of the auditorium. The **third theatrical plant**, referable to the second Roman phase, brings a radical transformation and introduces new components. Transformation of the scene enriched in architectural terms, the expansion of the stage and, at the sides of it, the coverage, with large barrel vaults, parascenia giving rise to the so-called *versure*; the new introductions are an arcade behind the scene (*porticus postscenium*) and two large semicircular passages crowning the auditorium that complete the transformation of the theater in the second phase. The **fourth theatrical plant** is attributable to the third Roman phase, the transformations concern the modification of the orchestra and the abolition of the first steps in the bottom of the cavea for the realization of an ambulatory and a pre-fence above it. The purpose of these changes was to obtain a large hypogean environment thus creating a real arena to assign to games and bloody battles, therefore the transformation in the amphitheater.

3.1 Survey and restitution of the Greek - Roman theater of Taormina[1]

Considering the complexity of the fabric, it was necessary a preliminary study of the restoration project. The used laser scanner is a Leica HDS 3000. A total of 27 scans were performed. It was decided not to merge all the clouds, but work on groups of them. For example for the scenic building 10 clouds were merged, while only 5 were used for the cavea. Two clouds were aligned for each of the two versure. Without going into the technical details, it was necessary to consider that the various software do various operations of different detail and quality. The front of the theater, that is the cavea, does not allow having a projection in true form and size, also in this case we are in the presence of an object that by moving in the two directions

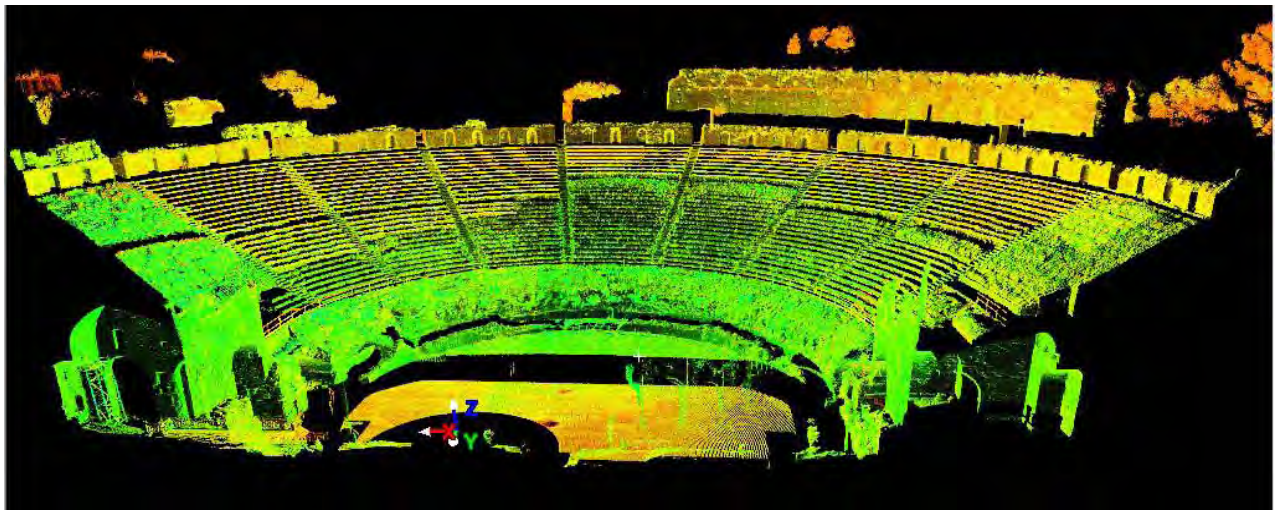

Fig. 8: the theater of Taormina, the scanning phase

X, Y continuously changes along the third dimension. It is also necessary to emphasize that the theater on the superior part is surmounted by an outside arcade or passage, bounded in the side of the cavea by a wall laid out a circular directrix. This passage was over come by a barrel vault with circular generatrices. In

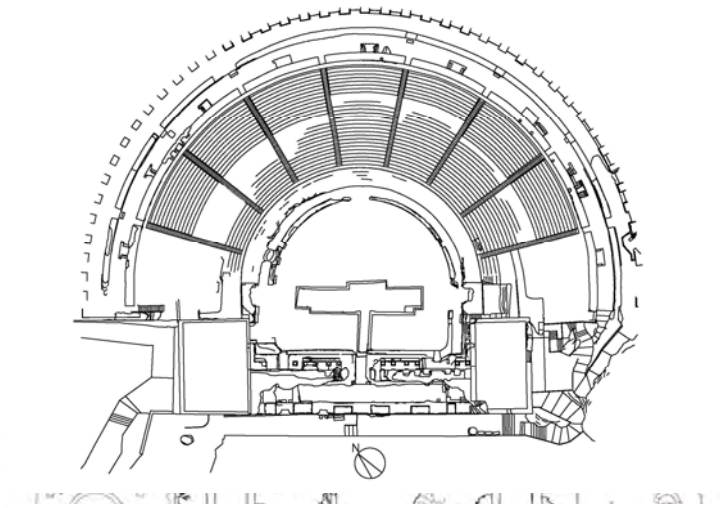

Fig. 9: the theater of Taormina, the plane

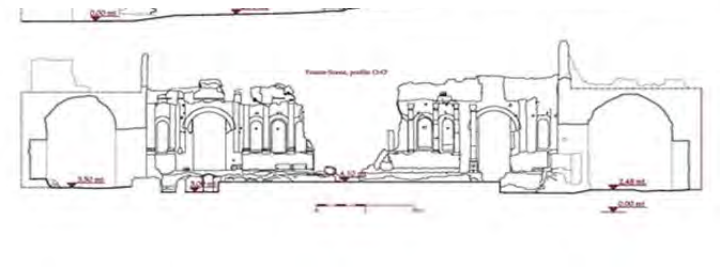

Fig. 10: the theater of Taormina, the sections into the scene

practice it is not possible to develop a prospect or a section that represents in true shape and size the view of the theater and its parts. Considering the purpose of studying both geometrical and chronological aspects,
in three dimensions, that is, without losing information on the complexity, even in this case it was decided to develop three-dimensional models from the cloud of points. In the case of the cavea it was decided to restore the plant in the traditional way, while for the scene it was appropriate to employ prospectuses, profiles, and orthophotos. Different processes were carried out for versure, starting from the structured clouds it was processed a meshing phase, of texture mapping, profiles were extracted in automatic mode, edges were obtained, i.e. polylines exportable in cad formats that describe the object [7].

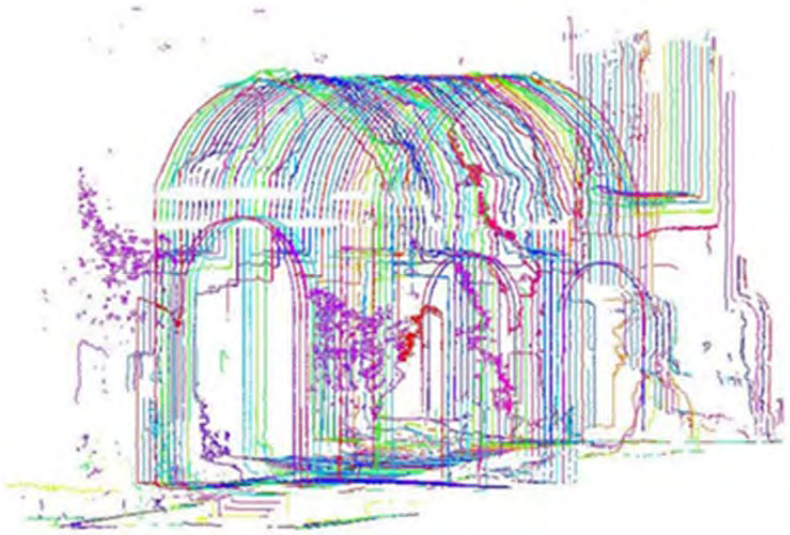

Fig. 11: the theater of Taormina, the vertical profiles of the west versure

4. The roman amphitheatre of Syracuse[1]

Some preliminary aspects of the Roman amphitheater of Syracuse were already introduced at the XI International Forum [8]. Afterwards further studies were broached in order to obtainthe graphic rendering and the geometric aspects. The returned elaborates were the plan and the elevation, i.e. the section along the major axis. That was already said previously is worth also in this case, the geometric complexity of the object, does not allow to use a planar projection to develop studies on its geometrical aspects. This consideration assumed value for the two ambulatory placed under the seats, partly dug in the rock using a polycentric directrix. Of these ambulatories we chose to study the west, for the betterconditions of its vault.



The study took place using the three-dimensional model of the cloud, and restoring through polylines in 3D, such as discussed in the next paragraph.

Fig. 12: the anphiteather of Syracuse

4.1 Evolution and revolution in survey - Construction of a 3D mesh[2]

In this note we give the first results of the restitution of the west ambulatory in the Roman amphitheater of Syracuse. The examined ambulatory is placed under the order of the steps, for the entire development of the overlooking part of the cavea, and has generatrices set on a polycentric arc. In the summit is overcome with a barrel vault. Starting from the point cloud, the current study was formulated to restore its three-dimensional progression in the intrados. The restitution took place following the contour of the apparent segments of the ashlar in the vault. We worked in a CAD environment using spline or pline.

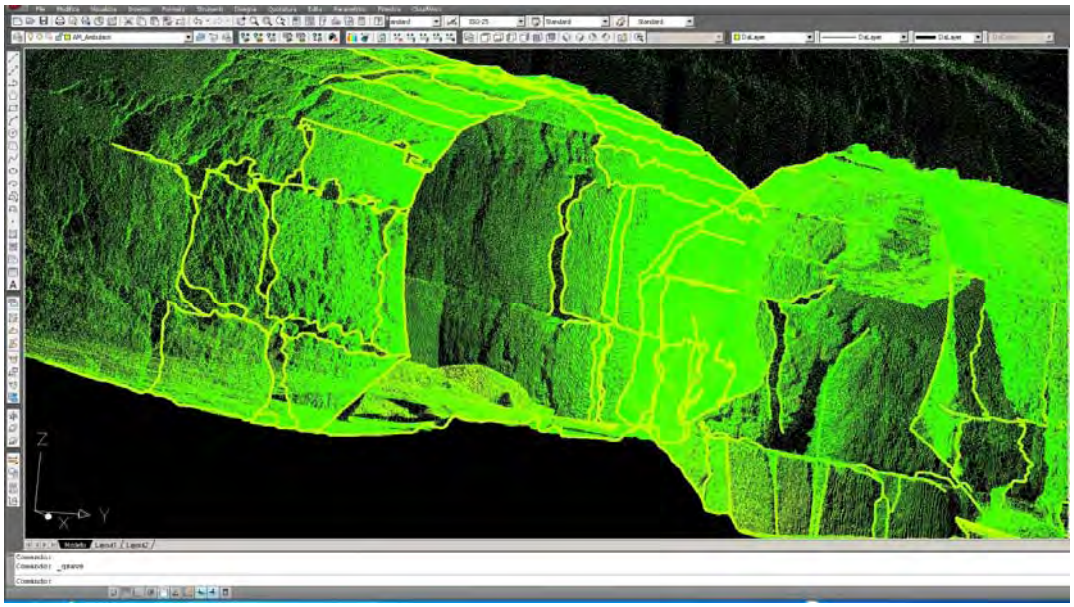

Fig. 13: restitution of three-dimensional progression in the intrados following the contour of the apparent segments of the ashlar.

After the reproduction of the wire (Wireframe) three-dimensional model, some inspections were carried out by comparing the three-dimensional model and the cloud of points from different angles, to eliminate any

cases of ambiguity. So the model obtained was the starting point for the study of its geometric genesis. The next step was the analysis of the cross section, which was obtained by checking the profile of some typical sections. The final result was that in many parts it was a round arch.

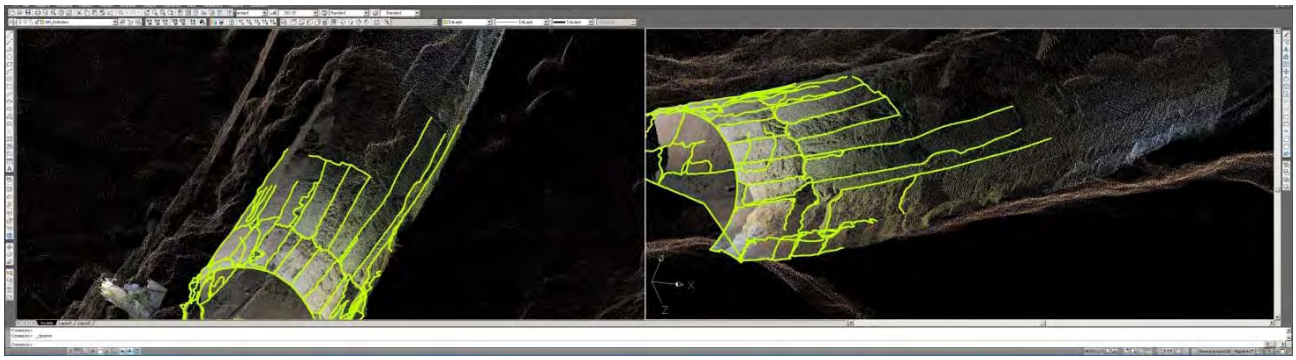

Fig. 14: Comparison between the three-dimensional model and the cloud of points from different angles

Subsequently we tried to determine the trend of the generatrices of the intrados surface. The operation took place by tracing the trajectories that could interpolate the profile of the lower edge of the cavea and by drawing arcs of ellipse through the offset tool. These are on the *xy* plane of the UCS reference. *X* and *y* axes corresponding with the ones of the ellipse. Then it was executed the sweep of the section with centre at a point of the ellipse and belonging to the *xz* plane, and as a consequence proceeded to the comparison of each torus found with the detected traces of the ambulatory.

In this way it was possible to check if the detected surface corresponds to a real offset of the geometry of the arena.

For the research of the directrix there were done several attempts by using four different types of construction of the oval:

- Diagoneo oval (by graphic costruction Serlio)
- Equilateral oval (fourth costruction Serlio)
- Golden oval
- Ellipsis

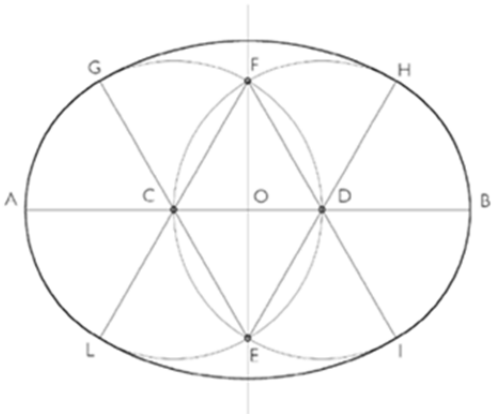

Fig. 15: fixed dimensions of equilateral oval

In the first three types of construction, after setting the length of the major axis, an excessive deviation between the obtained 3D solid and the relief of the ambulatory was recorded near the minor axis. Further attempts conducted by fixing the length of the minor axis, allowed to obtain several zones of overlap in the portion between 60° and 120° degrees from the major axis. An interesting result was obtained with the equilateral oval: by setting the dimensions AB and AC respectively equal to 73.5 m and 24.5 m (Fig. 15, and by translating the entire solid of 5.26 m, it was possible identify a wide correspondence from 40 ° to 140° (0 ° on the major axis).

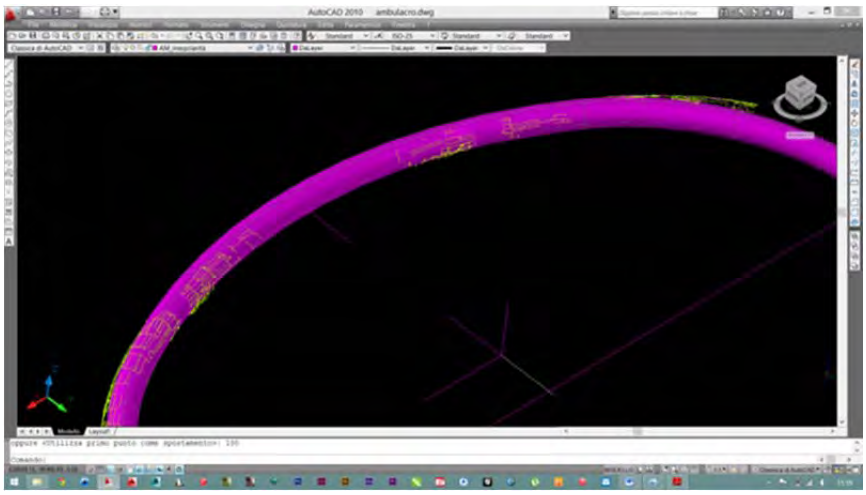

Fig. 16: : the wide correspondence identified using the equilateral oval directrix

The ovoidal torus built fixing for the axes of the elliptic directrix dimensions 73,61 m and 21,66 m, gave extensive parts of correspondence with the object of the study, presenting differences, with deviation of about 59 cm, near the vertices of the major axis, in the part between 0 ° and 12 ° degrees (Fig. 17).

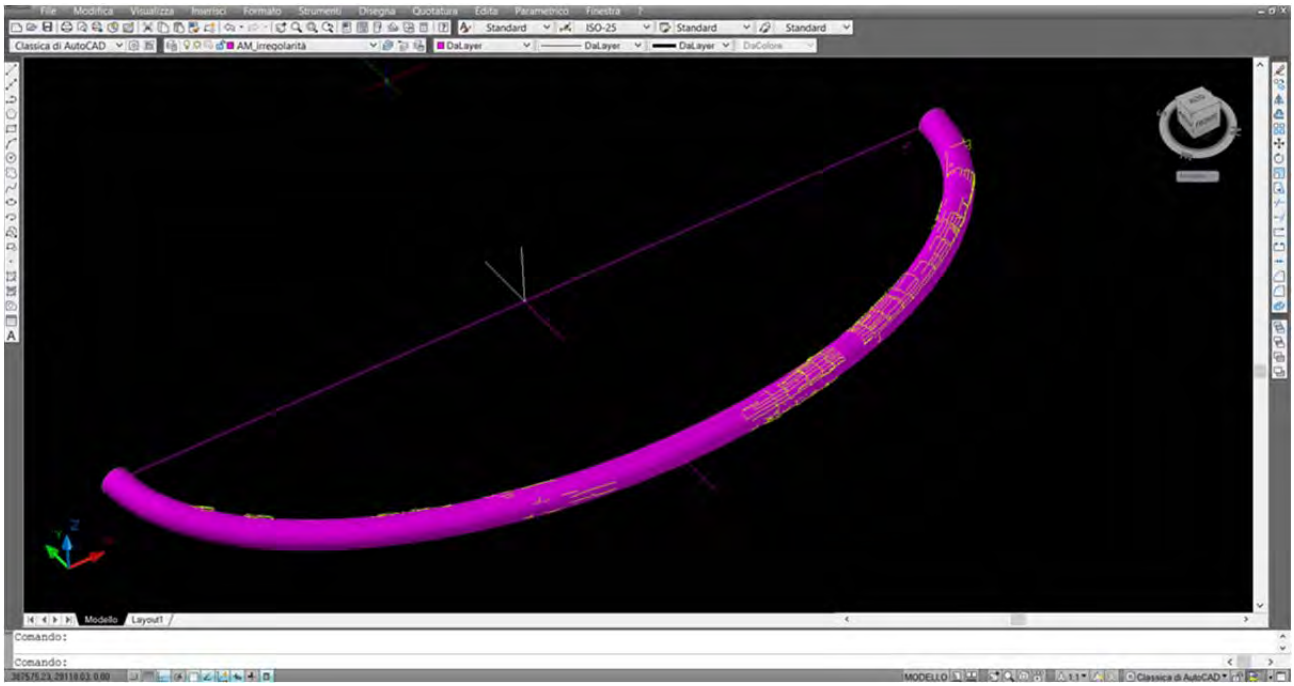

Fig. 17: The extensive parts of correspondence between the ovoidal torus and the object of the study

Bibliographical References

PAPPALARDO Umberto, *Teatri greci e romani*, arsenale editrice, Verona, San Giovanni Lupatoto, 2007

NEPPI MODONA Aldo, Gli edifici teatrali greci e romani, Firenze, Leo S. Olschki editore, 1961

RIZZO Giulio Emanuele, *Il teatro greco di Siracusa*, Milano-Roma, 1923.

BERNABO' BREA Luigi, *Studi sul teatro greco di Siracusa*, in << Palladio >>, XVII, 1967, pp. 97 sgg.

BELLAFIORE Giuseppe, *Civiltà artistica della città*, Edizione Le Monnier, Firenze.

ANTI Carlo, *Guida per il visitatore del teatro antico di Siracusa*, Firenze, Edizione Sansoni, Firenze 1948.

ALLARDYCE Nicoll, *Lo spazio scenico – Storia dell'arte teatrale*, Roma, Ulzon Editore, 1971.

VITRUVIO, *De Architettura*

DI GREGORIO Giuseppe, GIACCONE Domenico, MONTELEONE Angelo, The roman amphitheater of Syracuse: a forgotten archaeological artifact - Fabbrica della Conoscenza numero 39 - La scuola di Pitagora editrice, Napoli, 2013

Quotations

[1] During the 29th annual meeting of the World Heritage Committee of UNESCO, which took place in Durban, South Africa (10 to 18 July 2005), it was registered as the 40th Italian site under the name: "Syracuse and the rocky Necropolis of Pantalica "

[2] U. PAPPALARDO, Teatri greci e romani, arsenale editrice, Verona, San Giovanni Lupatoto, 2007

[3] A fewstudies on the cavea of the greek theater of syracuse, were conducted by: Alessandra Dora Contarino, thesis, "*Rappresentazione dei manufatti Archeologici con gli scanner Laser 3D – Il rilievo dei luoghi antichi di spettacolo" "Il teatro greco di Siracusa"*, Supervisor prof. Giuseppe Di Gregorio - Catania 2013

[4] Some experts believe that the number of tiers was to 67, while 57 orders are currently visible, including 22 under the diazoma, and 35 above, that the summa cavea. Polacco L., Anti C., *Il Teatro Antico di Siracusa*, p. 125, cit.

[5] U. PAPPALARDO, op.cit.

[6] Only a few remains of the temple are visible today

[7] A fewstudies on the theater of Taormina, were conducted by: Fabio Di Raimondo and Roberta Scarciotta, thesis, "*Rilievo e rappresentazione del Teatro Antico di Taormina tramite Laser Scanner 3D- La scena (F. Di raimondo), Le versure (R. Scarciotta) "*, Supervisor prof. Giuseppe Di Gregorio - Catania 2013. The floor plane is based on a draw of "Centro di Progettazioen e Restauro – Palermo"

[8] In this regard, see: Giuseppe Di Gregorio, Domenico Giaccone, Angelo Monteleone, The roman amphitheater of Syracuse: a forgottenarchaeologicalartifact - Fabbrica della Conoscenza numero 39 - La scuola di Pitagora editrice, Napoli, 2013

The Fig.4 is based on the restitution conducted by Alessandra Dora Contarino, thesis, "*Rappresentazione dei manufatti Archeologici con gli scanner Laser 3D – Il rilievo dei luoghi antichi di spettacolo" "Il teatro greco di Siracusa"*, Supervisor prof. Giuseppe Di Gregorio - Catania 2013

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The experience of the journey. Digital technologies and visual itineraries to enjoyment of the city's cultural heritage

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Abstract
At the time of the Grand Tour, the guides who accompanied the traveler during his trip for educational purposes were reports, diaries, letters. With the birth of mass tourism are appeared the first modern guides designed to accompany the hurried traveler. In the 1836 is published the Murray guide and in 1914 the Touring Club of Italy published the first volume of the famous “Guide Rosse”.
With the intention to renew the goal and the spirit of guides, the paper focuses on the relationship between digital technologies and enjoyment of the cultural heritage and suggests some itineraries for a "Digital Guide" for the appreciation of the cultural 'city' through experiences in Augmented Reality and Augmented Virtual.
At the center there is just one “macro” case study: the city of Ascoli Piceno because it is paradigmatic of Italy’s cultural heritage, in other words, of the extremely extensive and varied cultural heritage which is considered as “minor”. In relation to the case study, the applications designed are proposed as itineraries of a guide to for the city which provide different ways to approach the different cultural contents.
The itineraries use mostly visual communication models which exploit sensory involvement, experience and participation. These involve the traveler and encourage him to act following the memory of his emotions, the timescale and actions of the story. With this meaning, the purpose that unifies the applications is to propose a journey through a handbook with which to experience a new vision of the city.

Keywords: cultural heritage, digital technologies, visual technologies, digital Guide, Ascoli Piceno

1. Travelling in Tourist Guides in the Nineteenth and Twentieth Centuries
The first Guida Rossa, “Piedmont, Lombardy, Ticino”, was published in 1914. 150,000 copies were printed, destined for members of the Touring Club of Italy, which was founded in 1894 in Milan by Luigi Vittorio Bertarelli, using other European tourism associations as an example.
Touring had already been preparing different publications for its members since 1895, but it was only with its Guide Rosse project, edited between 1914 and 1929, that Italy could speak of its own real modern tour guide. It was based on the English Murray (published since 1836) and the German Baedeker (published since 1828 but widespread only after the late 1830s), but designed for average travellers rather than the elite, thus coinciding with the first true phenomenon of mass tourism.
These guides have some particular characteristics that distinguish them from previous large-production travel literature and allow them to be classified in their own genre. Among such characteristics are the useful, recognizable graphics; the colour of the cover, the format, and the typeface, for example, allow the guides to be easily identified. Another common element is the task the guides should fulfil, essentially to be practical and full of facts. These functions are deployed on two different, parallel but co-existing, levels.
Some passages of *A Room with a View*, written by E. M. Forster in 1908, are particularly enlightening in this sense, highlighting the role played by these guides. In particular, the second chapter of the first part of the book is entitled *In Santa Croce with no Baedeker*. When Miss Lavish decides to visit Santa Croce and to take Lucy with her, she “at once opened the Baedeker to see where Santa Croce was” and, when they realized they were lost in Florence, Lucy would have done the same if Miss Lavish had not only prevented

her, but also sequestered the Baedeker, declaring they would “simply drift”. So when Lucy finds herself alone and without the Baedeker with tears in her eyes, she not only asks herself “How could she find her way home?”, but especially “How could she find her way about in Santa Croce?” The guide would have been able to indicate “which, of all the sepulchral slabs that paved the nave and transept, was the one that was really beautiful, the one that had been praised by Mr. Ruskin”.
These are, therefore, travel compendia that collect detailed displays of touristic sites, monuments, and sites of cultural interest, as well as brief descriptions of art, architecture, nature, and traditions. At the same time, they contain a lot of practical information regarding the safest streets, means of transport, hotels and restaurants, etc. These are therefore tools that allow travellers to deepen their knowledge about places and in which useful information in planning a trip can be found. They were then new devices that freed the greater public, allowing them to individually face and guide their own travel.
But there is also another characteristic that distinguishes these publications and constitutes the authentically identifying feature. This is the definitive disappearance of the author, who is “eliminated from the cover, the title page and also from the preface. These functions are fulfilled by the editor or publisher” [1], which, with its authority, guarantees the content. One is no longer faced with the tale of a traveller, the narrator, the author; no longer is an already-travelled voyage described. The modern guide is a genre that should contain all the different possibilities for many different trips in the making. And so that these can be realized, the narrator should necessarily be impersonal; the author has to disappear.
Thus, without an author, another subject prominently comes into view: space. In the guide, it is the space that is told through the story of possible itineraries. It is by means of this offer to the reader that one gets ready to travel. The theme of travel is thus defined in relation to the description of the space, and places acquire meaning in the story due to the possibility of being experienced. The reader, in turn, immersed in the story of the space, becomes an active subject, planning the trip and turning into a traveller.
The greatest innovation in modern guides, the real invention, is therefore certainly that the traveller is woven among the places in a mesh through which both the enhancement of the space, presented as “text containing sense and possible paths” [1], and the construction of the identity of the subject, which is defined by being travelled through, is realized.

2. Digital Technologies and Visual Itineraries for Fruition of the City’s Cultural Heritage

It is in the context presented above that we present various experiments realized in order to reintroduce the requests of last century’s guides, renewing them in light of the possibilities offered by digital technology. At the same time, these applications are proposed as an opportunity for wider reflection on the relationship between digital technologies and enhancement of the cultural heritage. In fact, the experimentation is based on an assumption that the cultural heritage can only be completely realized if the cultural good and knowledge of it can be enjoyed and used by the community.
In this direction, digital technologies are used to identify forms of communication that contribute to making the values of an ever wider range of citizens accessible and understandable, with the focus placed on the visitor. In this scope the applications presented suggest itineraries built using particularly visual models of communication that involve the senses, experience, and participation, but which are always reliable with regard to the quality of the data developed and the content produced.
The different applications were purposely designed and developed within a single case study, the city of Ascoli Piceno, which is an ideal example of Italy’s cultural heritage, in other words, the extremely vast and variegated so-called “minor” cultural heritage. The scope is to offer these applications as possible itineraries for a new, renovated guide, a prototype digital guide aimed at enhancing places and building the identity of the visitor.
In addition, we also chose to adopt a further, particular point of view, building itineraries that allow the traveller to discover the city starting from some of its main representations. The nineteenth-century city is illustrated in the works of one of its artists, the painter, landscape artist, and archaeologist Giulio Gabrielli (Ascoli, 1832-1910), who dedicated much of his life to documenting the less-well-known areas of the old city centre. Another application digs deeper into the city and compares its current appearance to what it looked like in the early twentieth century, drawing on photographs in the “Cesare Mariotti Collection” housed in the Municipal Historical Iconographic Archives. The photographs were taken during one of the Alinari brothers’ numerous campaigns to portray the most important cities in Italy and contribute to creating a national identity. Finally, the object of the last experiment, the place that inspired all the real — and imaginary — images of the city of Ascoli Piceno [2], is the 1646 pseudo-perspective plan by Emidio Ferretti.
It is precisely this last application that illustrates the main intention of the article, i.e., to re-interpret urban representations by exploiting all the opportunities provided by visual technologies, be either hardware or software, thus proposing experimentation to develop a prototype for a digital guide.

3. Ascoli through the collection of Giulio Gabrielli

3.1 Giulio Gabrielli and his paintings of Ascoli Piceno

The painter, landscape artist, and archaeologist Giulio Gabrielli (1832-1910) was born into a wealthy family in Ascoli Piceno. At twenty he moved to Rome to study at the Academy, where he specialised in real-life paintings — especially landscapes in the Lazio countryside — and developed an interest in the works of foreign artists. In 1856 he moved to Naples and came into contact with the School of Posillipo, which influenced the development of his style. He later came into contact with artists belonging to the Macchiaioli movement, and his interest in "macchia" painting led him to Florence, where he steadily became proficient in this style.

In 1858, after a series of economic problems, he returned to his native city. Using the experience he had acquired elsewhere, he retreated into a very private style focusing on the in-depth study of real-life drawings and paintings in order to represent specific views of the city of Ascoli Piceno and its ongoing changes (Fig. 1). In 1861, driven by his interest in the conservation and protection of the artistic heritage of Ascoli Piceno, he founded the Civic Art Gallery together with the sculptor Giorgio Paci.

In 1878 he travelled to Paris, attracted and inspired by the Impressionists. Their influence, and his personal re-elaboration of this last contribution to his studies, is visible in his later works. In fact, in the last twenty years of his life, his artwork became more concise, with solid masses and colours reflecting a greater sensitivity to the effects of light.

3.2 The proposed experience

From amongst all of Gabrielli's artworks, the application focuses on his paintings of urban views of the old town centre executed in the latter part of his life [3].

The application is intended to enhance the artwork of Giulio Gabrielli, not only to increase knowledge about the artist, but also to use his work as a way of discovering or re-discovering the previous form of the city of Ascoli Piceno. In fact, his artworks accurately and carefully portray the changes that have taken place in the city over the years.

In particular, the goal is to illustrate the relationship between Gabrielli's artwork and the nineteenth-century changes in certain areas of the city in order to emphasise how his paintings can be considered as historical evidence of the changes that have occurred in certain urban views of Ascoli Piceno.

The application provides information about Gabrielli's artwork, including interactive, dynamic, fascinating, and intuitive considerations about his paintings, which can be used by people of all ages and cultural backgrounds.

Interaction with and use of the information is provided through touch screens. The screens display a historical map of the city which acts as an interface to access and view the technical sheets in the catalogue thanks to a simple numerical icon positioned at every place/point corresponding to one of Gabrielli's paintings/watercolours/drawings/sketches (Fig. 2). The touchscreen hardware, as an interface for both input and output, fulfils two goals and underscores the relationship between different scales of analysis and data — the visualisation of the map and the technical sheets in the catalogue. On the one hand, it makes the "invisible" information in each sheet/map available and accessible, and on the other, it contextualises the information; in other words, it helps users to understand how these different interpretations — Gabrielli's works and the city — are interrelated, and it allows users to move from one level of interpretation/visualisation to another (Fig. 3).

The visual communication choice on the one hand (planimetric representation of the city) and the in-depth data on the other (classification using technical sheets) are intended to provide a dual virtual extension of the museum archives — and therefore its contents — to the city. The former places the subjects of the paintings within the city itself, clarifying their spatial relationship with the real urban space. The latter facilitates comprehension and sparks interest in each painting in the catalogue by providing access to more data about the work. It also tells users where the original is stored and can be viewed (archive, library, etc.), thereby creating a virtual link between different works, and therefore between different institutions in the city.

The added value of this approach is that it visualises and explains the material and immaterial data about the urban context, as well as transmits cultural contents as edutainment. Last but not least, it also increases knowledge and encourages greater intellectual involvement compared to traditional, conventional ways of consulting city archives and libraries, visiting museums, or viewing an ad hoc exhibition.

4. Visual interfaces for rediscovering the city through the Alinari photos

4.1 Cesare Mariotti and the Alinari photography collection

Born in Ascoli Piceno, Cesare Mariotti (1861-1950) was an expert scholar of his native region. He studied at the Faculty of Law in Pisa, but after graduating decided not to enter the profession, and instead became a

local journalist, which also allowed him to dedicate time to studying the humanities and the history of Ascoli Piceno. In 1899 the town council named him director of the Civic Museum and, following Giulio Gabrielli, director of the Municipal Library (until 1926). He was a member of the Marche Region's Delegation of National History, and in 1927 he became the corresponding member of the Marche Academy of Science, Letters and the Arts.
Mariotti's fondness for and great love of his native city were behind the many thorough and meticulous studies and research he recorded in his notebooks, which have survived to the present day, and the numerous books he published on the history, art, and architecture of Ascoli Piceno [4], [5], [6].
In 1913, the famous art critic Corrrado Ricci asked him to write a monograph entitled "Ascoli Piceno" for the "Italia Artistica" collection published by the Italian Institute of Graphic Arts in Bergamo. A second edition of the monograph was printed in 1928. With its 171 illustrations, the book is credited with illustrating the history, art, and architecture of Ascoli and making it known all over Italy. In 1925 Tipografia Cesari published the "Guide to Ascoli Piceno". As a pocket edition, the book had fewer illustrations and images, but it included a foldable map of the city at that time (Fig. 4).
The Cesare Mariotti photography collection contains 1276 photographs of artwork and architecture taken by the Alinari brothers and is divided into six files organized according to pictorial and architectural school.
The photographs of the city used in the application are from file C, which is dedicated to architectural images. The photographs were taken in the early twentieth century during one of the Alinari brothers' many campaigns to document and describe important Italian cities. The intention of the Alinari brothers was to document Italian cities and their most important and meaningful architectural artefacts so as to reconstruct the history of Italian culture and, more generally, to contribute to creating a national identity.

4.2 The proposed experience

Using photographs by the Alinari brothers from the "Cesare Mariotti Collection" held at the municipal Historical and Iconographic Archive, the application can be used as a mobile guide to rediscover the city of Ascoli Piceno in the early twentieth century. The guide provides in-depth information about the city by comparing the contemporary city with a historical image of the city in the early twentieth century. The comparison is achieved thanks to an augmented-reality visualisation method that superimposes images of the historical photographs and three-dimensional reconstructions on the real image of the urban space that users are actually walking through.
The application is one of the information and communication technologies used to appreciate cultural heritage. Its ultimate goal is to enhance cultural heritage by proposing particularly successful strategies to access and enjoy cultural contents. In this case the goal is to improve knowledge about the historical and architectural assets of the city by stressing the relationship between documentation and hands-on experience and, at the same time, making it possible for users to gather more in-depth information about a very special topic: architectural photography.
The application uses an immediate and dynamic visual mode to access the participatory and interactive information and provide users with a wide range of cultural contents that they can use to create personalised itineraries and receive more in-depth information.
Walking through the city streets, visitors can visualise on their mobile devices the early twentieth-century photographs by the Alinari brothers in the Mariotti collection. They will be able to view what a particular corner of the city looked like in the twentieth century, as well as access other related cultural resources.
The application relies on tracking and visualisation technology using a monitor-based system. Prior digitalisation and georeferencing of the data along with the GPS system installed in the smartphone or tablet allow users to download and activate the application, and receive all the necessary data about the urban sites photographed by the Alinari brothers.
When visitors move around the city and frame a real scene in the webcam, as when taking a photo, several touch-sensitive icons appear superimposed on the image. These icons show all the places where cultural content can be accessed and visualised. Once the place of interest has been chosen, the application proposes an interface that offers a series of options to visualise the resource. Selecting one of the filters and framing the surroundings in the area of interest, users can then visualise the resources associated with the choice made. The application also works like a navigator and helps visitors locate the urban sites photographed by the Alinari brothers. Thanks to a direct link with Google Maps, the "Take me there" button provides the directions necessary to get to where the users want to go.
Once there, they will be able to access all kinds of contents: historical photographs by the Alinari brothers (full screen), data sheets, and several hypothetical 3D reconstructions superimposed on the real scene through augmented reality (Fig. 5).
In particular, the 3D reconstructions are proposed to users when the Alinari image does not correspond to the contemporary scene, either completely or in part. When architecture has been destroyed or modified, or in very special cases when street furniture has been relocated to other parts of the city, the application suggests possible visual reconstructions of the sites where and how they were using digital 3D models based on information in the Alinari prints (Fig. 6).

In short, the application can combine users' active behaviour (movement) with the real space they are exploring (level of interaction) and propose visual fusion between the real space (the scene) and the virtual space (content). In other words, it is possible to superimpose multimedia informative levels on real experience (augmented reality) and create effective and intriguing communication. The application creates itineraries to learn about assets in the Historical and Iconographic Archive, which are available and can be enjoyed outside the archive itself, and effectively sever the physical link between the contents in the archive and the city. As a result, the application not only encourages greater cultural comprehension through direct comparison between the current state of the site (urban contextualisation); it also establishes a link between the city and the cultural institutions responsible for preserving the cultural heritage. This gives users a much broader, in-depth experience because they are more involved than they would be if they visited the city in a traditional or conventional manner, because in this case they would experience the city as something separate from the documentation locked up inside museums and archives.

5. A portrait of Ascoli Piceno. The map by Emidio Ferretti (1646)

5.1 The image of the city in the representation by Emidio Ferretti

In the sixteenth century, all important Italian cities began to create their own representations, a trend later followed all over Europe. Ascoli, however, had to wait for its first pseudo-perspective representation of the city; in 1646 Ferretti's representation, commissioned by the local authorities, shows it to be fully developed and in harmony with its immediate surroundings.

We do not know why it was commissioned, but at the time it was quite normal to create city maps so they could be published in Italian and European atlases. The idea might have been dictated by citizen pride and their desire to emerge from the political and economic weakness experienced by the city – a recovery which unfortunately never materialised.

Not a lot is known about Emidio Ferretti. Born into a noble family, he lived in a building in Ascoli between via Soderini and Piazza San Giacomo, later the site of the Pie Operaie Concezioniste. He died in 1667 and is buried in the Church of St. Peter Martyr.

We know he wrote a letter (unanswered) to the Ascoli Senate in which he proposed that the city purchase the library (7,000 books) belonging to the Mancinelli family from Macerata, and even offered to participate in the expense.

Nor do we know much about his work as an architect. The little we do know shows him to be a versatile figure with many cultural interests, like many of his fellow Renaissance artists.

Ferretti has been accredited with the modernisation project (not really appreciated by his contemporaries) of the twelfth-century Church of St. Venantius, which was built over the ruins of a first-century B.C. Roman temple. His design included a new Greek-cross plan with a dome, window and new door (both rectangular) to replace the Roman door and rose window on the façade.

He has been accredited with a map of Macerata drawn for a book by Pompeo Compagnoni, "La reggia Picena", printed by Giuseppe Grisei in Macerata in 1661. The folded map was meant to be inserted on page 224, but by mistake was only included in only a few books. The remaining prints were unfortunately destroyed in a fire that destroyed the publishing house.

Although two different engravers worked on the maps of Ascoli Piceno (1646) and Macerata (1661)—Petrus Miotte (Pierre Miotte) and Joseph Mattheius, respectively—there are several easily identifiable similarities, for example the cartouches and the way green areas are portrayed (Fig. 7).

This confirms the theory that Emidio Ferretti designed both representations, and was therefore the surveyor, draughtsman, and person responsible for their execution and production.

A few years later, the two maps were used in the first book of the atlas by Joan Blaeu, "Theatrum civitatum et admirandorum Italiae", printed in Amsterdam in 1663 (Fig. 7), and later reprinted in 1704 and 1724 by Pierre Mortier (who had purchased the rights to the printing house belonging to the Blaeu family), as one of the four books of the "Nouveau théâtre d'Italie, ou description de ses villes, palais, eglises".

Although the maps were almost identical in size to the originals and portrayed the same subject matter, the versions in the Blaeu editions were very different. The standard images reproduced in colour make the maps extremely flat and expressionless. All the details of the cartouches, coats of arms, and non-essential ornamentation are gone, and the standardisation, especially in the graphics of the green areas, destroys the relationship between the space inside the walls and the immediate surroundings—the primary characteristic of the sharecropping settlement system adopted in the Marche region.

The original copper plate used for Ferretti's map of Ascoli (2 pieces, each 750 x 550 mm) is still housed in mint condition in the Municipal Library.

In the upper left corner of the map, an enormous cartouche lists the 91 most remarkable sites in the city and the date it was printed (1646), this time in Arabic numerals. Above this there is a smaller cartouche topped by a crown, with the coat of arms of the city represented by a gate with two arches between two towers, one with battlements and the other with a roof. Amid the volutes and triumphant cornucopia with fruits and

flowers in the frame around the cartouche, there are also two large winged putti holding up two rulers; the ruler on the left specifies the ratio between handwidths and steps and the one on the right shows the graphical scale in steps. The compass rose is located in the centre at the bottom.
The square framing the map is broken (at the top centre) by a crowned coat of arms with an eagle coming to rest on a gonfalon, which probably represents the Piceno area. A ribbon with the name of the map “Asculum Picenum” is supported by two winged putti surrounded by scrolls. The central composition has an additional cartouche with the name of the author “Emigdius Ferrettus D”.
Since the north is at the bottom of the sheet (as if viewed from Monte Ascensione), Ferretti’s print shows the relationship between the city and the physical site, which gives the latter its unique urban form.
For all intents and purposes, the image of the city frozen in time by Emidio Ferretti remained the same up until the early twentieth century. With its natural defences, the city is located in a very strategic position. Protected by Colle San Marco and Colle dell’Annunziata to the south and Monte Ascensione to the north, the city stretches along the peninsula created by the Tronto and Castellano Rivers, which are depicted to the right of the print as two bearded wise old men. The shape created by the riverbanks is further emphasised by the defensive walls around the city, with its nine gates and the Pia Fortress, built in the south-west area of the city where there are no natural defences.
The map portrays the perfect merger between the city and countryside by illustrating the whole city, its separate parts, and each individual element. The buildings are shown inserted into their surroundings—a dense network of individual medieval row houses aligned in blocks and pictured with their roofs, windows, and towers. With the same images used for the countryside outside the city, the green areas inside the city are shown as orchards, gardens, and tree-lined avenues. In fact, the surroundings outside the city walls are homogeneous with the green areas in the city; every single space on the sheet is filled with hatching or shading: city districts, individual houses, convents, the orographic lie of the land, fields, and vegetation are all portrayed with the same dedication and importance.
For all the reasons listed above, and apart from its unquestionable aesthetic qualities, scientific and technical importance, or expert portrayal of the profound and intimate nature of the citizens and history of Ascoli Piceno, the pseudo-perspective map of the city by Emidio Ferretti needs to be properly understood, appreciated and enhanced. It should be considered as a monument thanks to its documentary importance, and as material evidence of a civilisation.

5.2 The proposed experience

The ambitious objective of this experience is to turn an average visit to the historical centre of Ascoli Piceno into a journey of discovery that reveals the city’s temperament and character. Travellers should begin their own personal itineraries by going back in time. They should dedicate some time to studying the perspective view of an ideal and idealised city—the one designed by Emidio Ferretti—and embrace the overall enchantment it emanates, but without focusing on any particular detail.
At a glance, travellers will be able to understand the composite nature of the entire city, the unique traits which hold the whole together with its individual parts: the space inside the walls with the immediate surroundings, the monuments with the houses, the buildings with the open spaces.
Travellers will have the privilege of entering into the space of the map, moving around its hypothetical reconstruction and becoming part of a scene frozen in the pseudo-perspective representation designed by Emidio Ferretti in 1646.
To provide travellers with this experience, a three-dimensional model was elaborated and animated based on the 1646 map and other historical and contemporary documents. At present the model includes the urban area around Piazza Arringo and completes the parts which are not visible. The model was also texturised to imitate the graphic effect of the engraving.
Of all the applications presented so far, this is the least scientific; however, our ultimate aim, as mentioned earlier, was to propose a method of communication with a very strong emotional impact.
This unique experience was then tested considering several applications which varied based on the operating device.
One application is navigation within a 2.5D space in the Virtual Tour, which can be accessed online from a personal computer; it is also available as a more immersive stereoscopic display (Fig. 8). In fact, apart from the current configuration, the scenes provided for the virtual visit to Piazza Arringo also include the hypothetical reconstruction of its layout and appearance as it has changed over the years, as well as what it looked like at the time the 1646 map was drafted by Emidio Ferretti.
A further application is a short but inspiring video that explains the similarities between the reasons why the seventeenth-century image of Ascoli was created and the motivation for its current three-dimensional reconstruction. This time-lapse video shows images spanning from when Ferretti designed the map to when his map was turned into an animated digital model.
The video could be made available on the institutional websites of local authorities interested in promoting and developing tourism or in tourist information kiosks in the city. But most importantly, it could be displayed

in the local Municipal Library where Emidio Ferretti's map is currently housed. The aim is to appropriately enhance this cultural resource.
Another application was designed for mobile devices. Developed only for the area around Piazza Arringo, it can be used on a smart phone or tablet, either off- or on-line (Fig. 9).
The first interface is obviously a two-dimensional image of Ferretti's map: the map provides touch-screen access to textual information and historical iconography about the most important historical buildings (whether or not they currently exist). By clicking on a 3D icon, the user can navigate a three-dimensional reconstruction of the square and access all the descriptive data. If the map is accessed online, the three-dimensional model can be seen in augmented reality, that is, superimposed in real time on the area of the old city centre where the visitor is actually standing.

6. Conclusions

With the intention to renew the goal and the spirit of guides, the paper focused on the relationship between digital technologies and enjoyment of the cultural heritage and suggested some itineraries for a "Digital Guide" for the appreciation of the cultural 'city' through experiences in Augmented Reality and Augmented Virtual.
In relation to the case study, the applications designed were proposed as itineraries of a guide to for the city of Ascoli Piceno which provide different ways to approach the different cultural contents.
This is certainly not a logical, orderly guide, but rather a mix of realistically useful and possibly delightful data. It is a guide to travel with, to create a journey of understanding and pure enjoyment; a journey whose only objective is the pleasure of discovery and the joy of knowledge; a journey inspired purely by curiosity in the company of a guide that aspires to be a handbook for creating a new vision of the city.

Bibliographical References

[1] RAGONESE, Ruggero. Guide turistiche: un'introduzione. In GIANNITRAPANI, Alice. RAGONESE, Ruggero. *Guide Turistiche spazi, percorsi, sguardi.* Anno IV, n. 6, 2010. E|C Serie Speciale. Journal online of AISS - Associazione Italiana di Studi Semiotici. ISSN (on-line) 1970-7452, ISSN (print) 1973-2716. p. 5-18.

[2] DE SETA, Cesare. *Ritratti di città: dal Rinascimento al secolo XVIII*. 1ª ed. Torino: G. Einaudi, 2011. 376 p. Saggi 921. ISBN 9788806207311.

[3] PAPETTI, Stefano. MAZZOCCHI Maria Gabriella. (edited by). *Paesaggi d'Italia: Giulio Gabrielli (1832-1910) tra Corot e Fattori*. 1ª ed. Acquaviva Picena, AP: Tip. Fast Edit, 2011. 300 p.

[4] MARIOTTI, Cesare. *Ascoli Piceno*, 1ª ed. Begamo: Istituto Italiano d'arti grafiche, 1913. 141 p. Collezione di monografie illustrate. Serie 1, Italia artistica 69.

[5] MARIOTTI, Cesare. *Guida di Ascoli Piceno.* 2ª ed. illustrata interamente rifatta. Ascoli Piceno: G. Cesari, 1925. 150 p.

[6] MARIOTTI, Cesare. *Ascoli Piceno romana, medievale e moderna*. 2ª ed. Milano: Sonzogno, 1926. Le cento città d'Italia illustrate, n. 148.

[7] MOCINI, Renzo. *La comunicazione turistica: strategie promozionali e traduttive*. 1ª ed. Viterbo: Sette città, 2011. 127 p. ISBN 9788878532717.

[8] IPPOLITI, Elena. MESCHINI, Alessandra. Dal "modello 3D" alla "scena 3D". Prospettive e opportunità per la valorizzazione del patrimonio culturale architettonico e urbano / From the "3D model" to the "3D scene". Prospects and opportunities for the enhancement of an architectural and urban cultural heritage. In *DISEGNARE CON*. Anno 3, n. 6, 2010. ISSN: 1828-5961. p. 77-91.

[9] IPPOLITI, Elena. MESCHINI, Alessandra. La scena 3D per la valorizzazione del patrimonio culturale architettonico e urbano: Piazza Arringo ad Ascoli Piceno. In GAMBARDELLA, Carmine. *Le Vie dei Mercanti. S.A.V.E Heritage Safeguard of Architectural, Visual, Environmental Heritage*. Napoli: La Scuola di Pitagora, 2011. ISNN 978-88-6542-046-1 ISBN 978-88-6542-046-1. p.1-10.

[10] IPPOLITI, Elena. MESCHINI, Alessandra. MOSCATI, Annika. ROSSI, Daniele. DE LUCA, Livio. Shedding Light on the City: Discovering, Appreciating and Sharing Cultural Heritage using 3D Visual Technology. In GUIDI, Gabriele. ADDISON, Alonzo C. *Proceedings of the VSMM 2012 Virtual Systems in the Information Society*. Piscataway, NJ: Institute of Electrical and Electronics Engineers, Inc. (IEEE), 2012. ISBN: 9781467325639. p. 141-148.



Fig. 1: Some drawings and paintings by G. Gabrielli of Ascoli Piceno representing views of the city and its ongoing changes: Porta Maggiore, the Novelli tower, demolition of the Mercatili Palace.



Fig. 2: The touch screen: A historical map of the city acts as an interface to access and view the technical sheets in the catalogue thanks to a simple numerical icon.

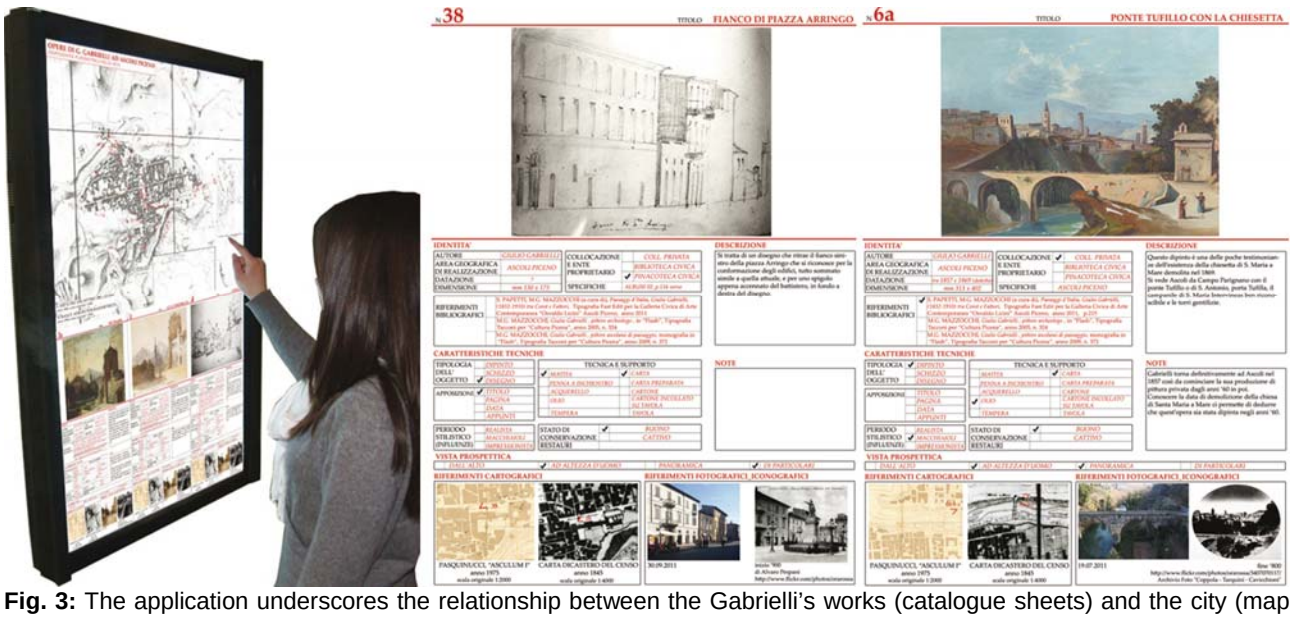

Fig. 3: The application underscores the relationship between the Gabrielli's works (catalogue sheets) and the city (map visualisation) and it allows to move from one level of interpretation to another.



Fig. 4: Some monographs of Ascoli Piceno published by Cesare Mariotti. The sheets on the photographs by the Alinari brothers held at the municipal Historical and Iconographic Archive.

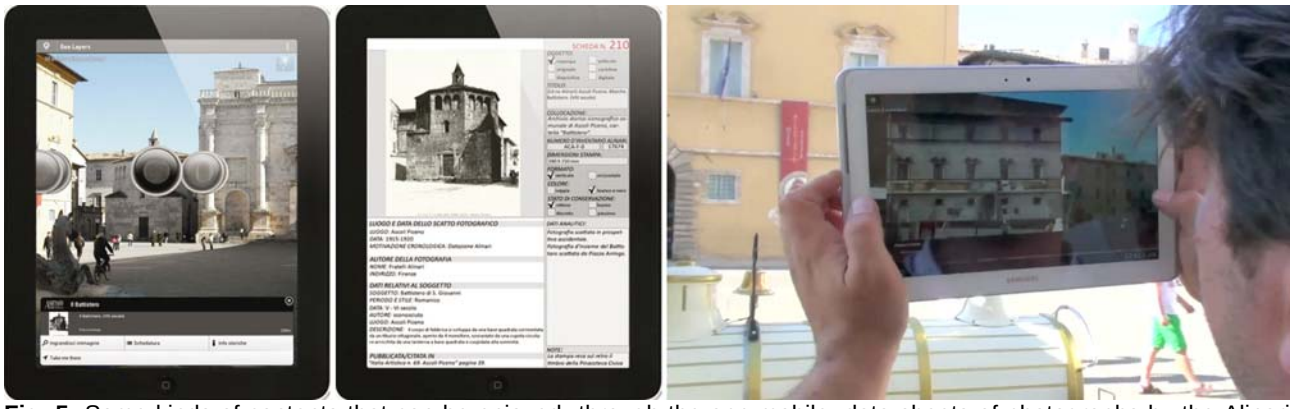

Fig. 5: Some kinds of contents that can be enjoyed through the app mobile: data sheets of photographs by the Alinari brothers, several hypothetical 3D reconstructions superimposed on the real scene through augmented reality.

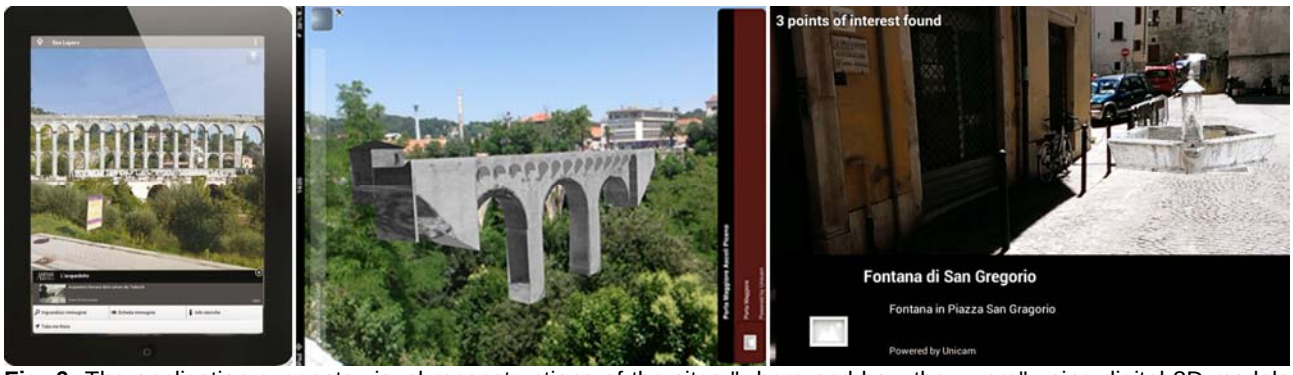

Fig. 6: The application suggests visual reconstructions of the sites "where and how they were" using digital 3D models based on information in the Alinari prints: architectures modified or destroyed and street furniture relocated to other parts of the city.



Fig. 7: The Maps by Emidio Ferretti. Asculum Picenum, 1646. Macerata Helvia Ricina, 1661. Asculum Picenum, 1663.

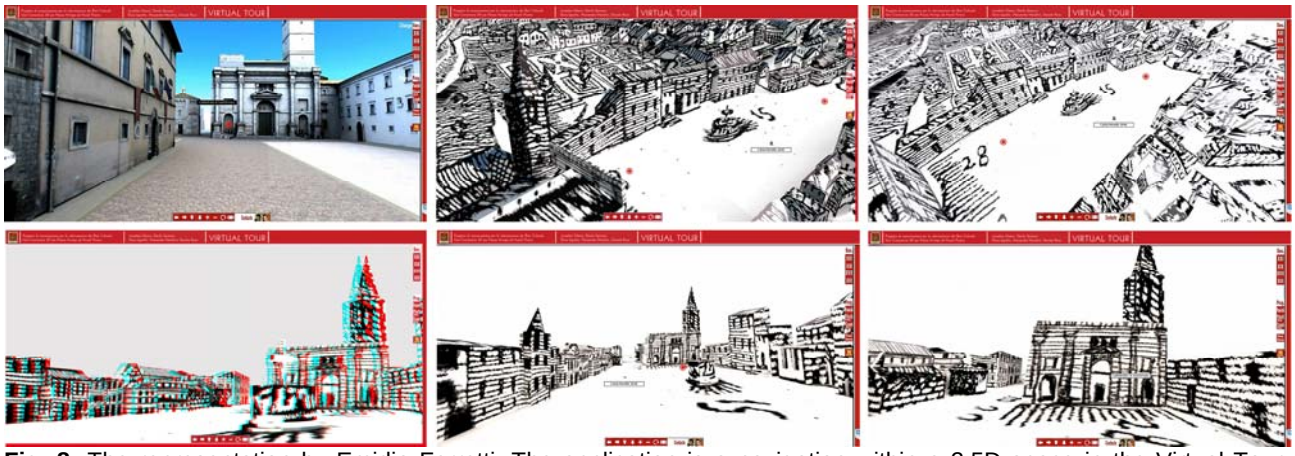

Fig. 8: The representation by Emidio Ferretti. The application is a navigation within a 2.5D space in the Virtual Tour, which can be accessed online from a personal computer; it is also available as a more immersive stereoscopic display. The scenes provided for the virtual visit to Piazza Arringo also include the hypothetical reconstruction of its appearance as what it looked like at the time the 1646 map was drafted by Emidio Ferretti.

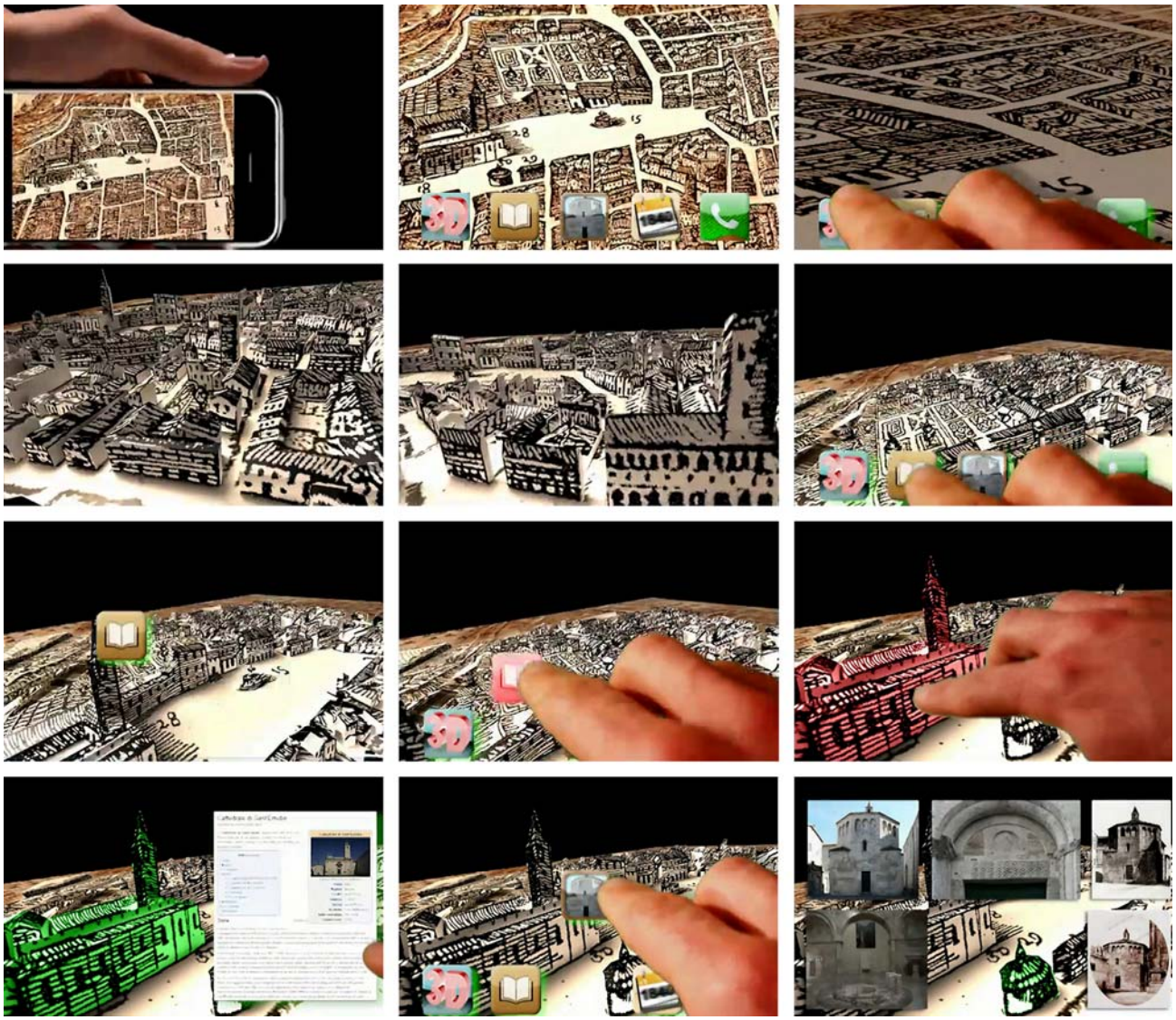

Fig. 9: The representation by Emidio Ferretti. The application designed for mobile devices.

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Golden folder from the Wall Mosaic of S. Giovanni in Fonte. Remarks and Scientific Analyses on the Constituent Materials

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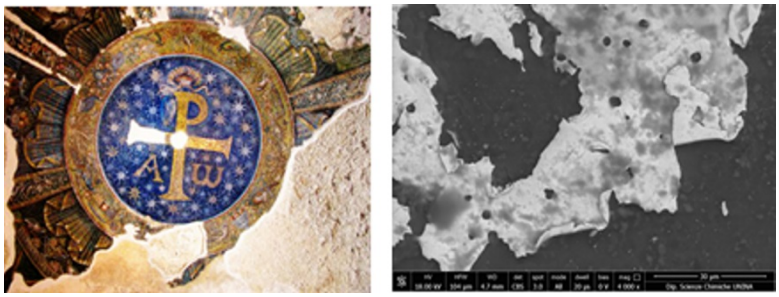
Abstract
For conservation and restoration actions to be effective and respectful of cultural instances, it is crucial to acquire the knowledge framework of the examined monument by following a method which allows systematically collecting all the information needed to define its state of conservation. Managing complex data about a cultural asset requires a methodological guide that enables to coordinate information from multidisciplinary skills systematizing it and highlighting relations and connections between the various levels of knowledge. Based on such considerations, a study on the mosaics of the dome of the baptistery of San Giovanni in Fonte was carried out.
The dome is located down the right nave of today's Basilica di Santa Restituta and is attached to the Cathedral. Its mosaics are considered as one of the most important expressions of paleo-Christian art in Italy, as a rare example of wall mosaic decoration still existing in the south of the country. At the ridge of the octagonal-based dome, on a starry sky background, stands out the "Chrismon", i.e. the monogrammatic cross symbolizing the glorious Christ with the letters alpha and omega hanging from his arms.
Based on a previous methodological study, in this paper we present new results, which, placing particular attention to the dome of the baptistery, focus specifically on a micro sample, called "cartellina d'oro", belonging to the mosaic of vault and more specifically to the monogrammatic cross, placed in the center of the dome.
The availability of innovative analytical measures, allowed to carry out further laboratory investigations, in order to deepen the existing knowledge about the Byzantine mosaic and thus be a useful tool to go back to the artistic techniques used in paleo-Christian era.



Monogrammatic Cross - Surface of a "golden folder" observed by SEM (Scanning Electron Microscope): using a CBS detector (Circular Backscatter detector), it's highlighted the contrast between the gold film (white) and the glassy surface(dark gray).

Keywords: Santa Restituta Basilica, Golden folder, mosaic, laboratory investigations

1. The Santa Restituta Basilica or the Cathedral of Naples
The Santa Restituta Basilica also known as the Cathedral of Naples, is an interesting example of early Christian architecture and, more in general, of the Roman Empire. Founded by Emperor Constantine I, in the first half of the IV century, because of many changes of style, keeps only few elements of the original early Christian structure (Fig.1a). The interior is characterized by the presence of 27 columns of cipollazzo and granite, with Corinthian capitals, overlapped to rude dosserets, probably recovered from the ancient temple of Apollo, that was present there before the construction commissioned by Constantine I [1]. The pointed arches date back to '300, as well as the raising of the floor, wanted by Archangel Guglielmelli, which led to the coverage of the original bases of the columns. He was also in charge of realizing the play's prospects to the columns of the choir on the counter facade. Along the main nave there are 18 rounds representing the

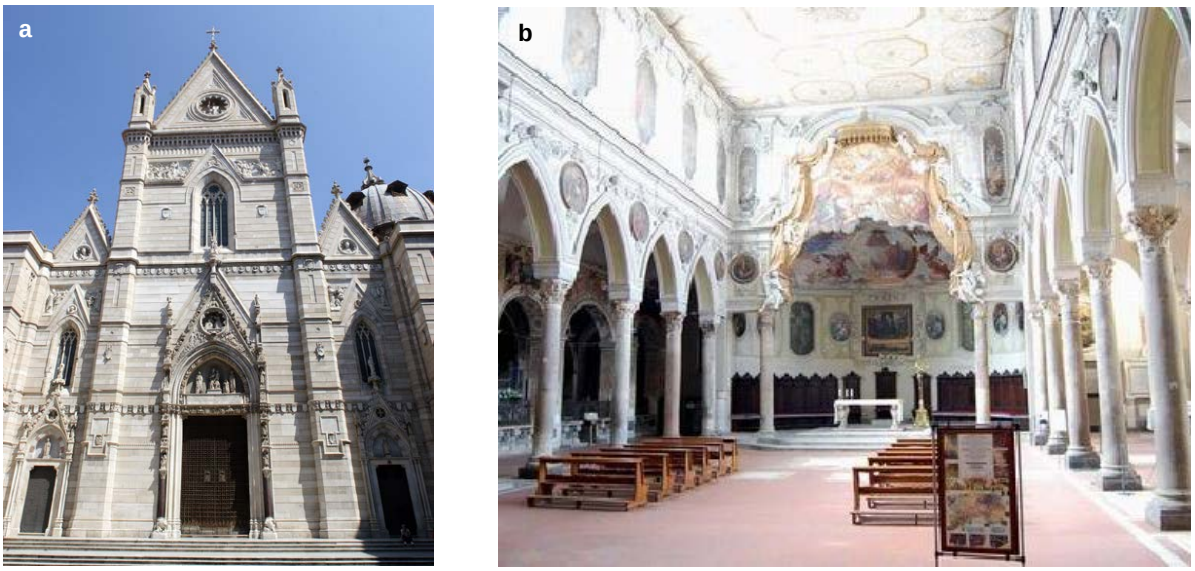


Fig. 1 - Facade of the Cathedral of Naples - Santa Restituta Basilica, **a** - Overview of the nave in which it is possible to see some of the 18 rounds, **b**.

Madonna, Jesus and some Saints, given in 1734 by Fortunato Mauro. However, 16 paintings commissioned by Santolo Cirillo Gennaro Maiello (Fig.1b) can be seen among the major windows. There are also numerous tombs: on the floor one finds many tombstones from various eras, most notably those of the canons of the Cathedral, reproduced in a marble relief of 1475; on the walls, however, near the entrance, there are numerous memorials dedicated to famous people. Composed of five naves and, probably, of 5 entrances, one for nave (currently accessible from the left nave of the Cathedral of Santa Maria Assunta), two of which were walled following the work carried out after the earthquake had in 1456 and, the corresponding aisles, adapted in chapels. Moreover, its structure was originally much longer than that which can be seen nowadays, while it was subsequently demolished to leave place to the new medieval construction. After several consolidation restorations, in 1692 the basilica was reopened, while in 1742 the two remaining side entrances were walled by Cardinal Spinelli, and the left aisle was adorned with the funerary monuments dedicated to Alfonso Carafa and Alfonso Gesualdo. From this chapel one can enter the Baptistery of San Giovanni in Fonte, that is rich in mosaics of great value, that seem to indicate it as one of the oldest examples of western baptisteries [2].

2. The Baptistery of San Giovanni in Fonte - historical framework and restorations

The Baptistery of San Giovanni in Fonte is probably the oldest baptistery of Western Christianity. Its foundation is generally attributed to Bishop Severus (362-408), nevertheless, the sources are conflicting in this regard. The legendary "Chronicle of Saint Mary of the Principle", a work of the thirteenth-fourteenth century, attributed this work to Emperor Constantine, at the same time of Santa Restituta Basilica (i.e. first half of the fourth century AD) [3]. According to other sources, the Baptistery was built by the Bishop Sotero (465-468) or by the Bishop Vincenzo (554-578), because "the Chronicles of the Neapolitan Church's Bishops", reports that both built a Baptistery "intus Episcopio" [4]. The architectural structure of the monument and the stylistic analysis of the mosaic decoration allow us to date its construction in all likelihood to the end of the fourth century. During recent renovations, it was found that in the fifth century, probably under Sotero, the wall structure was consolidated, the size of the windows was reduced, while three of the four headset plumes, in which there are the symbols of the evangelists, were expanded and decorated. Furthermore, the mosaics in the lower range of the dome were restored. The Baptistery in its primitive form was a separate building, not connected to S. Restituta Basilica: in fact its floor is situated at a higher level. The entrance was through the two doors, the traces of which remain in the western wall of the building. Today, however, it is possible to access to S.Giovanni in Fonte from the right nave of the Constantinian Basilica, through the doorway opened in 1647 on the south wall, that was originally free. The north side front presents an arcade framed by four columns, added during the door-opening works that connected directly the Cathedral to the Archbishop's Palace (1644). The building, built with stone calcarenitic has a square plan, at the center of which, set in the modern floor, there is the baptismal font of circular shape made of earthenware (opus sexstile), with a 2.61 m diameter (Fig.2a) [2]. Originally, the tank was cordoned, as it can be deduced from some traces still present, while there is a hole for the drainage of the water which, however, was added manually after being transported in the Baptistery by containers. Four corner niches unify the basic squared structure to the octagonal drum; on the drum there are four windows, resized during the restoration had during the fifth century. The cover consists of a small hemispherical dome that hosts one of the most important early Christian mosaic cycles (Fig.2b).

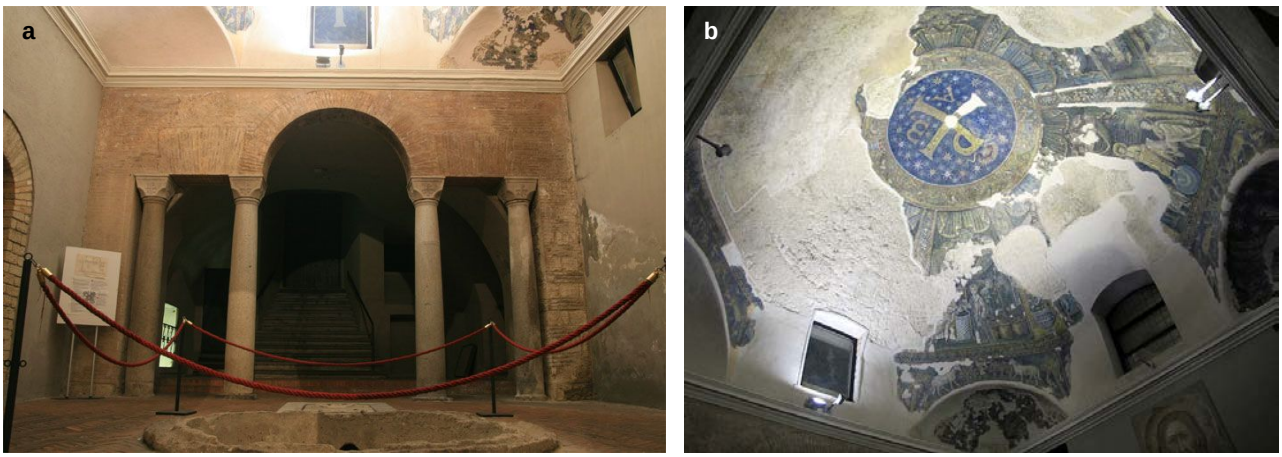
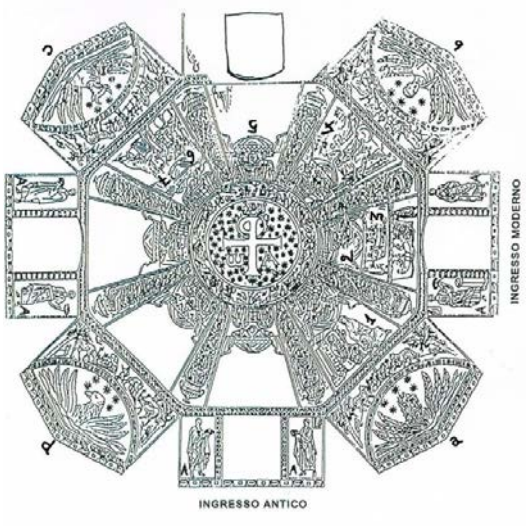


Fig. 2 - The Baptistery of San Giovanni in Fonte: the tank cordoned, **a** - T the "Chrismon" at the center of the hemispherical dome mosaic, **b**.

In these mosaics there are represented several topics concerning the sacraments of Christian initiation relative to the Church of the first centuries; fragmented scenes from the entire cycle remain still nowadays. The background of the dome is formed at the center by a sky dotted with golden stars, blue and white, eight-rayed, of unequal size, on which the monogrammatic cross ("Chrismon") stands between the alpha and omega letters. The cross is topped by the hand of the Eternal Father ("Dextera dei"), which holds a laurel wreath and a phylactery. The frame with a golden background surrounding the dome is decorated with branches, palm trees, baskets of fruit on which there are birds of various kinds, including peacocks, pheasants, partridges, parrots [3]. a phoenix (symbol of resurrection to new life to which the neophyte could aspire with the sacrament of baptism) is perched on a small hill, between two palm trees. At the bottom of this circular edge, blue draperies descend, with golden threads and eight garlands of foliage, fruits and birds, only one of which remains whole. These garlands hosted biblical scenes, four of which there still remain: "The pious women to the Sepulchre", "The miraculous catch", "The Wedding at Cana" and "Traditio legis"(Christ standing on the universe that deliveries to Peter the scroll of the law, iconography widespread within the early Christian) [6]. The symbols of the four evangelists are located in the four plumes, closing the figurative palimpsest of the dome.



Tab. 1 - Baptistery of St. Giovanni in Fonte, reconstruction of the mosaics that covered the dome: **1**. Angel appearing to the pious women - Resurrection; **2**. Christ appearing in the lake (Peter and Christ walking on water); **3**. Miraculous fishing (Christ order to cast the nets into the sea); **4**. Traditio Legis (Christ on the globe between Peter and Paul); **5**. Scene difficult to interpret (Baptism? Paralytic? Multiplication? Traditio clavium? Ascension?); **6**. Wedding of Cana; **7**. Christ and the samaritan woman at the well. **A**. Martyrs with crowns; **a**. Winged lion (above: Shepherd of the sheep); **b**. Angel (above: Shepherd of deer at the fountain); **c**. Winged bull (above: Shepherd with sheep on his shoulders); **d**. Eagle (above: Shepherd between two hinds at the fountain).

The winged man for St. Matthew, the winged lion for St. Mark, the winged bull for St. Luke and the eagle for St. Giovanni (completely disappeared). On the plumes, in addition, there are scenes from the Psalms (Tab.1).

In the XIV century, upon conclusion of the construction of the Cathedral, the mosaics were restored and the missing pieces were complemented by frescoes depicting "The Annunciation" and "The Dinner of Emmaus ". Furthermore, two windows were closed (now reopened) that were frescoed with the figures of Christ and the Virgin by Pietro Cavallini. In 1576 the Brotherhood of Santa Restituta of the Blacks, was given the usage of the Baptistery for a temporary period, in fact, after the Brotherhood was transferred in 1647, the Baptistery fell into disuse [1]. A broad restoration work, aimed to revalue the structure, was carried out only at the end of the XIX century: the restoration activities, started only in 1938, in order to remedy the serious water seepage from the roof of the Baptistery, denounced by the Curia of Naples to the Royal Superintendence of Campania, were never completed, due to lack of funds. Prompted again in 1959, the Superintendent of Monuments between 1961 and 1963 evaluated several expert reports for the restoration of the Duomo and

the Baptistry, starting actions which were limited, however, only to a first general cleaning, to the closing of some cracks in the roof, as well as to works of upkeep. In the late sixties the measures implemented by the architect Di Stefano concerned essentially the arrangement of the roof, the floor, the original tank, the dome, the drum, on the north side, and the opening of a window on the same side. The restoration of the mosaics of the Baptistery, left in extremely precarious conditions, with danger of detachment in large areas, began in 1974, allowing the resolution of some causes of moisture present, through the digging of a crawl space and the removal of the embankment below the Baptistery. Cleanup operations on the mosaics of the dome itself started to remedy the obvious damage caused by the surface alterations and the progressive detachment of golden folders, where the monogrammatic cross were present (Fig.3a,b) [8].

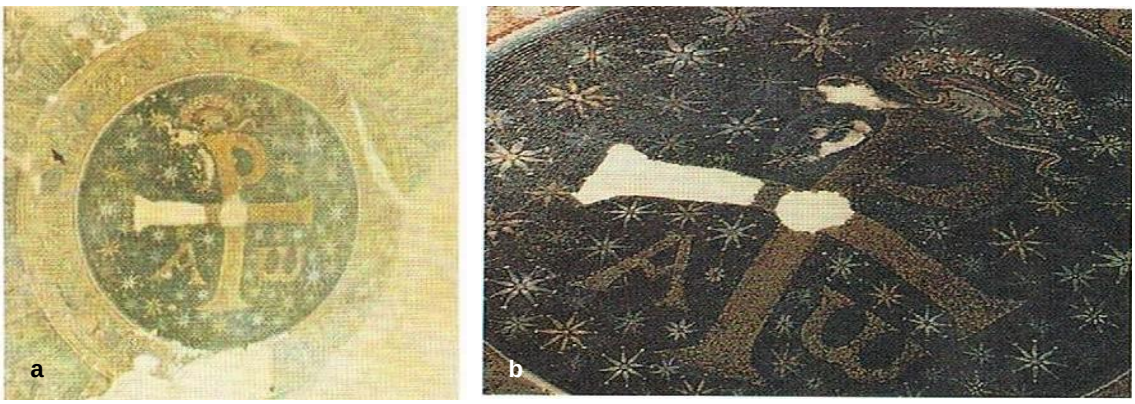


Fig. 3 - Restoration of the monogrammatic cross (1989-90), before, **a** - and after, **b** .

By this moment, actions *in situ* on the plaster and other areas of the octagonal drum in the dome of the Baptistery and the walls, were carried out, thanks to the Superintendence for Artistic and Historical Heritage of Naples, flanked by archival investigations relative to the documents of previous restorations. During one of the site verification the heaviest damage detected concerned the winged bull present in the niche (**C**), "the samaritan woman at the well" and "the wedding of Cana", present in the niche above the winged lion (**A**), "the Angel appears to the pious women" and around the monogrammatic cross (Tab.1). The degradation found was due to the lack of adhesion between the mosaic and the wall substrate and between this and the 'lime plaster; no less important was the continuous infiltrations of rainwater from the roof, which contributed to the formation of cycles of crystallization between brickwork and plaster and between plaster and mosaic support [7].

3. History of gilding and techniques applied to the mosaics.

The Gold has always been the precious metal most wanted and still bears the title of "king of metals" that was given by the ancients. Gold foil and leaf gilding have been used by most human civilisations since very early times to decorate all kinds of materials as metals, stones, ceramics, wood, Egyptian sarcophagies [9]. Most of the progresses done throughout centuries by the artisans are linked to two parameters: one is the evolution of the thickness of the gold film, starting from hammered foils with a thickness of several micrometres and progressively improved until obtaining very thin leaves of some tenth of micrometre [9-12,14]; the second one is the continuous research on good adhesive material suitable for the various substrates to be gilded [9,13,14]. Leaf gilding technology was more or less complemented for metal gilding around the beginning of the Christian era by mercury gilding (amalgam), a technology which involves a completely different process than leaf gilding.

It is mainly under the influence of Byzantine art that precious objects come into the churches as offerings of the faithfuls and also as ornaments for liturgical use; remarkable are the enclosures, or glasses, crosses, candelabras and other objects of this type. The gilding was a very common technique of Byzantine art and architecture, especially regarding the gilding of mosaic visible in majestic works of great historical value (Fig.4). This practice was not always assigned to a particular category of artisans



Fig.4 - An example of Byzantine art: Pantocrator Christ - Cathedral of Cefalù - Italy.

but was often practiced by the artists themselves, who forged liturgical objects in copper of the XII, XIII and XIV centuries, by painters or sculptors who made tabernacles and frames for pictures altar [10]. The gilding on the mosaics was obtained through the use of a thin metal foil beaten (gold, silver and their alloys), hot fixed between two layers of glass called "support" (a few millimeters thick) and a folder (of a thickness less than the mm) which has the task of covering the metallic foil to protect it from oxidation or detachment and to increase the gloss. Theophilus tells that in the Byzantine period the leaf was applied on glass, sprinkled with powdered glass, then put back into the oven: however, this was not possible because it would form bubbles [11]. The adhesion of the leaf during heating is a difficult process, because the metal must form the oxide and gold and silver oxidize difficulty; Furthermore the different composition of the metal and the glass prevents the glass to adhere. It also needs the absolute cleaning of the surfaces, which is very difficult in the furnace; furthermore, the cooling process creates tensions between metal and glass for the different contraction of the materials, causing in some cases the detachment of the folder, leaving the gold leaf, exposed to degradation.

4. Previous and most recent studies

Part of mosaic folders from these niches and, more in detail, those from the horizontal decorative band that encloses the upper middle decoration of the monogrammatic cross, were the subject of morphological and chromatic classification studies, which date back to about twenty years ago. Through simple microscopy techniques glass pastes were studied by morphological studies and by the evaluation of the following parameters: structural appearance of the material (glass, crystal, mixed); shape and nature of the pores of the material; presence or absence of material in the pores and its features. Regarding the chromatic classification, according to the Munsell notation, the mosaic folders object of study, were grouped in series characterized by the same color hue (H), which presumably corresponds to differences in the chemical composition or the microstructure [16]. Previous knowledge about this type of material, sampled, tested and already published, was examined in this work, for the availability of advanced analytics, such as Scanning Electron Microscopy (SEM) alongside the microanalysis of the constituent materials. The informations obtained from here, could not only extend previous knowledge, but also offer insights on the state in which are currently these mosaics and be a useful tool for restorers in reconsidering recovery activities of these mosaics of considerable historical interest, in order to stop or at least slow down the possible degradation processes, where present. It is also essential to obtain information about the type of material used, for undertake further studies on the artistic techniques and for the exegesis of this type of mosaic

5. Golden folder studied: Sample 623

Several golden folders (sample 623), fall down from the Baptistery's dome of San Giovanni in Fonte, some of which are in poor state of preservation, reason why the most intact and representative was selected (Fig .5). The morphological and compositional (chemical) analysis of the constituent materials, was done on this sample, using the Scanning Electron Microscopy (FESEM, Field Emission Scanning Electron Microscope) technique, alongside the semi-quantitative microanalysis EDS (Energy Dispersive Spectrometry). The sample, was mounted on an aluminum stub, provided with a carbon tape, metallized with Au and Pd and observed both horizontally for surface study and vertically for thickness study.

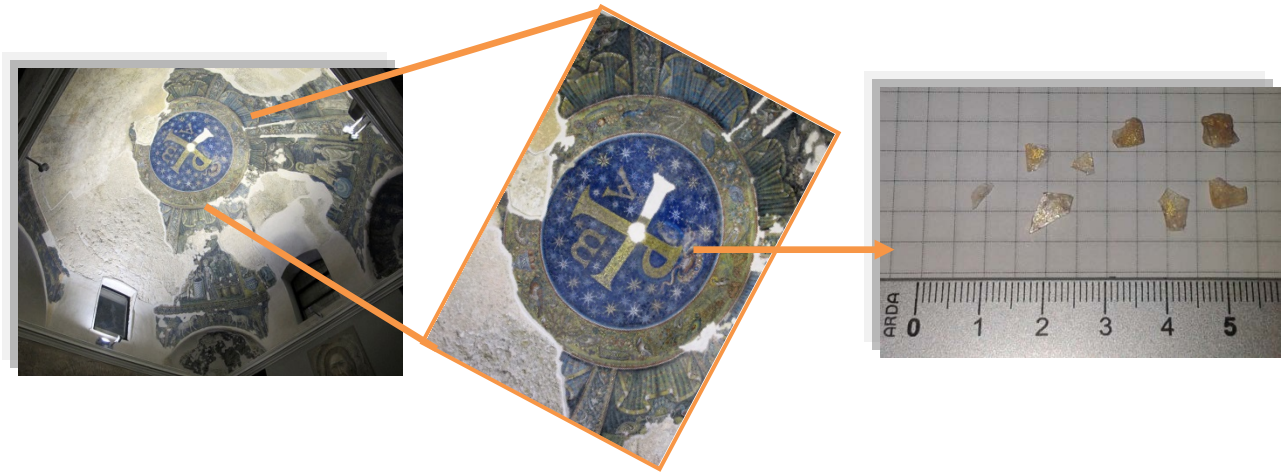


Fig.5 - Monogrammatic cross or "Chrismon" at the center of the Baptistery's dome of San Giovanni in Fonte, **a** - Chrismon's magnification, **b** - between the golden folders tra le cartelline (Sample 623), have been selected one more representative than the others, divided into other small fragments for SEM-EDS analysis, **c**.

5.1 Morphological and chemical analysis. observations and discussion

By the observation at low magnification of metallized golden folder, it's possible to notice an heterogeneous matrix, where homogeneous and compact areas are immersed (Fig.6).

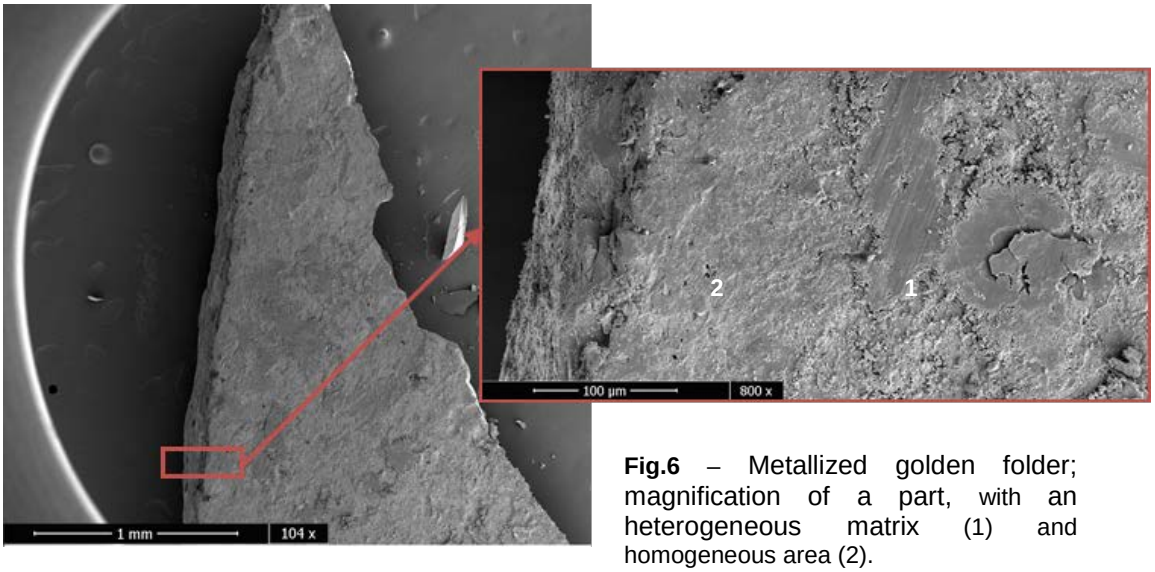
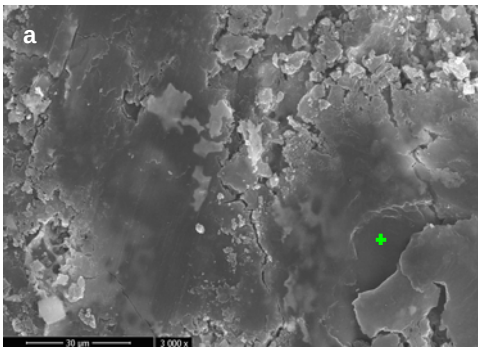
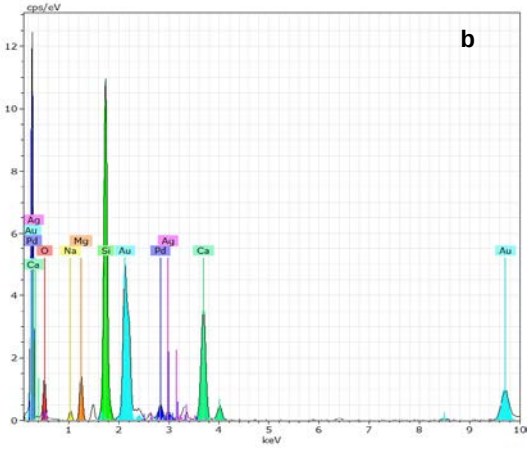


Fig.6 – Metallized golden folder; magnification of a part, with an heterogeneous matrix (1) and homogeneous area (2).

5.1.1 Homogeneous area.

From a first morphological analysis, the initially homogeneous and compact area appears heterogeneous at high magnification (800x) , with light and dark patches and jagged edges (Fig.7a).
its composition was therefore investigated, to determine if the presence of such patches depended on the different concentration of one or more elements. EDS punctual microanalysis, showed that it's made of Au and other elements such as Ag. There are the constituents of the glass, elements as Si, O, and Ca, Mg, Na which could result from saline depositions or from patinas and suggest then alterations of the fragment observed, given the antiquity workpiece in question (Fig.7b).





Element	(wt %)
O	12,62
Si	22,76
Pd	4,07
Au	38,41
Ag	0,70
Na	1,46
Mg	4,54
Ca	15,43

Fig.7 - Punctual microanalysis, **a**- EDS spectrum of the main elements present; results, **b**.

The first morphological insights relating to patches and jagged edges is done by the observations of non-metallized folder. The Fig.8a shows the general view of the surface as it appears: at 1000x numerous holes are visible, highlighting the status of degraded golden surface; on going to 4000x, the alteration is immediately observable especially on the margins of the same (Fig.8b). These observations, repeated for other areas of the folder, have confirmed that the presence of different types of patches, is due to the different folding of the edges of gold surface: the bright patches, with a good chance, indicate altered margins folded, or margins in detachment.

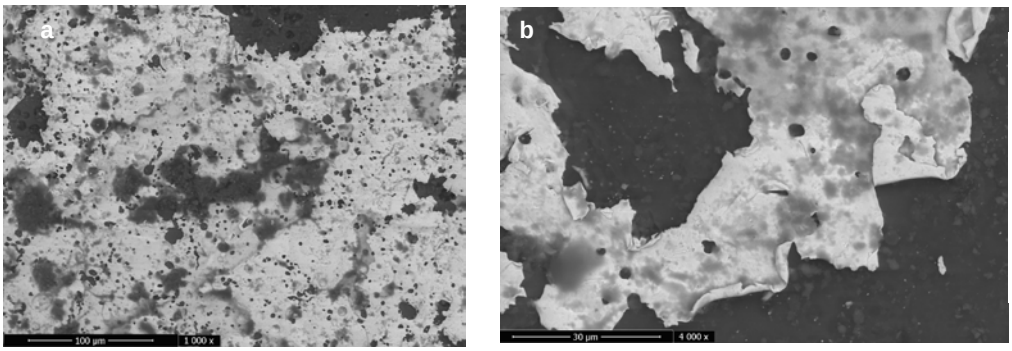


Fig.8 - Not metallized golden folder surface observed by using a CBS detector (Circular Backscatter detector). It's observed the pierced surface, **a** - foil with folded edges, **b.**

Initially the object of this study was the identification of the mosaic's stratigraphy to understand if it were constituted by two or more overlapping folders, one of which was placed on the golden surface, to protect it. From first observations, it's possible to notice the presence of two vitreous folders, whose main surface it's about of 52 µm (Fig.9a), in more detailed view this surface has a first layer of about 7 µm and another of about 49µm (Fig.9b at 1600x). To evaluate the real thickness of the golden surface, it was decided to observe its folded edges: the Fig.9c shows thinner areas with a thickness between about 26 nm to 200 nm.

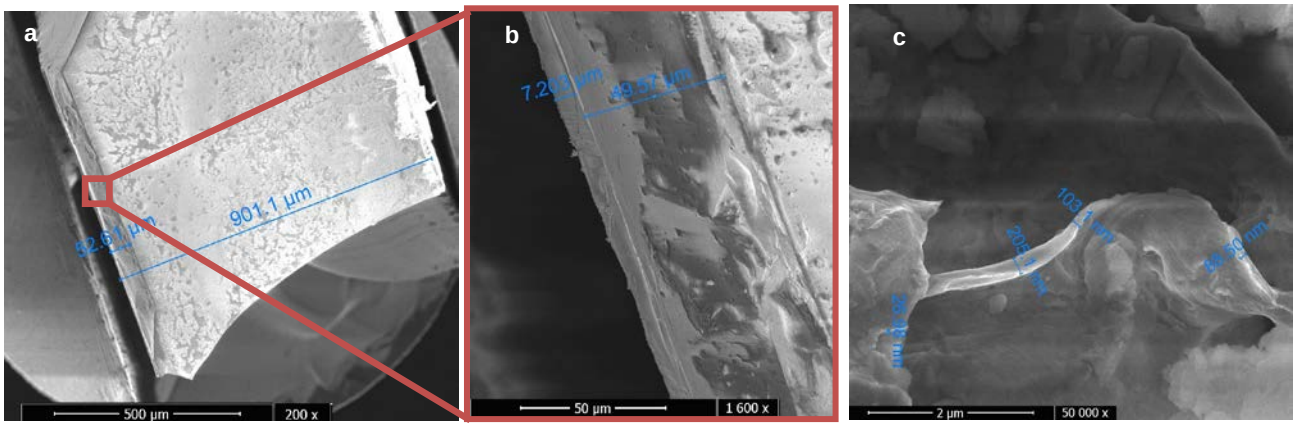
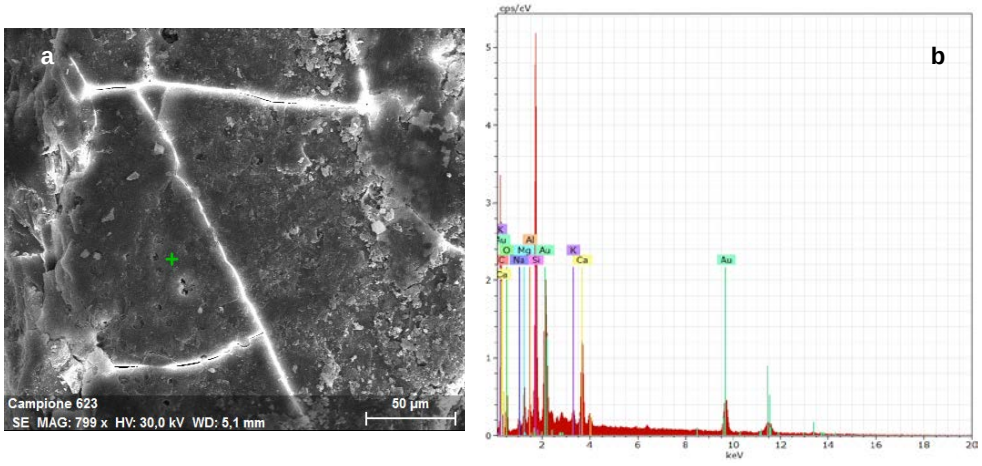


Fig.9 - Overview of the golden folder placed vertically, **a** - detail, **b –** measure of the thickness of folded edges, **c**.

5.1.2 Heterogeneous area

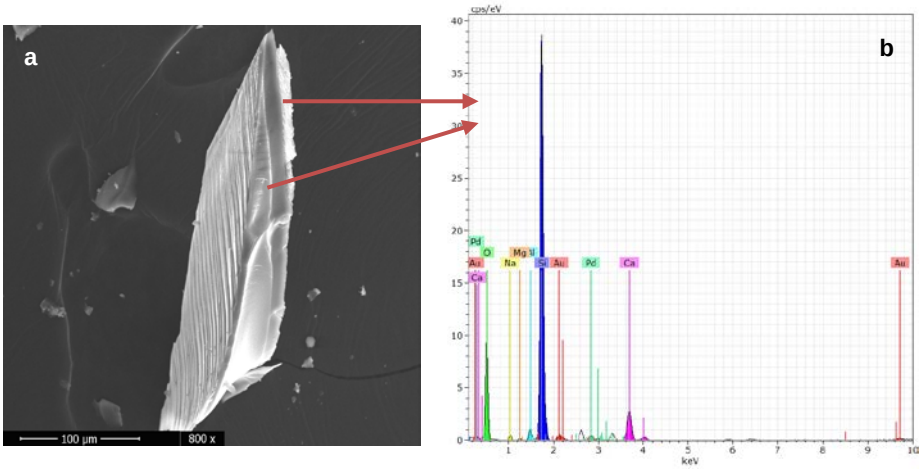
Morphological analysis highlights the roughness and the strong alteration of this surface, also highlighted by the presence of large fracture lines (Fig.10a). The EDS microanalysis indicates that, the main elements are Si, O and Al, constituent just of glassy support and other trace elements such as Ca, Na, Mg, K, probably resulting from saline depositions or of alteration patinas (Fig.10b).



Element	(wt %)
C	56,74
O	14,24
Na	0,26
Mg	1,18
Si	7,26
Ca	4,99
Al	0,17
Au	14,63
K	0,52

Fig.10 - Punctual microanalysis of the study area, **a** - EDS spectrum with results, **b**.

To study the composition of the elements constituting the glass and have an EDS spectrum as free from interference, little fragments not altered were observed, detached from the main glass tile. It was possible appreciate the presence of two layers of glass, one more altered than the second one, which was more compact (Fig.11a); in another fragmentn "defects" of the glass matrix were observed (Fig.12). Microanalysis was performed on both vitreous areas of the first little fragment, to detect any compositional differences; instead the results (Fig.11b) show that the two areas have the same vitreous composition of Si, O, Al and even here elements such as Ca, Na and Mg, the first more abundant than the others.



Element	(wt %)
Au	2,41
O	47,06
Si	39,95
Ca	6,44
Pd	1,74
Al	1,27
Mg	0,19
Na	0,95

Fig.11 - Fragment observed with two glassy layers, **a** - Average EDS spectra and results, **b**.

EDS map in Fig.12 highlights spherical inclusion embedded in silicate glassy fragment, of mainly calcic composition.
By tilting the sample 50°, it was possible observe the surface of the golden folder from a different point of view; in fact, as it can be seen from Fig.13, the "defects" (holes - a and inclusions -b) become evident both on the surface and inside the glass (Fig.13c).

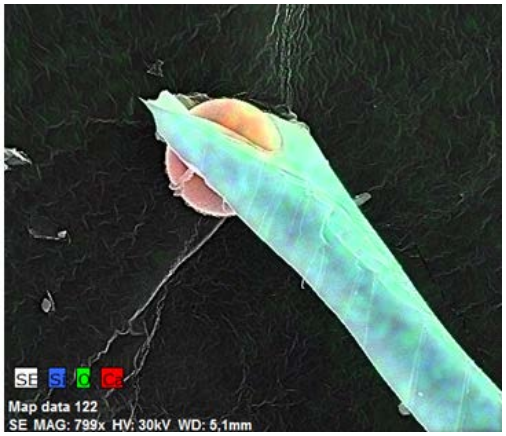


Fig.12 - EDS map of another little fragment with a clear spherical inclusion, calcic composition (observation to 30 µm, 3000x).

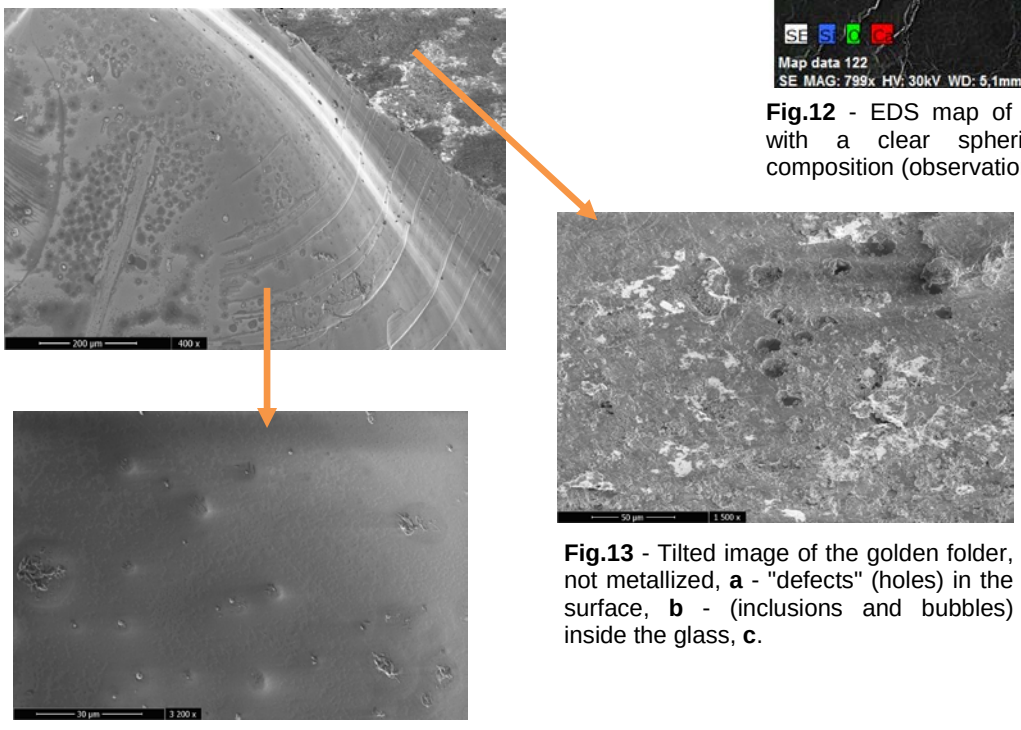


Fig.13 - Tilted image of the golden folder, not metallized, **a** - "defects" (holes) in the surface, **b** - (inclusions and bubbles) inside the glass, **c**.

6. Concluding remarks

From the literature [17] the presence of holes and patinas, can depend on saline (Na, Cl, Mg) and calcite infiltrations, coming from the “malta” (a kind of concrete), which fixed the golden folder. These ions migrated, over time, determined a slow alteration inside the glass itself, with superficial manifestations of big or little holes and inclusions, giving a spongy appearance. In the specific case the alteration of the golden surface was remarkable, as to cause its gradual laceration and detachment. The appearance of the fragment analyzed, became at high magnification, strongly altered, hardly appreciable at low magnification. The results obtained and the observations made so far, should be a warning bell for, given the great importance of these mosaics, reconsider a new recovery plan and emplacement of the golden tiles. EDS microanalysis offers only semi-quantitative indication of chemical elements present and should be complemented with other specific analyses (X-rays, ICP MS, etc.) for further investigations in the future.

7. Bibliography

[1] Referring Web Pages Web: http://it.paperblog.com

[2] Referring Web Pages Web: http://www.napoligrafia.it

[3] LICCARDO, G. “*Redemptor meus vivit. Iscrizioni cristiane antiche dell’area napoletana*.” Trapani: Il Pozzo di Giacobbe, 2008. 195 p. Oi christianoi series. Ancient section. *Redemptor meus vivit. Ancient Christian inscriptions of the Neapolitan area.* ISBN 978-88-6124-012-4.

[4] Referring Web Pages Web: http://www.lacooltura.com

[5] Referring Web Pages Web: http://www.bollettinodarte.beniculturali.it/

[6] Referring Web Pages Web: http://www.storiacity.it/

[7] CUCCO, G. “The mosaics of the Baptistery of San Giovanni in Fonte, in the Cathedral of Naples. Restoration techniques”. *Proceedings of the National Congress on the restoration in situ of wall mosaics.* Ravenna, 1990, 1-3 Ottobre, p. 219-224.

[8] DE CASTRIS, P. L. “The mosaics of the Baptistery of San Giovanni in Fonte, in the Cathedral of Naples . The literature, ancient and current restorations. *Proceedings of the National Congress on the restoration in situ of wall mosaics.* Ravenna, 1990, 1-3 Ottobre, p.203-212.

[9] CRETU, C.,VAN DER LINGEN, E., “Coloured Gold Alloys”, Gold Bulletin, 1999, v. 32, n. 4, p. 115-126,

[10] Referring Web Pages Web: http://www.treccani.it

[11] Referring Web Pages Web: http://www.micromosaic.it

[12] ODDY, W.A., "Gilding through the ages", *Gold Bulletin,* 1981, v. 14, n. 2, p. 75-79.

[13] NICHOLSON, E.D., "The ancient craft of gold beating", *Gold Bulletin,* 1979, v. 12, n. 4, pp 161-166.

[14] DARQUE-CERETTI E., FELDER E., AUCOUTURIER M., “Foil and leaf gilding on cultural artifacts; forming and adhesion”, Matéria, 2011, Rio de Janeiro, vol.16, n.1.

[15] Referring Web Pages Web: https://9travels.wordpress.com

[16] PICCIOLI C., PALUMBO M., “The wall mosaics of the Baptistery of San Giovanni in Fonte.Observations and scientific analysis on constituent materials”. *Proceedings of the National Congress on the restoration in situ of wall mosaics.* Ravenna, 1990, 1-3 Ottobre, p. 213-218.

[17] FIORI C., “Study of the composition and degradation of mosaic materials of the S.Vitale presbytery in Ravenna. *Proceedings of the National Congress on the restoration in situ of wall mosaics.* Ravenna, 1990, 1-3 Ottobre, p.43-53.

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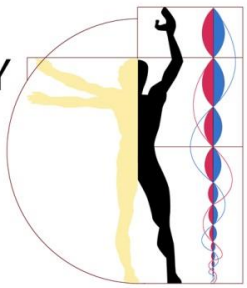

Strategies for the sustainable development of historical town centre and compatible conservation and reuse of the built heritage

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Abstract

The conservation and development of the historical cities means to implement a very complex of innovative and specific management tool. The paper presents a research project aims to support the valorisation of the cultural patrimony of ancient cities through a method of combined management of the cultural heritage both for the aspects linked to conservation and also those related to the valorisation, with the creation and the strengthening of the cultural systems. The methodology was applied in some contexts of South of Italy. The proposed objectives and strategies, acting globally on the total historical town complex, will strengthen the interaction and understanding of the diverse historical architecture that border the city.

The Conservation operations are focused on, Maintenance, Repair, Restoration, Renovation, Rehabilitation. The Development operations are focused on Reusing, Sustainability, Social and Economic Improvement, Knowledge, Educational Values, Urban Identity, Urban Environment and Landscape values. In addition different actions concern the promotion of sustainable tourism because the cultural and historic tourism is the main economic factor for regeneration of historical urban spaces.

Keywords: Sustainability, Identity, Conservation, Cultural tourism, Strategies

1. Introduction

The Italian Cultural Heritage is a crucial resource for economic and cultural development of the country and its exploitation is the strategic tool to overcome, without trauma, the economic crisis. Italy is an unique venue in the world is the widespread presence of cultural assets and their preservation pattern, supported by an effective system of laws and public departments, performing control activities on cultural heritage management [1]. The presence of a detailed and well-structured cultural heritage supply represents a factor able to support pluralism, cultural growth, and facilitate social cohesion; it is also a useful condition that contributes to the improvement of the citizens' life quality, and especially to the economic development of the territory.

Indeed in the past decades the cultural, social and economic impact linked to the process of valorisation of the cultural material and immaterial resources has taken on an increasing importance and is already considered one of the explicit goals of the European development policies. The intervention strategies in the cultural patrimony sector, so far enforced in Italy, however, were not able to ensure an adequate valorisation of the cultural heritage, compatibly with the peculiarities of these resources and with sustainable solutions for the assets and the connected territory, oriented towards fruition [2].

Still cultural heritage is not a sufficiently enhanced resource, despite its remarkable consistency, its elevated attraction from a tourist point of view, and its ability to contribute to the reinforcement of the community's identity. This patrimony can become a spark for the local economic development in as much as the resources and the services are integrated inside the areas with strong and recognizable territorial identities [3]. The lack of a combined management and the promotion of a strategy regarding the cultural patrimony, based on the engagement of the community and the stakeholders involved in the activities linked to the

promotion and valorisation of the patrimony, represent a fact in all italian regions. Furthermore, always more frequently, many historic architectures and many valuable cultural landscapes are used for new purposes, because keeping their traditional function turns out to be too onerous, and this leads to a re-balance of the conditions in terms of management and subjected economies. But reuse choices are often taken without a large-scale enhancing strategy concerning physical, economic and social context.

2. The cultural heritage and cultural tourism in Italy

Italy is the country that boasts the highest concentration UNESCO sites at world, being inserted well 49 in the World Heritage List,between cultural, natural and mixed. Also, in Italy, there are as many as 5.143 places of culture for fruition. The enhancement of such sites should be implemented in terms of system integrated inseparable, that combines the preservation of Heritage with the tourism and cultural economic growth [4].
However, considering the Italian case, there is, unfortunately, a negative trend of cultural tourism. The weight loss of the tourism sector Italian at both European and global level both internally is the origin of the debate that has developed in recent years to replace, improve and innovate the offer, basing it, above all, on what strongly characterizes Italy: the cultural heritage and landscape.
Cultural tourism, the rest is what is less affected by the crisis in the Italian tourism sector in terms of attendance, so its role has been increasing more and more in recent years, although the demand for holiday in the cities of art tends to shrink.
It is precisely for this reason that it is necessary to implement new policies for promotion of cultural heritage, so that the cities of historical, artistic and cultural able to innovate their offer, thus increasing their "charm attractive" towards tourists.
Italy has the highest concentration of cultural heritage in the world, has 16.3 sites each 100.000 kmq. The areas of particular value, are subject to restrictions by the Code of protection of cultural heritage and landscape, and covering just under half of the national territory (46.9%) [5]. Some regions of Italy are in a position of advantage, with respect to the ability to protect and enhance their cultural heritage as a factor in public welfare, and are those where historically the pressure the anthropogenic component was minor, where a high density of cultural heritage and a widespread presence of historic landscapes, urban and rural, is combined with a relatively low population density, and thus with context conditions tends to be more favorable to conservation [5].

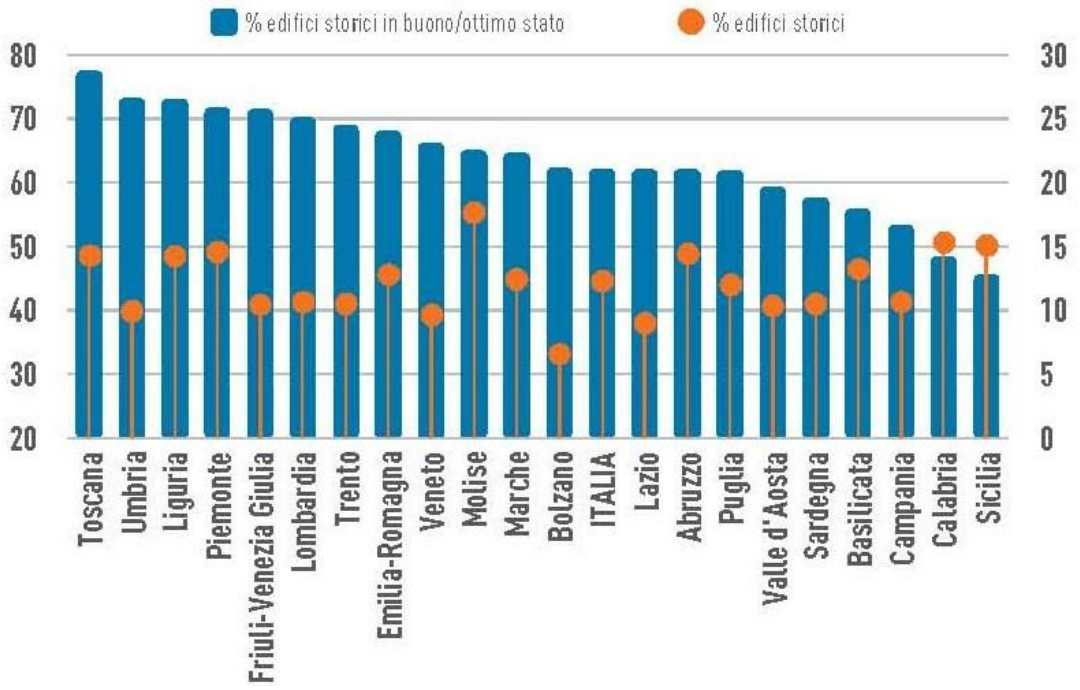

Fig.1 Historic buildings and level of conservation in the Italian regions. Year 2001. Percentage of historic buildings in excellent or good condition of conservation by region, and percentage of historic buildings on the total buildings. Source: Based on data Istat, 13th General Census of Population and Housing

The historical centers are among the most emblematic and identifying components of national cultural heritage. Besides the big cities, in every village of Italy is characterized by the uniqueness of its historic core, which - when it is vital and well preserved - is in itself an asset to the community that resides there and for that, broader, however, will recognize that an identity value.
The state of conservation of historic buildings have a considerable importance because is a significant indicator of the quality of life in urban contexts. On entire stock of residential buildings, in Italy, nearly two on ten buildings were built before 1919. In absolute terms, there are more than 2.1 million historic buildings inhabited, of which over 60% are in excellent or good condition [5].
The selection of new uses compatible with the buildings and to predict possible building transformations, which preserve their identity, also following social-economic development trends of the territories is a goal essential to activate the correct policies of sustainable tourism.
As the historic centers of cities, even some rural territories are to be considered part integral to the cultural heritage, to be protected for their historical value, but also for the economic potential that their landscapes represent for the local development. In these areas, where they are active traditional farming practices and a sustainable agricolture, which have shaped the image history of the area, giving it a specific identity, the conservation of traditional landscape is a pull factor for tourism and gives value added to the quality food production.
The tourist phenomenon imposed itself internationally as one of the modalities of transformation of the territory which causes the major alterations to the natural ecosystems and environmental values, and the most significant loss of resources and identities of the local landscapes, while researching short-term income sources. In order to value the cultural heritage, it is necessary to have a planning that involves both the authorities in charge of the management of the cultural heritage, and the industrial and service systems able to make the cultural tourism production chain competitive on the regional, national and international market [6].
In addition the management of cultural heritage in Italy has suffered from budget cuts purchases significantly higher than the average of the other missions, further compressing a voice in the national budget State for which Italy, in spite of the exceptional impact qualitative and quantitative composition of its assets, ranks among the last for some time in Europe. Italy's position does not change if we consider the impact of the spending for cultural activities of the total public expenditure. Even in this ranking Italy is one of the last positions in Europe [5].

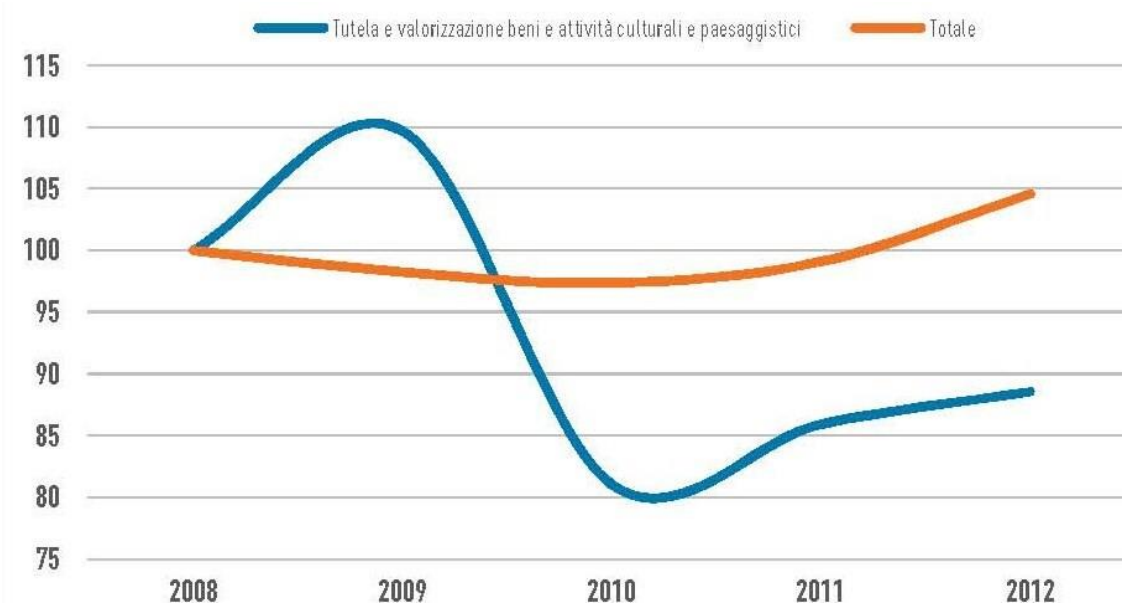

Fig.2. Reduction of total expenditure (payments) of central administrations for the protection and valorisation activities of cultural heritage and landscape - Years 2008-2012. - Source: Based on data from the General Accounting (RGS), spending the central government of the Italian State

The expense of Italian Municipalities for cultural heritage reaches fact the 14.3 euro for inhabitant in the North of Italy, in the Center of Italy is 12.3 euro for inhabitant, while in some regions as Abruzzo, Apulia, Calabria and Campania have achieved less than average [5].

2. The sustainable planning process of cultural heritage

Italy is one of the countries that has a wealth of invaluable artistic, archaeological and landscape that are capable of creating a competitive advantage to our country. Certainly, given the complexity of the activities of the protection, enhancement and promotion, the competent authorities and those responsible must impose the principles and limits to prevent the Italian cultural heritage is put at risk. And so was born the importance of planning processes of cultural heritage in accordance with the principles of sustainable development, and, also,reducing the risks due to the conflict between conservation and transformation [7].
There are three key factors to be taken into account and that can actually influence the success of the process of enhancement of cultural and environmental issues, based on the principles of sustainable development: these factors are time, space and function [8].

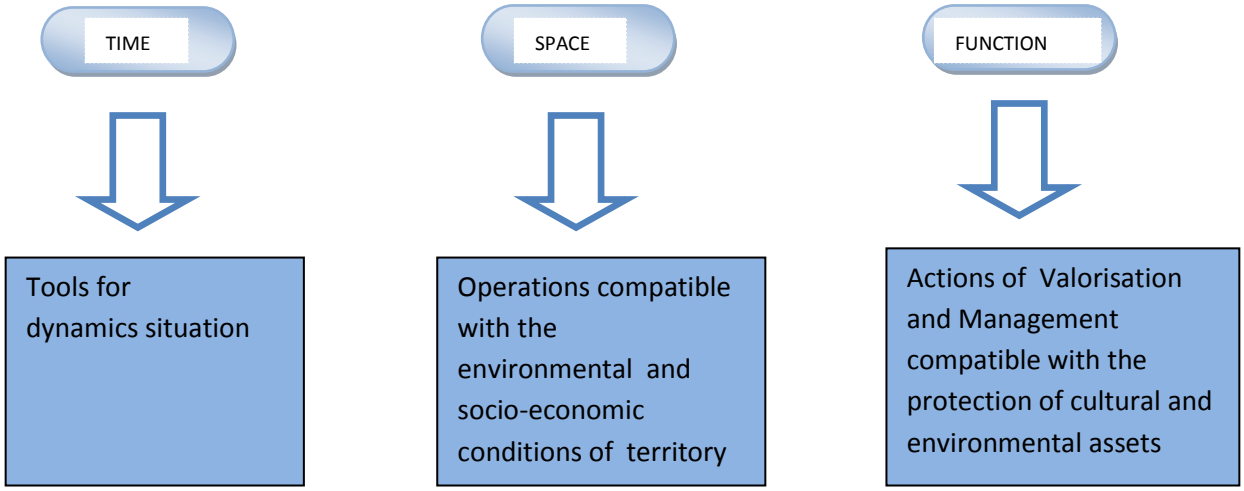

Fig.3 The main factors to consider in the process of the sustainable valorisation and promotion of cultural heritage

Constrain and protect the Historic Heritage allowed preserve places and culture that, otherwise, would been lost and which might be destroyed, if the approach to them was dictated purely by logic economistic. The valorisation of cultural heritage means promote knowledge of cultural heritage and promote the development of culture ensuring the best conditions of use and public enjoyment and includes the promotion and support of the interventions of conservation. It is evident the need to maintain a cultural heritage to be able to make available, and to valorize for enhance the quality, qualify the site in which it falls, and it can make a tourist attraction, which would be an economic and social opportunity, capable of self-sustaining financially [9].
The privatisation process can be an opportunity for widespread requalification only if the owners will be able to plan urban and land development strategies, and to guarantee the coherence of the reuse with these planning, by enhancing the assets' value system [10]. The main objective should be, therefore, harmonize the relationship between public and private, with appropriate checks, aimed at make a collective cultural service, where the private will certainly deduce its own advantage, but where will always be the primary the public advantage [11][18]. There is the need to promote a model and a method of policy to cultural heritage protection and enhancement, as a result of an organic strategy overall, in a modern and international key, that put the Culture at the center of primary objectives of the country, to give a decisive contribution to the resolution the current crisis[12].

3. The research context of the project.

Regarding the topics and geographics areas of study, the research study the depressed coast areas, focusing on Calabria Region in Italy.

The Calabria region is a depressed region of the South with a cultural heritage that represents an immeasurable wealth. In the past this region has been subjected to drastic transformations under a strong human pressure and mass tourism which has determined an excessive and indiscriminate ground consumption and high risks for landscapes and cultural heritage due to the inadequacy of planning tools. Regarding the historical cities, these areas include important buildings and heritage constructions now degraded due to the strong depression caused by the explosion of beach low-cost mass-tourism outside the region. In all geographics areas of study, through the methodology to undergo, the intent for these areas is to supply an organic and coordinated set of multidisciplinary planning actions which aim to strengthen the cultural and landscape identity of the local communities, value the existing cultural heritage and increase the tourist attraction, activating new opportunities of sustainable development that are fully compatible with the environmental and landscapes qualities.

The coastal historical cities in Calabria Region are numerous and scattered throughout the region. Restoration and conservation and valorisation project for the the historical cities regional heritage is conduct by Calabria Region into different programme as the “Integrated Coastal Zone Management”, or the “Sustainable Environment”, or the “POR Programme Agreement (APQ) 2000-2006 "Agreement Framework Programme of Cultural Heritage" with which there were significant investments for the protection and enhancement of a significant part of the regional cultural heritage consists of the historical cities .

Interventions, many of which are in progress, involved a large number of assets, placing the emphasis on recovery and restoration interventions to enhance and networking. In the new programming period is necessary to complete the recovery and restoration intervetions and activate the necessary actions to build, from this cultural heritage, a regional system of cultural attractions able to make the most attractive Calabria Region to visitors / tourists and operators in the sector of sustainable tourism and cultural industry [13].

The specific objective (5.2) of the POR FESR 2007-2013 consists in Valuing Assets and cultural activities which comparative advantage of Calabria to increase the attractiveness of the region, to strengthen social cohesion and improve the quality of life for residents.

The Operational Objective 5.2.1 consist in to protect, to systematize, enhance and make accessible the cultural heritage of Calabria Region consists from the areas cultural and archaeological parks, from the historic buildings monuments and important architectures, from areas and facilities of industrial archaeology.

The objective of the strategy is the activation of an organic and integrated set of mutually consistent interventions aimed at the stewardship and valorisation of areas of high cultural and environmental importance. It does this by coordinating specific actions and through research into all possible synergies between the environment and adjoining areas, especially tourist ones, and favouring conditions to create new forms of employment.

Part of the interventions specifically regarding the the historical cities restoration projects, are a series of works aimed at improving the accessibility and safety of the most abandoned and degraded buildings. The interventions fits into a sustainable tourism process, promoting the development of eco-compatible, archaeological and cultural forms of tourism. Fixed and functional activities will make these assets accessible, and improve understanding and appreciation of the important role that they have played historically. The economic effects for local areas and populations will be extremely important [14].

The the historical cities works programme foresees a series of actions aimed to:

- implement safety measures on the restore buildings and their related areas;
- conserve the structures of the buildings;
- preserve the memories and stories, however small, and the historic and cultural value of the locations;
- valorise individual buildings and highlight tourism itineraries (including through signposting and posters) to build a deeper understanding of the the historical cities system of Calabria, and at the same time to valorise and grow the cultural and environmental resources within the area;
- valorise jobs involving the coastal zone culture and landscape, with the aim of growing sustainable tourism in these areas and to provide economic opportunities which will limit the exodus of local populations;

– restore economic value to coastal zone and defence sites that have suffered from centuries of neglect and abandonment, rediscovering the potential of coastal assets as sources of energy for local and regional development.
In essence, the intention of the Calabria Region POR programme is to contribute the characteristic identity of each area. At the same time, the project aims to repay these areas for the important roles that they played, by turning them into crucial nodes of a larger re-discovery of the territorial history of the Region.
The end goal is for thriving coastal areas and the historical cities with sustainable and quality tourism. The interventions will need to be complementary, systematic and coordinated, in order to achieve cultural recovery and, more generally, social and environmental restoration.
Consequently, the use (through a range of tours and visits) and management of each individual building, is intended to form part of a larger integrated system, and must result from the constant and active cooperation between Calabria Region and the various stakeholders.

4. **The strategies for the sustainable development of historical town centre**

The public heritage properties require enhancement strategies, which assume conservation and at the same time the development as a priority. Therefore the general objective of the research is the development of an integrated management strategy of the cultural heritage of historical cities for its re-use and valorisation in conjunction with the dynamics that regulate the evolutionary processes of the landscape and with the concept of sustainable cultural tourism to sustain the public and private decision makers [15].
Another objective of research is to verify and analyze the modalities of transformation and use of the cultural territory concerning the touristic development policies conducted by the local administrations and suggests the definition of a new type of planning and management that can integrate art, landscape and the quality urban and architectural system, oriented towards a typology of sustainable tourism; so it aims to establish an identity process. It is a new approach in the knowledge aware that a cultural territory should not only be examined scientifically, through conventional research systems, but also through an “artistic” and ”poetic” essence of the sites, always linked to objective contexts and to the perceptions of social communities. In plus in order to protect civil and symbolic function of the cultural heritage of historical town centres, public administration should take a strategic role of guidance and control of buildings’ transformations; to be effective, this requires new models of collaboration with the private stakeholders [16].
The research and sperimental work, in progress, developed with municipalities, in several coastal areas of Calabria, had aim to:

- Regenerate, re-use and value the cultural heritage through micro planning interventions which build relations between the spaces and generate identity processes;
- Suggest a model of sustainable tourist development for these areas;
- Satisfy the new requests in this sector, avoiding to compromise the landscape/environmental qualities and the historical/cultural sites;
- Promote an awareness and a widespread responsibility on the local landscape through participation processes;
- Support the opportunities of a tourism based on the sustainable valorisation of landscape and cultural resources of the territory, and the local identity peculiarities through the involvement of all the field operators and the local authorities in the planning process;
- Develop survey methodologies and operative procedures to identify a repertory of elements and indicators for the measurement of the cultural identity in scientific terms, in relation to the cultural, historical and architectural heritage, and to the considered territory;
- Develop an integrated model for the knowledge of the cultural heritage which completes the potentialities geographic information systems, socio-economic models and risk evaluation methods;
- Develop territorial marketing strategies and urban planning to know and control the territory through the defining of computerized technologies and geographical information systems;
- Identify strategies for the tourist fruition of the cultural heritage so to have an integrated territorial development, the creation of cultural itineraries and territorial marketing for the companies of the territory, through technologies that support the decision making;
- Propose guidelines for governance and development of innovative projects for the promotion of cultural heritage .

-

The results of the project were:

- favouring the sustainable tourism applied to the cultural heritage;
- expanding the potential of the cultural heritage promotion sector;
- enhancing the dissemination of research results and news in the field of innovative management of cultural heritage;
- increasing the visibility of the social and economic importance of the cultural heritage sector;
- supporting educational and training programmes and activities and also transfer/exchange of knowledge in the sector;
- developing a common framework of policies aimed at improving the protection, fruition and valorisation of cultural heritage;
- developing high-value tools and strategies applied to the cultural heritage management.

6 Conclusion

The goal of research project is to diversify the lines of economic development of territory and to encourage the development of a strong local identity through the creation of a cultural system that to support the valorisation of the cultural patrimony of historical cities. The proposed method combined the management of the cultural heritage both for the aspects linked to conservation and also those related to the valorisation, with the creation and the strengthening of the cultural systems.

The project develop an integrated Action Plan for the management and standardization of cultural heritage sites through a direct and constant involvement of the community and the stakeholders, and through the use of methods and procedures for the creative re-use of architectures, territories and sustainable cultural tourism policies.

The Integrated Cultural System contemplate a number of synergistic actions that produce a wide range of services and marketing activity and communication as finalized as possible [17].

The cornerstone of the proposed strategy lies in a strong integration between the components of the territorial dimension of the cultural sector and the related sectors: tourism, cultural communication, marketing, research, education, the vocational training, etc..

The integration between different sectors and between different places is pursued through a "territorial specialization," or through the identification of places for the settlement of actions to value, for cultural entertainment activities, for the diffusion of itineraries for the location of training related.

Bibliographical References

[1] SETTIS S., *Italia S.p.A. L'assalto al patrimonio culturale*, Torino, Einaudi, 2002

[2] ALIBRANDI T. - FERRI P., *I beni culturali e ambientali*, IV ed., Milano, 2001.

[3] FOÀ S., *La gestione dei beni culturali*, Torino, Giappichelli, 2001.

[4] BOBBIO L., *Le politiche culturali in Europa*, Bologna, Il Mulino, 1992.

[5] AA.VV*., Paesaggio e patrimonio culturale,* Bes, 2014

[6] CICERCHIA A., *Il bellissimo vecchio. Patrimonio culturale e territorio*, Milano, Franco Angeli, 2001.

[7] VALENTINO P.A. (a cura di),Dossiere guida sulle strategie di valorizzazione integrata delle risorse culturali, Formez, Ravello,2005

[8] VALENTINO P.A. (a cura di), *I distretti culturali*, Roma, Associazione Civita, 2001.

[9] ROSSINI V., La valorizzazione dei beni culturali. Quale futuro?,iIn *rivista AR* n. 109, 2014

[10] DE MEDICI S. –PINTO M.R., Valorizzazione dei beni culturali pubblici e strategie di riuso, in rivista *Techne* n.3, 2012

[11] CHITI M.P. (a cura di), *Beni culturali e comunità*, Milano, Giuffrè, 1994.

[12] DE VERGOTTINI G., *La tutela e la valorizzazione del patrimonio storico-artistico fra Unione Europea, Stato e Regioni*, in *Rivista giuridica dell'urbanistica*, 1996, 243 ss.

[13] CAMMELLI M. (a cura di), *Il codice dei beni culturali e del paesaggio*, Bologna, Il Mulino, 2004.

[14] FUSCO GIRARD L., NIJKAMP P., *Energia, bellezza, partecipazione: la sfida della sostenibilità. Valutazioni integrate tra conservazione e sviluppo*, Milano, Franco Angeli, 2005.

[15] SCAZZOSI L., *Politiche e culture del paesaggio. Esperienze internazionali a confronto*, Roma, Gangemi, 1999.

[16] BARACCHINI C., *Il ruolo dei sistemi informativi nella valorizzazione e gestione dei beni e nella programmazione territoriale: l'integrazione di competenze e risorse*, in *Primo Seminario Nazionale sulla Catalogazione*, Roma, 1999.

[17] De MEDICI, S., *Nuovi usi per la tutela e la valorizzazione del patrimonio costruito. La privatizzazione dei beni immobili pubblici*, Milano, FrancoAngeli, 2010.
[18] PINTO M.R. e DE MEDICI S., “The governance of the Italian cultural heritage: the enhancement process”, in FINCH E. (Ed), *Healty and Creative Facilities*, Proc. intern. conf. CIB W70 in Facilities Management, Emerald, Bingley, pp. 49-56, 2008.

HERITAGE and TECHNOLOGY
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Structures for the museumification of underwater cultural heritage

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Abstract

Today the underwater cultural heritage is increasingly in danger, thanks to new technologies it is possible to dive at an affordable price, resulting in considerable increase of pillage and destruction of underwater ruins. UNESCO has always been at the forefront for safeguarding this immense heritage, housed in the largest museum of the world, the sea that covering 70% of the Earth. This research aims to illustrate a different and original way to increase the values and museumification of the underwater archaeological assets. Through the observation of some projects from the past few years and especially with the analysis of contemporary projects, this research proposed a study on floating structures adapted for underwater heritage. Contemporary totem to indicate the presence of an archaeological structure or underwater ruins for diving in situ as well as educational promotion tool. The research was inspired by some of the 70's architecture projects, where the discover of the sea was a new frontier line of study, abandoned and resumed only in recent years with the emergence of the problem of consumption of resources and soil.

Keywords: Jellyfish Barge, Underwater heritage, UNESCO, floating architecture, Mokoko floating school

1. Underwater Heritage

The underwater cultural assets is under a special safeguard by UNESCO, only with the Convention of 2001[1] has come to an official document approved by more states partners. Today due modern technologies, it is possible to make immersion at a derisory price, this factor caused decay and bare of underwater sites. Involving the loss of priceless assets, composed of statues, amphoras and moveable decorations. The 2001 document was an important goal for guarantee the safeguard of this millenary cultural "deposit [2]". The convention suggest a series of actions for limit or spare damages submerged furniture, underwater structures and objects that must be in particular hygrometric conditions.
The principal aim is to maintain in situ the heritage, except for specific situations. Important is the concept of movable and motionless. Most of heritage is composed by buildings. It will be covered again, a technique fallen in disuse because could damage remains. It will be adopt techniques of partial conservation as to put a metal cage around the rests (Cape North of Rab, Croatia). Low-tech solutions that do not provide total protection of underwater asset, in these conditions it is possible to visit the site only with subs equipment and only in maritime situations.
This paper aims to analyse different ways to enjoy underwater static heritage, with the study of new solutions influenced by recent architecture projects. Solutions with not high budget as the Baiheliang Underwater Museum in China (26.000.000, 00 €, source: UNESCO[3]), but projects realized in recent years, in a period of economic crisis, made by unskilled workers and local materials, following principles of self-construction and sustainability.

1.2 Underwater assets in Italy

This amazing heritage studied by Italian research ***Archeomar***[4], in 2004 and 2009. The objective of the researchers was to conduct a census of Italian underwater heritage, giving to competent authorities a GIS tool with correct positions of sites and real situation of conservations. The research study territories of these regions: Campania, Basilicata, Calabria, Sicilia, Puglia, Lazio and Toscana. The South Seas of Italian peninsula was the location of cultural trades in more than thousand years of history. Today South of Italy is in a dramatic work situation. In maritime cities with this type of monuments, for decades, it is tried to produce jobs realizing civil ports and boatyards, setting aside develop in cultural preservation and valorisation. Predictably, with economic crisis, ports are luxury parks for rich people and shipyards are halted waiting from last wealthy people. In this scenery voluntary associations works without support of local authority or Superintendence, with courses and tours to discover this “cultural deposit”. When will we realize that there is a need to invest in this asset? Without protection and without enhancement, you may lose these riches that the world envies us. Are we willing to take that risk? The excuse of lack of funds is no longer eligible. There are countless documents attesting sprees for conservation projects that are made without an order or made worse, as the work performed on the “**Sacello degli Augustali**” in Miseno (Italy), after a short time the sea has flooded the site, cancelling all economic efforts made by local authorities.

2. Limits of *in situ* preservation

The UNESCO recommends in situ preservation, describing it as the first choice for the conservation of underwater cultural heritage. Clearly, there are not common strategies for all sites; each site has its own history and its problems. It is a basic concept of the restoration works. Similar strategies may be adopted for the same types of remains on which it operates. Following the classification of Archeomar researchers, identify structures, relicts, groups of rests and isolated evidence.

The idea of an archaeological park in situ, where the cultural evidences are maintained in not altered conditions is not a new proposal. This solution for an underwater site it is a hard challenge; there are many technical difficulties by hostile environment in which to work. The proposal of this paper is to find a possible solution for this situation, a lightweight structure allowing the use of the property by a floating structure, which will have the task of monitoring the remains as well as allow it to fruition through immersions. A building designed as a “base” for classrooms, cultural tours to the area or a support to a submerged yard with educational purposes. All these functions are necessary for the correct fruition of an archaeological park.

3. Best practices

From 70's to 80's there was an increase of floating architectures, offshore buildings on submerged cultural heritage. This "**movement**" has not been successful and that revolutionary thrust aborted before birth. The ideas were to use new materials, advanced technologies, to achieve a kind of dream, a vision of the future. Excessive cost of these solutions, the design too often inspired by amoebas or boats, have led to the death of this current. Very interesting and always a bad eyesight by critics as design exercises in themselves, far to conventional architecture movements and just an utopian buildings. One of the few examples of implementation of a framework for the preservation and enjoyment of an asset is the submerged USS Arizona Memorial in Pearl Harbour. It is a project on a “modern monument”. Not followed by other projects, except for achievements of naval purposes or for the discovery of the sea. Recently the projects of structures related to the sea rose, in spite of economic crisis.

In this period, where the architects fail to realize traditional buildings, some studies are looking for solutions to real problems, with floating structures (cultivation without soil or waste of realization of primary services "without soil"). Many of these ideas are now construct, with the use of simple structures and sustainable techniques. Simple Architectural solutions but not simplistic, behind these proposals are very in-depth technical studies and interdisciplinary involving experts from various fields of study with the community.

The winning idea is to self-constructions concept important but not essential for the success of the work, only in view of the optimization of the final costs. This type of structure is characterized by simplicity in construction, buildings with dry mounting and in situ, even some parts are mounted on the water, unlike the proposed buildings on architectural magazines with parts or entire structures built in the factory and generated by parametric calculations worthy of a spaceship. In the following are the three projects that best summarize the possibility to build on the water, with the use of limited economic resources and with a strong bond with the site. They are not a design exercise for architects; it is a technical and architectural response to a **real problem**.

The collaboration with local people is the demonstration of the success of these projects. In the Makoko Floating School[5], the community help to construct the prototype, showing the aim to build something new, as a contemporary monument that breaks the ordinary, in a city / slum where there are only spontaneous architecture.

3.2 USS Arizona Memorial in Pearl Harbor, U.S.A.

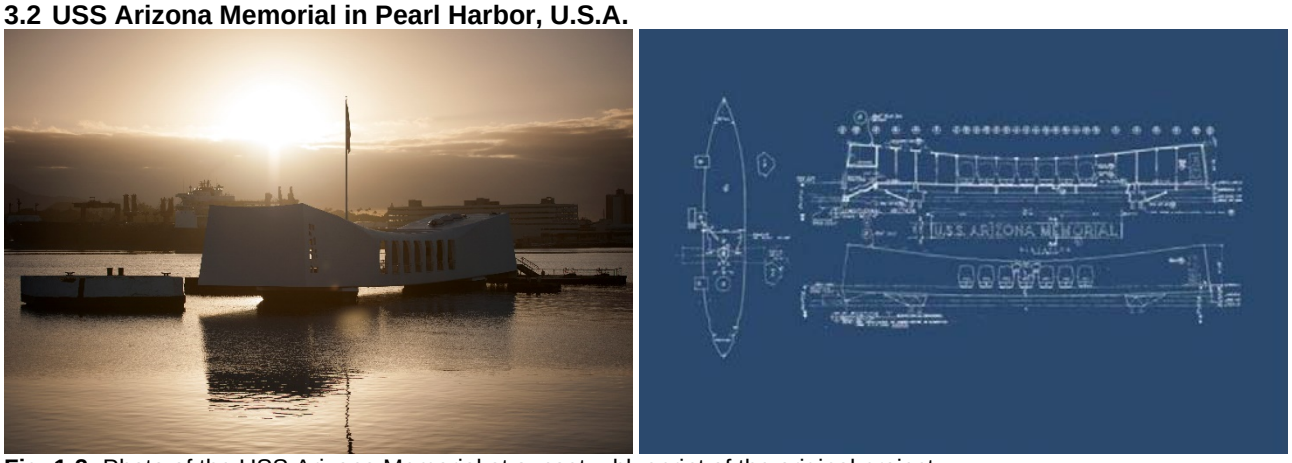

Fig. 1-2: Photo of the USS Arizona Memorial at sunset – blueprint of the original project.

This building is not a floating structure but represents a best practices for all the principles expressed in this paper. It is an intervention on a "recent monument", the warship USS Arizona[6]. A memorial dedicated to the victims of Pearl Harbor (Hawaii, USA), built in 1961 and designed by Austrian architect Alfred Preis, symbolically built on the boat's relict, far 100 meters from the coast, superimposed on the wreck destroyed with all the crew in the historic battle. Is an interesting blend between preservation and modern architecture, although the monument in question is not ancient because it was built in 1915. The concept is clear, overlay to the remains a symbolic structure long 56 meters capable of attracting attention in the bay, denouncing the presence of the monument and at the same time ensuring the protection, both from the weather and from possible looting or damage. The blueprints show a very ambitious project for the time, as well as a great sensitivity of the architect that overlaps the building without touching the sunken ship. An advance of about 40 years of the concepts expressed in the UNESCO Convention of 2001 that specify important of in situ conservation.

3.3 Jellyfish Barge, Italy



Fig. 3: Jellyfish Barge is a project developed by Pnat, photo by Matteo de Mayda[7].

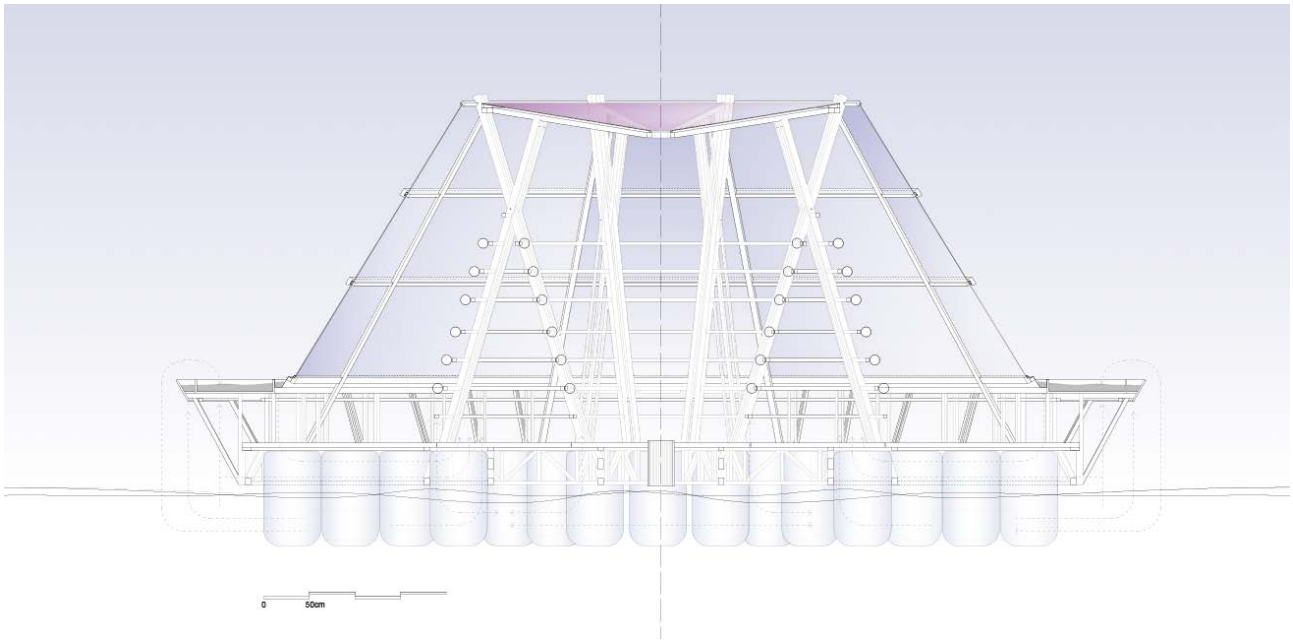

Fig. 4: Section of the Jellyfish Barge by Arch. Marco Russo.

The prototype have a total cost of € 200.000,00, the goal is to limit and optimize use of land, producing food for two families. The project will be sold at a figure of € 20.000,00, ensuring the livelihood of the users with for low cost and low tech solutions. In fact, the facility is equipped with self-sufficient technologies, without the contribution of electricity or be connected to the local water supply. One of the main strengths of the project is the modularity; the prototype shows an isolated structure that is designed to live in small or large river communities. One of the drawings published by the group of studies **PNAT**[8], presents a plan consisting of multiple units aggregated along a path / axis, more "cells" connected each to others. Important is the design of the greenhouse of 70sqm, the geometric shape ensures optimum behavior at sea, thanks to the position of center of gravity of the structure, even interior pillars serve to stiffen the entire structural system, between wood pillars there are the crop cultivation system. The manufacturing system is easy to construct and joint less, very fast and simple to install even by unskilled workers experts, very important concept for the realization of similar works. This element is crucial for projects that want to be achievable, with a low budget. The designers are not propose a "naval" solution, hybrids between architecture and boats, very expensive and achievable only by skilled labor. Very costly projects that marked the decline of many ideas proposed in 70s and 80s, but also in recent years. One of the precious solutions to be highlighted is the floating surface of 70 sqm, not all usable seen the shape of the shell. In fact, with this type of design the usable space in the building is reduced by -35.7%, the initials area becomes from 70 sqm to 45 sqm (calculation made by subtracting the space that is not usable for geometric constraints of the cover). Considering that much of the internal structure is "invaded" by inclined support, we have 29 sqm, 12 sqm net space, -58.4% of the initial surface. A common situation for this type of structure, probably trying to adapt these buildings for exhibitions and museums, you will think at a solution that does not sacrifice much of the interior space, more than half of the indoor space is lost.

3.4 Mokoko floating school, Lagos

This prototype was born in a unique context, in the outskirts of Lagos, slum area of Makoko called "the Venice of Africa" or "black Venice". "*An estimated 100,000 people reside in Makoko in housing units built on stilts. Yet the community has no roads, no land and no formal infrastructure to support its day-to-day survival. In many ways, Makoko epitomizes the most critical challenges posed by urbanization and climate change in coastal Africa. At the same time, it also inspires possible solutions and alternatives to the invasive culture of land reclamation*". **Nlè Architecture**[9]. The project is completely merged with the city, where there are buildings on stilts and floating, totally improvised are the background to this project which is designed as a new landmark for the rebirth of the area, as a low-cost and low environmental impact prototype for a new building typology. Based on a simple construction system, with easy to find and cheap materials, such as bamboo or wood or recycled plastic drums, very abundant in the area. Parts of the funds for the work are self-funded while the largest contribution comes from the program UNDP / Federal Ministry of Environment Africa Adaptation Programme[10]. Compared to previous project this building is bigger, the floating surface is 100 sqm, composed of 16 modules each containing 16 plastic drums. The basis of the prototype is 10 m x 10 m, which is erected on the triangular enclosure 10 meters high in which are located three useful levels. The design

of the building, for functional reasons, is translated into a triangular shape, always in order to optimize the behavior of the structure at sea. Once again, the position of the **center of gravity** has a considerable weight in the design process, resulting in a minimum loss of net space. The decrease of the structure results in a loss by -22% on the first level (classroom), while the -44% on the second floor (roof terrace) than the initial 100 square meters of "ground floor" (green and open space), of which loses about 10%. Wood is the material used to create these prototypes, a material very easy to carry and simple to assemble. The plastic drums are made from recycled material, also the use of solutions that reduce power consumption are the basis of these projects. Furthermore, having reduced dimensions, require little energy to operate.



Fig. 5: Mokoko floating school in Lagos by Nlè Architects.





Fig. 6 - 7: Photos of floating platform.

4. “Guidelines” for underwater heritage

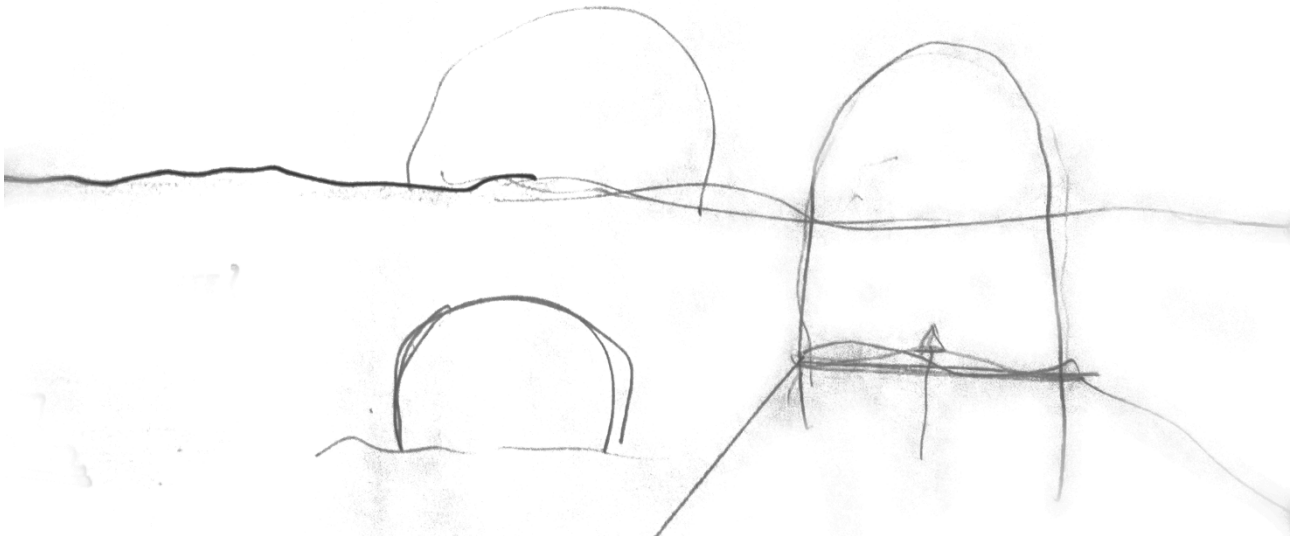

Fig. 8: Sketch of the French architect Jaques Rougerie about floating structures, Paris 2012.

In times of economic crisis finance ideas that could enhance territories and monuments is a difficult undertaking. The illustrated projects are for the most part are self-financed, carried out thanks to community programs. These groups works as a start-up with the "hope" of being able to pursue its vision and achieve something more important than a prototype. The hypothesis behind this paper is to collect some guidelines that could be used to develop a prototype of a structure able to enjoy area of the archaeological submerged remains, for constantly monitor of the area, indicating the remains or archaeological site. A design based on **modularity**, with the possibility of adding "cells" or to use one single unit, according to the requirements of site and economic availability. The idea is to propose a **low-cost** design solution, contrary to usual expensive projects. An architecture solution, a structure designed for humans, not merely an engineering floating structure. The concept is that at the bottom of prototype will be essential elements, while the shape and architectural language will be at the discretion of the designers and consequence of local identity and materials used. As previous projects the architectural form is forced by the behavior of the structure in maritime situations. The centre of gravity plays a very important role in the final design of the structure. This involves the use of simple forms, pseudo-prismatic volumes, which do not compromise the safety of users and any artifacts. In the case of Jellyfish Barge was a truncated cone shape with an octagonal base, in Makoko floating school, a triangle extruded, slender volume but solidly fixed to floating surface in order to meet any possible waves and storm surges. The architects of the study NLE Architects specify that structure is held in place by an anchor, is not fixed to the seabed using dead bodies to facilitate transport in bad sea conditions. Solution adopted too by Studiomobile[11]. Furthermore, the creation of structures fixed permanently at sea entails a very high cost, and very complex studies to ensure the feasibility of the work. The sea is unpredictable, an optimal location would be a hollow or a bay, where the currents are not very strong or even absent, as the Centre for underwater Archaeology of Jacques Rougerie in Alexandria[12] (2001). The “mobile” solution seems the most practical and feasible, also allows to secure the structure during heavy storms or maintenance, lowering costs compared an intervention totally in sea. Referring to the project of floating Greenhouse, photos of the site show the construction of the work on the ground and then put into the sea. All elements are made on-shore and later mounted on float surface. The structures are made with wood parallel elements, with an additional stiffeners places it in the middle and the end points. This technical solution optimize time and cost. The construction elements should be all equal, in order to realize quickly all structural components and mount them in a short time and in a simple manner for unskilled workers. This solution certainly does not affect the design choices of the architects, since it is a rule that applies to traditional onshore buildings.

4.1 Architecture vs. Boat

Often architects draw projects inspired by the underwater city of Otoh Gunga (Star Wars - Episode I), resulting in a structure that loses touch with reality and becomes the protagonist of territory, in negative mode. With this project theme is easy to fall into cliché, making boats or very expensive oil platforms. Many contemporary architects that work on maritime solutions, as the Belgian architect Vincent Callebaut, that in one of his many projects, such as **Physalis**[13] - the amphibious garden, imagine a jellyfish’s boat-shaped! A

naval engineer solution, it is a bad practices. The two references above, Jellyfish Barge and Makoko floating school, best represent the concept that architecture placed in the sea does not have to be inspired by the natural forms. Proposing a fluid language to be able to get to a building "organic" and should not have a complex structure but can also be supported by a simple structural system, elegant, inspired by the trusses of Japanese buildings, where the components are all joint less. Best practices are represented by some projects of the architect Jacques Rougerie, who seems to have a greater sensitivity in some projects, as **Archéoscope** (1977) and **Centre d'Archaeologie Flottant**[14] (1976).

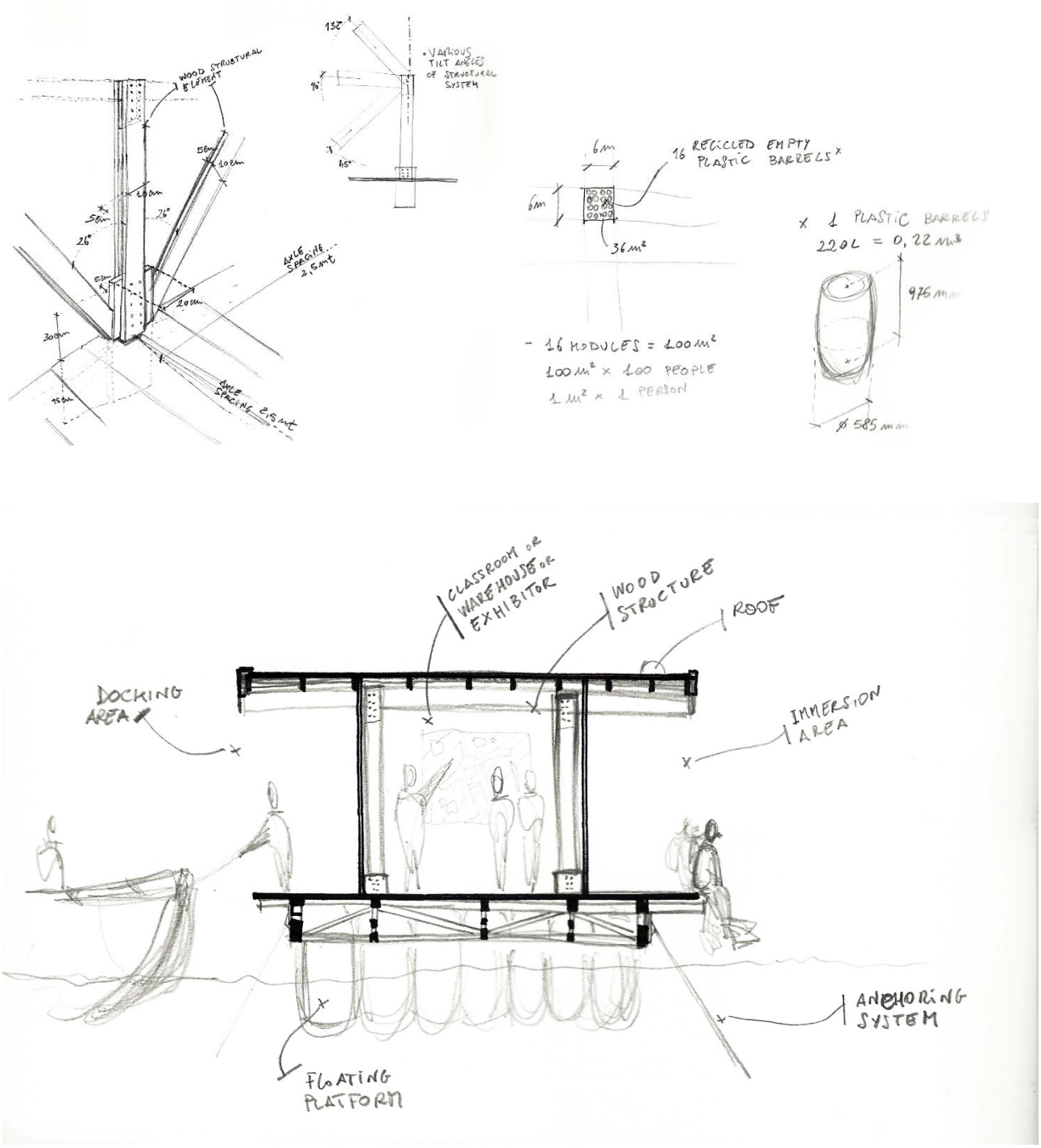

Fig. 9: Guidelines for the “prototype” by Arch. Marco Russo.

5. Future visions / Conclusion





Fig. 10 - 11: Vision of the Makoko floating building by Nlè Architects.

This article represents the first stage for development of a **prototype / floating building** that wants to be an alternative for the protection and enhancement of the submerged asset. An interesting challenge and unpublished, made possible by the simplicity to create low cost floating structures. The idea of small structures or a series of floating pavilions, could be perfect for this type of heritage. Tours in the areas of submerged sites and courses on underwater archeology are organized in small groups of people. Consequence of the fact that the mobility is via boats of small / medium size. There is no specific territory for the contextualization of this building. The goal is not to invade all archaeological sites with the same structures. The assumptions of the research is to identify basic concepts through which we can develop a small structure, it would be interesting and desirable that the shape of the building took its cue from the place. Adapt the concepts on identity of the place. This solution is adaptable both on submerged buildings, both sites with movable cultural evidences, as relics or remains of ship's loads. In the case of underwater buildings, it would be interesting to try to create a platform to serve as a in situ "base" for diving as well as a location for augmented reality / virtual reconstructions room, where you can understand through computer graphics thing hosted on seabed. For the movable remains, the most common solution is to transport the rests in a nearby on shore museum or ad hoc building. This solution is applicable only in case of amphoras or small items. In the case of wrecks or objects difficult to transport, it is essential to create a station that promotes diving activities. This research does not consider phenomenon of diving as a **temporary solution** to the fruition of this assets. Indeed, this is in many areas an important business sector, as in Phlegrean Fields, where there are many associations that organize archaeological tours. The aim is to design a building that favors diving activities and underwater archaeology. A tool that ensures the protection of the remains, reporting them physically and can promoting use of the sites by diving or even just visiting the marine protected area. As the artifacts that rests buried for centuries and millennia are still almost intact, remains at sea undergo the same process. For this reason, UNESCO suggests leaving in situ all the rests, to avoid further damage to the findings and possible destruction of this heritage. The protection and restoration of these sites is very expensive, and subject to frequent maintenance, costs almost impossible to sustain for superintendents and local authorities.

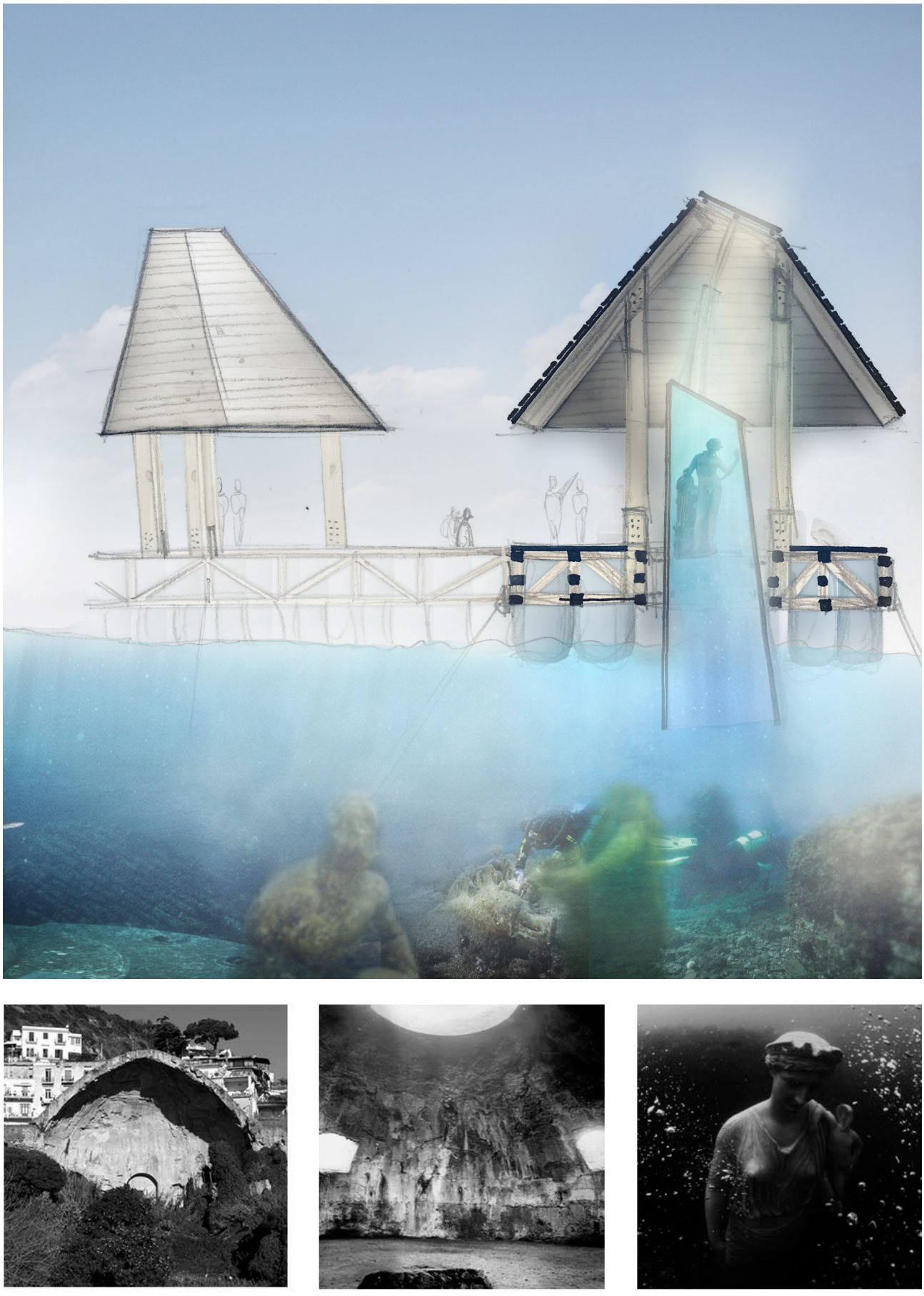

Fig. 12 - 13: Proposal for a floating structure for the Phlegrean Fields, Arch. Marco Russo.

Bibliographical References

[1] MAARLEVELD, Thijs. GUE'RIN, Ulrike. EGGER, Barbara. *Manual for Activities directed at Underwater Cultural Heritage - guidelines to the annex of the unesco 2001 convention.* Parigi: UNESCO, 2013. 100 p. ISBN 978-92-3-001122-2

[2] CALABRESE, Omar. Renzo Piano. Pompei, progetto per la città del tesoro. In Eco. U, Zeri. F, Piano. R. *Le isole del tesoro.* Venezia: Electa, 2008, p. 107.

[3] Baiheliang Underwater Museum: www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/about-the-heritage/underwater-museums/the-baiheliang-underwater-museum

[4] Archeomar: www.archeomar.it

[5] ADEYEMI, Kunlé (Nlè Architect). *Makoko Floating School*. A+U, 524. Tokyo: Japan Architect, 1970 – 2015. ISSN 4910019730545.

[6] BERGMAN, Teresa. *Submerged Patriotism: Evolving Representation at the U.S.S. Arizona Memorial Visitor Center*. Exhibiting Patriotism. Walnut Creek, California: Left Coast Press. p. 31/58. ISBN 978-1-61132-679-6.

[7] Jellyfish Barge photos: www.matteodemayda.com/Jellyfish-Barge

[8] Pnat: www.pnat.net/jellyfish-barge

[9] Nlè Architects: www.nleworks.com/case/makoko-floating-school

[10] GLANCEY, Jonathan. *Learning from Lagos*. The Architectural Review – September 2013, p.64-71. London: EMAP. 1896 – 2013. p. 64-71. ISSN 0003–861X.

[11] Studiomobile: www.studiomobile.org/Jellyfish-Barge

[12] ROUGERIE, Jacques. *Museo di Archeologia sottomarina in Alessandria d'Egitto*. L'arca, 278. Milano: Arcadata, 1986 – 2014. p. 80 – 83. ISSN 0394–2147.

[13] CALLEBAUT, Vincent. *Physalia*. L'arca, 278. Milano: Arcadata, 1986 – 2014.p. 84 - 89. ISSN 0394–2147.

[14] ROUGERIE, Jacques. CIVARD RACINAIS, Alexandrine. *De vingt mille lieues sous les mers à sea orbiter.* Parigi: Democratic book, 2010. p. 218. ISBN 2361040026.

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Architectural and Environmental Compositional Aspect for Technological Innovation in the Built Environment.

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Abstract
This paper focuses on the complex relationship between historical consolidate context and new building design projects, both from compositional and environmental points of view. In spite these two approaches often show contradictions in their nature, their integration is essential from the very early stages of the design process, both to improve and/or efficiently preserve the environmental and architectural quality of spaces. The aim of this work is to define a number of guidelines to support and inform the design process since its early stages, and eventually ensuring the quality of the built environment, both aesthetically and environmentally. To this end, the paper explores the use of climatic and microclimatic analysis as a tool to maximize the environmental and sustainability performance of future buildings. In particular, the work analyzes tools such as the site microclimatic matrix, as support to the climatic considerations about different technological choices for heating and cooling systems; and to the architectural/compositional approach definition.

Keywords: architecture, environment, microclimate, technology, innovation

1. Introduction
The building sector, excluding industrial buildings, is responsible for almost 40% of total primary energy consumption in developed countries [1]. This percentage includes energy demand for space heating and cooling, hot water production, lighting, cooking and other appliances. In addition, considering the global warming effect of a persistent trend of green-gas emission, the energy consumption for space cooling is rising in several countries [2&3]. Within this framework, a passive approach to building design and construction, i.e., taking envelop rather than HVAC system as the main indoor environmental control technology, is essential for reducing energy consumption in the building sector. This approach can contribute to curb the global warming trend related to carbon emission from oil and gas-dependent space conditioning systems. Nowadays, technologies able to increase the efficiency of building and equipment are consolidated and incentivized in legislation, standards, and codes of practice. In addition, passive and hybrid solutions for reducing solar gains and mitigating internal gains in summer, and solutions for increasing solar gains in winter, are well known – even if, especially for cooling, not widespread – could decrease drastically, if more diffused, the energy need for heating and cooling a building. However, to reach much more stringent goals such as the one related to near-zero-energy-buildings (NZEB), as set by EPBD 2010/31/EU by 2020, or, even more, the future net-positive-energy-building (NPEB), a much stronger effort than currently done to integrate low environmental impact technologies to a sustainable architectural design approach needs to be exerted.
In spite the scientific progresses achieved in the studies of environmental systems and technologies, the debate about the aesthetic of sustainability seems to have fell behind the interest of professionals and academics. The projects categorized as ‘sustainable’ are often defined either according to the number and type of environmental systems and technologies utilised, as well as their efficiency, rather than their architectural design approach. The contemporary examples of ‘sustainable’ architecture show a number of different aesthetic approaches that designers seem to have undertaken. These approaches span from the more literal design solution of ‘environmentally aware’ buildings, in which the relation with the natural resources was conceived as a design tool; to the more technology oriented approaches, where technologies and environmental artificial systems became expression themselves of an architectural aesthetic. Examples of

these approach can be considered: 1) the Jacob House 2 by Frank Lloyd Wright, in Middleton, Wisconsin, United States, built between 1944-1948, in which the incidence of the solar light was literally utilised to shape the building and the floor plan; to the 2) the environmental houses largely produced in the 70s where technological features where heavily applied to the buildings without much design integration efforts; to 3) the more sophisticated example of high tech buildings such as the Centre du Pompidou by Renzo Piano, in Paris, France, built between 1971 – 1977. The architectural language of sustainability seems therefore to follow either the mimetic tendencies of relating to the environment in a literal manner; or to show the approach to sustainability by expressing the efficiency of the technological features put in place. Yet, today the path of integration seems not to be explored or discussed as much. This happens despite the vast availability of software and tools that can assist the design process, by integrating microclimatic analysis and environmental systems and technologies analysis. This paper will explain in the next sections how some of these tools could 1) offer support to the design process; 2) enhance the integration between design and environmental technological systems; and 3) contribute to the debate on the definition of an aesthetic of sustainability.

2. The preliminary design process

According to Nigra and Marfella [4] the delivery process of building projects can be subdivided in a number of theoretical areas such as: building opportunity generation; building scope formulation; building/project production; building erection; building functioning; and project definition and control. Each of these phases, - from conception to construction - is characterised by a number of instances in which the integration between design choices and technological systems can be critical to enhance the environmental and architectural performance of projects. Specifically, this paper will deal with the area of project production, focusing on the design process, as critical moment to explore the integration between architectural characteristics and technological features. Several researchers [5] explained that the earliest involvement of environmental awareness in the design process, the more cost, time, and quality effective this process appear to be. Moreover, Grosso [6&7] together with Chiesa [8] pointed out a number of critical aspects to consider during the phases of building design programming and building preliminary design, the design process. Beside the clients' need, the building scope and the building codes or regulation – characterising the building program – another important part of the preliminary design, the site analysis, represents a critical aspect of integration between environmental awareness and architectural design approach. The site characteristics, such as sun, wind, light, ground, water, surrounding buildings, and urban legislation, has the potential to dramatically inform building orientation, dimensions, interrelation, and localization, as well as informing the overall design approach. During the preliminary building design, technical and environmental requirements can contribute informing geometry, volumes, colours, construction systems selection, and assembly/erection type.

As the flow chart in Figure 1 shows, the building design program phase is centred to a loop between compatibility and performance assessment of choices related to the definition of virtual space units, which is a result of fulfilment of both functional and environmental requirements. These, in turn, depend on the client brief – determining design objectives, activities to be performed in the building, and relevant needs – as well as laws, standards, and regulation at various scales. On the side, but not less important, the site analysis – often not considered part of the building programming – represents an essential operation for the environmental compatibility assessment of building design choices.

3. Environmental aspects of the preliminary design

The environmental aspects of the preliminary design process are related to the assessment of all factors affecting the impacts of the building-to-be-designed on the physical context at various scales: spatial, i.e., global, regional, local, and indoor/outdoor as well as temporal, i.e., concerning both the day-by-day running of the building and its entire life cycle.

Environmental assessment implies different approaches and methods at different scales. However, at the preliminary design phases, two main types of analysis are, generally, considered: environmental building programming and site analysis. After a brief framework description, this paper will focus on the latter, with particular attention to site climate evaluation.

3.1 Environmental building programming

Environmental building programming follows a performance-based approach characterized by a process of analysis and assessment from user needs and activities to requirements, and from functions to virtual space definition, according to the compatibility (environmental) loop above described and shown in Fig. 1.

During this process various tools, such as diagrams, checklists and matrixes, can be applied. Examples of these applications are numerous, but generally they do not deal with environmental aspects [9;10&11].

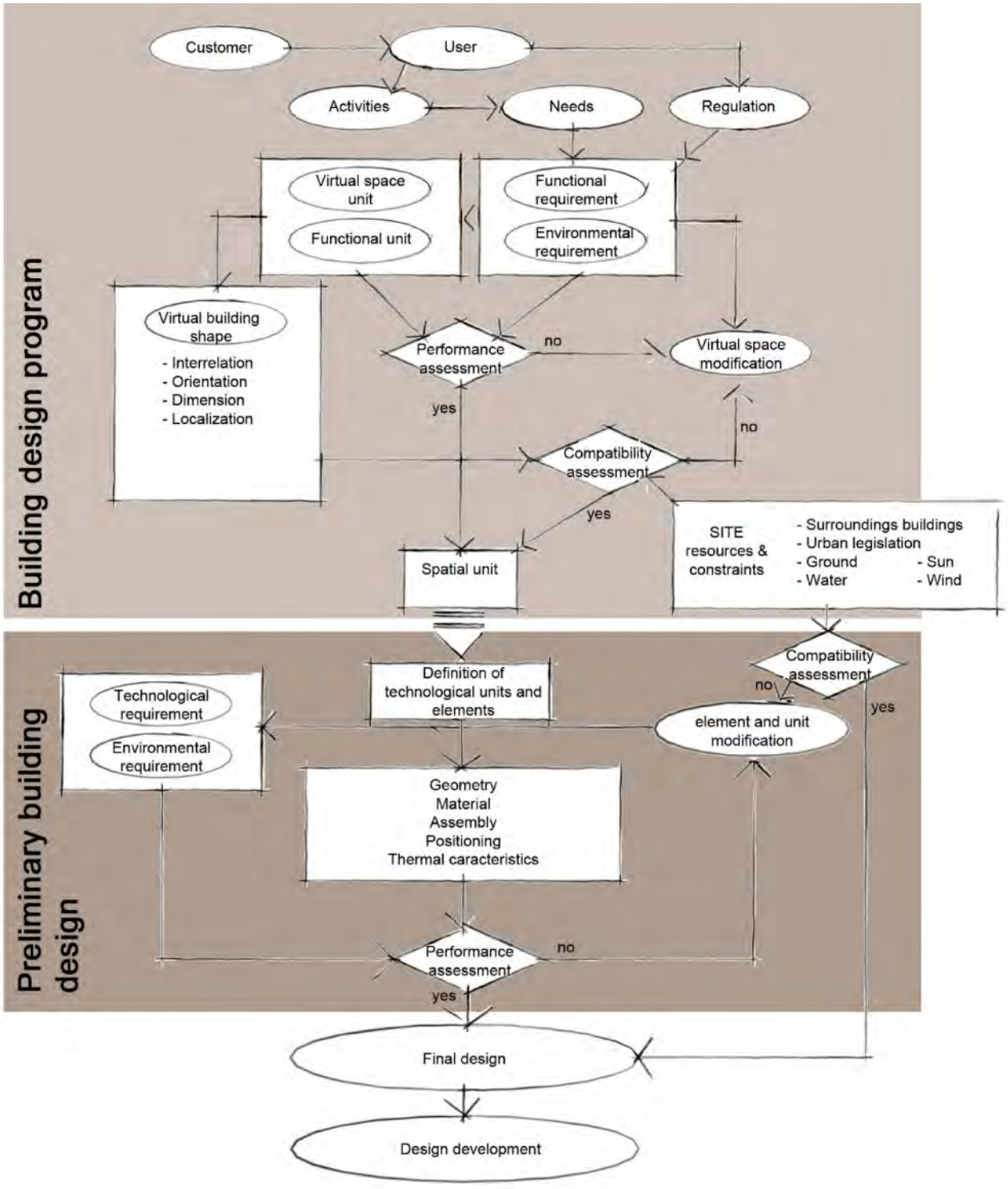

Fig. 1: Flow-chart of the preliminary design process based on a performance-driven approach (image modified from [6]).

The main actions to be carried out in the environmental building programming phase are the following:

- reception of the client brief including building design objectives and users' needs;
- reception of laws, standards and regulations related to the building type to be designed;
- list and classification of activities and relevant environmental requirements;
- analysis of input/output flows related to the activities affecting the environment, both outdoor and indoor;
- list and classification of functions related to the activities;
- definition of virtual space units as spatial representations of aggregated functions;
- definition of dimensional (order of magnitude) and environmental requirements of virtual space units;

- aggregation of virtual space units according to their reciprocal linkage characteristics and constraints in compliance to the defined environmental requirements;
- alternative configurations of virtual space virtual layout.

A virtual space does not have physical boundaries but just potential links within itself, with other spatial units, and with the external context. These potential links are related to various aspects: dimensions, context, geometry, communication, physics phenomena (airflow, daylight, solar radiation). The environmental building programming focuses on some of these aspects, the ones which have an impact on resources and emissions as mentioned above.

3.2 Site-climate analysis

The site analysis phase of a preliminary design process concerns various aspects, such as urban context, transportation, landscape, social issues, town-planning tools, land use, economic value, environmental impacts. Within the latter, the site-climate analysis is aimed at evaluating the potential vocation of a specific site to locate an activity, or a virtual space, or a building, with regard to thermal comfort as a function of climate factors such as solar radiation and wind flow [7&12]. The site-climate analysis uses a site microclimate matrix (SMM) as a tool allowing for optimising the location of outdoor activities, space units, of aggregation of them, i.e., buildings, in relation to thermal comfort and energy flow. The elaboration method behind it was introduced by two American scientists [12] and modified by Grosso [7]. It allows designers to locate properly, according to a sustainable and bioclimatic approach, the different activities/functions/space units defined in the building programming phase as described above. An SMM can also be used to study the optimal layout of buildings in urban design by evaluating the influence on potential exposure/protection related to solar radiation and wind either for new assets or in a specific existing context.
An SMM is elaborated as a graphic overlay of output from the analyses of solar shading and airflow dynamics on a lot resulting on a four variable zoning derived from the combination of shaded/non-shaded and windy/sheltered zones (Fig. 2). This zoning is called “matrix” because it is discretized by a normal grid, whose cells are characterized by one of the four variables. Each variable is then associated to a potential comfort level (see Table 1) in order to assess its vocation as a recipient of activities.
The SMM is built on a virtual plane, which is generally set at the ground level, even if it is possible to produce different matrixes by changing height or to create a three-dimensional matrix of the project site. This choice depends on the specific needs, remembering, however, that three-dimensional analyses require a higher investment in terms of time, cost and complexity, and could require three-dimensional CFD software for airflow studies. It is advisable to proceed with analysis on the vertical facades of building under design, or retrofitting, in order to evaluate the mutual influences between different buildings and obstacles.

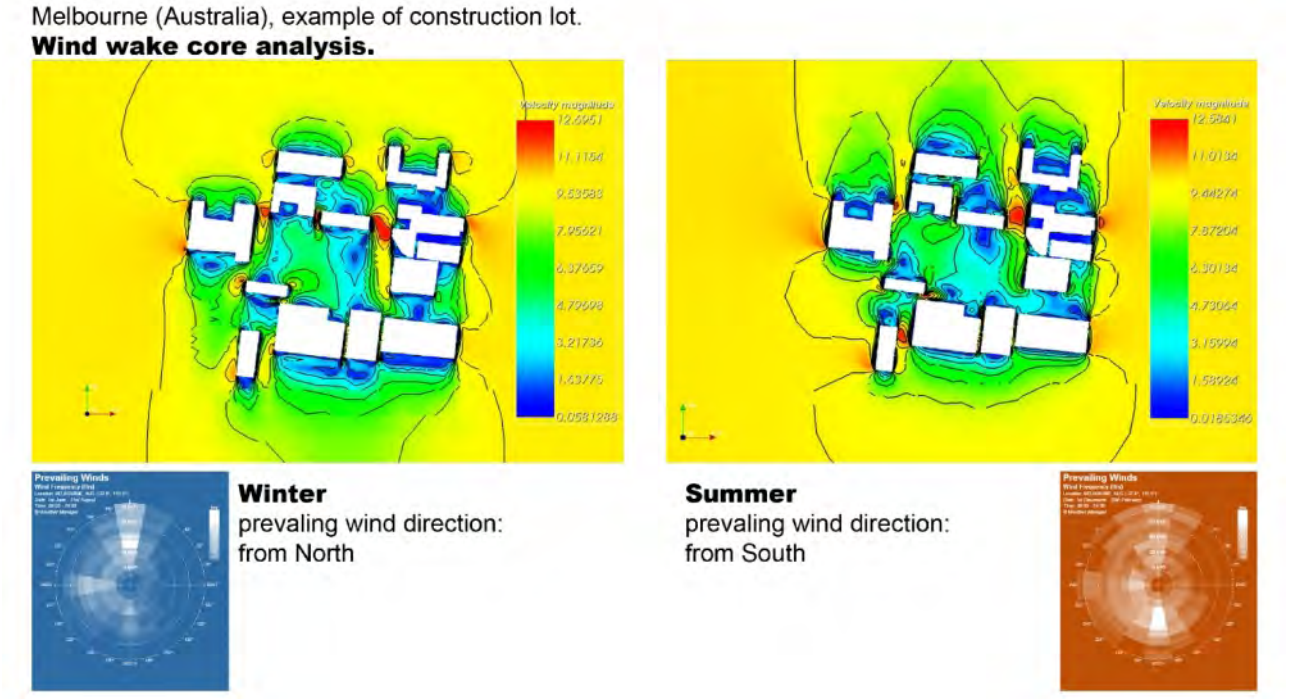

Fig. 2: Example of wind wake core analysis on winter and summer (point 4) for a construction lot in Melbourne, Australia. The airflow analyses were conducted by using the software KARALIT CFD.

Theoretically, an SMM changes over time following the yearly, daily, and hourly apparent sky position of the sun and the seasonal (or monthly, daily, hourly) prevailing wind direction, on the considered site. However, a SMM, being used as a design parameter, is elaborated at reference extreme climate conditions as expressed during solstices, in the morning and afternoon, and relevant seasonal prevailing wind directions. As an example, the reference dates are, in the Boreal hemisphere: 21 December at 10:00 and 14:00, and 21 June at 8:00 and 16:00. However, it is possible to choose different timing based on the hottest and the coldest days of the year, estimated by using the typical meteorological year (TMY) of the locality or using as general reference July 21st and January 21st at 9:00, 12:00 and 15:00 [12]. When the calculation of shading is conducted by using specific software, it is important to paid attention to the correct time definition (local Meridian, reference Meridian, solar hours).

The following steps shall be performed to elaborate an SMM:

1. definition of the site context and constraints due to surrounding built and natural obstacles;
2. discretization of the analysed lot by a normal grid with cell's dimensions depending on design scale (for example, 5x5 m);
3. analysis of solar paths and relevant shading dynamics in different reference days and hours;
4. seasonal analysis of wind wake cores (see Figure 2) (or different temporal analysis, for example day-night breezes);
5. overlapping of the results from the above analyses (steps 3 and 4) on the grid defined in step 2 in order to classify each cell by a 2x2 matrix of climate conditions (sunny-windy; sunny-calm; shaded-windy; shaded-calm); this process is repeated for all considered hours and days (see Figure 3);
6. assigning a score to the four classes identified according to the activities to be located for each matrix developed in step 5 (see Table 1);
7. construction of four time-referenced SMM for each type of activities/functions/space units.

In Figure 2 wind wake core seasonal analyses on a specific plot localized in Melbourne, Australia, are reported. The prevalent chosen wind directions are from North in winter (from hills to sea) and from South in summer (from sea to land), even if an analogous change in directions occurs daily due to a day-night breeze regime. These analyses were carried out using the CFD software Karalit [13]. Existent building context reduces the wind velocity at the ground floor in the East side of the construction lot, characterized by a low potentiality for natural ventilation. At the same time, on the same side, nearer to building, a Venturi effect is evident, with consequent increases in the wind velocities. The predisposition of tree barriers with different height could represent an effective solution for curbing this potential discomfort situation.
Wind analyses could be conducted in different ways: using a CFD software, which needs specific aerodynamics knowledge and is time-consuming and costly; by wind tunnel simulation, which requires a physical model, specific knowledge and a dedicated laboratory facility; or by a simplified method based on the statistical correlation of wind tunnel test data on modular solids with varying geometrical dimension and wind incidence angle such as the one elaborated by Grosso [7] on the basis of a previous research [14].
The score assigned to each cell of an SMM, as indicated in the above step 6, is based on a classification of potential outdoor comfort conditions related to types of activities and their relevant metabolic rate, that can be assess on a qualitative scale (Table 1) or using quantitative values.

Activities		**Season**	**Relation between site microclimate matrix and comfort conditions**			
			shaded-calm	**shaded-wind**	**sun-calm**	**sun-wind**
Low metabolic rate	Stay; walking around	Winter	Unfavourable	Worst	Optimal	Good
		(cold wind)	Good	Worst	Optimal	Unfavourable
		Summer	Optimal	Good	Worst	Unfavourable
		(high RH)	Unfavourable	Optimal	Worst	Good
Medium metabolic rate	Walking fast; slow running	Winter	Unfavourable	Worst	Good	Optimal
		(cold wind)	Good	Worst	Optimal	Unfavourable
		Summer	Good	Optimal	Worst	Unfavourable
		(high RH)	Unfavourable	Optimal	Worst	Good
High metabolic rate	Run fast; gym activities	Winter	Worst	Unfavourable	Good	Optimal
		(cold wind)	Good	Worst	Optimal	Unfavourable
		Summer	Good	Optimal	Worst	Unfavourable
		(high RH)	Unfavourable	Optimal	Worst	Good

Tab. 1: A classification of outdoor thermal comfort conditions in relation to the macroclimate matrix variables for different types of activities.

As an example of a quantitative assessment, a score could be, for a high metabolic outdoor activity, such as running: in winter, 1 for shaded-calm, 2 for shaded-windy, 4 for sunny-calm, 5 for sunny-windy; in summer, 1 for sunny-calm, 2 for sunny-windy, 4 for shaded-calm, 5 for shaded-windy.

3.3 Architectural/compositional implications

The SMM presented above was used as a base for a design research atelier conducted in the Master of Architecture (Sustainability) of the Polytechnic University of Turin. The call of the atelier was to develop a design proposal for a new university building in Melbourne, following the existing brief for the new Architecture Building and planning faculty at The Melbourne University.
In this atelier, the microclimatic analysis was applied to a number of stages of the design process, to inform the decision-making process on a compositional level.
As showed in figure 3 and 4, the microclimatic analysis produced a reading of the site that showed the areas of calm (wind and sun) over different time of the year. By analyzing the site characteristics, a design proposal was defined optimizing the volumetric definition of the building, in order to defined accesses; shape the volumes; define the internal layout and spatial allocation of functions; and determine the microclimatic characteristics of each façade defined in the project (figure 4). This latter allowed the design of a façade in which pattern, shading systems, and glazing features where equally balanced according to the solar incidence and surfaces exposures (figure 6).

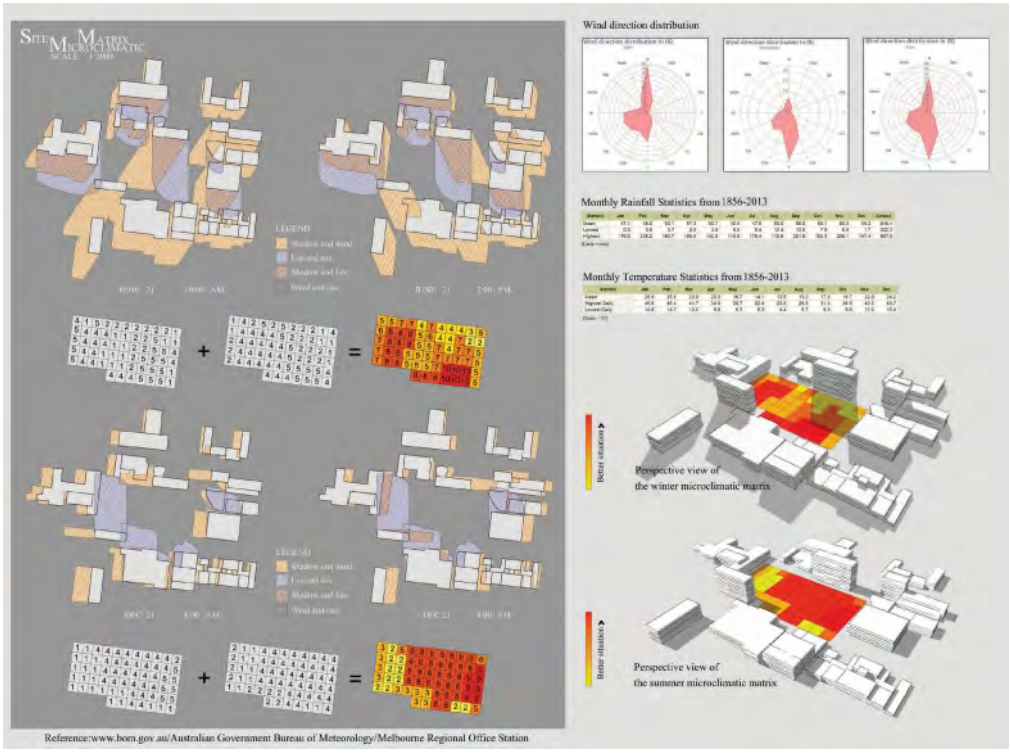

Fig. 3: Example of calculation of a site microclimate matrix as base for a volumetric study (study by Mamak P.Tootkaboni, Danial Mohabat Doost, and Xiaochen Song).

The definition of the volumetric organization allowed the definition and the further analysis of the facades in the design proposed. Figure 5 shows and example of solar exposure analysis in which the facade was 'mapped' according to incidence of the sun on each its part. This analysis allowed modifications and further decisions on the shading devices design as well as of the perforation patterns of the façade envelope (figure 6).

Further analysis was also utilised to determine the performance and specifications of the main façade components defined in the project proposal. Specifically, glazing characteristics, shading devices, and ventilated façade rain screen were selected ad-hoc for each façade, according the exposure and characteristics, elaborated in the micro-climatic analysis.

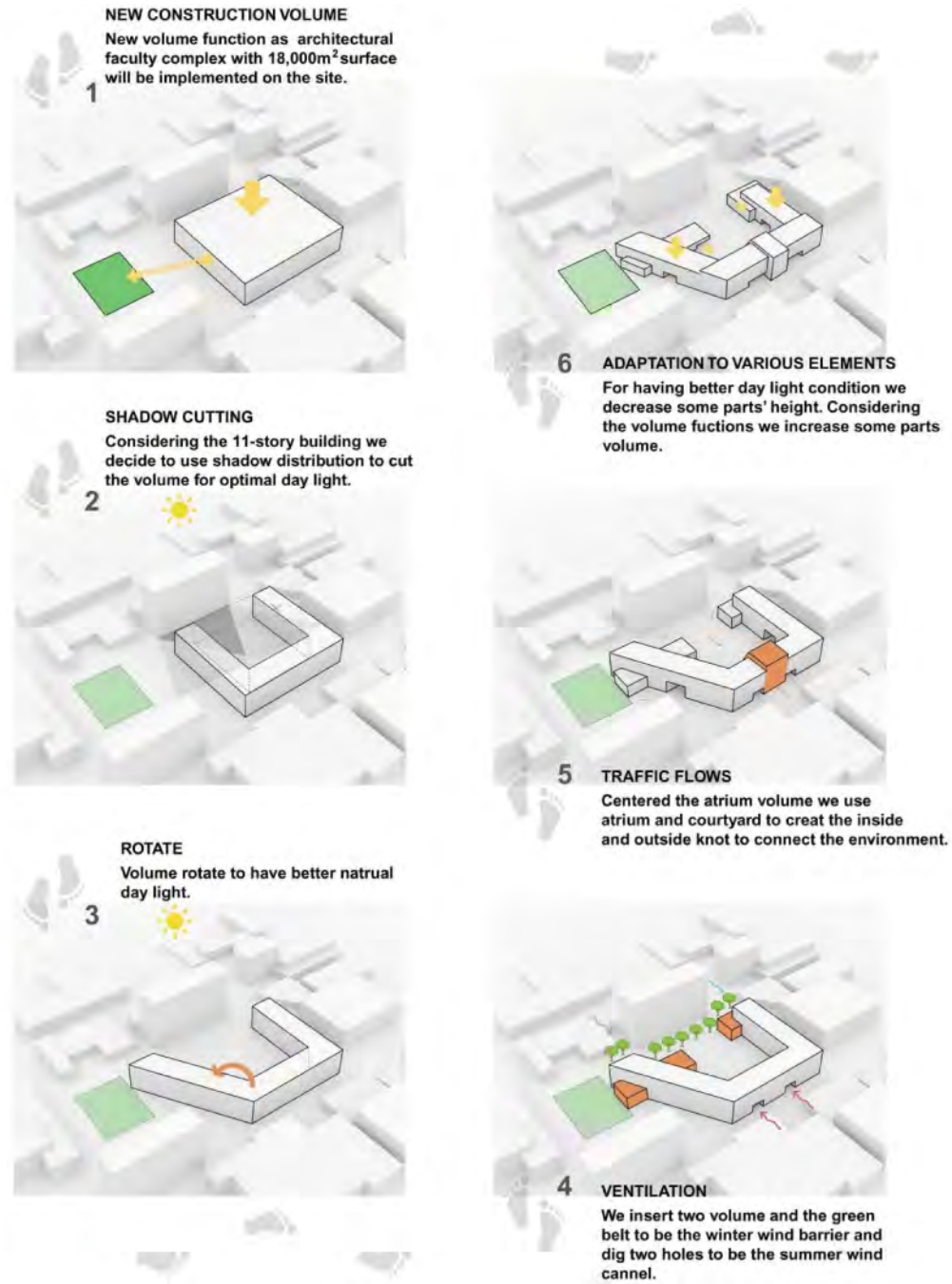

Fig. 4: Example of design process in which the volumetric organization was defined to maximize the characteristics of the site, previously explored by the microclimatic analysis (study by Mamak P.Tootkaboni, Danial Mohabat Doost, and Xiaochen Song).

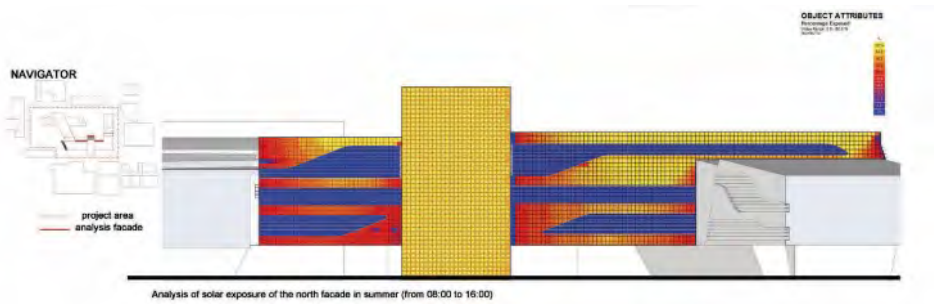

Fig. 5: Example of solar exposure analysis on the design proposed for the site (study by Mamak P.Tootkaboni, Danial Mohabat Doost, and Xiaochen Song).

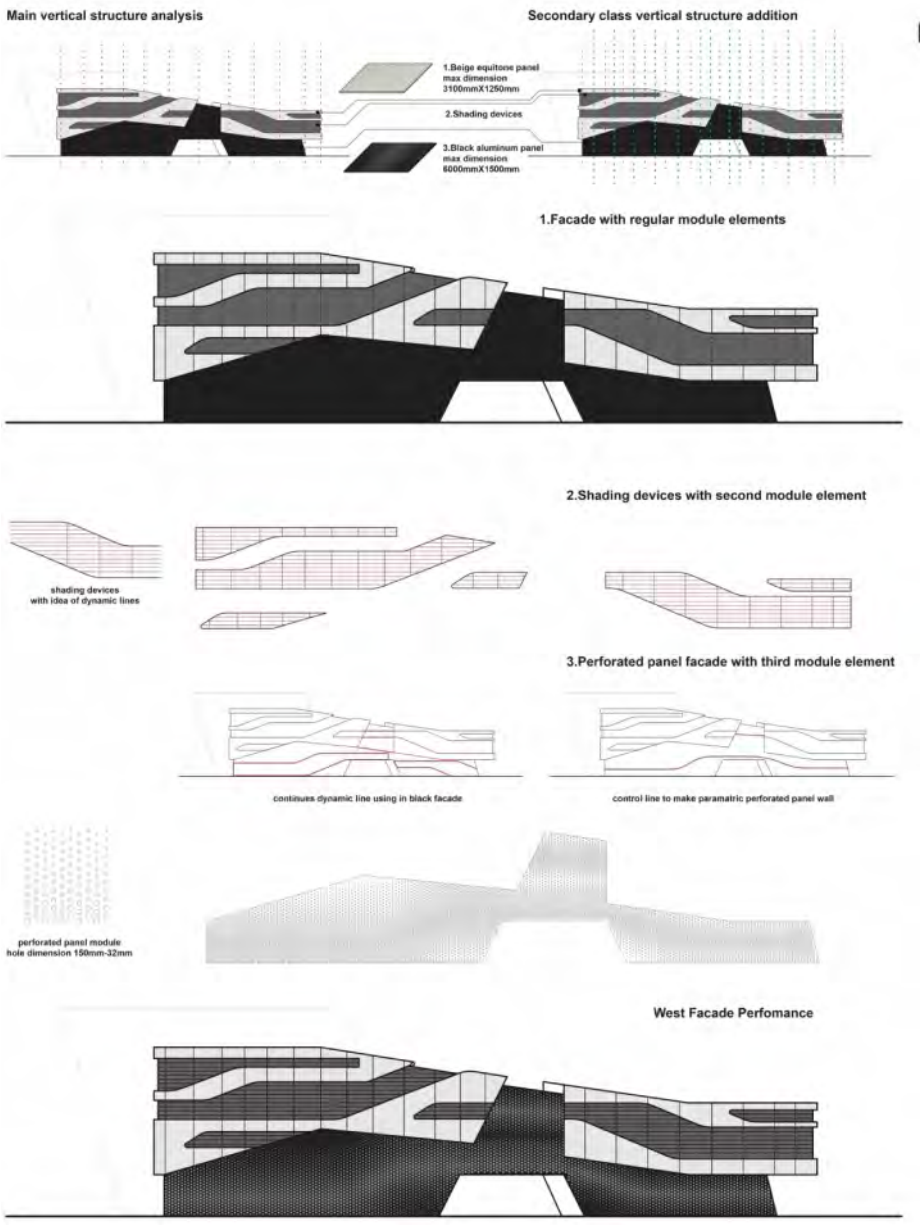

Fig. 6: Example of design process to establish modules, patterns and shading devices in a façade design proposed according to the solar analysis on the façade, based on the micro-climatic analysis (study by Mamak P.Tootkaboni, Danial Mohabat Doost, and Xiaochen Song).

4. Discussion

The use of a SMM showed a number of aspects that can enrich the design process, such as the ability of 1) providing design alternatives; 2) the assistance in the definition of technologies and specifications; 3) the contribution to the selection to the more appropriate construction systems; 4) ensuring quality throughout time,

1. The ability of providing design alternatives could be referred to the ability of exploring different options of volumetric configuration and location within the site; the definition of people flows and accesses in relation to the building orientation and volume; the use (or re-use) of the land; the inclusion (or use) of natural elements found on site as architectural features; and the possibility of using the site characteristics as main concept for the overall design approach. Moreover, the microclimatic analysis can also inform elements of façade design such as the relation between open and close elements; shading configuration and location; colours and patterns diffusion, volumetric configuration of elements; orientation and type of façade elements.
2. The use of a SMM can also assist in the definition of technologies and specification, by informing on the relation between performance required and positions within the building; defining the need of

specific technical requirements and therefore offering guidelines on required elements; and highlighting the opportunity to design ad-hoc/innovative elements or details.

3. The awareness of the microclimatic configuration of a site could assist in the selection of the more appropriate construction systems, by offering an accurate analysis of areas of the future building that could be design or treated with the use of different construction systems. This aspect could also contribute in saving in cost and time by applying the use of construction systems only where required. Moreover, the results of a microclimatic analysis could as well inform the design of innovative construction systems.
4. The ability of designing buildings that embed the site-specific conditions can also contribute to achieve better conditions throughout the life span of the building itself. Not only architectural features, but also more effective choices in terms of construction systems, and technologies can contribute to a degree of sustainability over time.

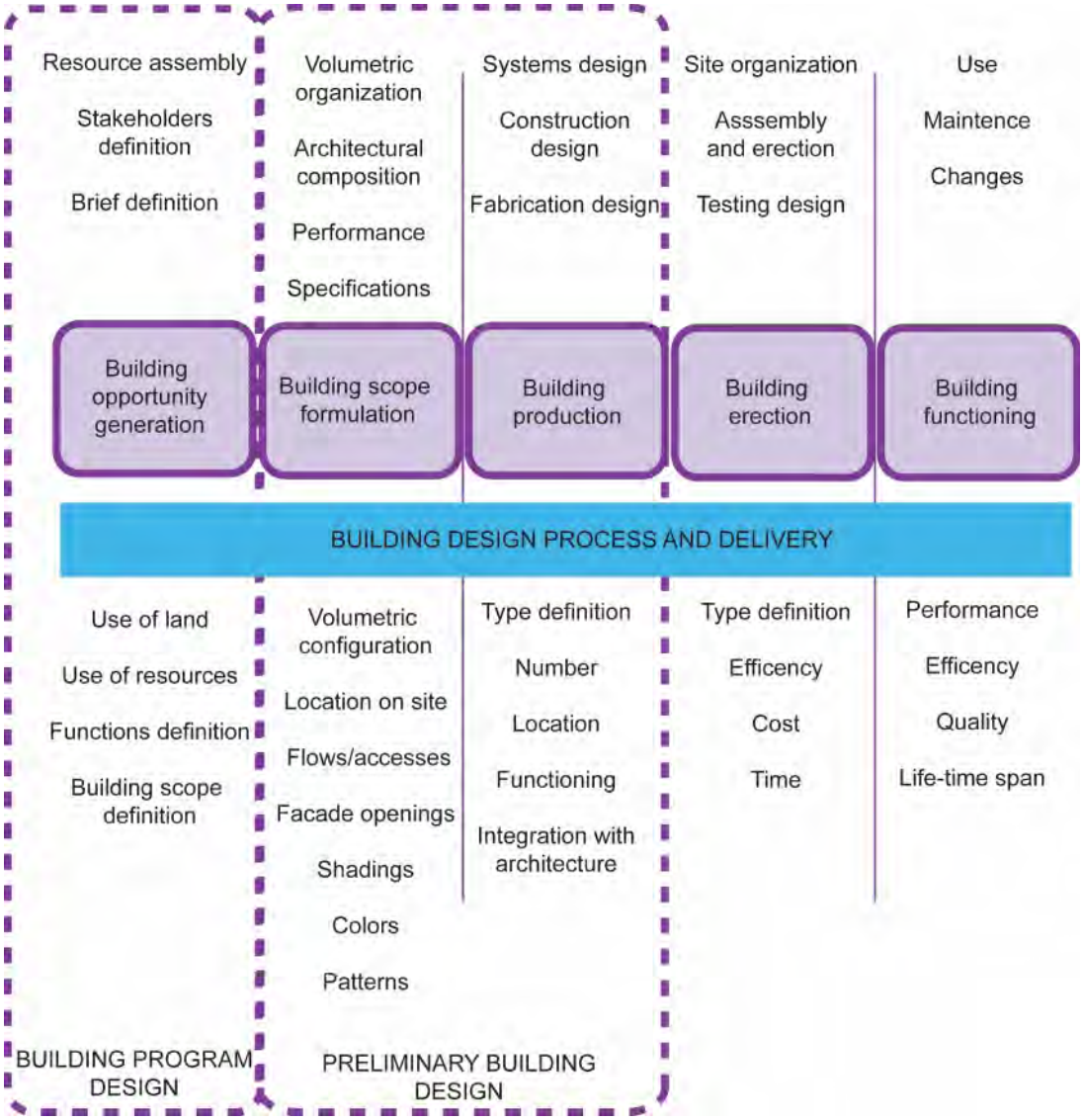

Fig. 7: The image shows the design parameters that can be informed by the use of microclimatic analysis for each phase of the design process and delivery. Above the blue band the design process is summarized in its phases and characteristics. Below the blue band the design parameters that be enrich/integrated by the use of the micro-climatic analysis are listed for each phase of the design process.

Figure 7 summarizes a number of parameters that can be modified and informed by the use of microclimatic analysis throughout the design process and delivery. In the image the design process is described in all its phases and related to all the design parameters that can be utilised in each of its phases. The ability of relating the use of a site-climate analysis, design phases and design parameters represents a design methodology that can be applied through all the phases of projects delivery. This methodology could assist in both

considering technical parameters, and optimizing design solutions, without impinging on the creativity side of the design process, which instead informed on a number of potential design alternatives. Moreover, this methodology could assist the development of specific requirement schedules for each technical element, and support the testing of the quality of design choices and their optimization.

5. Conclusions

Environmental building programming and site-climate analysis can provide designers and architect with the ability of open an informed discussion on the role of design within the sustainability approach to buildings. Having a number of design alternatives directly informed by the environmental context could contribute defining a new architectural language that consider all the approaches that have been taken so far in the history of architecture until now, and implementing them toward an integrated language between design and technology. This language could potentially produce a variety of buildings that, not only try to limit energy consumption and resources depletion, but that are able to express the identity of those buildings. At the same time an environmental and technological approach to design, by using the performance-driven approach since the preliminary design phase, is essential for considering these issues in the design process evaluating different compositional solutions and suggesting possible optimization procedures.

Bibliographical References

[1] ORME, M. Estimates of the energy impact of ventilation and associated financial expenditures, In *Energy and Buildings*. vol. 33. Amsterdam: Elsevier, 2001, pp. 199-205.

[2] GIVONI, Baruc. *Passive and Low Energy Cooling of Buildings*. New York: Van Nostrand Reinhold,1994.

[3] SANTAMOURIS, Matt (ed). *Advances in Passive Cooling*. London: Earthscan, 2007.

[4] NIGRA, Marianna, MARFELLA, 2014, Technological Changes by Design? The Answer of three iconic Australian buildings' facades. In AA.VV. *Proceeding of the 48th International Conference of the Architectural Science Association (ANZAScA)*. Genova: The Architectural Science Association & Genova

[5] CHIESA, Giacomo, DE PAOLI, Orio. Modelling for project design: instruments for sustainable and integrated design. In *SMC Magazine*. Vol. 1. Napoli: Sustainable Mediterranean Construction Association, 2014, pp. 115-119.

[6] GROSSO, Mario. Valutazione dei caratteri energetici ambientali nel metaprogetto. In GROSSO, Mario, PERETTI, Gabriella, PIARDI, Silvia, SCUDO, Giovanni. *Progettazione ecocompatibile dell'architettura*. Napoli: Esselibri, 2005, pp. 307-336.

[7] GROSSO, Mario. *Il raffrescamento Passivo degli Edifici in zone a clima temperato*. 3ª ed. Sant'Arcangelo di Romagna: Maggioli, 2011.

[8] CHIESA, Giacomo, GROSSO, Mario. Sustainable school buildings: design-management-monitoring, results and weaknesses. The case study of the High School "L. Orsini ", Imola. In *Techné*. Vol. 9. Firenze: Firenze University Press, in press.

[9] CHIESA, Giacomo. *Biomimetica, tecnologia e innovazione per l'architettura*. Torino: Celid, 2010.

[10] FERRÉ, Albert et al. (eds). *Verb Conditioning.* Barcelona: Actar, 2005.

[11] FERRÉ, Albert et al. (eds). *Verb Connection.* Barcelona: Actar, 2004.

[12] BROWN, G.Z. (Charlie), DEKAY, Mark. *Sun, Wind & Light. Architectural Design Strategies*. 2ª ed. New York: John Wiley & Sons, 2001.

[13] KARALIT CFD: http://www.karalit.com/

[14] BOUTET, Terry. *Controlling air movement: A manual for architects and builders*. New York: McGraw-Hill, 1988.

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UAV Remote Sensing for the Preservation and Restoration of Houses of Worship. Potential and Limitations

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Abstract
The use of Unmanned Aerial Vehicles (UAV) is becoming increasingly widespread: these remotely controlled aircraft can be outfitted with an extensive range of sensors, such as digital cameras and video cameras, thermal imaging devices, multispectral sensors and laser scanners that are able to perform low altitude surveys. Their growing employment has been reflected in applications related to topographic surveying used to map land, caves, high risk areas, archaeological sites, etc.
The possibility of acquiring images rapidly from unique angles in areas that are not easily accessible either for their imperviousness or for safety risks has made the application of UAVs desirable even in the surveying and recording activities necessary for the preservation and restoration of architectural heritage sites. Close range photogrammetry allows the creation of a 3D model with centimetre-level precision and a CAD vector-based draft providing details on the degree of decay of buildings. This technology is discussed through the illustration of paradigm cases in Europe and Italy with special reference to places of worship – among which the buildings of the Carpi diocese and St. Stephen's bell tower in Belluno – in order to glean its potential, limitations and the corresponding theoretical and practical implications for the preservation of religious architectural heritage sites.

Keywords: UAV, APR, drone**,** restoration, churches.

As it is now a practice generally followed in architectural restoration, during the planning stage, it is necessary to make a preliminary survey of the state of the buildings undergoing interventions, in order to establish the maintenance and restoration works to be carried out. As punctual and detailed as possible is the survey, as accurate as possible will be the diagnosis for intervention, which will meet the real needs for protection of the architectural asset. As regards the investigations on the number of different kinds of alteration and decay of structures and of single buildings or building agglomerates, besides the traditional survey, it is possible to use more and more sophisticated and continuously developing instrumental techniques, aiming at a faithful reconstruction of the original structure and to a more and more complete knowledge of the building being investigated.
Among the latter, a new instrumental methodology is represented by proximity sensing, that is at low altitude, by remotely piloted aircraft system (RPA), which, even if it has a famous French predecessor dating back to the first decennia of the Twentieth century [1], it starts its history in Italy only in 2005 as an "open source" device, bound to revolutionize the world of photography [2], and consequently, the different professional fields related to it, such as the field of architectural survey and representation.
It is a technique of data collection which allows specialists of this sector [3], to investigate, under absolute safety conditions, buildings or parts of them, being otherwise absolutely inaccessible, by the use of sensors mounted over vectors (drones or radio controlled helicopters), thus making it easier to detect building decay pathologies. These vectors are particularly useful in case of damages which cannot be easily inspected and which are caused by the lack of maintenance or also, as it is said below, for analyzing the immediate effects of calamities. As an example we mention here the bell tower of St.Stephen's church, surveyed by the firemen sent by the Town Council of Belluno, who had intervened after the collapse of parts of the cornice. The investigation, carried out in the last July, thanks to the help of an hexacopter weighing about eight kilos,



Fig. 1: Rome, Church of St.Mary in Montesanto, crape shot by a quadricopter Phantom DJY (arch. L. Pantone).

provided with a high resolution device meant for taking full HD photos, has made it possible to find out how the infesting plants were the cause of damages. The photos, taken at a height of over thirty metres, have showed this in detail. A similar case can be reported as regards the Romanesque cathedral in Trani, where the simultaneous presence of sea aerosol and water infiltrations, have damaged not only the bell tower but also the roofing elements of the building, which have been surveyed in detail by means of a drone inspecting all the critical points.

For more than a half decade specific cases of intervention have also been registered on houses of worship, where it is most desirable to use such techniques of diagnostic survey, since these buildings are often characterized by a mainly vertical development of the structure itself, which makes it impossible to periodically monitor the state of the not visible architectural elements. Let us remember, for example, the spires of the European Gothic cathedrals or the bell towers in general. At first, the English company "Cambridge UAV" has experimented the inspection of decorations and structures being little or almost inaccessible, by the help of remote sensing surveys carried out by multi-rotor drones provided with HD cameras. The possibility of "live" viewing the images on a monitor set on the ground, has allowed to choose shots, and getting closer, if necessary, also by operating the zoom mode, to examine, in a short time and at no cost, details such as the erosion degree of lightning rods, the integrity of façades and their decorations, the right fixing of cables, the stability of cornices, not only outdoor but also indoor, that is within the liturgical spaces, thus greatly influencing the decision about the necessary interventions to be carried out and the efficiency of the planned maintenance. Similar inspection systems can also be found in Italy: multi-rotor drones have been used, for example, for explorations within the Church of St.Mary of Jesuits in Venice, in order to carry out photo surveys and high resolution videos, being preliminary for the drawing up of survey graphs and plans; in the Church of St.Mary in Montesanto, the so called Artists' Church in Rome, they have resulted to be necessary for the drawing up of the plan of restoration interventions concerning Bernini's dome, the sacristy vault with the tempera painting representing "the Angels' Glory" and the decorations of the structure [4]. Finally we remember the photo shots carried out by drones for the church of St.Michael the Archangel in Mercato San Severino, situated within the province of Salerno, supporting the survey of the state of the building, being preliminary not only to the drawing up of the restoration plan but also to the related estimate of the intervention costs. The inspection made by the help of proximity remote sensing, by revealing the different degrees of decay being not visible, such as the breaking or cracks of the pantiles of



Fig. 2: Rome, Church of St.Mary in Montesanto, detail shot by a quadricopter Phantom DJY (arch. L. Pantone).

the roofing and the vegetation infesting eaves and downpipes, which did not allow the right optimization of the meteoric water regime, has allowed not only to do more detailed survey graphs, but also to better calculate interventions on the roofing and the façade plasters [5].
The spreading of this technique, which among its main characteristics, shows the possibility of significantly shorten the investigation time, has gained momentum following the need of inspecting and surveying, under safety conditions, the damages caused to the building heritage, by seismic events, thus avoiding the repetition of tragic events, such as the collapse of the vault of the Major Basilica of St.Francis in Assisi. Taking advantage of "Remote Sensing", by drones it is possible to get not only qualitative and quantitative information on structures and ornaments, but also on the conservation state of the liturgical furniture, and more in general, of works of art, which are difficult to be surveyed on the occurrence of calamities.
In particular, after the seismic event occurred in May 2012 in Emilia Romagna, which damaged, among others, the churches of the Archbishopric of Ferrara-Comacchio, the collection of data concerning the state of health of two houses of worship situated within the town of Bondeno in the province of Ferrara, has been carried out by means of a combustion engine propelled helicopter (about 14 x 21 cm, height about 41 cm), provided with a high resolution videocamera (1920 x 1080) that is a number of 2,073,600 pixel photogram [6]. In the church dedicated to St.John, as an example, two shots have been made, the first of them has showed the big break of the architrave overhanging the portal accessing to the Church, situated along the main façade, and the second one has showed the cracks of the bell tower, thus providing information fundamental for the drawing up of the final planning intervention, to be immediately carried out after having secured the religious complex with underpinning and hooping operations, at the cost of about 30 thousand euros. As regards the parish church of Mary's Nativity, in which some collapses occurred, four surveys have been made to examine any cracks existing in the façades [7] and in the Mathilde's tower, also providing details on the conservation state of the acroterions, the mouldings of the circular large windows and other architectural elements.
In the nearby diocese of Carpi, in the province of Modena, the technique of drone remote sensing has also been used, because drones have been provided by the Regional Administration of Umbria, which has availed itself of these devices since the telluric event occurred in 1997. The monitoring campaign coordinated by architect Filippo Battoni after the seismic event occurred in 2012, also provides the inspection of the basilica of St.Mary of the Assumption in Carpi, where the survey of the three naves has been carried



Fig. 3: Mercato S. Severino, Church of St.Michael Archangel, detail of the façade shot by a hexacopter FlyNovex (archh. P. Illiano, M. Bicco).
Fig. 4: Mercato S. Severino, Church of ST.Michael Archangel, detail of the first capital on the right of the large window, shot by a hexacopter FlyNovex (architects. P. Illiano, M. Bicco).

out after the seismic event, under safety conditions, as well as a digital survey has been carried out in the Cathedral of St.Maria Maggiore in Mirandola, notwithstanding the critical conditions of stability of the structure. Moreover, among the ruins of the cathedral of Carpi, a tracked drone, provided by a mechanic arm, has detected a silver jug belonging to the liturgical furniture of the cathedral.
As for any well made survey campaign, even if drones are used, in order to obtain a scientifically accurate work, a planning of the flight and the kind of shots to make (low altitude, at a close distance, in hovering mode, etc.) is necessary, by suitably choosing the drone equipment, according to the needs and the purpose of each specific case (photo-videocamera, thermal camera, laser scanner, etc.). First of all it is necessary to delimit the area within which we want to operate, to check the surrounding area, as regards the presence of cables and vegetation, the speed and direction of the wind, and to check for the signal quality reception, even if, in order to prevent any possible inconveniences, most of the drones are provided with an automatic driving device, which, starting to operate when the signal is off, can take the aircraft to the taking-off point (Return-to-Home). Since it is possible to keep a direct eye contact with the object to examine, up to a maximum distance of 300 metres, if the area to investigate overcomes such limit, it is necessary to provide for a ground station, by introducing a display which receives live images to keep control over what we are examining or to consider the possibility of planning an autonomous flight, by previously setting the route by waypoint (up to a maximum of number of 50 waypoints in general), of which it is possible to specify different parameters, such as the altitude, the curve trend, the pause time, the speed kept up for single distances, etc. Moreover, if the purpose of the flight is a photogrammetric survey which allows us to create a three dimension model with one centimetre resolution and a vector CAD based survey, it is necessary to determine the coordinates of the Ground Control Points belonging to the object being surveyed [8].
Among the possible instruments to be used for making surveys, the UAVs allow the installation of an advanced type of thermal cameras, supported by a gimbal device. The flights carried out by the help of these devices allow to survey the state of health of buildings, with special reference to the presence of dampness, thus complementing the non invasive diagnostic images. In particular, as regards the thermographic shots, a series production of a variable pace four-rotor drone is being planned, which is characterized by a higher degree of efficiency and a faster control mechanism [9] that has been already tested in many different experimental activities, among which there are the structural analyses of the basilica of Collemaggio, carried out after the earthquake occurred in L'Aquila. The characteristic of the system is that of carrying out thermographic surveys by automatic flight plans, reaching a so high level of precision of images that not even ground inspection stations can provide.
Even if the technology of these devices is quite sophisticated, experimentations in the field set newer and newer goals to overcome today's limits in the use of these instruments. Such limits can be found in the possible interferences they may have with the electromagnetic fields, if sensors able to avoid collision risks



Fig. 5: Mercato S. Severino, Church of St.Michael Archangel, detail of the bell tower shot by a hexacopter FlyNovex (archictecs P. Illiano, M. Bicco).
Fig. 6: Mercato S. Severino, Church of St.Michael Archangel, detail of the Church of St.Michael Archangel, detail of the large window and of the decoration elements shot by a hexacopter FlyNovex (architects P. Illiano, M. Bicco).

lack, in the instability of the equipment in case of adverse climatic conditions, above all in the presence of the wind. In this regard, arch. L. Pantone has carried out an interesting test in Macerata, by the help of an hexacopter Gismodrone 6.0 provided with a GoPro 3+ camera, which shows the effect of the wind on the shooting of a video by a drone. Companies cope with these inconveniences by offering new practical solutions on the market, such as an even higher stability of aerial shots, due to accelerometers and the magnetometer because of its self-levelling device or by providing an increase in the resolution of shots themselves.
The positive effects of the development of such technique on the carrying out of the planned maintenance of buildings in general and of the religious ones in particular, are undeniable, since it allows to carry out surveying campaigns, matter and decay investigations, without the help of invasive scaffoldings, thus reducing investigation and planning costs. Another important advantage is that such devices would be certainly a precious resource for the technical sector of the different dioceses, which will be able to monitor on their own, and within really shorter times, the huge architectural heritage belonging to each of them. Therefore it is necessary to plan all the investigation interventions on the state of conservation of the houses of worship. This job should pertain to a new professional figure having suitable technical competences, who could be in charge with the coordination of the monitoring of the assets belonging to each diocese and of the organization of the related diagnostic and planning operations. He should be an expert in the restoration sector, continuously keeping himself updated on the daily progress of the newest technologies in the field and being able to manage the quality and amount of data and information collected by the help of the new instruments, and would provide the diocese with the most updated information about the state of health of its own architectural heritage.





Fig. 7: Mercato S. Severino, Church of St.Michael Archangel, portal shot by a hexacopter FlyNovex (architects P. Illiano, M. Bicco).
Fig. 8: Mercato S. Severino, Church of St.Michael Archangel, eastern façade shot by ahexacopter FlyNovex (architects P. Illiano, M. Bicco).

Bibliographical References

[1] MASALI, Luca. *Multicotteri & Droni. Guida pratica*. Bologna: Aeroplanino Editore, 2014, pp. 11-15. ISBN 978-88-905532-7-1.

[2] The Italian team coordinated by Massimo Banzi together with David Cuartielles, Tom Igoe, Gianluca Martino and David Mellis has created a more affordable and more easily programmable card (See, MASALI, Luca. already quoted, pp. 15-17).

[3] The use of drones is regulated by the Directives issued by the Italian ENAC (National Civil Aviation Body) being enforced on April 30th 2014.

[4] We thank arch. Luca Pantone for having allowed us to provide our text with his images.

[5] BICCO, Margaret. ILLIANO, Pasquale. SALVATO, Michele. *Chiesa di S. Michele Arcangelo in Acquarola di Mercato S. Severino. Gli interventi di restauro*. Salerno: Gutenberg Edizioni, 2013. ISBN 978-88-7554-062-3.

[6] *EAI Energia Ambiente ed Innovazione* CANDIGLIOTA, Elena. IMMORDINO, Francesco. *Historical heritage safeguard: remote sensing by drones for knowledge and emergency*. March-April 2013, pp. 78-85; and INDIRLI, M. CANDIGLIOTA, E. IMMORDINO, F. MORETTI, L. ABATE, D. FURUNI, G. PIERATTINI, S. SCREPANTI, A. ANGELINI, M. GAMBATESA, T. MASSAIA, C. *Assessment of historic center through a multidisciplinary approach based on the simultaneous application of remote sensing, gis, and quick procedures for survey and vulnerability evaluation*, in 5th International Congress on "Science and tecnology for the Safeguard of Cultural Heritage in the Mediterranean Basin" Istambul, Turkey 22-25 November 2011, Roma 2011, ISBN 978-88-905639-3-5.



Fig. 9: Mercato S. Severino, Church of St.Michael Archangel, western façade shot by ahexacopter FlyNovex (architects P. Illiano, M. Bicco).

[7] The apse of the Church was damaged, as well as the vaults and the walls of the bell tower (See *EAI Energia Ambiente ed Innovazione*, Candigliota, E. Carpani, B. Immordino, F. Poggianti, A. *Damage to religious building due to the Pianura Padana Emiliana eartquake*, April-May 2012, pp. 58-68).

[8] *Dronezine*, RUSSO, Valentina. *Rilevamenti volanti*, nr. 7 Novembre-Dicembre 2014, a. II, pp. 36-37. ISSN 2384-2703; and *Recupero e Conservazione* MILELLA Nicola, *L'utilizzo dei droni nel rilievo architettonico e nel monitoraggio. Il caso di una torre di avvistamento a Bari*, nr. 113, May 2014, ISSN 2283-7558.

[9] Roberto ALFIERI, *L'invasione dei droni. Il futuro sopra di noi*. Milan: Hoepli, 2015. ISBN 978-88-203-5965-2.

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From ruin to hinge of urban renewal: the restoration of the church of St. Demetrius in Ceglie Messapica (BR)

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Abstract
The case of the Church of St. Demetrius in Ceglie Messapca is a typical example of how the recovery of a worship's building, decommissioned and transformed into a ruin, may be central in the policy for the promotion of a historical center. In a moment of global crisis where the architectural heritage suffers the lack of economic resources for the recovery, protection and enhancement, restoration applied on the church of St. Demetrius wants to be a model of intervention considering that was made possible with a budget extremely limited.
Beyond the technical and technological solutions adopted, the restoration project, which not aims to return the monument to the cult but proposes a new use, bases its foundations on an accurate phase of knowledge of the object, from the relief to the historical and archival research, from the analysis of diseases and disruptions to the understanding of the role of the building for the community.
And it is necessary, in fact, establish a strong feeling between "knowledge" and "project", putting to any projectual proposal a comprehensive study of the structure, that is the knowledge of matter, physical and pathological, the identification of the layers of time that have made unique the monument.
Advanced techniques of representation have enabled the "participation" in the project even to the non-experts and then to the ordinary citizen. The success of the proposed intervention was born, so, even before the beginning of the works.

Keywords: knowledge, Ruin, Restoration, Intervention, Project

1. The path of knowledge
Preserve buildings means placing oneself the aim of conserving material, formal, aesthetic and historical aspects that characterize them and that are configured as vehicles of values, as a testimony of the experience, as a set of messages that come to us from the past. In this sense, a building is both document and monument.
As document is characterized by the set of traces and signs that are deposited on the materials from which it is made; as monument is instead intended as architecture, in the sense of physical realization of an architectural thinking (compositional, figurative and expressive) which is organized in space and place, and that has changed in the form and manner during its history.
The process of knowledge, which goes from the historical archival research to the survey, is the basis of every project. Design means to systematize the initial, objective and subjective data. The objective components correspond to what exists, to the numeric data, the economic availability, the state of the places, etc. The subjective components are , however, the designer in his own ability to interpret initial data and to propose, with the architectural project, the appropriate solution.
In a historical context as that in which it is the Church of St. Demetrius in Ceglie Messapica, the objective data of knowledge are binding even in the subjective choices of the designer. In fact you create that sort of interaction between history and design, including size and functions, building tradition and technology. The charm of the restoration project is in the combination of components apparently conflicting, but that are

critical in the reuse of abandoned historical buildings. Interpret history by adopting what technique and modern technology propose nowadays is the most difficult challenge in a restoration project.
From this premise comes the obligation and the duty, by the designer, to know in depth the artifact, and to frame the same both in the historical context and the city, both in construction techniques and in the analysis of the state of consistency and instabilities existing.
In the practice of the survey, the historical investigation plays a key role, not only because through the knowledge of the history of the studied object you are able to decipher and interpret correctly the elements of architecture which is the object of study, but also because the historical knowledge allow us to trace a correct and accurate path of analysis.
In this regard it should be emphasized that, in the survey, you can not indicate a unique approach, established once and for all, therefore it is necessary to define a project that is specific for each particular situation, and that can provide sure and reliable answers .
The elements derived from history, in some cases, can be the basic trace around which to build the entire project, starting from the assumption that the way to do architecture or the laws that govern the growth of a historical core, are different in different historical periods and that, through their understanding, passes the opportunity to realize a survey without misunderstandings.
The knowledge of history of architecture is, therefore, one of the key points in the preparation of those who are going to complete any type of architectural or urban survey.
Detecting means returning to the project, rebuild through drawing the plot of the complex operations which led to to the construction of an artifact, so the historical knowledge help us to understand and decipher not only stylistic and formal elements but also technical and construction ones.
History and survey are closely related since it is possible to read the architecture and redraw it, only if you know the language that was used to build that particular architecture.
In this sense, retrace the history of the city of Ceglie Messapica, we felt it was the right way to propose a series of considerations on the monument under study, to define, then, the directives of the restoration project.
Similarly, the analysis of the inhabited city center from the point of view of historical growth is served to highlight the importance of specific knowledge in relation also to the history of town planning, in the moment in which knowledge and recovery of the individual building are closely linked to knowledge and requalification around the historic city center.
In this case, the complexity of the topic is given not so much by the situation of ruin of the object of study, but from the difficulty of pick up the threads of a past that gave it identity , both in his the role of historical and architectural monument, both in its historicized function in the historic center of Ceglie Messapica.
The historical analysis linked to the survey nevertheless has ways of investigation related to operational practice, it is not limited to a mere collection of data, but is the guide for the drawing of the detected elements, so in this way is useful to support the research carried out on the texts with a collection of iconographic and photographic material , that is able to clarify the history of the building in different historical periods. The availability of old plans, historic photos, etc., helps to better organize the operations to be conducted in situ since it is easier to understand the genesis of the design of the body that you have to detect and recover.
Although the researches on the texts are conceived and organized keeping in mind that these are just one of all the moments of a complex process of knowledge, which aims not only to the historical reconstruction but especially to the graphic description of the building or of the urban core that are being studied.
The historical analysis used to the survey follows, therefore, a specific methodology and is often conducted in parallel with the graphical analysis, since drawing and history are the guide elements which are responsible for the opportunity to complete a correct survey.

2. Operational methodology for the restoration project

The instrument through which conservation takes place is the restoration project. This is configured in a proceeding in which are noted the dimensional connotations of the building , its material and technological characteristics as well as the static, spatial and functional patterns. The signs and traces that overlap on the object are also collected, as well as the information on the conservation status of the elements that compose it.
But no intervention can be planned and implemented without an accurate knowledge of the object on which you has to operate. It is 'necessary, therefore, to establish a strong link between “knowledge” and “project”: one cannot ignore the meticulous listening of the building on which you operate in order to fully understand the material, physical and pathological status, to read components, lines, layers, signs of time that made it unique and irreproducible.
The operations of historical research, survey, scientific investigation, diagnosis, identification and physical-chemical quantification, although conducted by different professional figures, become useful and functional to the final objective, only if humbly communicate with each other. In this way they become a full document formed by all the information acquired in the construction site, useful for subsequent checks on the state of

the building. Today surveying techniques can take advantage of increasingly sophisticated tools and software capable of returning the entire building or parts of it in a precise and detailed way. Even diagnostics, thanks to technological innovations, allows an analytical knowledge of any local situation, arriving to a precise reading of the elements that characterize the material and to the identification of possible pathologies in progress. For this reason it is essential to prepare two separate projects: a diagnostic one (knowledge) and an intervention one (therapy). The diagnostic project, using the contributions of interdisciplinary has as its purpose the full maintenance of the matter object of intervention through the relationships between data and matter, history and architecture, cause and effect. This cannot be seen as a closed project, indeed must be designed and structured as something dynamic, able to cover all the needs in order to capture complete and reliable data about the building. The second project is realized only after the first one, and with purely therapeutic purposes, comforted by the careful control of the outcome. A sort of "diagnosis of second level" dedicated to the choice of products, materials and techniques both traditional and innovative if they are compatible with the existing. This process is important to know that the matter "is" the one that "will", to test the techniques and products that can consolidate and store the object without distorting it. For this reason, the preventive knowledge phases and the "medical history" will always preponderant in a correct restoration project.
The preliminary study begins with the historical research on bibliographic and archival sources , with eventual archaeological excavations, with the general and detailed photographic survey, with the geometric, material and degradation survey, which will guide the choice of intervention to follow. For a proper diagnosis of the materials and the state of degradation you have to perform a series of technical-scientific investigations that allow to establish the scientific nature of the material and of the layers of deposit. The preliminary stage of knowledge allows to operate in compliance with certain basic principles, including the minimum intervention, the compatibility between building and technology of intervention and a proper maintenance project.

3. The Church of St. Demetrius: from ruin to multifunctional center

This methodological approach was applied to the restoration of the church of St. Demetrius in Ceglie Messapica (BR). The present church is the result of a rebuilding from the foundations of an old church always dedicated to St. Demetrius, whose origins are very old, because they related to a clear Byzantine origin of the cult, but also because there is evidence of such a church in ancient documents that show the numerous pastoral visits made by the bishops of the Diocese of Oria from 1565 to 1900, in the same place. In fact, since 1500, there was a church dedicated to St. Demetrius, which was destroyed in the first half of the nineteenth century.
The first documentary source that directly quotes the church of St. Demetrius dates back to 1565, when it was carried out in Ceglie Messapica a pastoral visit by Archbishop Carlo G. Bovio. They talk about it again in 1627 during the pastoral visit made by the Bishop Ridolfi and again in the report drawn up by the archpriest Donato Maria Lombardi, between late 1747 and early 1748, in response to the Instruction of the Holy Apostolic Visitation sent to all the parishes of the Diocese of Oria by the Bishop Castrese Scaia. As reports Ciraci, in 1791 the church suffered a fire and finally on the entrance portal there is the date of re-building of 1854.
The latest news concerning the renovation of the paintings in the vault of the presbytery of the church dating back to 1929 and the collapse of a part of it in 1967. The church was built on the ground capitulate, in the "Garden of the Great Church", with the support of the brotherhood of the Death of St. Demetrius (founded in Ceglie Messapica in 1621), was finished in a few months and consecrated in 1855 by Bishop. Luigi Margarita.
All this information, collected from bibliographic sources and from public and private archives, were later corroborated by archaeological surveys conducted within the church. Archaeological excavations were conducted in April 2012 by the Cooperative Society "S.A.E.T.T.A."in the persons of Dr. Elisabetta Caliandro, dr. Clavica Arturo M. and Mr. Tamborrino Domenico, under the scientific direction of Dr. Daniela Tansella, official archaeologist of the Superintendence for Archaeological Heritage of Puglia.



Fig. 1: Old Town of Ceglie Messapica and identification of the Church of St. Demetrius




Fig. 2 and 3: Overview of the archaeological excavations




Fig. 4 and 5: Detail survey of dividing wall and tomb




Fig. 6 and 7: Main facade and side elevation on Giovanni Mele Street

The church of St. Demetrius is in neoclassical style, with a single nave, with two altars, one central and one lateral. The vault of the nave was decorated with frescoes depicting floral motifs and the one of the apse was painted with angels and scenes from the life of the Mother of Jesus. The access of the bell tower is from inside through a steep staircase placed on the right of the main entrance.
Before the restoration, the church was in a state of total neglect and decay, due to a collapse occurred in 1967 that caused the total loss of the covering vault, of the bell tower and of parts of the walls, representing

an outstanding point in the old town of Ceglie Messapica near the Mother Church and few meters far from the castle.
The remaining structures, however, were still a valuable testimony of religious architecture during 1800. For this reason the council has opted for a restoration and a reuse of the structure, in which the new destination use was born from the need to create a socio-cultural space in the historic center of the city. With this intervention you can make the church again usable: for centuries it has been part of the daily life of citizens of Ceglie Messapica, and even today it is part of the memory of the oldest inhabitant, which remind the church before the collapse. Among the objectives of this intervention, in addition to the reuse of the property, other important steps are: the enhancement of the historical and cultural center of the city, which in recent years has been “rediscovered” by a significant flow of tourists; the creation of the basis for the housing facilities of the old town, which in recent years has seen the decline in the number of the residential presence in favor of moving to the suburbs, an area in which there are no decaying buildings that can constitute element of danger in case of particularly intense weather events or in the event of natural disasters; the operation to “give safety” to an important artifact that, in the event of total collapse, would lead to much higher costs from a social point of view, as it may adversely affect also on the adjacent structures. All the design intervention moves in order to restore and recover the entire building operating with the methods of architectural and archaeological restoration, with an eye to solving structural problems and to the preservation of the architectural elements still present.
The church is made of masonry of “carparo” placed in regular rows, outside the wall is visible, while inside the church was completely plastered and decorated in the style of neoclassical architecture. The blocks of the bearing structure were connected by poor pozzolanic mortar mixed with bolus, because of this reason and because of the aggression of atmospheric agents, the wall facings, especially where the plaster was detached, were poorly cohesive, in fact, were almost without mortar between connections and were covered with infesting vegetation, mosses and lichens.
The survivors walls of the church were very disarranged and had many lesions, quite evident in the union between the main facade and sidewall that for its shape and for a not perfect union between the transversal masonry represented a point of weakness of the structure.
The lack of covering and therefore the action of atmospheric agents, in the long years of neglect, had caused a total washing away of the interior of the church, resulting in degradation of the plaster and detachment from almost all of the walls.



Fig. 8: Apse: decorated star vaults




Fig. 9 and 10: View of presbytery and interior view of the church entrance




Fig. 11 and 12: Central altar and Lateral altar

To identify the chemical and physical characteristics of the stone material used for the construction of the church, its origin and its compatibility with those of new quarries were performed petrographic analyzes on samples of material taken from the site and on those taken from the quarries. This allowed us to define the petrographic composition of the stones used in the construction of the church, to identify and find stone materials petrographically identical to the historic ones to be used for the restoration work. The structures in fact needed to integrate the existing material and that recovered from the ruins of the church itself, with new material with similar compositional and textural characteristics.

The performed historical analysis, the surveys and the tests carried out, the study of diseases and instabilities present on the structure led to an intervention essentially “reconstructive” of the wall texture, to the restoration of old spatiality (though using modern materials) in order to give back to the community the building as a social and a cultural space in the historic center of the city.

It is important also to add that all the proposed interventions were determined on the basis of the knowledge acquired in the course of the inspections and of the analysis phase. The foundations were consolidated thanks to underground foundation on piles of “ root type” and a ventilated crawl space was made being careful to protect the pre-existing walls and tombs discovered during archaeological excavations through the realization, only in this area, of an appropriate steel structure on which to rest the floor.




Fig. 13 and 14: The new roof




Fig. 15 and 16: Constructive steps: new covering





Fig. 17 and 18: Construction phases of the decorated star vault with pernervometal

Masonry was consolidated by disassembly of parts of masonry for the height deteriorated by lesions and subsequent reconstruction, with the same material deriving from demolition; the removal of the vegetal layer; the joints sealing with mortar made of pozzolan and lime; the integration of damaged blocks of stone (undo-redo) with new blocks; the mending of the dividing walls without toothing through arrangement of diatones placed across the wall. The project involved, as the next step to the static consolidation of the present walls , including plumes of support for the collapsed vault, the reconstruction of the parts of the masonry and of the same plumes through blocks from a local quarry.
The petrographic analysis carried out, by Dr. Geol. L. Spalluto, showed that the outcropping litotypes in the quarry located in Contrada Grieco (Town of Ostuni) are the only ones among those analyzed, petrographically compatible with those used originally to build the Church of St. Demetrius.

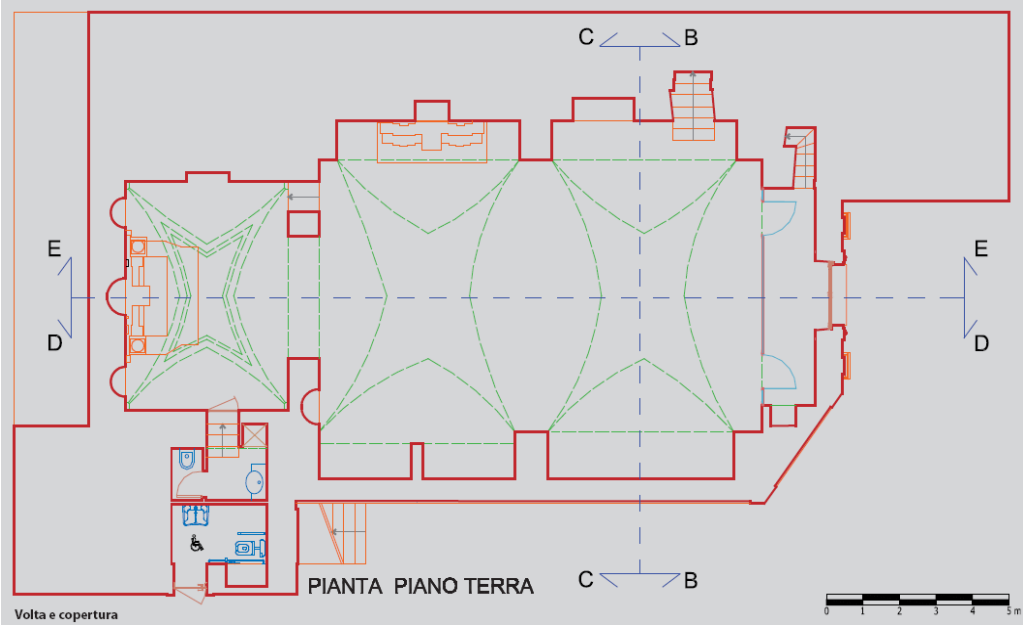

Fig. 19: Table of project - plant



Fig. 20: Table of project - sections

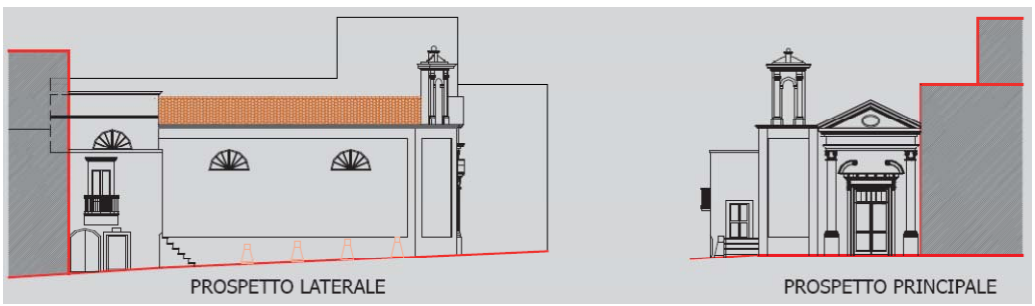

Fig. 21: Table of project - elevations

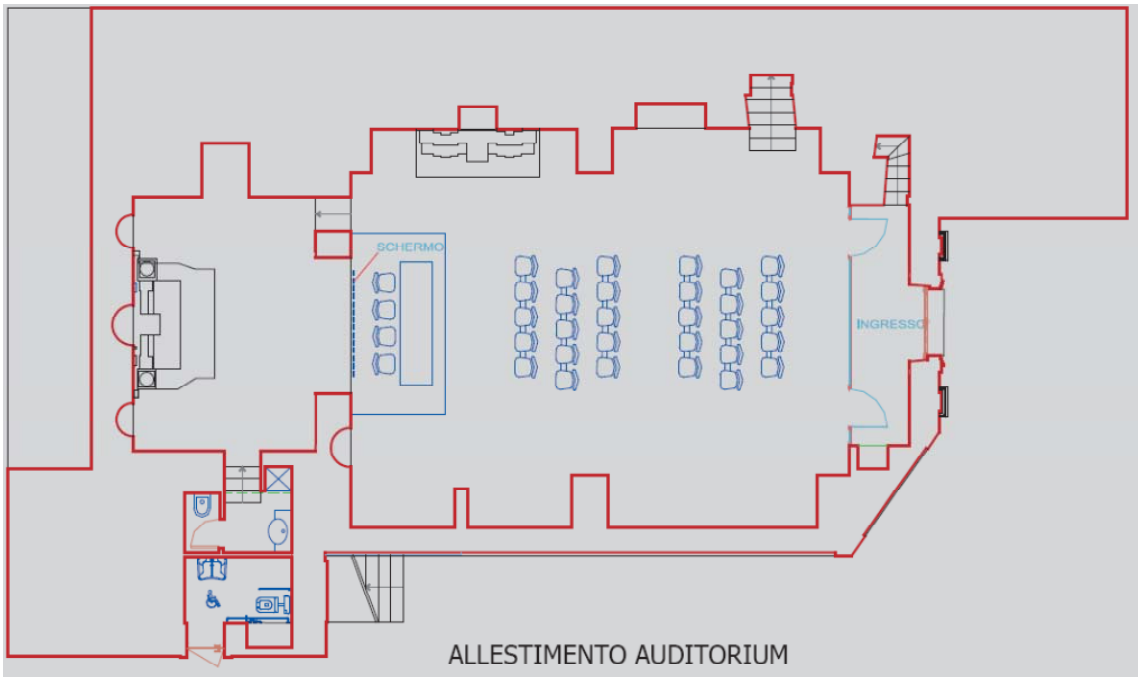

Fig. 22: Table of project - construction of the auditorium

The project involved the construction of a new covering, a ventilated roof of laminated wood, with final seed coat made by curved tiles, while in the interior of the nave, to restore the ancient image of the church, made a not load bearing valut (according to the old shape as deduced from the reading of traces of the collapse on the walls) using a port plaster net of *pernervometal* type. Finally the bell tower was rebuilt in the same place and with the same features as the original, all the decorative elements inside and outside were restored, and the new finishes and new plants more suited with the new use were realized (e.g. exhibition hall and auditorium).



Fig. 23: The bell tower before the crash and the new bell tower



Fig. 24: The Church of St. Demetrius after restoration

The idea of reconstruction has been supported by historical certainties of the original architectural element placement and in respect of what is required by the Charter of the Restoration of Krakow, 2000. *"The reconstruction of entire parts "with the same style" should be avoided. The reconstructions of limited parts which have a particularly architectural importance may be accepted only if they are based on a precise and indisputable documentation ..."*.

4. Conclusioni

The knowledge of the historical construction of the masonry was a major precondition for the restoration project and for the evaluation of structural consolidation. The problems encountered in the restoration of the church of St. Demetrius were those common to all the historic buildings, including the inability to know certain data characterizing originally the building, the changes that occurred over time due to the phenomena of damage resulting from anthropogenic transformations, from 'aging of materials and from the natural disasters following one another over the years.

There was therefore the need to use techniques of analysis and interpretation of the artefact through diagnostic investigations with different levels of detail. These operations have been dictated by the proposed objectives and involved parts of the monument, in order to determine numerical values necessary for the qualitative and quantitative interpretation of the structural operation.

The methodology adopted, in which the object and the history, its knowledge and its protection go hand in hand, and the attention given in this restoration intervention have had the intent to convey the "feeling" of enhancement to the conservation and the reuse of the monument. Only in this way the Church of St. Demetrius can go back to being a witness of the past again "at the service" of all.

Bibliographical References

[1] CARBONARA, G. Il restauro e la manutenzione delle chiese. in STRAPPA, G. *Edilizia per il culto*. Milano 2005, pp. 120-123

[2] ANTONUCCI, R. *Restauro e recupero degli edifici a strutture in muratura*. Rimini: Maggioli Editore, 2008

[3] TORSELLO, P. Il rudere come testo e pretesto. in AA.VV. *Il rudere tra conservazione e reintegrazione*. Gangemi Editore, 2003

[4] MECCA, I. Metodologia operativa per il restauro ed il riuso di edifici ecclesiastici abbandonati. Il Restauro di due chiese in Basilicata e Puglia. in BERTOCCI, S. VAN RIEL, S. *Re.USO La cultura del restauro e della valorizzazione. Temi e problemi per un percorso internazionale di conoscenza*. Firenze: Alinea Editrice s.r.l., 2014, Vol. 1, ISBN 978-88-6055-829-9, pp. 517-521

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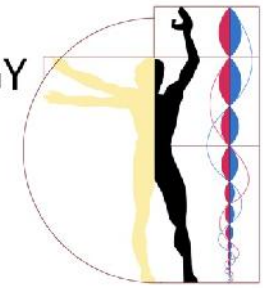

Architecture of Light - Case study St. Cross Church in Nin, Croatia

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Abstract
Since the immemorial time and first cultures, light symbolic role has been related to sacred, religious and cosmologic beliefs. This symbolism can be found especially in religious buildings, trough creation of aesthetics and worshipping. This connection can be found not only between the believers and their religion, where light is treated as the materialized representation of the Divine, but also between believers and the architecture of the building, or to better say architecture of light.
This paper main goal is research and comparison of the way light flows through build religious environment. General study focuses on exploring of the meaning and importance that light has in religious architecture. Through comparison of light at different times and seasons in St. Cross church in Nin, Croatia we are going to make a mapping of different light movements with 3D simulation, and find a relation between form, ritual and light.

Keywords: Light, geographical latitude, sun movements

1. Introduction

1.1 Inability of builders or architectural perfection
According to M. Pejaković at a time when church of St. Cross was erected, which is probably ninth century, Nin already had larger churches, church of St. Marcela-Mary, cathedral of St. Asel Bishop and Martyr, and St. Michael. Builders in Nin region already have experience in the construction of religious buildings, so the thesis of S. Gunjače in "Starohrvatska baština" where he states that "our bricklayer was clumsy in his trade." is disputed. However, it is natural to wonder why the church of St. Cross looks so irregular and so clumsily built.
First writings regarding the church were from Ivan Kukuljević Sakcinski in 1857 when he travelled through Dalmatia toward Napoli and Rome. Afterwards Viennese researcher Eitelberger wrote and examined the church, but only when curiosity of Mladen Pejaković was aroused towards the church, he conducted detailed quantitative analysis and provide answers to many questions.

1.2 Erection of the church and Saints of Nin

Almost certainly we can consider erection of church as the work of the Benedictines who operated in Nin during the ninth century. Written proof from that period is grant issued in Nin in year 1069 that read how the Croatian king Petar Krešimir IV donated islet Maon near Zadar to Benedictine monastery of St. Krševan in Zadar. Grand exudes with solemn tone and is donated in festive occasion at the beginning of the New Year, which was then calculated on 25th of March and is related to the equinox. Later in this text we shall discover the length Pejaković calls "new year pointers / wises, length on which shadow of northeast ray falls.

It is important to note, in favour of the builder theses, that court offices kept textbook for calculation of dates, and the time was counted by scholars, church people, abbots and bishops.

We should emphasize that there were three local saints that were specially celebrated in Nin. St. Asel bishop and martyr – 26th of August, St. Ambrose his deacon – 9th of February (monastery church is dedicated to St. Ambrose), and St. Marcela the Virgin – 23rd of August (she was maid of Lazarus' sister). The basic layout of the apse, the apertures, and the septum is set in dependence of the sun's position on St. Ambrose, the deacon. (Figure 1)

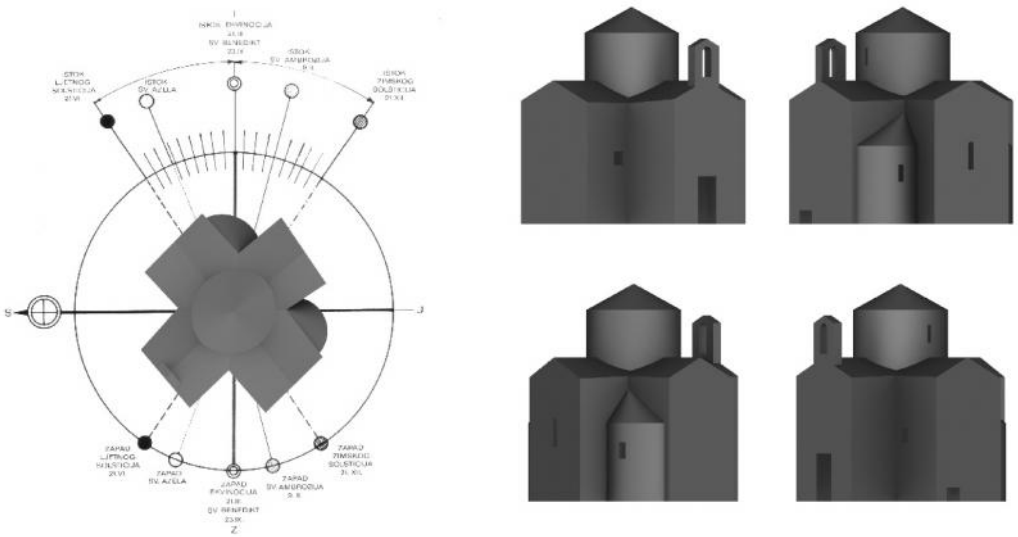

Fig.1: Layout of church in accordance of calendar dates of Saints and the cardinal points with facades of church from exact cardinals, in order from left to right: north, south, east west.
(sources: left composite image: Pejaković (1978) and authors, right images: authors)

1.2 Celebration of light in religious buildings throughout the history

In early Christian and Byzantine Churches light was considered as the materialized representation of the Divine. Geographical position of Byzantine Architecture with its worm and bright climate of the Eastern Roman Empire, required small apertures to admit the necessary light, and the employment of mosaic in large windows weren't adequate in accordance to climate. Light was sometimes filtered through thin sheets of alabaster to create even softer illumination. Early Christian, and some Byzantine, churches maintained the form of the Roman Basilica with central nave flanked by lower aisles and a wall pierced by clerestory windows in-between. But the most commonly preferred system were windows at the base of the dome, with apertures sometimes grouped in the gable ends or within the semi-circular arch beneath the dome (Fletcher 1905).

Medieval Cathedrals Romanesque Architecture interiors were heavy in their making and had dim lighting. The nave was usually consisting of two levels; arcade and clerestory. A third level was later inserted between them, a gallery called the 'triforium', which opened into the space beneath the sloping roof of the aisle. On the other hand Gothic Architecture was characterized by lightness and soaring spaces and structures were 'designed around light' (Swaan 1988), where cathedrals used different methods to capture light and transmit it into the spaces. Gothic churches employed vast expanses of stained glass, displaying a visual attempt to create a setting 'where people could get a taste of heaven' (Scott 2003).

Renaissance and Baroque Cathedrals Renaissance Architecture valued most of all pure light from nature. It was the ideal tool and no more diffusion of light was used. The return to Classical Architecture produced a turn back to oculi, in the form of the lantern mounted on top of a dome. Studies of different shapes of windows marked the architecture of this era. In this era, the theme of altar illumination was explicitly raised, where the 'quadro', or the 'pala' (the ornate front of the altar), receive double light shafts from two apertures on both sides (Davis 2002). Light shafts were used to create three phenomena: firstly to fall onto the altar in the morning; secondly, to fall on certain icons in certain dates; and thirdly, to pore light on Jesus' image in the dome's interior. Latter, in Baroque style, light was used dramatically with high contrasts of light and shadow. Main effect was chiaroscuro. The supreme example of this period was that of The Basilica Di San Pietro, where the sunbeams from the clerestories reflect from the polished surfaces, bathing them in ethereal glow.

2. Metric system at the time of foundation of church

2.1 Anthropological units of measurement

It is the metric system which was used by Augustus architect Vitruvius and about which he wrote in the book "De Architectura". Human body is divine act, it is consistent. Therefore, starting from man and proportion of body parts, considering them suitable as a base for the ideal number system and proportions:
Tenth part of the body = face from chin to forehead and the beginning of hair = palm of the hand from the crease to the tip of the middle finger,
Eighth part = head from the chin to the top of the scalp = from the lower part to the occiput,
Sixth part = from top of the breast to the beginning of the hair,
Fourth part = from mid chest to the top of the scalp,
Third part = on face from the beginning of the chin to the beginning of the nostrils = from nostrils to the beginning of each eyebrow,
One third = from the middle of the eyebrows to the beginning of the hairline,
Sixth part of the body height = foot,
Fourth part = elbow,
Fourth part = breast,
Belly button = the centre of the body, a circle with the centre in the navel that touches fingers and toes.
Man's body is taken even as a guideline for the square, by taking measure of the height of a man from the bottom of the leg / foot, to the top of the head, and that distance is then transferred to the width of his hands. Painters and sculptors also have used these proportions, same as the builders which applied a similar principle. They took proportions corresponding between some body parts towards the whole, taking proportional relations of the parts against the whole structure, with having thumb, palm, feet or elbow as standard measures. In Vitruvius six is a complete number. In this system: 1 is , 2 is , 3 is , 4 is , 5 is , and this is the basis of the measurement system with the anthropological measurement units.

2.2 Proportions

For Vitruvius, man is a metaphor for proportional cosmos; that man erects churches, houses of prayer for his creator according to the law of numbers. Number was created by their ultimate creator, and a man erects the same way as me was created [1]. Human body houses three types of proportions, and book of wisdom writes about it. Proportions are relations between the numbers, and they can be constructed with compass and ruler. Ancient builders used arithmetic, geometric and harmonic proportions.
Numbers in arithmetic proportions, a, b, c, if true , for example 2, 4, 8 and so on. Or in arithmetic progression where the middle number is semi-sum of adjacent members .
In geometric proportion of numbers a, b, c, first and secondary equal to the ratio of the secondary and final or secondary number squared is the product of adjacent members . Specially geometrical proportion of a four members sequence a, b, c, d where , but when we take in equation that the first number is sum of first two, and forth same as first, we get proportion , where the smaller part to the larger concerns as a whole toward larger part. This is sequence according to Fibonacci from Pizza. They also use golden section.
Harmonic proportion , , for example 6, 8, 12, 24 and so on.
For measuring they use rope with twelve nodes, because it is convenient in measuring and constructing right triangle (3, 4, 5). The geometric relationship, and numeric halves, thirds, sixths, twelfths appear further through the forms and volume of the church. (Figure 2)

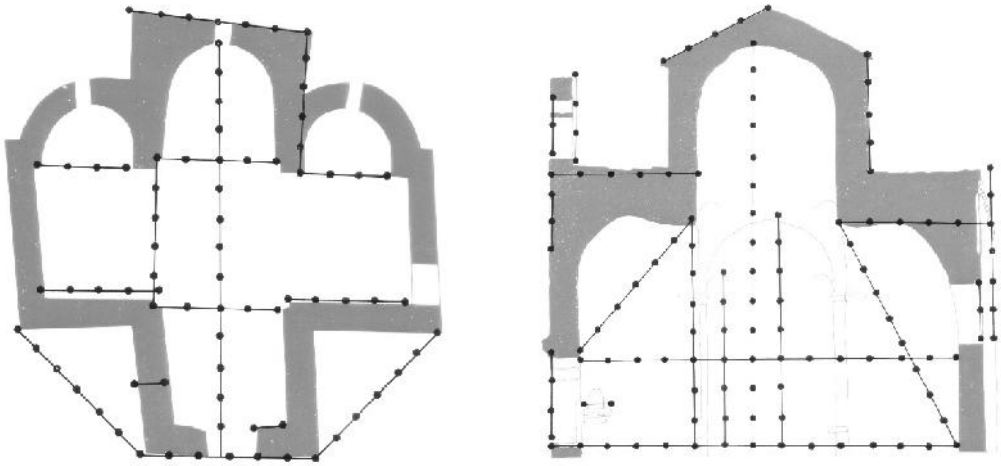

Fig.2: Measuring of layout and section with the help of a rope, with modular measurement unit of 2 feet, from which we can see that dimensions are given in integers.
(source: Pejaković (1987))

Ancient builders more often than not construct their proportions with ruler and compass, using also proportional lengths, surfaces and volumes. They don't calculate proportions and they don't think of numbers, instead, they think of space itself.

2.3 The inclination of the sun's rays

In Vitruvius time there is still typical use of geocentric system, and jet the annual and daily movement of the sun was precisely determined. Term of geographic latitude is known back then. From the position of the equinoctial shadow, obliquity of the ecliptic is calculated, which causes the change of seasons. It is assumed that the tilt of Earth's axis at 24° is fifteenth part of angle of circle, which is a difference of 0.5° in relation to nowadays measurements.
Height of sun or the angular inclination of the sun's rays on the horizontal plane is determined by the rod called gnomon. It is oldest astronomical device that is used to determine the solstice and equinox days, noon line and its exact direction north-south, length of the year and the ecliptic.
The sun on its way through celestial sphere passes through different points and thereby changes its angle to the horizon plane. At noon, when the sun culminates in the local meridian, gnomon shows shortest shadow. As during the year sun changes its position of sunrise, it also changes the local azimuth, therefore changing the angle of the observer in the plane of the horizon.

3 Square as a determinant of form for the little church St. Cross

3.1 Squares and double squares

First glance at the layout, facades and sections, it is clearly visible that the form which determines the church indeed is a square. The diagonals of the square intersect in the point that is twice irrational, which is because the diagonal of the square is incommensurable with its side. When cross is drafted through the centre of the square, it results with four equal squares, and if we combine together adjacent squares we result with double square or doubles with a diagonal of . Diagonal of whole square and the diagonal of one double square, intersect in a point which is from mathematical point of view trice irrational point. But if taken two doubles and such point of each smaller square and of two diagonals of square, that are four points, and now in the square we can distinguish the square shape of a cross, which is also called cross-thirds. This tripartite division with isosceles cross is fundamental form and measure of project methodology of early Christian and early medieval architecture and is rich in symbolism. (Figure 3)

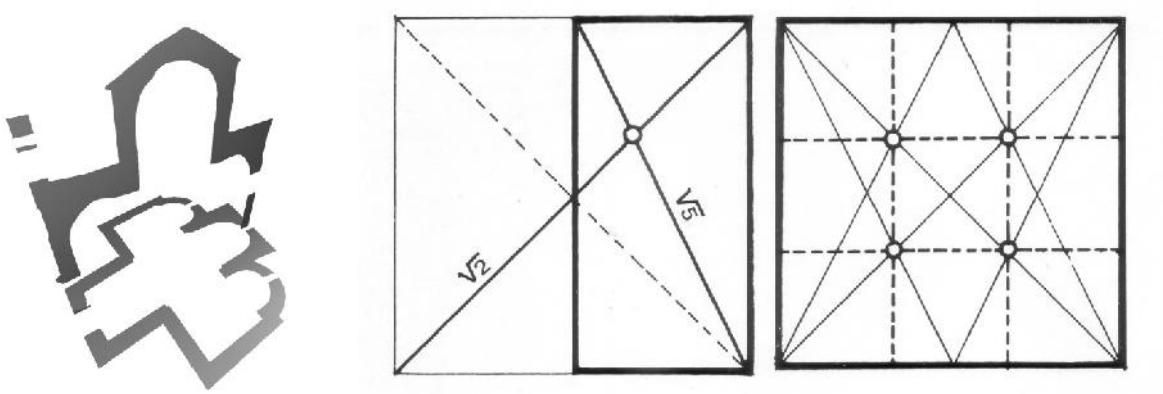

Fig.3: Layout and section positioned in the space with schematic display of diagonal of the doubl square and shaping of square cross.
(sources: left image: authors, middle and right: Pejaković (1987))

3.2 Layout and under dome figure

Pejaković starts from church layout and draws above it square as “decryption net”, using the method which Claude Lvi-Strauss described and through its means he studies quantitatively distinctions. Noting deviations, he sees similarity in them. They are regular and show certain rhythm, which reinforces the stance of Pejaković about church layout being made with deformation, which is intent deviations, and not some random making of some not so skilled constructors.
In his next step he reveals that shape under the dome has one side deflected whit same angle as outer walls in relations to projected square. Earlier researchers thought that it was a trapeze.

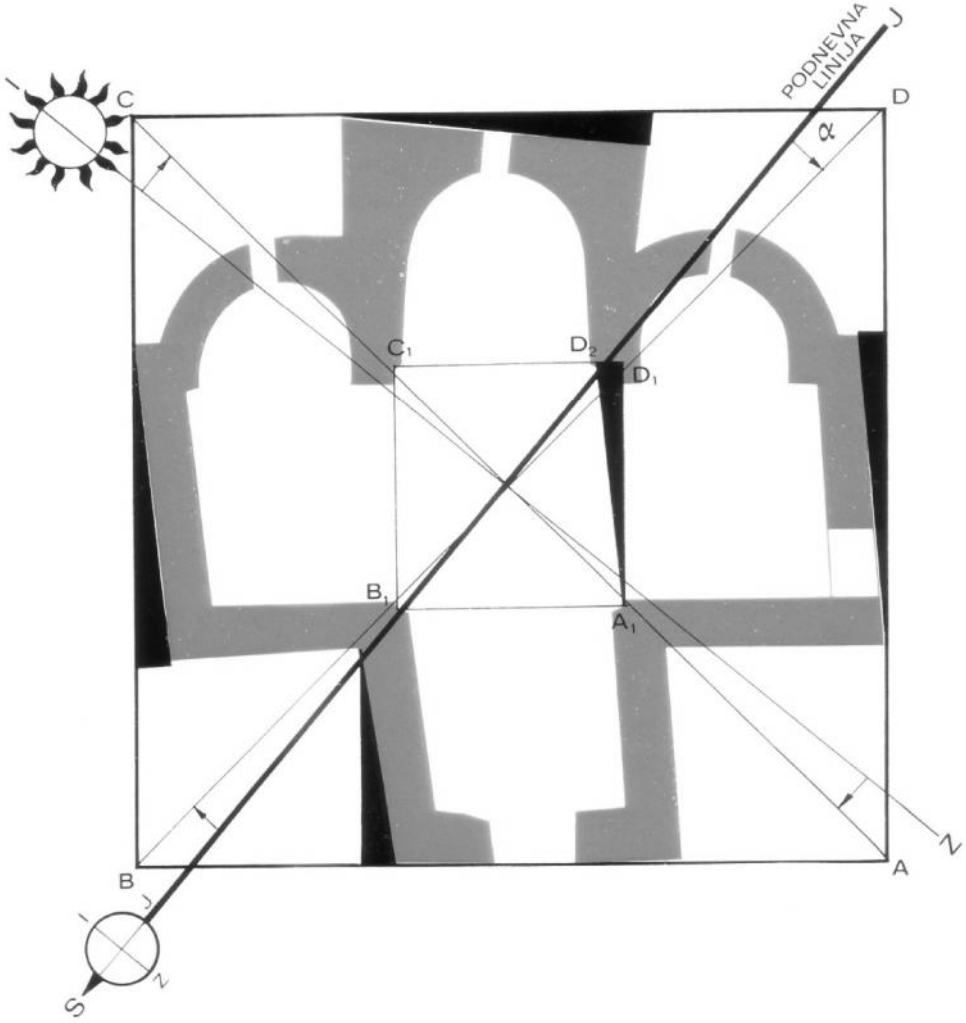

Fig.4: Incline angle reveals a sense of regularity showing diagonal of deformed under dome figure. Illustration shows as projected square with silhouette of church layout, and in it drawn under dome form . Pejaković checks everything, he even thinks that it is rectangle, because by simply checking it is shown that the sides of the square are mutually parallel. Sides and with and , also sides and with side , but side is averted from its initial position towards inner of figure position of so that projection of sun rays would fall in position north – south. (Figure 4)
It is the same angle for which the outer walls area averted from square. When the day is clear and sunny, at noon when sun passes through local meridian, on this line falls shadow from vertical pole known as gnomon. Length of the shadow changes in accordance to angle of sun rays in specified day. In three places the same angle is placed: in outer line of layout, in under dome section and in alteration of diagonals of designed square towards direction north – south / south – southwest. Central point of layout is O point which is central of rotation for diagonals and altered diagonals, it is projection of small dome diagonal above which it is a line that every day houses a noun ray. Irregularity is measured with angle .
A ray of light is delayed due to the natural obstacle of the Velebit Mountain. This delay is built in the design of church.
(source: Pejaković (1987))

4 Experience the sun through the church

4.1 Sun threatening the horizon

Horizontal and vertical arrangement of the church reflects the height of the sun in the meridian in the days of the equinoxes and solstices. In Nin, on 21st of March and 23rd of September inclination of the sun's rays is 46 °, and the solstice inclination is 69 ° 19 'and 22 ° 26' at the time of the winter solstice.
With use of the declination of the sun and the latitude the angle is determine for inclination of the sun's rays when passing through the local meridian. Declination of the sun on equinox is , on summer solstice it is , and on winter solstice . Geographical latitude of Nin is , and height of the sun in meridian on equinox is , on summer solstice , and winter solstice (Figure 5)

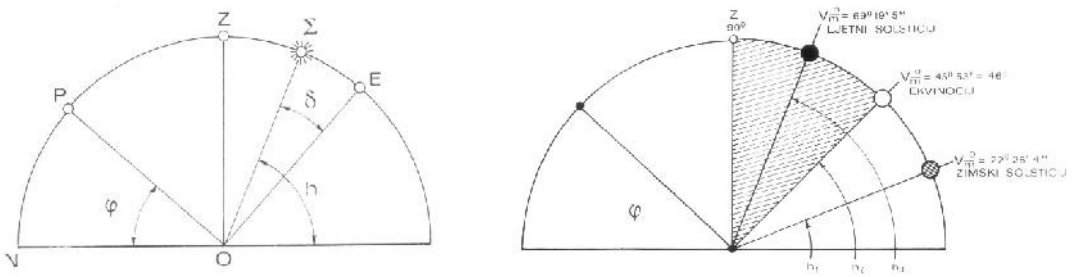

Fig. 5: Calculation of equinox height in local meridian and calculation of sun height in local meridian in accordance to equinox and solstice.
(source: Pejaković (1987))

4.2 The church wrapped in rays of the Sun

Church layout is tetraconch (a tetraconch, meaning in Greek "four shells", is a building, usually a church or other religious building, with four apses, one in each direction, usually of equal size. The basic ground plan of the building is therefore a Greek cross.), when viewed from above and in volume resulting from the circular roof and ring beneath it.
All outer walls of church are rotated in direction of sun rays on exact dates, and that is the reason why the layout could be "wrapped with rays of sun" which was firstly observed by Mladen Pejaković. Façade which encloses main apse, AB length on illustration, is the façade which is laid in the direction of summer solstice east, which falls on 21st of June, known as Ivanovo in Croatia (St. Ivan / St. John).
Diagonal of projected square is placed in the direction of the first ray of light on spring equinox, 21st of March day of St. Benedict, and autumn equinox, 23rd of September, day of St. Mihovil. If this equinox rays conjoin we obtain a square which is disrupting church St. Cross layout. The shadow in the north corner outside the church, and in that rectangle from point D to point E. The northeast wall, CD, entrance wall from point E and south-eastern direction of GH were laid in the direction of the rays of the sun on the winter solstice. Entrance façade EF lays on the base of projected square and is also parallel with base, DG and height CH under dome square. Here we see that deformation is motivated through function of dates. (Figure 6)

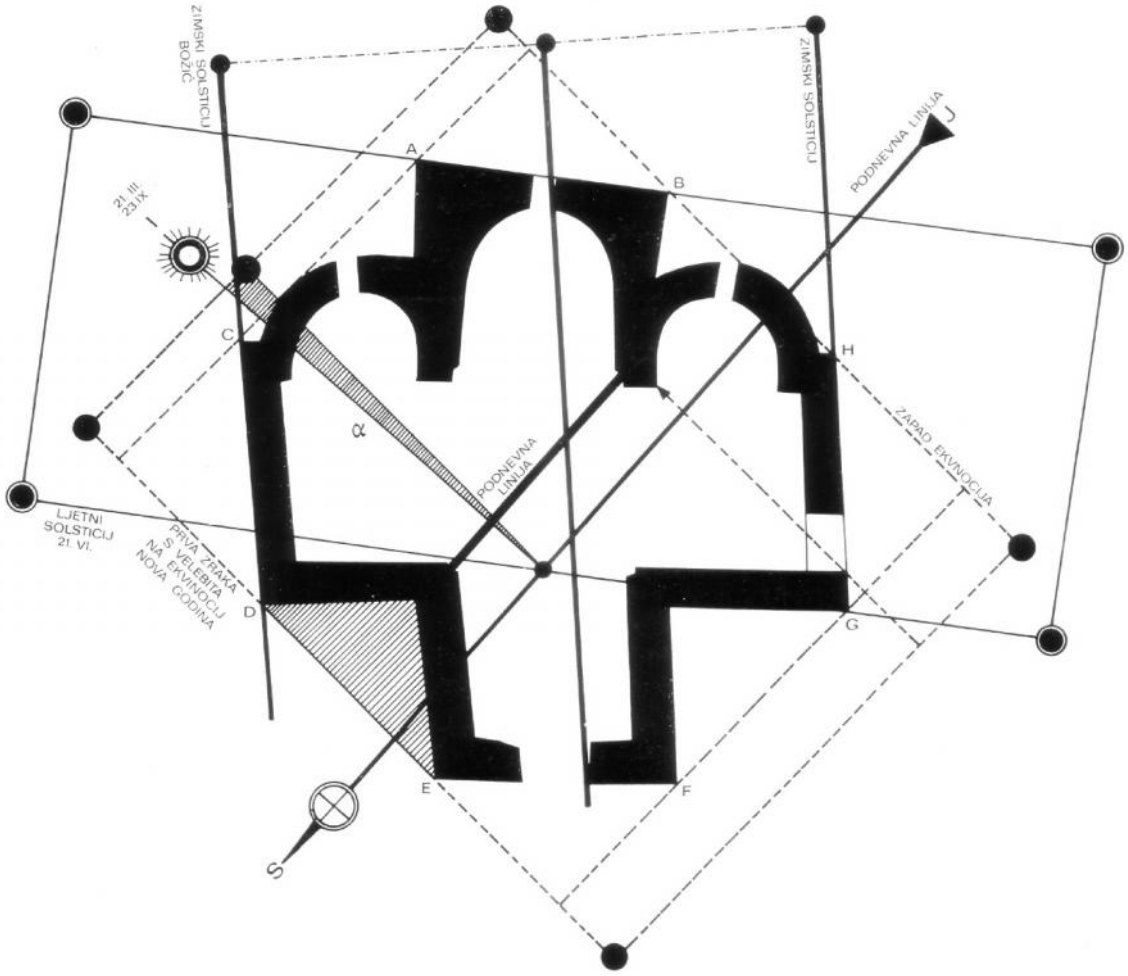

Fig. 6: Functionally motivated deformation
(source: Pejaković (1987))

4.3 Interior of church

Interior layout of church is somewhat more regular than the exterior layout.
Entrance to church is rectangular, and when passed through we enter longitudinal nave, and it finishes whit three apses with their apertures. Apertures on lateral apses are rectangular. When person stops at the entrance to the church on position C, all three apertures A, G, B on all three apses can be seen. Last position from which all three apertures could be visible is position D. Width of the entrance, EF length is connected with apertures so that angles CDE and CDF are equal to angle of equinox and solstice point on local horizon of the viewer in Nin 23,5°. Angle ADG and BDG are 33,6. (Figure 7)

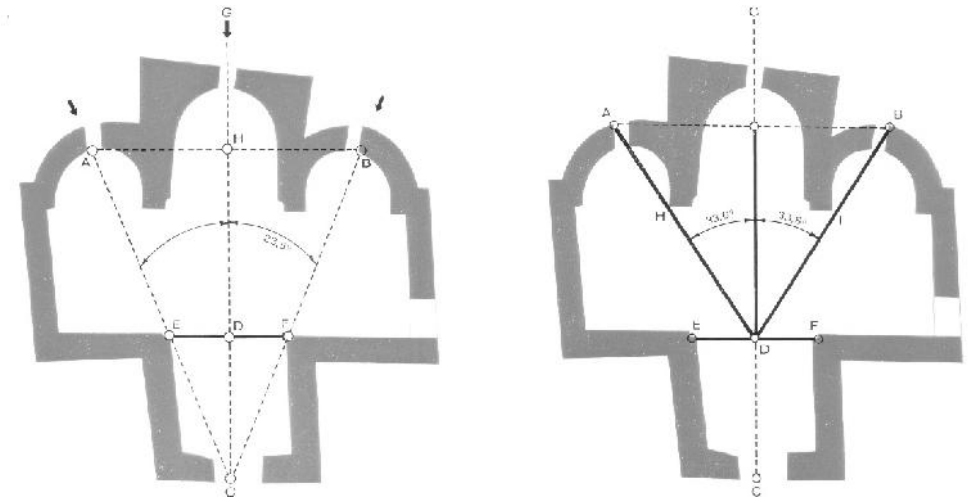

Fig. 7: View from the entrance where we have all three apses in our field of view, pointing to the "correctness" of the interior space
(source: Pejaković (1987))

Pejaković also reveals that on the feast of St. Ambrose the deacon AD ray falls through aperture on lateral apse all the way to point D, and in its extension falls on C point, defining in that way entrance wall. Clear diagonal of entrance to the church in late evening hours shines the holly water in basin.

4.4 Sun woven in praying hours of the church

Benedictine monks created in year 529 *SANCTI BENEDICTI REGULA MONACHORUM* in Monte Cassino monastery, in which they defined forms and arrangement of monastery life, under their motto: ora et labora.
Sixteenth chapter of Regula enumerates praying hours of the day. This notion is important to us because by examining this hours, and the way light falls in church through apertures, we confirm the statement of Pejaković, in which he states that the inner and outer shape of church are made deliberately in accordance to sun rays. So the sun is “literally” wove in all ways with church itself.
Below are three illustrations that show light flow through church during praying hours. Dates that are taken are equinox, summer and winter solstice. (Figure 8, 9, 10)

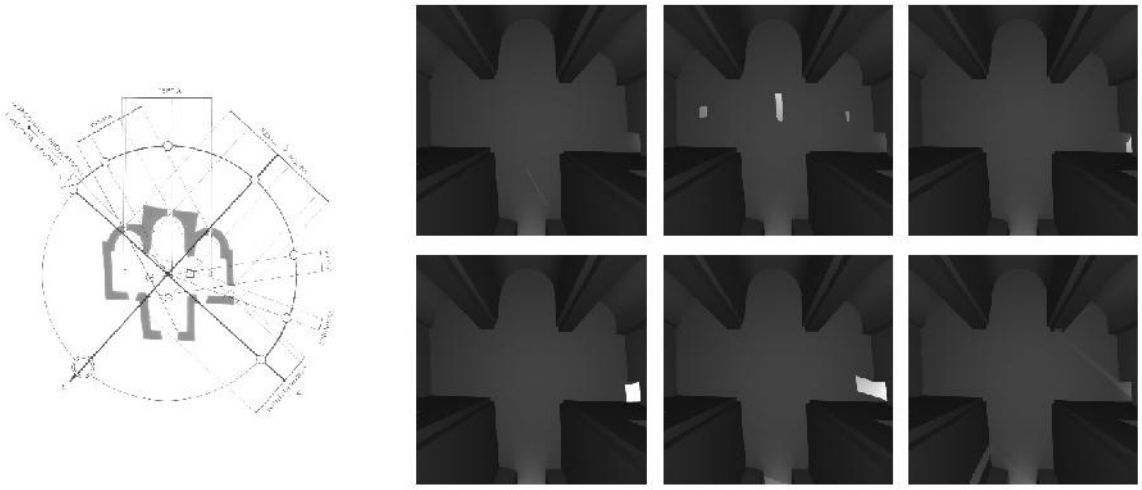

Fig.8: Layout scheme of praying hours on 21st of March, and 23rd of September, or spring and autumn equinox. Praying hours: Prima 7h49’, Tertia 9h50’, Sexta11h52’, Nona13h53’, Vesperae 15h54’ and Completarium 17h56’.
(sources: left: Pejaković (1987), right images: authors)

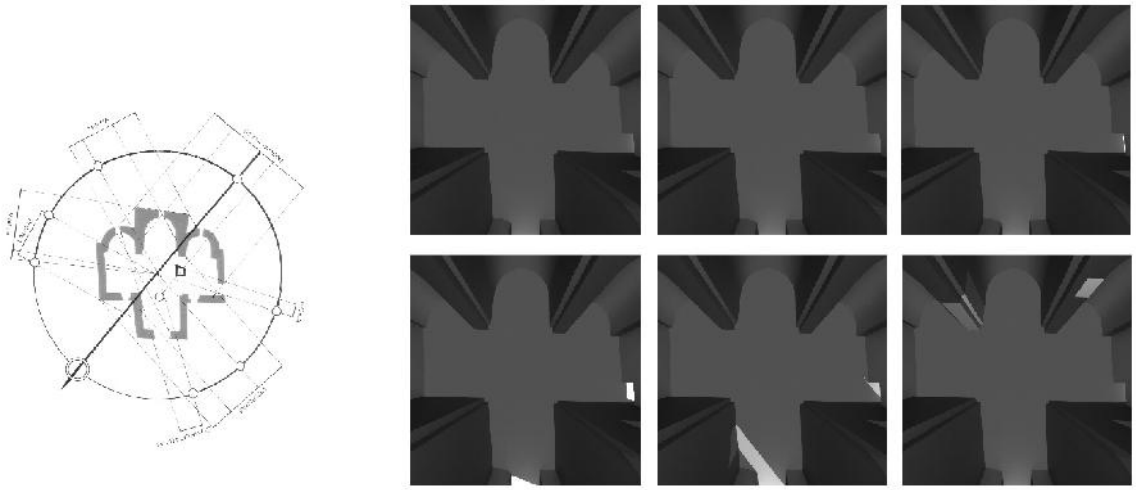

Fig.9: Layout scheme of praying hours on 21st of June, or summer solstice. Praying hours: Prima 6h45’, Tertia 9h26’, Sexta 12h20’, Nona 14h35’, Vesperae 17h05’ and Completarium 19h38’.
(sources: left: Pejaković (1987), right images: authors)

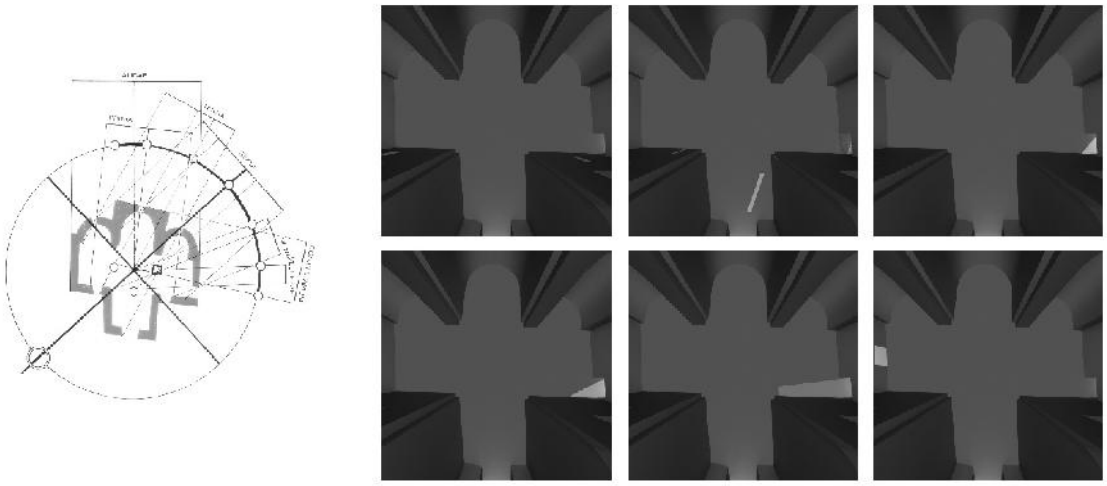

Fig.9: Layout scheme of praying hours on 21st of December, or winter solstice. Praying hours: Prima 9^h, Tertia $10^h27'$, Sexta12^h, Nona$13^h27'$, Vesperae $14^h54'$ and Completarium $16^h21'$.
(sources: left: Pejaković (1987), right images: authors)

5 Conclusion

St. Cross church was built on Maon insula which Petar Krešimir IV donated to Benedictine monastery of St. Krševan at the beginning of a New Year, which, at the time being started with the spring equinox. The manifestation of the time was a privilege associated with the court and scholarly Benedictines.

We have shown that the church of St. Cross was created by careful consideration of its authors. Today we can freely say that the church is well coded transferor of information. We interpret that the authors knew well the geographical position that determined Nina, the movements of the sun and wit that knowledge they were capable to construct elements, skilfully used measuring system and proportions of that time. This small structure permanently transferee us knowledge and beliefs, and customs of the citizens of Nina and the environment

Bibliographical References

[1] FLETCHER, Banister. *A History of Architecture on the Comparative Method for the Student, Craftsman, and Amateur.* London: B. T. Agnew, & CO, 1905.

[2] PEJAKOVIĆ, Mladen. *Broj iz svjetlosti Starohrvatska crkvica svetog Križa u Ninu.* Zagreb: Nakladni zavod Matice Hrvatske, 1978.

[3] SWAAN, Wim. *The Gothic Cathedral.* Georgia: Omega Books, 1988.

[4] SCOTT, Robert. *The Gothic Enterprise: A Guide to Understanding the Medieval Cathedral.* Los Angeles: University of California Press, 2003.

HERITAGE and TECHNOLOGY
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Innovative working spaces: the case study of Novartis and the "InNova" project

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Abstract
This contribution offers itself as evidence of a learning experience of the Degree Course in English language in Architecture, Interior Design and for Autonomy carried out in Department of Architecture and Industrial Design "Luigi Vanvitelli" of the Second University of Naples. Starting from a design competition sponsored by the pharmaceutical company Novartis for the redesign of the entrance and office building of the Campus of Siena, reserved for students and of which this project is one of five winners, the carried out experience investigated complex aspects linked to the symbolic value of the building, environment, landscape and history of an industrial settlement that develops in one of the most self-defining Italian municipalities for stylistic unity and historical and artistic heritage absolute value that constitutes it.
Starting from the study on the "non-linear" geometry experimentations and on the new contemporary architecture paradigms, without neglecting the necessary technological and structural in-depth analysis, the submitted work focuses on the study of a "building magnet" as a possible intervention strategy in response to the program demands, the place nature and the need of the typological workspace review.

Keywords: building magnet, non-linear geometry, contemporary architecture, technological and structural analysis

1. Innovative working spaces
Architecture is fed of expression. As well as an artwork, no matter what is the style, taste or method of representation, it will always have something to communicate. Even if the project is the result of a simple speculation, the result of a disaffected work, anyway it will express something, also if it is anonymity. For who instead practice their profession with devotion, it becomes a constant research of a value. The value is given by the ability to respond to a need and do it with style through the sense elaboration of the architectural sign. Awareness that comes from the constant confrontation with some unavoidable variables, such as the environment (urban, landscape, environmental), or the functions, the time and the mutability...
As of today, much has been achieved and is being experimented in the field of architectural expression. In the contemporary practice, the major innovations in formal, structural and technological terms, arise chiefly from the initiatives and investments in the services sector.
Here it is given to the architect the possibility to create, to think bigger and ever more forward, revisiting not only the conception of the production environment, to which is increasingly being attributed a strong visual identity, but also the way in which it is performed the work through the study of space management. It begins to speak about Sign-buildings or Magnet buildings and the spatial experiments to which they are subjected.

1.2 The building magnet

To the Building magnet we associate the image of a monumental architecture, an attractor, that, while in the past had a purpose purely related to politics and to the affirmation of the economic power of a country, today consists to build buildings that offer a spectacular vision of architecture and that exalt, with their shape and their representative image, the technical and design avant-garde of the work and, therefore, of who was the promoter and manager, featuring the city and attracting the flow of tourists in the countries. But to the Sign building, is asked not only to celebrate itself and design abilities of its creators neither to just integrate perfectly into the landscape, but to "represent" something. This something can be an ideology, a brand, a philosophy of action.

Each company works hard for the creation and publication of its brand. Once they reach the desired level, the goal is to maintain the quality standards or even to improve it.

It becomes crucial to invest in marketing to increase the popularity of the brand, so that many companies expand their horizons of action to make sure that their names resound everywhere.

Strong image helps the company to stand out from its competitors and influence the way in which it is perceived by consumers and employees. That's why more and more widely, most successful companies commissioned the design of their offices to visionary and unconventional architects, able to express in the most original way the DNA of the company.

“The workplace is more than a place for people to sit”, explains Andrew Garnar-Wortzel, who designed the New York headquarters of the National Basketball Association, "a company that chooses not to characterize its proper place of work transmit silent messages to its customers and employees, such as that of carelessness or even frugality, without any connection to the company mission".

The architect concludes identifying three fundamental characteristics, which according to him, a working environment should possess in order to avoid these unintended messages:

VIABILITY:

Just as healthy food is referred to as being “nutritionally dense,” a successfully branded building will provide workplace productivity densities and efficiencies. "A work in order to be valid, must be able to support all the activities carefully – focusing on the operational aspects of the business and how it can be expressed in the built environment".

MEMORABILITY:

This involves the physical elements that touch the heartbeat of the organization. “To be memorable, (the workplace) needs to create an emotional connection to people that will make the experience an event”. These include visual connections, physical connections and lighting.

LIVABILITY:

This is referred to as the environment supports the ability of employees to do their job. "A building 'live' over time. As such, it should not be designed to last for one day. It must be able to grow with the business over time."[1]

1.3 The non-linear geometry

The architectural idea and its form are expressed through the geometry and the combination or subtraction of its figures. The celebration building then arises from the creative and meaningful elaboration of its volumes. This is true, up to a certain point, in which man questions himself and his axioms according to technological innovations and continuous experimentation and, above all, mutual contamination with other forms of knowledge: biology, physics, genetics.

The result of this research has been that the categories of form, function and structure are deprived of their iconic value, constantly challenged and subjected to continuous verification processes: “there is no formal repertoire assumable as referral aesthetic canon, no reduction/simplification aimed to the structural standardization, no freezing of the spatial arrangement intended to the definition of functional typologies”[2].

Architecture becomes a constantly evolving "organism", the subject of careful investigation also through the ability to "simulate" own by computer tools.

The goals of the non-linear geometry and of complex shapes in space finds its origins in the empirical experimentation of those who, convinced of the need of the plastic research, forced himself and his employees to observe in the mirror catenaries of wires hanging from the ceiling and then redraw them and reproduce the shapes on the paper; or as famously used to do Antoni Gaudi who gave life to his "phytomorphic forms" using fishing nets, or chains, interacting with systems of weights able to change and direct the geometric pattern, in order to obtain new original and engaging visions.

Since 1992 the German Hermann Finsterlin, sensed that the elementary geometric figures had not yet been exploited in all their expressive possibilities, since the criteria by which they were used did not include changes in the shape or in the architectural box and they were related to traditional canons of symmetry, axiality, hierarchy etc...

"Finsterlin introduced transgressions to the consolidated rules able to undermine the traditional classical spaciousness, making himself be influenced by a rich and vibrant world, where the facade and the wall, the roof and the ceiling are melted. Its spatial concept is based on the distinction of the three dimensions that

tends to overcome the functional division of the environments to search for a fluid continuity. His architecture, his sketches, strongly reminiscent, in a stated and embarrassing way, investigations that now we found in many magazines that deal with experiments and theories of the architecture referred as digital.
However that way of comprehension and conception of space, reluctant to be represented and described in the Cartesian visions of plan, section and elevation, could find a wider diffusion thanks to the ease with which the computer and specialized software design have made accessible to everyone the study of complex shapes, derived from the application of non-linear geometries"[3]. The result that have achieved these experiences before the era of modeling software is something that can really be called "architectural artwork" because it is the result of a total control by the designer and is 100% product of his will and artistic expression. To the computer design must be given the opportunity to explore new ways taking advantage of its potential to the fullest, without losing sight of a final image which must be "intentional" and proper of the designer's vision.
If there is not a final reason that supports and substantiates the project, the project doesn't exist, it remains a mere exercise chart, and sometimes, unfortunately, constructive. Therefore, the challenge for the theory and practice of contemporary architecture is to develop, in a more sophisticated way, the areas of technological development, not simply to draw upon a new assortment of free forms, but to allow the total and conscious management of new spatial relationships able to interpret a different system of values related to living and inhabiting.



Fig. 1: From box to blob and back again: the two extremes of the aesthetics of digital as punctual results to the variation of one information.

2. The Novartis competition and the "InNova" project

In 2014, the multinational pharmaceutical company Novartis Vaccines announces a competition of ideas, in collaboration with the Department of Architecture and Industrial Design "Luigi Vanvitelli", for the design of an office building and the entrance of the headquarters campus in Siena. Of that contest, the project described in this article, is one of five winners. Strategy and research, not only formal, were the key elements of the development design. Dictated by the entrepreneurship proper of the company, that already in the site in St. Johann in Basel has invested in a profound revision and modernization of its headquarters.
Originally based on a masterplan by the Italian architect Vittorio Magnago Lampugnani, in the last decade, thanks to the contribution of the leading figures of contemporary architecture, the campus has developed into a vanguard working environment that combines laboratories, administrative functions and communication.
A similar spirit led the ideas competition organized in collaboration with the Department of Second University of Naples.
During the meeting for the presentation of the announcement, company representatives, in addition to describing the role of Novartis in the pharmaceutical sector and to illustrate the status quo of the headquarters of the campus in Siena, expressed a number of expectations, also accompanied by images examples. The interpretation of such requests, provided the key to identify the design choices, choices dictated by the study and by the absorption of those theories that have been discussed in the preceding paragraphs regarding the Magnet building and non-linear geometry.
At the base of the concept was the desire to represent the world Novartis through the expression of the innovation and research.
Architecture had to recount of a brand and of its purpose, it had to be the emerging sign in the identification of an important area, a "Science Park" where are studied innovative vaccines which help, preventing the spread of disease, to save millions of lives in the world.
How to interpret the innovation? Through the formal and technological research, with the aim to create an enveloping and attractive design, able to create a pleasant and engaging work environment, and to host a minimum of 200 employees: Innova is born.

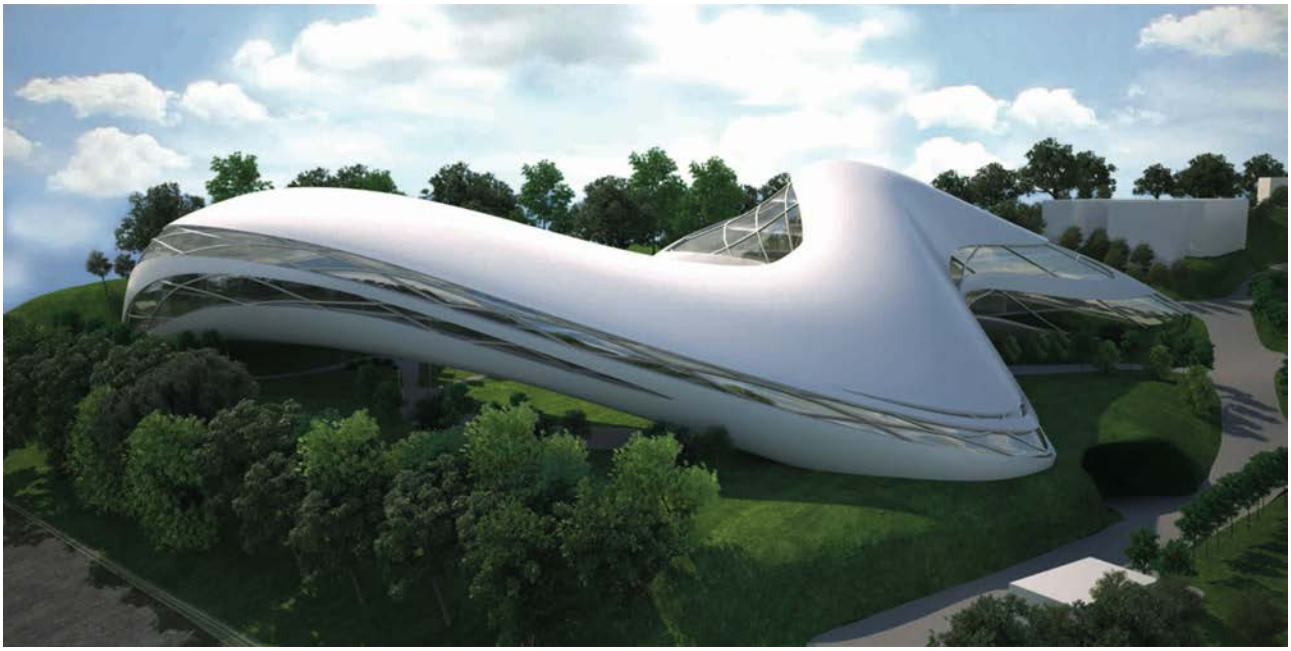

Fig. 2: Render of the office building at the entrance of the headquarters of the Campus

The first step of the design was the redefinition of the main streets in the campus, defining, in this way, the area devoted to new construction. Anyone passing by Fiorentina street cannot fail to notice the new structure that gives to the street its longest side. Entering the site, the sea of cement of the existing project has been replaced by a wide expanse of green that welcomes visitors on both sides of the entrance. On the left is the new building and always on that side is the entrance to the underground parking. From the southwest it accessed to the building and the park below. The latter is designed to ensure walks between green and shadow areas created by the cantilevered structure of the building above.



Fig. 3: Masterplan of the project intervention

The organization of space in a so complex shape, has resulted simple and complex at the same time, due to the subdivision into six floors of the building that are imperfectly aligned. The organic shape also involves the loss of usable space due to the heights that decrease, at the edges, below the 2.40 m. The goal was to leak

the most of the steel structure of the building, and allow to the visitor the palpable feeling of having disclosed the true essence of the architectural form that hosts it. This design desire, combined with contemporary interpretations of the workplace, have meant that the creation of interior partitions was reduced to a minimum. The open spaces welcome workstations, enjoying the light coming from both sides. Bright glass wall separate the meeting room and space for group work, as well as defining the small bubble rooms, which ensure, when necessary, the confidentiality of the meeting. Easier than expected, was the division of the functional environments, since every single slice of the building suggested its intended use.



It has been established, also due to the territorial structure, that the second floor represented the main entrance to the building. The funnel shaped plan, seemed perfect to express the concept of hospitality and to direct the gaze towards the office area. The employee may linger at the bar on his right to have a coffee before starting the work shift, settling on the tables specially prepared or on the sofas, in the waiting area. Visitors or external members, however, will receive all the necessary information to the reception, on the left. After passing the entrance, two curved walls delineate a small exhibition gallery that points to the office area Here can be posted photos and publications that celebrate business success, as well as the results of competitions and announcements. The first floors house, on the one hand, with a double overlooking of the park, a nursery for employees'children up to 5 years while, on the other hand, a leisure area, for game and relaxation during breaks from work.
At higher levels, the location of the archive, the conference room and the direction. Each plan is different, for area, shape and lighting, so every aspect has required a careful study whose purpose was to ensure uniformity to a space whose strength is dishomogeneity!

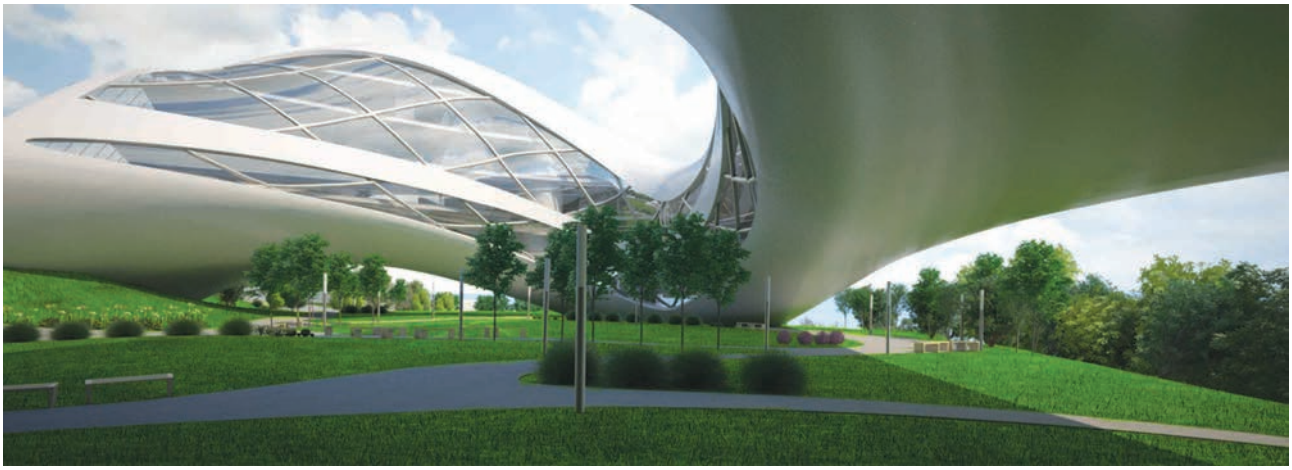

Fig. 4-5: Render of the court

2.1 Structural consideration

A so complex geometry, deserved, a preliminary study of feasibility.
First of all, the definition of construction details of opaque and transparent claddings.
The identification of the components and the definition of materials has been required in order to calculate the quantities and determine the loads to which the structure is subjected.

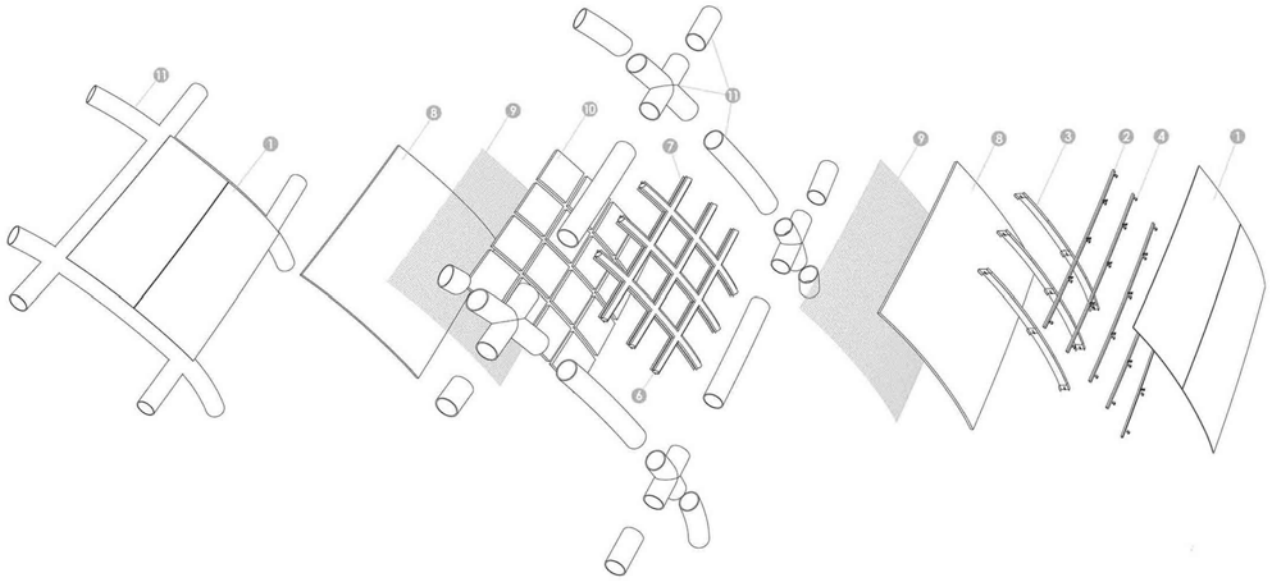

Fig. 6 Exploded view of the opaque envelope

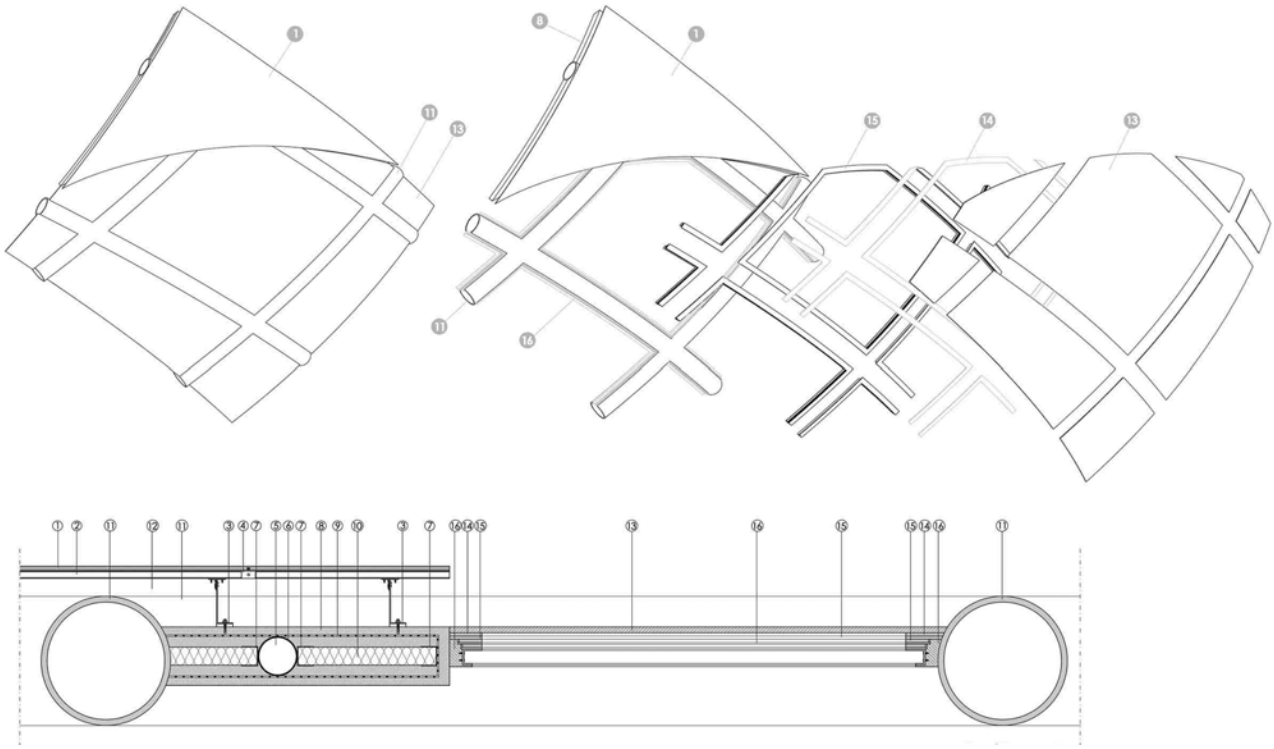

Fig. 7 Exploded view of the transparent envelope

It was then proceeded to the delineation of a simplified schematization of the structure above the ground level and all the preliminary security assessments that followed them.
Once pre-sized the structure in elevation, has been defined the scheme of foundations consisting of the underground parking and the layout pattern of the piles in the deep foundations.
In the definition of a preliminary structural design, the building has been simplified by associating it with two converging bridges and thus initially schematized as two arches hinged to the base with an uniformly distributed load. Between the two, the more problematic is the first, because more lowered and therefore with greater stability problems.

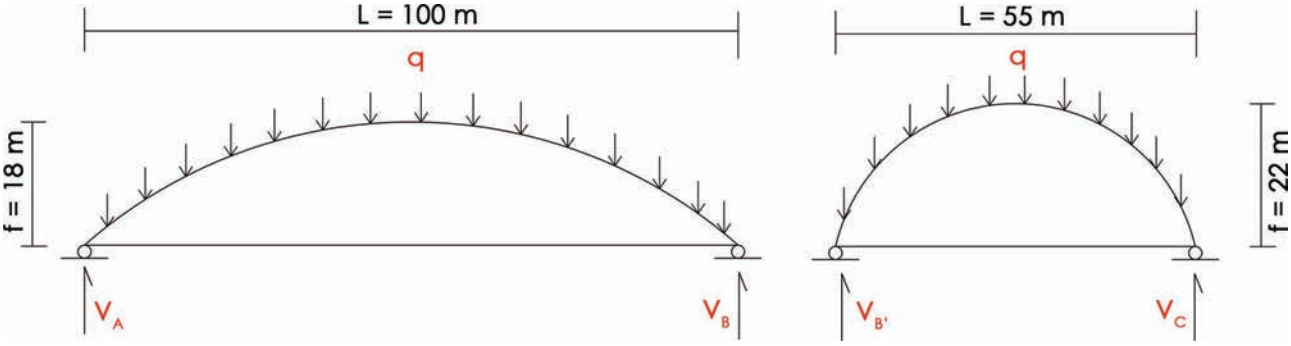

Fig. 7 Static schematization

From the structural point of view the arc performs the same function of a beam, it downloads the vertical loads on two support points distant from each other, but with a different static operation compared to the latter. While the beam is a non-pushing structure (it has only vertical reaction forces), the arc instead generates horizontal thrusts.
This has the advantage of a more efficient transmission of the loads, allowing the covering of broader spans than those that can be managed with a beam, while presented as a disadvantage a more complex construction and the need to provide methods to counteract the lateral thrusts.
One way to solve the problem is to build arches thrust eliminated making chains that connect the two lay down sections.
In the case study, the role of the chain was taken from the floor of the underground parking, which warping, along the directions of the arcs, is increased to ensure an increase in stiffness and so transform the previous scheme, in an arc with eliminated push.
Defined the scheme, the next step is the calculation of the load to which the structure is subject. Usually in arched steel structures, a common problem is the lateral instability, linked to the slenderness, caused by the high compressive forces.
In the case of the building in question, the problem does not subsist, because the section is sufficiently large and thanks to the warping of the floors, it behaves like a huge multicellular caisson. Since this is a preliminary study, it was decided to determine the biggest point of the building and extrapolate from there a section of a linear meter, calculating the incidence. The value, in kN/m, was then multiplied by the diameter of the arc thus obtaining the total load to which the structure is subject. Then calculate the reaction VA, VB, VB 'and VC, we know the load to which are subject the foundations. In particular, the foundation in the support B is the most stressed, because on it converge the values of VB and VB '.
The section has been decomposed into basic elements for which the material components are defined by quantity and density. The sum of the total values of the latter was added to the variable load of an office building defined by the NTC 2008. Called the load "q" has been calculated the incident load on the three supports. The calculation of the structure was carried out in a first approximation for the vertical loads only, since the horizontal actions on the arcs are of considerable importance, especially for the calculation of the foundations, due to the increase of the thrusts. The City of Siena in which the work is located is considered to have low seismicity and then, in the absence of detailed information on the type of soil, both the arch and the whole foundations have been considered in this phase of the design able to meet any limited horizontal actions due to the earthquake.
The car park structure combines two structural solutions.
1. A set of rectangular reinforced concrete columns (100 x 200 cm) with larger stiffness according two different axes and with a distance up to 15 m
2 multicellular boxes. In the pillars, underpinning the building, are set concrete walls to form the cells. The same criterion is applied to the entire park area divided into four large concrete cells by partitions, perforated only in the vehicles transit areas.
The piles, of 1 m diameter, are arranged in a triangular grid, with piles at the vertices of an equilateral triangle of side d = 6m, according to the classic "quincunx" arrangement d = 6m. The mesh thickens below the supports and the distance between the piles is halved.

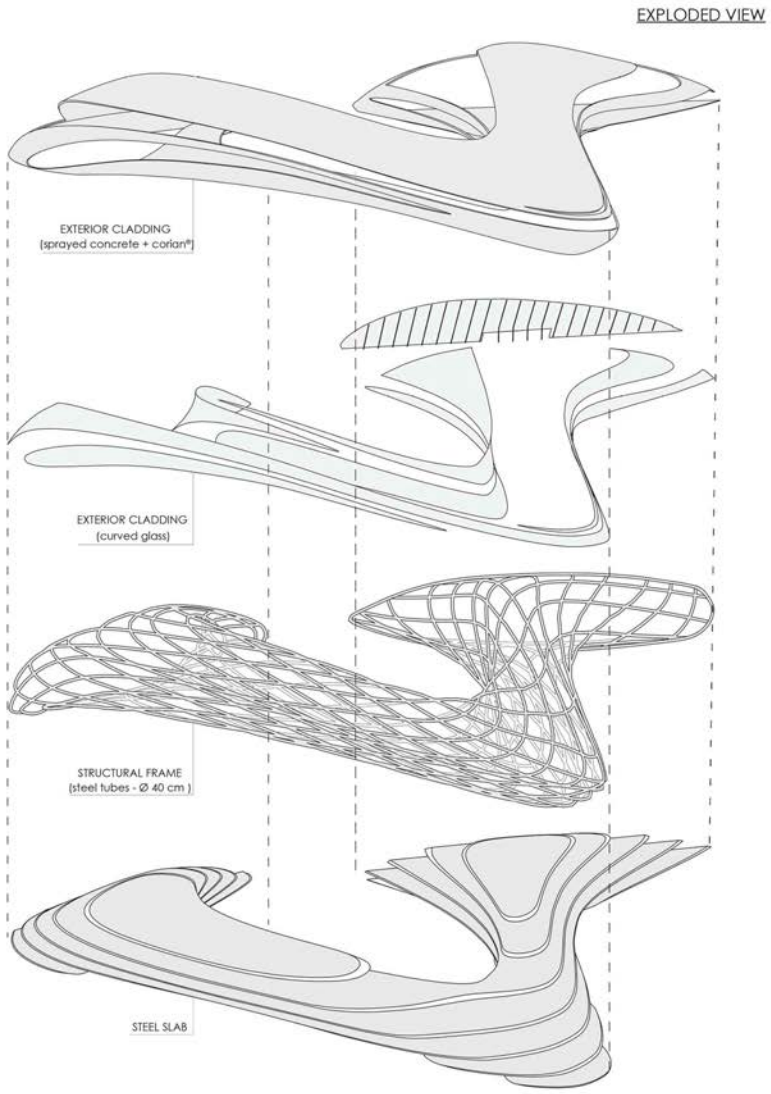

Fig. 8 Exploded axonometric view

Bibliographical References

[1] RICKARD-BRIDEAU, Carolyn. *The power of aligning design with brand*. New York: Little Diversified Architectural Consulting, 2009.

[2] FABI, Silvia. *Anticipazioni formali dello sperimentalismo strutturale.* Milano: Area 124, Motta editore, 2014.

[3] KIPNIS, Jeffrey. *Towards a New Architecture.* London: AD: Folding and Pliancy, Academy Editions, 1993.

[4] MEOSSI, Maurizio. *L'architettura performativa dell'età dell'informazione* . Info-Aesthetic Manifesto, 2001

[5] DE KERCKHOVE, Derrick. *The architecture of intelligence.* Torino: Testo & imagine, 2001.

[6] MCCULLOUGH, Malcom - J. MITCHELL, William – PURCELL, Patrick. A*rchitectural knowledge and media in the computer era.* The Mit Press, 1990.

[7] VYZOVITI Sophia*. Supersurfaces.* Bis Pub*, 2006.*

[8] http://www.architecturalgeometry.org

[9] http://www.arcspace.com

[10] http://www.arcspace.com

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Sanfelice Palace, the house of a genius: some insights about the geometrical relations

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Abstract
The work of Ferdinando Sanfelice (1675-1748) was always subject to an extensive and authoritative studies, carried out in particular by the context of historical disciplines [1], but it also attracted the interest of eminent researchers in the field of the architectural design [2].
That is because the architectural production of Sanfelice expresses, in the spatial and formal composition (always brilliant), a complexity of ideas and important elements that determine the different and multidisciplinary interest.
This work aims to integrate the wealth of knowledge that many authoritative studies helped to create, going to deepen, through the specific tools of survey and representation, some aspects of Palazzo Sanfelice - personal abode of the genial architect - and so, the research of the original features of its design.
The contribution of that particular approach, based on the analysis performed through the architectural and material survey, rises not only to the role of fundamental support to other types of researches, but also in giving new elements to read the monument. Especially when the object of the research has some extraordinary peculiarities as in this building, that hides beyond the remarkable and noble front - in the privacy of the two inner courtyards - the most valuable product of the capacity design of Sanfelice, brilliant architect and defined today really modern, with an unusual ability in design, simulation and spatial control.

Keywords: Survey, geometrical relations, Sanfelice Palace, monumental staircase.

1. Introduction
This paper, part of a wider research, proposes an deepening study about Palazzo Sanfelice, through specific tools of survey and representation [3]; the contribution resulting from this specific approach is useful not only as support to other types of research, but it can provide even unpublished topics in the reading of the monument. In particular the building has some extraordinary features, showing itself at the visitor's eye as a noble building of its time - which in fact it is - but at the same time hiding, in the privacy of the two courts, the most valuable product of Sanfelice's design capacity (the staircases), brilliant and very modern architect, equipped with a large capacity and spatial control simulation.
Palazzo Sanfelice was built between 1724 and 1728 [4]. The final date of 1728 is advertised in the inscription on the portal of access to smaller court, today corresponding at via Sanità n. 2 (called *A* in this paper), and it refers to the new construction of the minor building, next to a pre-existing building that corresponds at via Sanità n. 6 (called *B* in this paper).
Around 1714 Sanfelice implemented the pre-existent building [5], giving the current characters and realizing, in the largest court currently correspondent at via Sanità n. 6, the extraordinary stair that we named *"wings of seagulls",* that defines – as an impressive scenography – the building's background, offering itself almost unexpectedly to the view of the visitor that goes across the entrance portal.
A first ingenious solution was adopted for the main facade. From narrow and chaotic via Sanità, the reading of two identical symmetric portals defines a first architectural pattern that, probably, came from a precise view of the designer: the sight of the imposing facade on the street, that combines an even architectural continuity the two different buildings (A and B), could be fragmented - at that time just like now - due to the reduced width of the road.

This condition determines, in fact, a difficulty in the reading of the full street profile. It is likely that the sequence of the two portals, perfectly identical to each other, has the aim to catch the attention of the passerby in movement, whose perceptiveness addicted to an heterogeneous basement vision during all the walkway, is unexpectedly "affected" by this replication, so as to elicit a desired curiosity.
Moreover the portal [6] shows the Sanfeliciana architecture, and it has a predominant role in the project, sometimes surpassing the simple role of compositional element of the facade, as well as the stairs [CAPOBIANCO, 1962 and 1963, ref.; ZERLENGA, 2014, ref.].

2. About the survey

The survey of Palazzo Sanfelice was planned in order to specify geometric and architectural aspects, to describe material and colorimetric characteristics and document the state of degradation at this time (2014).
The approach to the survey was exclusively “direct type”. It was also directed by a series of logistic circumstances, first and foremost the impossibility to obtain, for a sufficient period of time, the areas in interest without the cars who usually park in the courts! Then the survey planning had to primarily take into account the difficulty to perform instrumental free-field footage, as laser scans and other indirect applications; under these conditions, the contribution drawing on documentary website is very effective.
Where deemed more meaningful documentary level, was made back in the photoplan of facades or portions, implemented through mosaicking of photographic shooting returned in orthographic projection.
We proceeded to detect traits for subsequent measurements with the assisting of sketches and, where it was possible, of pictures. The measurements of the facades were taken with a “Leica 3D Disto”, that is an instrument which is essentially based on the technology of handheld meters, enhancing the possibility, such as 3d measurement and auto referencing the object.
Some stations were performed, to cover the total extension of the fronts. As mentioned, the instrument that was used, allows the measurement of points measured in sequence with respect to a third fixed position; this position corresponds to the station points, that refer, in subsequent moving of the instrument, through the so-called safe points (applied references), that by connecting to a coordinate system, allow the contiguity of the measurements even after a change of station. Through the execution of subsequent beats, a grid of main measures, was acquired corresponding to the points on the vertical alignments of campaign, eaves and ridge, in addition to the identification of the heights of the string courses and of the openings. Similarly, for the horizontal alignments, amplitudes of the individual buildings were acquired, of the the openings, their pace and in general of any major change in geometry.
The main facade on via Sanità is punctuated by a basement level, over seven meters high and covering two floors, characterized by two portals of entry in lava stone, topped both by pairs of mermaids holding the marble inscriptions bearing Matteo Egizio’s inscriptions, which for complexity and quality can be identified as true sculptures, consisting of pairs of mermaids holding the marble inscriptions [7].
Beyond this level, starts a succession of nine punctures, with alternating between windows topped by segmental arch pediments and balconies.
The axis of symmetry falls within the structure of gaps, against which it starts in reverse, on the right and on the left, a symmetrical order of windows and balconies.
A superior coping consists of nine concave niches which house many marble busts. The first of these on the left, looking at the building, is missing, probably lost or stolen.
Besides the main facade on via Sanità, which returns an apparent homogeneity of the factory, they develop two completely independent, two different factories for size, distribution and time of realization, characterized by a common design solution, which marks a Sanfelice’s architecture defining trait, i.e. to allow - and also to promote – the observer to look beyond sight the monolithic structure represented by on-road front through a precise sequence of architectural elements that punctuates this succession: portal – atrium – monumental staircase.
Both portals, outweigh the only works of the architectural element, passing and conjunction between two spaces, becoming catalysts of the observer's attention, tools of preparation and prelude to a discovery still hidden, which is just beyond the door, the spatiality of the courts and the spectacularity of bold shapes and scenic value of the staircases.
The portal in via Sanità n. 2 introduces to the smaller court (A), with octagonal plant with the staircase opposed to entry. The angulations of the walls of the structural system are slightly rotated in relation to the position of the main facade on via Sanità; this slight rotation originates from having hired, as angulation for generating the geometry of the court "A", the west side, i.e. the the border with the building on via San Nicandro.
The building of the smallest court at number 2, that is adjacent with the biggest building (court B), follows a different angulations which, as already mentioned, that originated from the border West and that determines a different orthogonal scheme revolved around two degrees than the court B. The axes so willing becomes the main of the building orientation at via Sanità n. 2 and also of the staircase with double circular ramp.

The facades of the court A present, in short, a different angle than that of court B; while the latter respect the orthogonality with via Sanità, the geometry of the facades at via Sanità n. 2 is implanted on the orthogonal axis to the direction of the border West of the building, towards via San Nicandro, returning a rotation of about two degrees.
The facades show signs of a rich ornamental apparatus, with gable windows, pilasters and friezes of eighteenth-century drawing. It is also of great value within the atrium court access - although disfigured even with the construction of a local stone structure - whose vestments exhibit decorations with friezes and whorls instead drawing "modern" and a big star that engages the entire barrel cover.
The portal in via Sanità n. 6 introduces on the biggest court "B", of rectangular plan, with the monumental stair opposed to entry. The court B develops following a geometry defined by orthogonality with respect to via Sanità.
The facades have a more sober, with decorative windows defined by flat pilasters and string courses.
A whole side is represented by the scale to *wings of seagulls* [8]. It occupies the entire width of the facade as opposed to entry and forms the fourth side of the factory, the geometric border and at the same time element of anticipation and presentation of the rear garden.
One must immediately point out that the solution adopted for this scale, commonly identified as *wings of seagulls*", is an architectural organism in its own right, a real building in the building. In fact, in addition to other exciting space, formal characteristics and structural, it becomes the fourth side of the building that, in addition to conclude the perimeter, not only serves as a spectacular backdrop to the observer that it introduces into the Palace but also into scenografy, from permeable separation by anticipation of further discovery, namely the monumental garden unfolds behind.
"Specifically, the spatial configuration to "wings of seagulls" comes from the peculiar planimetric design of the staircase. This, in fact, refers to the double monumental staircase with four flights of stairs that wrap around an empty space sharing a central flight. In this diagram, the edge of the staircase is set along the transverse direction, thus confirming the architectural layout called a double monumental staircase, and at the same time, giving the central bay on the ground floor, free and not committed to any flight" [ZERLENGA, 2014, ref., pagg. 1633, 1634].
The Est front is overlooking on vico Lammatari, and presents a simple facade as is compositional facility and as that ornamental. The facade overlooking the back garden is less well known and studied, and it forms the northern border of Palazzo Sanfelice.
The rear facade spotlight, adapting them to the garden, architectural solutions adopted for the courtyards.
Firstly, it is evident the difference and separation between the two blocks of buildings, the biggest, corresponding to the court "B", and the smallest court "A"; in the garden, that apparent uniformity sought for the front office, disowned, is completely through the purpose of clear and differentiated reading not only of the two buildings, but also of the various portions of the same.
The garden, slightly larger in size than the current extension, was supposed to be a place of contemplation and meditation more intimate for the inhabitants of the Palace, well differentiated from the public *agora* represented by short, even more so for their valuable architectural character, they couldn't hire a private connotation but, even more, is a supporter of as places for public enjoyment performed.
The configuration took almost trapezoidal geometry resulting from borders "clipped" in the Fonseca's slope, characterized by a declining topography with a widely extension falling the family's possessions from which it takes its name; the area was the subject of a noble building expansion between 600 and 700, by many noble families who made their vacation abodes: The planimetric plant monumental garden by Sanfelice filmed the classic configuration of that time, with two main and orthogonal routes they were going to define four broad flowerbeds.
Side of the central axis of the walkway at the top, which is accessed through a small stand of valuable, are placed two large vases in lava stone bearing the palace effigy. The garden has undergone a sort of plunder to return, with the perception of native planimetric plant. Four different buildings, more some structures attached to one of them, were built in the garden, in contempt to the sober and functional original design and more ruining the vegetation's richness which characterized the garden.

2.2 Geometrical relations of the design

The double-ramp staircase circular in the court A, although less spectacular than the other one in the same building - like than all the others Sanfelician staircases -, defines one of the most interesting solutions in contemporary architectural production.
Zerlenga, in her studies [ZERLENGA, 2014, ref.] defines "introverted" this scale, and singles out a character trait that includes and synthesizes the essence, that gives us a masterful interpretation of "spiral" configuration based on two independent elements, originating from a common invitation, that unfold themselves in two directions, each evolving inverse from the other, around a central core, through a complex articulation of landings, spatial intersections and an impressive system of vaults.
It is likely that Sanfelice has taken the inspiration from similar existing projects in Naples and in other European cities, such as the scale of Quarto del Priore in the certosa di San Martino in Naples [9] and scale

made in the rectory of the Kollegienkirche in Salisburgo [10] or even the stairway designed by Philibert Delorme in the 16th century for the Château de Saint-Maur-des-Fossé [11].
The design of the double-ramp circular staircase, in the smallest court at number 2, is based on two main axes, one axis defined longitudinal 2-bis and a transverse axis defined axis A.
The collection geometry it references, overall, these two guidelines, defining the orthogonality that stands out in the fundamental axes, marked in figure: 4 bis and C (fig. 5).
The plan is formed by two smaller circles within which the circular ramps develop, and two larger circles that define, with a circle arc of about 30 degrees of the amplitude, a "versus curve" formed by the inner wall in the first part of the two ramps (fig. 6).
The centers of the circles O2 and O3 in which grow the circular ramps, lie along the axis 4 bis, at the intersection with the axes C1 and C4. The points O2 and O3 are also the centers of the two stone elements around which the ramps envelop.
A relatively simple design solution, capable of determining a illusive perception into the people that begin to climb the ladder, through a sinuously that hides the concentric perception of the development (fig. 7).
The centers of the major circles O and O1, lie along the axis 3 bis, also at the intersection with the axes C1 and C4. The intersection points are along the prospect that welcomes the scale, symmetrically on either side of the common access ramp. After the short straight common section, the staircase brings to conventional share: (+ 1.90), at this floor the two opposite circular ramps differ; for each of these, the first part – i.e. between the first floor and the next – is enclosed within a circle arch about 30 degrees (with radius in O and O1). The development of these early strokes continues with nine steps whose orientation is not concentric, but mediates the parallelism between the first floor (the diagonals of the trapezoid) and the last one, i.e. the next scale chief floor place in conventional fee: (+ 3.80).
From the second floor that, for each of the two scales, gives the access to environments in the so-called mezzanine, geometric development of the two stairwells continues with a concentric trend; in fact and in greater detail, although the circumferences fulcrums are coincident with the two central elements to stone circular section, the treads converge in midpoint of the square that inscribes the fulcrum.
The four steps of each subsequent portion of radial ramp enclosed in an intermediate floor and the subsequent one, tend not to the center of the circle but in the midpoint of each side of the square that circumscribes the central "column", so that the vertex of the triangle, results in the midpoint of each side of the square. The confluence of four vertices on each side of the square defines, geometrically, a drawing of a four-pointed star inscribed in the square itself.
This pattern is repeated for the entire development, upstairs to conventional share: (+ 5.70) to end a conventional fee: (+ 7.60).

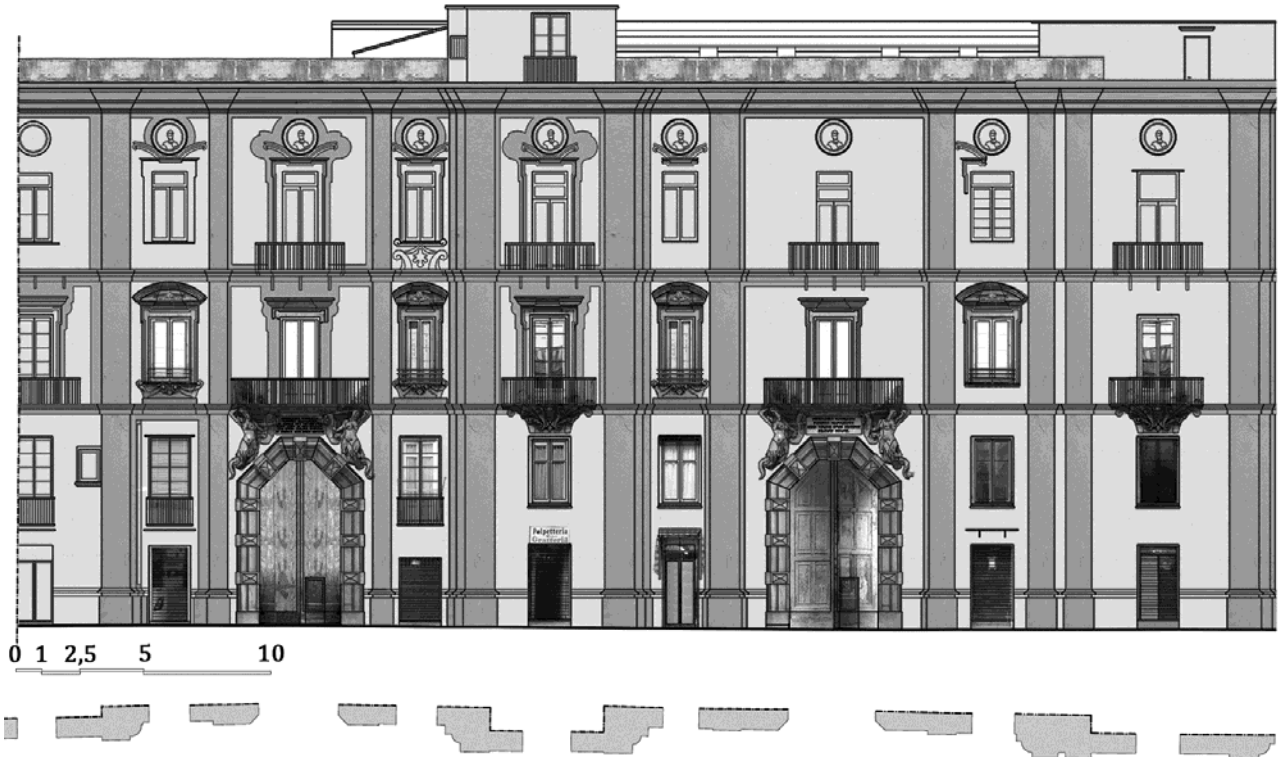

Fig. 1: The main facade in via Sanità.

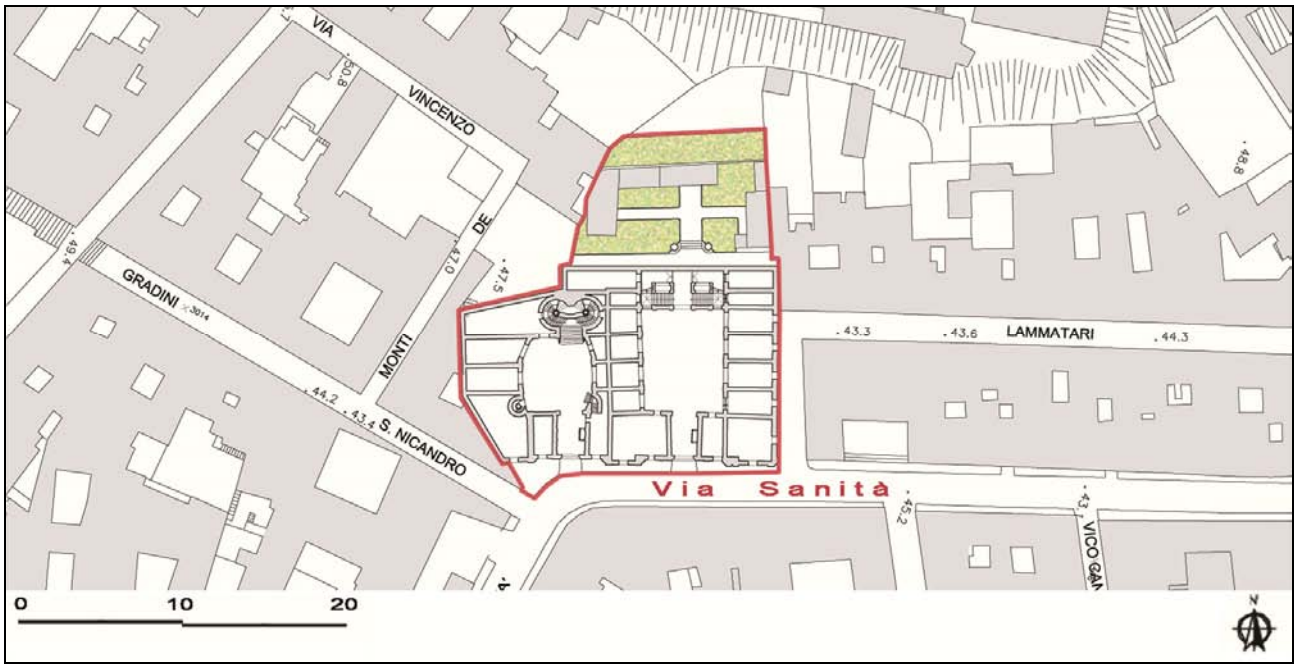

Fig. 2: urban individuation of Sanfelice's Palace.



Fig. 3: Planivolumetric representation of the building and of the back garden. Note the geometry and the heights of the roofs, terraces and garden.

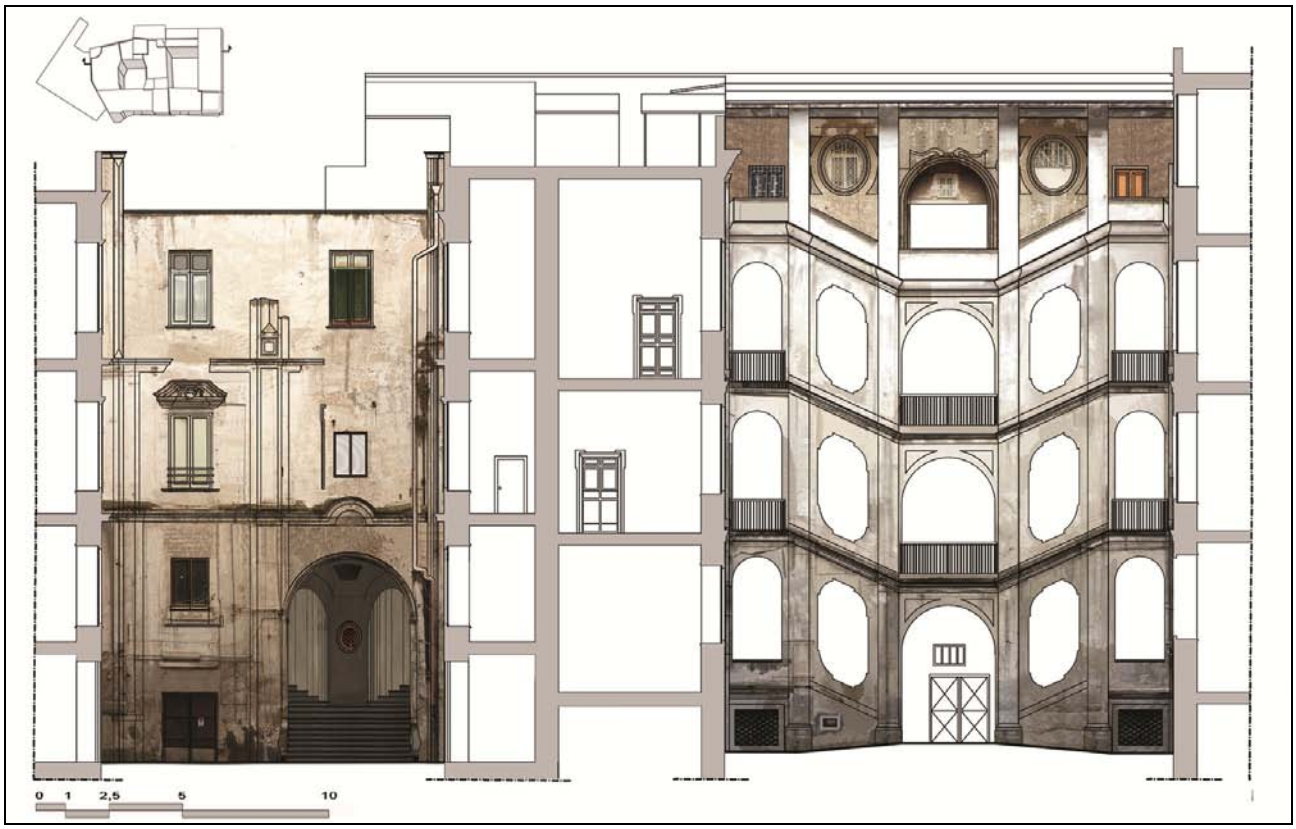

Fig. 4: Longitudinal section across the two courts. Note the fronts with the staircases: court A (on the left) and court B (on the right).

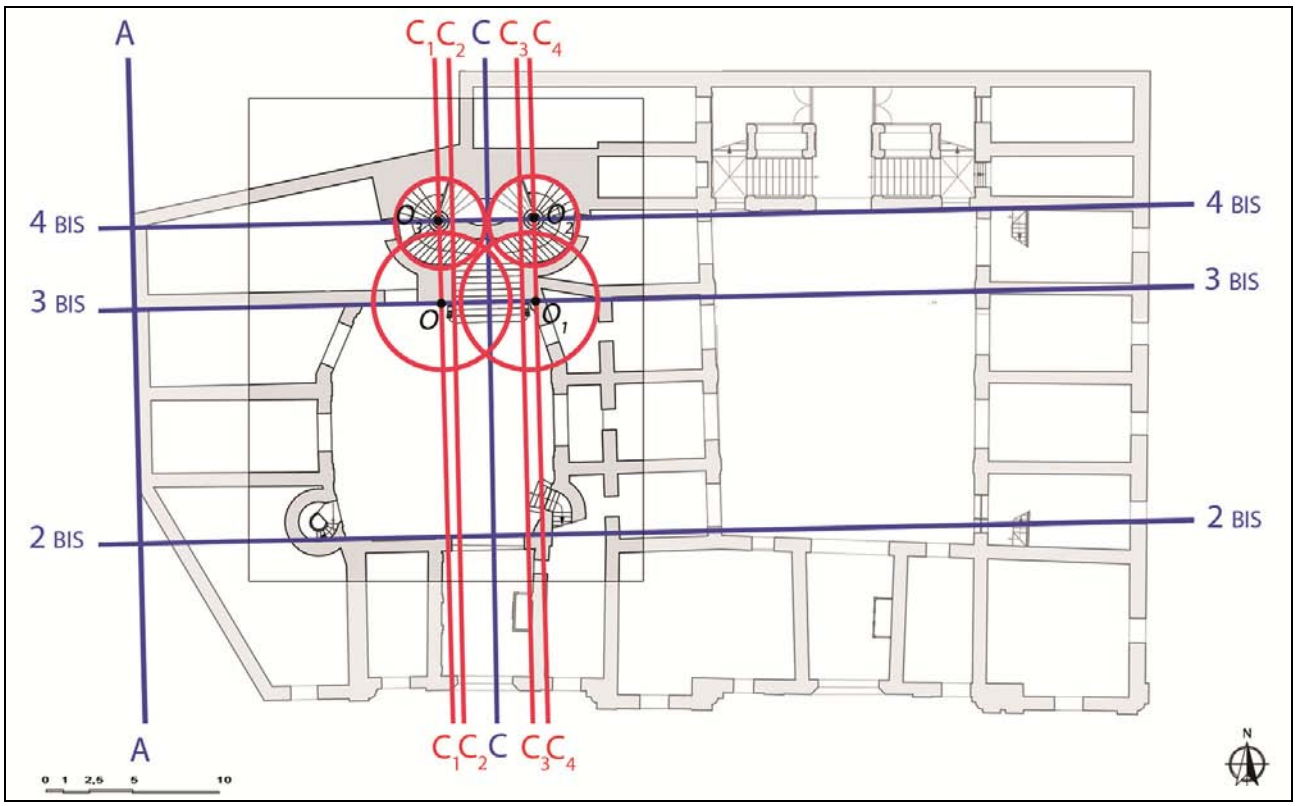

Fig. 5: Geometrical relations of the planimetric structures.

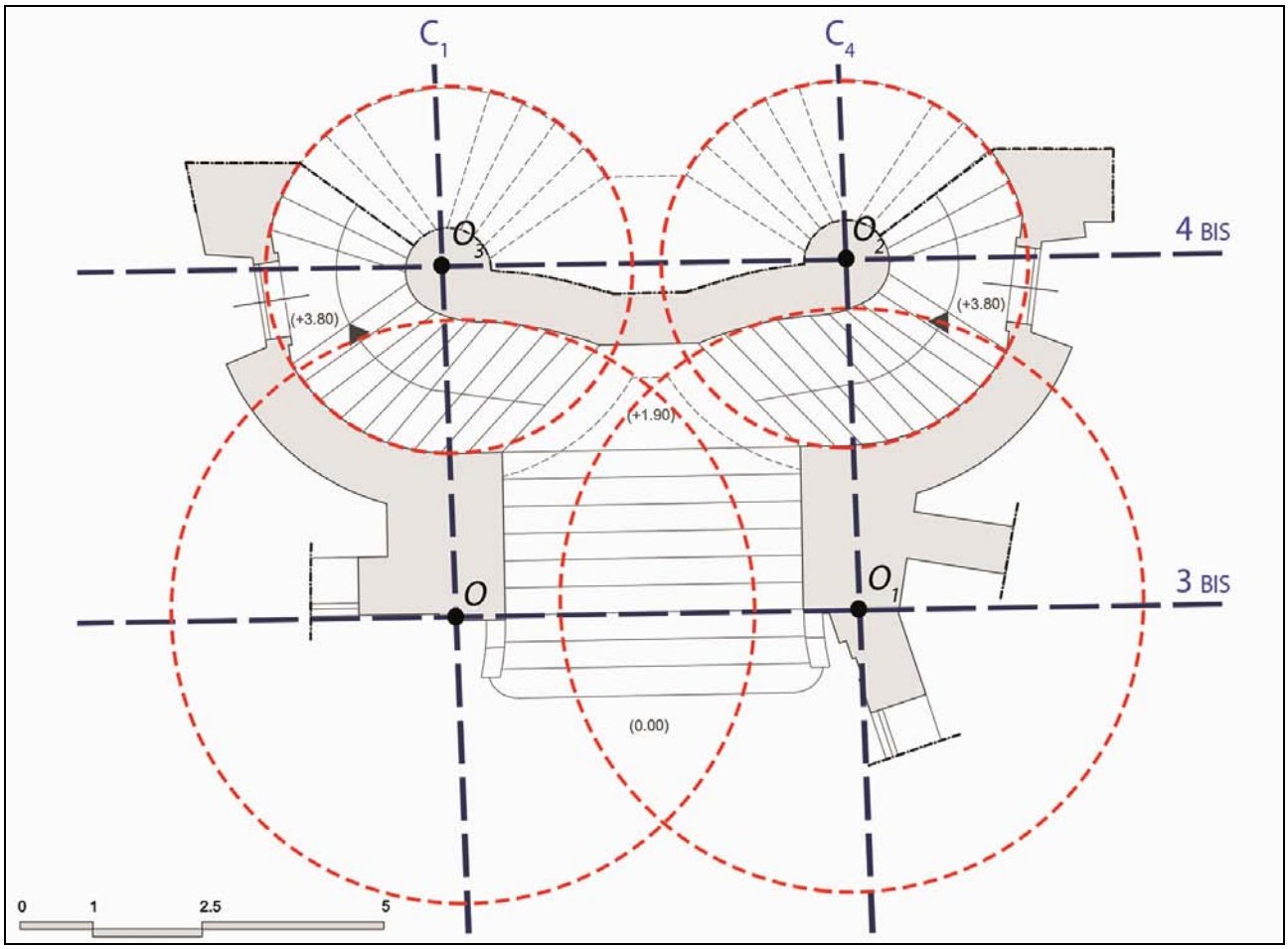

Fig. 6: Geometrical relations of the double circular staircase.

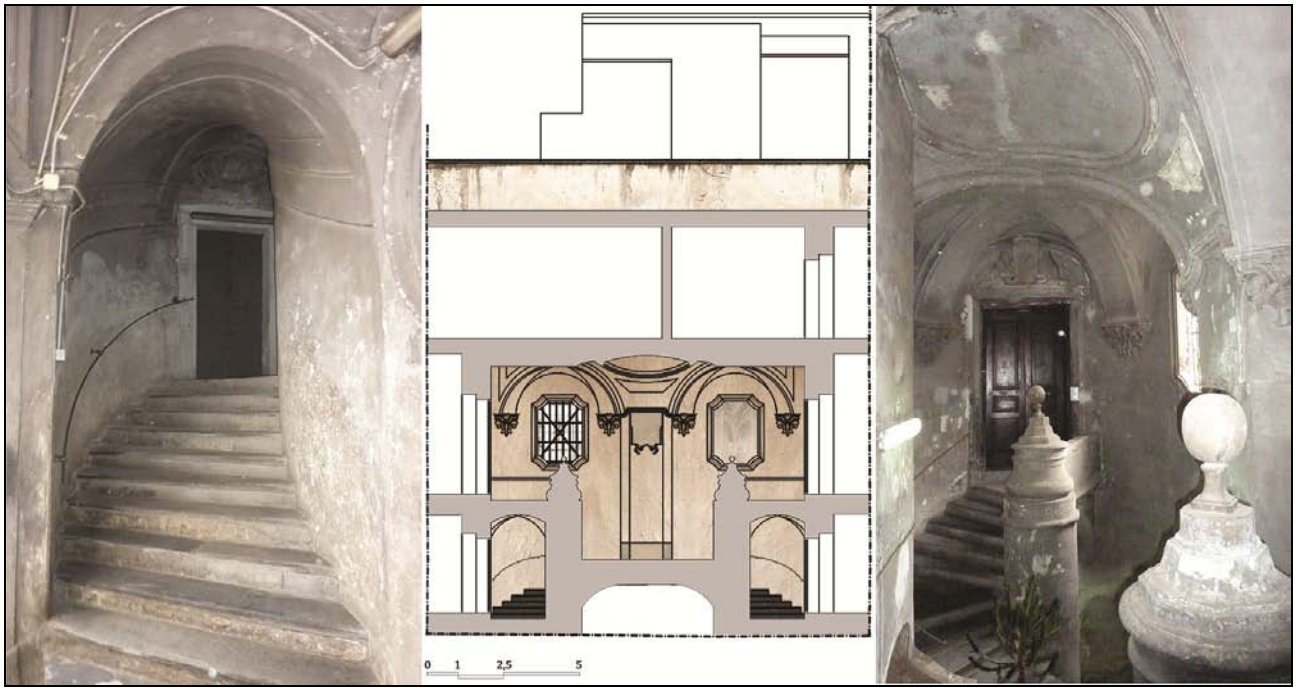

Fig. 7: From the left: picture at the base of the ramp, longitudinal section across the circular ramps, picture from the highest floor (+ 7,60).

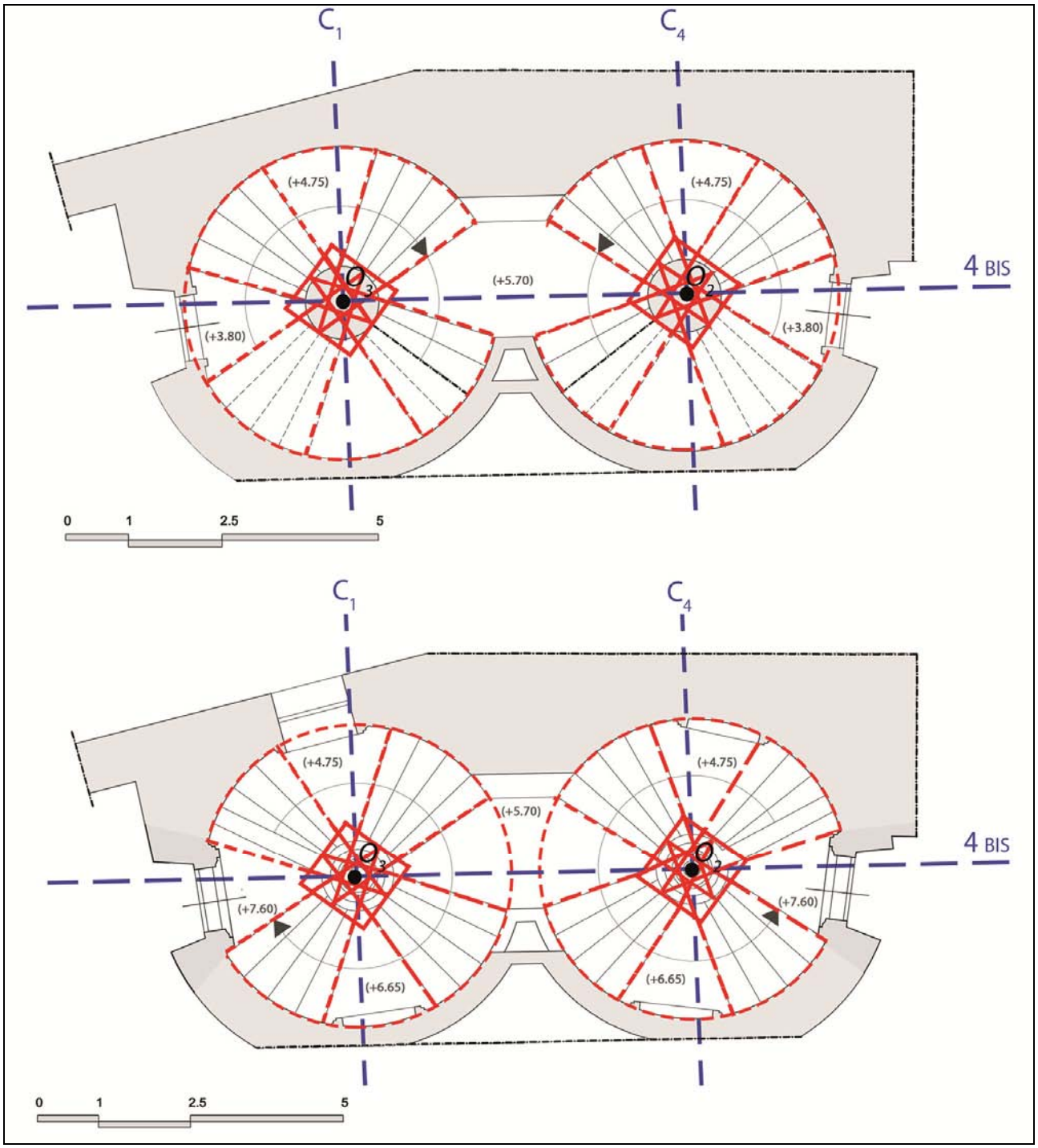

Fig. 8: Geometrical relations of the double circular staircase. Upper picture: floor (+ 5,70); down picture: floor (+ 7,60).

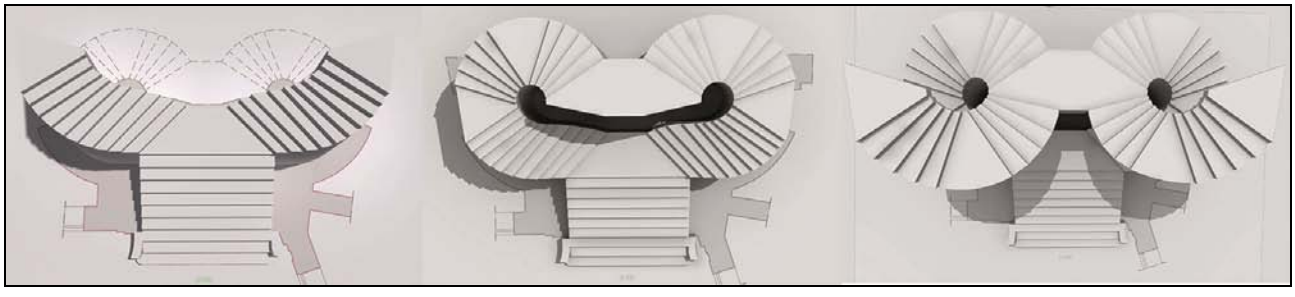

Fig. 9: 3d representation of the double circular staircase development.

Bibliographical References

[1] GAMBARDELLA Alfonso. *Note su Ferdinando Sanfelice architetto napoletano. Napoli*: Istituto Editoriale del Mezzogiorno, 1969/1975.

[1] GAMBARDELLA Alfonso. *Barocco napoletano*. Roma: Istituto poligrafico e Zecca dello Stato, 1992.

[1] GAMBARDELLA Alfonso, *La cultura Sanfeliciana nell'ambiente napoletano e la chiesa di Santa Maria succurre miseris*, in "Napoli Nobilissima", s. 3, VII, 1968, pp. 195–203.

[1] GAMBARDELLA Alfonso, *Ferdinando Sanfelice architetto*, Napoli 1974.

[1] GAMBARDELLA Alfonso, *Cultura architettonica a Napoli nella metà del '700*, in *Barocco napoletano* di AA.VV a cura di Gaetana Cantone, Istituto Poligrafico e Zecca dello Stato, Roma 1992.

[1] GAMBARDELLA Alfonso (a cura di), *Atti del Convegno*, Napoli e Caserta, aprile 1997.

[1] GAMBARDELLA Alfonso (a cura di) *Ferdinando Sanfelice. Napoli e l'Europa*. 2004, Napoli, Edizioni Scientifiche Italiane.

[1] CANTONE Gaetana, *Campania Barocca*, Milano 2003.

[1] CANTONE Gaetana (a cura di), *Centri e periferie del Barocco. Il Barocco napoletano*, atti del corso internazionale di Alta Cultura, Roma 1992.

[1] BUCCARO Alfredo (a cura di). *Il Borgo dei Vergini. Storia e struttura di un ambito urbano*. Napoli: Cuen, 1991.

[1] PANE Roberto , A*rchitettura dell'età barocca in Napoli*, Napoli 1939.

[1] DE' SETA Cesare, 1969. *Cartografia della Città di Napoli.* Volume I, Testo, introduzione di Francesco Compagna. Napoli, Edizioni Scientifiche Italiane, 1969.

[2] CAPOBIANCO Michele. Scale settecentesche a Napoli – 1. In: *L'Architettura. Cronache e storia*. 84, VIII, n. 6, ottobre 1962.

[2] CAPOBIANCO Michele. Scale settecentesche a Napoli - 2. In: *L'Architettura. Cronache e storia*. 86, VIII, n. 8, dicembre 1962.

[2] CAPOBIANCO Michele. Scale settecentesche a Napoli – 3. In: *L'Architettura. Cronache e storia*. 88, VIII, n. 10, febbraio 1963.

[3] ZERLENGA Ornella. I portali in piperno dei palazzi storici napoletani, in: Gambardella Carmine, *La cavità antropica di pianura*.

[3] ZERLENGA Ornella, Staircases as a representative space of architecture. In: Gambardella Carmine, *Best practices in heritage conservation and management From the world to Pompei*. Napoli: La scuola di Pitagora editrice, 2014.

[4] FERRARO Italo, *Napoli Atlante della Città Storica*, Stella, Vergini, Sanità, Edizioni Oikos, 2007 Napoli.

[5] RIZZO Vincenzo, *Ferdinandus Sanfelicius Architectus Neapolitanus*, Edizioni Luciano, 1999 Napoli.

[6] ZERLENGA Ornella. La catalogazione dei portali del costruito storico napoletano. In: *Fra le mura. Dai portali al verde nascosto*. Napoli: Elio de Rosa Editore, 1998.

[7] CELANO Carlo, *Notizie del bello, dell'antico e del curioso della città di Napoli*, con aggiunzioni di G.B. Chiarini, Napoli 1856-60.

[8] DE DOMINICI, Bernardo. *Vite dei Pittori, Scultori, ed Architetti Napolitani*. Napoli: 1742.

[9] DE CUNZO M., I documenti sull'opera di Cosimo Fanzago nella Certosa di Napoli. In: *Napoli Nobilissima*, s. III, VI, 1967.

[10] BLUNT Anthony. *Architettura barocca e rococò a Napoli,* [1° ed. London 1975, ed. it. a cura di F. Lenzo]. Milano: Mondadori Electa, 2006.

[11] BLUNT A., *Philibert de l'Orme*, [1a ed. London 1958, ed. it. a cura di M. Morresi], Milano 1997.

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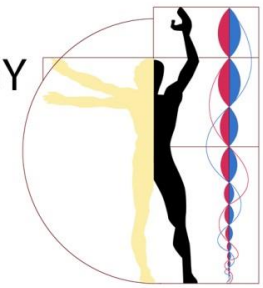

Toward the "Smart Polis": methods, tools and strategies of intervention for the sustainable regeneration of historic urban centres.

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Abstract
The new international standards for Urban Planning, suggested by the UNESCO World Heritage Centre together with the Historic Urban Landscape approach, introduce new cultural, social and economic urban dynamics, where protection of heritage and urban development are not at odds with each other but are at the heart of a long term vision for the city. The model to tackle the future of a large part of historical cities is based on planning driven by an advanced technological level, a more nimble management adaptable to the requirements of the future, and at the same time able to make the most of the uniqueness and artistic qualities of its historical heritage. This is a challenge that entails the necessity to calibrate interventions in a delicate balance between renewal and memory, innovation and tradition. This paper, presents the SmartPolis© project, launched by the CNR's Istituto per le Tecnologie Applicate ai Beni Culturali, to develop integrated models to favour the adaptation and rebirth of historical centres, open to an inclusive and inter-cultural dimension of the city. A vision where an historical city--from a place of history--can find new life and implement the transformation of new communities, establish a network of innovation, create cooperation, locate financing and launch start-ups. The case study, in cooperation with the Peking University, concerns the historical village of Cuandixia, about 90 km from Beijing. The research proceeds through an inventory of the urban landscape, qualities to be preserved, analysis of the vulnerability of social-economic pressures to indicate an urban strategy with the priorities for their conservation and a sustainable development.

Keywords: Built heritage conservation, Historic cities regeneration by climate change strategies, SmartPolis, Historic urban landscape, Traditional Chinese towns.

1. Introduction
The issue of the renewal of the historical centers and towns is not only a conservation issue, but aims to the respect of tangible and intangible heritage within a process capable of developing tools and guidelines for the control of contemporary interventions in historical urban contexts.
The new international standards for Urban Planning, suggested by 'UNESCO World Heritage Centre with the Historic Urban Landscape approach, introduce new urban dynamics of cultural, social and economic where the heritage protection and urban development are not in conflict but are the key for a long-term vision for the city [1].
This is because the model with which we must deal with the future of most historic cities is based on technology driven planning actions, on a more agile management able to adapt to the needs of the future, and at the same time capable to enhance the characters of uniqueness and quality of its artistic heritage. On this front, the opportunities for smart regeneration of historic cities is a challenge that can not be ignored but which implies the need to tailor interventions in a delicate balance between renewal and memory, innovation and tradition.
On these subjects, the Institute for Technologies Applied to Cultural Heritage ITABC of CNR, launched the SmartPolis© project, a proposal for identifying problems and finding solutions beginning from the very definition of its name, intended as a portal to the complexity of a multi-dimensional society focused on cultural growth, and not simply as a city environment to "preserve", but where is possible to achieve a model

of urban place for living and doing, of creativity. A vision where an historical city from a place of history can find new life and implement the transformation of new communities, establish a network of innovation, create cooperation, locate financing and launch start-ups.
A case study is presented to demonstrate this approach: the historical town of Cuandixia, in the Mentougou District, about 90 km from Beijing.
SmartPolis is a historic city made of intelligent network services and infrastructure, of sustainable mobility and integrated systems that make the cultural heritage accessible and shared.
SmartPolis bases its growth on the respect for its history and its identity within an inclusive dimension and promotes its cultural tourist brand with a smart presence on the web. Virtualizes its cultural heritage and traditions, that give back as a common asset for its own citizens and visitors; uses advanced techniques to create routes and thematic maps of the city to make them easily accessible.
This research project, started at the end of the 2014 year and in progress, is focused on the investigation, documentation and typological classification of a small historic town near Beijing by the means of recent emergent digital technology. In particular we have implemented the following digital tools: HBIM - Historical Building Information Management System Digital Photogrammetric survey, 3D laser scanner survey, GIS - Geographical Information System for documentation and Decision Support System for decision making (DSS). The research project also aims to identify strategies and methods to regenerate small towns of a distinct historic character and heritage value in a sustainable manner, to propose innovative conservation methods, to suggest appropriate activities/uses that may replace the previous function of production and outline ways of interventions, which will respect the historic, architectural and cultural significance of traditional landscapes. Our methodology combines traditional and innovative approaches to the analysis of small ancient towns.
This kind of cross-disciplinary research, that use methods for documentation and analysis of architectural heritage for urban regeneration, is able to give multiple answers to the many aspects of built heritage preservation and rehabilitation.
For this aims we started a joint research project between the Institute of Technology Applied for Cultural Heritage (ITABC) of CNR of Italy and the Department of Urban and Regional Planning of the Peking University of PRC, with a shared approach between our countries to the conservation and sustainable urban historical regeneration, developing a closer collaborative relationship in support of future research. The research project started on the framework of the Pumah project, (Planning, Urban Management and Heritage) a 7FP on International Research Staff Exchange Scheme.

2. The model and methodology of Smart Polis

Small towns represent a very important reality in Italy as in China, both numerically and in terms of territorial area, even if the population is concentrated in large cities. There are 7.593 Italian municipalities with less than 20,000 inhabitants, containing the 48,3 % of the country's population and the trend is that in the smallest centres the population is growing.
In China the extreme pressure of urban modernization are leading to high level of danger of disappearing of historic cities and sites [3]. But authorities cannot undervalue the great challenge of opportunities arising from cultural heritage conservation, that can create opportunities for local economic development [4]. The conservation of historically significant cities and sites, with their unique characteristics, such as the densities, mixed use, the presence of significant areas of cultural interest, are more competitive in attracting the investments and can create opportunities in today's globalizing world. Furthermore in historic areas, the upgrading essential services and infrastructure to accommodate urban growth, can rise standard of living of inhabitants while maintaining the traditional characteristics of the built heritage [5].
In order to test the rehabilitation methodology resulting from previous step, the methodology shall apply them to several renovations that have been recently executed (or that are currently running) in the European Union and in China.
In promoting new models of integrated valorization small towns can assume important roles, by:

- triggering processes of local development (cultural activities, tourism, agriculture and services) that contrast abandonment and favor the return of autochthonous populations, improving the role of immigrant populations
- responding to the need for housing of underprivileged populations
- seeks out integration, not only territorial, but also intersectorial, composed of diverse material and immaterial components (see the UNESCO Convention for the safeguarding of immaterial cultural heritage), involved in the process of valorization (cultural heritage, small business, tourism, agriculture, professional training, landscape)
- contrast the phenomenon of abandonment with the decline of physical structures contributing to the permanence of native populations, offering services for small business.

Therefore, in this step, testing in relevant environment (deep testing activities of the proposed technical solution) and testing on simulated environment will be realized, in order to demonstrate the new solutions effectiveness.
Identification of feasible case studies in the two countries (in Italy: small historic towns from Campania Region, in China small historic town of Cuandixia, Beijing).
The key objective is to define a Heritage-led Sustainable Regeneration Strategy for the preservation and re generation of small historic settlements and towns in China and in Italy, able to:

- maintain land contexts, historic topography and landmarks in historic areas
- preserve physical fabrics
- respect the original inhabitants' lifestyle concepts
- up to date and implement conservation management plan
- implement and apply Low Carbon Policy
- support local economy/identify funding strategy for covering ongoing revenue costs
- make old spaces suitable for today's modern life requirements of people who live there
- engage the local community

The methodology will follows different steps:

- Determining the input parameters for both of the cases study (Italian and Chinese)
- Obtaining of the best rehabilitation measures derived from the methodology developed in this research.
- Modelling and computer simulation of the recommended rehabilitation using this methodology
- Comparison on rehabilitation and evaluation of the differences obtained from the energy and socio-economic point of view.

The onsite research mission was carried out with a group of 10 experts from Italy and China, that started with a technical investigation on the structural, typological and environmental performance aspects of the courtyards in Cuandixia, with on-site investigation of the village, field surveys, including interviews with inhabitants and government officials.
The general aim was to provide an Action Plan capable to maintain the balance of the environmental and cultural system as a prerequisite for an effective strategy for urban regeneration.
This means, for example, to preserve and to rehabilitate the ancient town pathways and historic walking system, the fabric and the network of traditional houses, their proportions and directional axes, the cultural conventions that act as psychological hints of 'Feng Shui' chinese culture.
The design strategy wants to address three priority issues: preserving the historical topography of the territorial context and mantain the landmarks of historic districts; adapt historic homes to contemporary needs of their inhabitants, in a balance of vernacular characteristics and modern technology; regenerate a historic city in a way that, from a place of depopulation of its inhabitants and of overcrowding of tourist masses, could find new life and implement the transformation into new communities of people engaged in creative industries, farm holidays and handicraft activities.



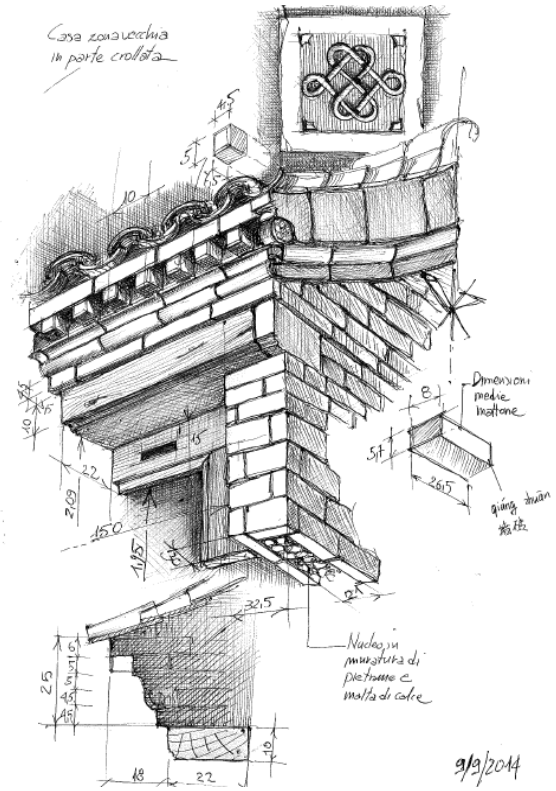

Fig. 1. Construction details of the traditional houses (sketch G. Cangi) .

3. Cuandixia

Cuandixia Village has a history of over 500 years but most of the courtyards were built in the late Qing Dynasty. It was founded by members of the Han clan who moved from Shanxi province and built many of the grand courtyards with imperial funding.

Cuandixia used to be a prosperous stage of commerce on the old post road in west Beijing during the last hundreds of years. It was invaded by Japanese in 1942 during the Sino-Japanese war, and some houses were burned.

During the Ninenty's many building were reconstructed according to original style. This ancient mountain village is constituted by more than 76 well preserved courtyard houses and stands on the northern gentle slope of a hill, surrounded by mountains. To respect nature, all the houses in the village follow the contour of the land stepping down from the high to the low. Instead of excavating into the earth, the courtyard houses are all built on landfill and fan out towards the sun and open space with views.

The village since 1995 is a popular tourist attraction, and recently had received a great media attention, being cited by the Chinese Government as a model for traditional Chinese architecture. Many of the courtyards have become small hotels offering homestays, but today the area is inflicted by a great tourism pressure and needs an organic planning for its future. Cuandixia Village is located in Mentougou District 90 km west of Beijing's urban area.

Cuandixia has a perfect Feng Shui Arrangement, with the Four Mythical Animals (Siling) of Azure Dragon, White Tiger, Black Turtle and Red Bird embraced the village affectionately, and has a "Jade Belt" of water. embraced the village. The Siling configuration is not only a functionally efficient formation (protect the site from the cold wind and orientate to the warm sun) it is psychologically satisfying as well. The shape of the village - a semi-circle degrading on the mountain - optimizes the potential of the land and buildings are developed from a close relationship with the natural environment, taking advantage of the topography to control the weather and climatic rigidity.



Fig. 2. General view of Cuandixia, highlighted the case study area.

4. Research methods

The first step of the research was gathering information and data for a preliminary urban analysis, then proceeds through an inventory of the urban landscape, an examination of the qualities to be preserved, and the analysis of the vulnerability of social-economic pressures.

We worked at the two scales: the urban and the building analysis. In order to organize the complete set of the data gathered from urban analysis in an integrated and cross-related manner, a GIS with the following characteristics was created: the capacity to georeference the information, the possibility to integrate heterogeneous data and to process them into complex information (such as forecasts, statistical processing, quantitative processing), the collection of this data into a single 'information environment', ease data consultation (by simply clicking on the graphic or through a 'query' in the data archive). Through the use of a GIS, the research evolved from a list-based information logic to data organized into a geographical reports

archive capable of integrating the descriptive and graphic aspects. In developing the database on the historic town of Cuandixia, the guiding principal was make it as simple and as easy as possible to consult, even by a non-expert.
The main data and sensitive information regarded:

- the yard division, in order to identify and perimeter the individual courtyard units;
- the datation of the courtyards, carried out on the basis of documentary sources and interviews with residents;
- open spaces with the analysis of the road and lane network, of the urban open spaces, of the green and the connection between the houses is useful for the understanding of urban space, the analysis of the property, and it was found that the vast majority of the houses are privately owned, with the exception of the “House of the Lord” (museum) and a few other community facilities, although the most of the owners during the winter lives in the nearby new town of Zhaitang;
- the architectonic style closely connected to the dating of buildings;
- the state of conservation emphasizes a general medium condition with periodic maintenance, especially finalized for tourist and commercial use of the buildings. The result is a lack of support for residential upgrading and protection to address these homeowner responses and their impact on historic areas. So to help homeowners understand best practice in residential upgrading is necessary the production of user-friendly design guidelines providing multiple visual examples of good and bad works.
- the function use a general trend is the use of the courtyards as restaurants or guesthouses and souvenir shops are multiplying and homeowners has begun to improve their homes as their incomes rise, resulting in a loss of traditional architecture.
- the survey of the existing Kang, a unique and very efficient ancient heating system, the result was that in most of the houses they have been replaced with modern heating systems, in many cases already obsolete; analysis on the new roofing and recent addition for satisfying tourism needs, that emphasized the exponential rate at which additions (roofing the courtyards, restrooms, warehouses) are built to improve tourism capacity, but these homeowner interventions have had a negative impact on the historic qualities of their neighborhoods.

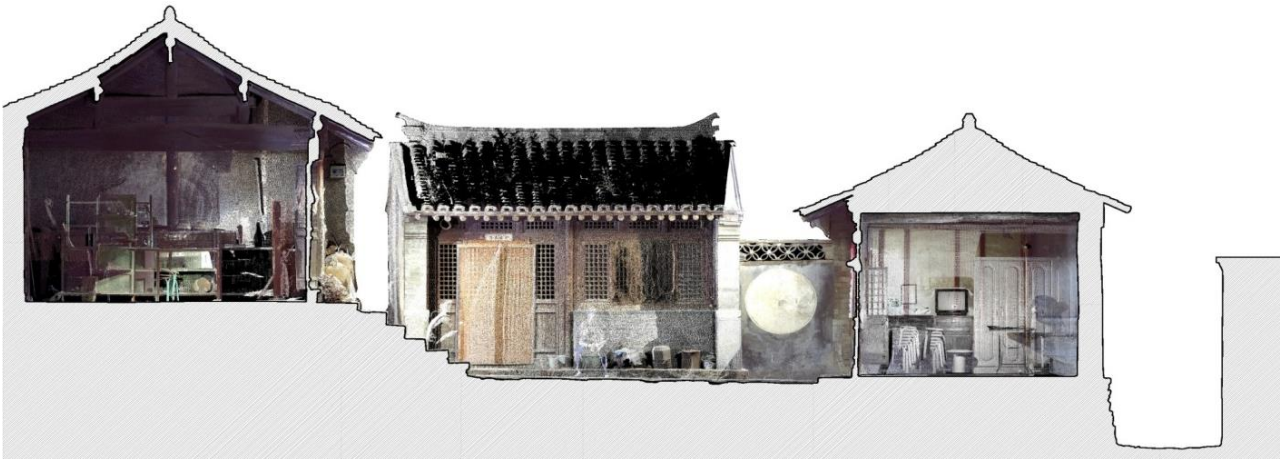

Fig. 3 Traditional courtyard house. Integrated survey systems: photogrammetric and 3D laserscanner (R. Gabrielli and F. De Silla)

At the building scale it was identified one of the best preserved courtyard: the Guangliang Courtyard (Landlord's House), a complex of four buildings situated around a courtyard, and a building in the upper level for the residence of the local lord. The survey has provided an accurate geometrical record of the building by the use of Photogrammetric survey, 3D laser scanner survey and direct survey. This first technical investigation addressed also the typological and structural analysis of the building, including construction techniques and structural deformations.
In order to create a digital archive useful for conservation and valorisation interventions and to facilitate the management of all the data, we are developing an Historical Building Information Modeling system (HBIM) that combines multi-dimensional visualization with comprehensive, parametric databases.
This Historical Building Information Modeling system involves the following stages:

- Definition of ‘typical’, but parametric, construction details from historic construction manuals;
- Definition of “specific “detailed data, from a metric survey of the structure, using hand measures, photogrammetric and laser scanner data;
- Building of parametric historic components and production of technical survey models and drawings.

The structural elements are organized in macro-families “component” and in a hierarchical aggregation of the different object elements composing the structural family. The level of hierarchical aggregation of building components is documented by a 3D model. The definition of the parametric models of the structures allowed us also to analyze the static performance of the system and simulate the behavior and response of structures subjected to the effects of heavy stress states. In this model a problem that emerges from the configuration of the frames regards the lateral stability of the frames. The purlins resting on the girders are not able to counteract any lateral movement; the phenomenon of instability is corrected, therefore, through the provision of beams positioned to counter the main wood.



Fig. 4. “House of the Lord”. 3D reconstruction and critical analysis of the wooden structure elements and building components. (G. Cangi)

5. Further developments

The next steps of the research will regard:

- Guidelines for the analysis and documentation of small historic towns .
- The development of the GIS (enlarging the surveys to the surroundings, to past and present land cultivation, to landscape changing)
- The development of HBIM (walls, construction materials, degradation phenomena, energetic behavior, etc.)
- The definition of guidelines and best practices for interventions with the goals of preservation, environmental sustainability and historic compatibility (implementing technical standards, guidance for the additions)
- Definition of a DSS to help policy-makers to design small towns protection policy
- Definition/testing of an assessing tool of the sustainability of materials and techniques for the preservation and energy savings of historic interest buildings
- Definition of the vision for the future (possible use of the courtyard and of the land, sustainable activities, creation of a network of cultural and naturalistic routs of the District)

6. Conclusions

The vision for the future of the historical area of Cuandixia and its surroundings is to transform the town into a vital hub of multiple activities and services by using its historical buildings not only for residents and fast tourism but also for a range of cultural, educational, and sustainable tourism purposes.

- For the implementation of best practices for a sustainable conservation and touristic development of Cuandixia, some goals have been identified:
- a general plan for urban renewal and environmental protection
- to increase the tourist market in the new eco-cultural flows
- the enhancement of local specificities
- the implementation of a Tourism Master Plan aimed of minimizing the impacts of technological and infrastructures adaptation, and of the promotion the use of new technologies.

The strategic actions to achieve the transition from the mass tourism, that destroy the local neighborhood's friendly atmosphere, to the sustainable tourism respectful of the original character, start from the creation of a high quality services system that meet the needs of environmental, cultural and ecological tourism. Some example can be: products and activities rich in meaning, identity and authenticity; socialization with local communities; multimedia and immersive digital tools for a deep knowledge of the visited areas; the creation of a cultural "brand" strongly connected with the territory, the exploitation of local and farm-related products; the promotion of cultural heritage and folklore with a communication campaign and the creation of a network of information points [6].



Fig. 5. A Gis survey of the area was performed in order to achieve urban analysis, with the vulnerability of social-economic pressures. The pictures shows a worrying aspect: the exponential rate at which additions (roofing the courtyards, restrooms, warehouses) are built to improve tourism capacity.

7. Bibliographical References

[1] Unesco, *Managing Historic Cities*, World Heritage Papers 27, Paris, 2012

[2] ENGLISH HERITAGE, (2006).Conservation Principles for the Sustainable Management of the Historic Environment: First Stage Consultation, English Heritage, London.

[3] SHIN, H. (2010): Urban conservation and revalorisation of dilapidated historic quarters: the case of Nanluoguxiang in Beijing. In :Cities, 27. Elsevier

[4] HONG, Y. (2004): Land conservation campaign, integrated management and local participation in China. In: ISCO 2004 - 13th International Soil Conservation Organization Conference. Brisbane

[5] RODWELL, D., (2007) Conservation and Sustainability in Historic Cities, Blackwell Publishing, Oxford,

[6] HONEY, M., ROME, A. (2005): Protecting paradise: Certification Programs for Sustainable Tourism and Eco-tourism. Institute for Policy Studies, Washington Dc

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Remote sensing evaluation of fire hazard: towards operational tools for improving the security of citizens and protecting the environment

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Abstract
Forest fires are a threat for both the environment and the security of citizens. This is particularly relevant in the Mediterranean, where the population density is high, and long dry summers drive vegetation into fire-prone conditions. Policy makers underline the key role of prevention over damage reparation, and indeed efforts are conducted at regional, national and international level to develop tools supporting fire managers' activities. The preventive allocation of intervention resources is based on fire hazard maps; these should be updated frequently throughout the fire season. In this framework satellite remote sensing can play a key role, providing daily measurements in the optical domain for the determination of vegetation water content, a key parameter for the prediction of fire hazard. This paper outlines current practices adopted in Mediterranean Europe, analyses how earth observation data are used, and underlines areas of improvement. Strengths and weaknesses of algorithms for the retrieval of vegetation water content are discussed. Examples are provided with the production of remote sensing maps of vegetation moisture in three different areas of the Mediterranean: Campania (Italy), Tuscany (Italy) and Provence-Alpes-Côte d'Azur (France). Finally, a brief review describes current and forthcoming Earth Observation missions with the potential to support fire prevention activities.

Keywords: Fire danger rating systems; Mediterranean; MODIS; Perpendicular Moisture Index; Copernicus Sentinels program.

1. Introduction
Forest fires are a major threat for both the security of citizens and the environment (**Fig. 1**). In the Mediterranean more than 290000 hectares were burnt in 2013, of which 72000 hectares belonged to Natura2000 sites of the European Union [1]. On average, about 50000 fires are recorded annually, burning between 700000 and 1000000 hectares [2]. Fires cause loss of human lives [3], have a negative impact on the productive potential of forests and surrounding lands, and affect regional economies and population's life quality, especially in the economically depressed areas.
The phenomenon is mainly dictated by climatic conditions. Prolonged summers with poor precipitations and high temperatures increase water loss through evaporation and transpiration, causing a reduction in live and dead fuels moisture content and an increase in forests susceptibility to fires. About 95% of fires are man-caused. Fire fighting activities employ 30000 workers every summer, rising to 50000 in the most hazardous years. About 300 aircrafts are used for suppression. The observed increase of the fire phenomenon in recent decades is due to changes in land use and climate. Predicted change in climate points towards increased temperatures and reduced summer rainfalls, thus leading to an increase in fire risk [1].



Fig. 1: Forest fires in Italy in the summer of 2007 (Source: NASA).

Strategies for the reduction of potential damage include early warnings and optimal allocation of resources. The former is ensured by the spontaneous alerts provided by the civilians, thanks to the high population density in the Mediterranean area. Therefore, the main concern of fire managers is about fuel condition and its variation with time, i.e. with fire hazard. This property affects the ease of inception and fire propagation, and serves as a basis for fire prevention planning. To allow for effective use, maps of fire hazard should be updated frequently thoughout the fire season. In this framework satellite remote sensing can play a key role, providing daily measurements in the optical domain useful for the determination of vegetation water content, a key parameter for the prediction of fire hazard.

The need for an efficient and advanced method to assess and monitor forest fire hazard is clearly acknowledged by the European Union. In 2006 the European Parliament has adopted resolution P6_TA(2006)0349 on “Forest fires and floods,” further reinforced by resolutions P7_TA(2009)0013 on “Forest fires in the summer of 2009,” P7_TA(2012)0147 on “A better environment for a better life,” and P7_TA(2012)0223 on “A resource-efficient Europe.” These resolutions recognise that forest fires not only affect Spain, Portugal, Greece, France, Italy and Cyprus, but also member States traditionally considered less at risk (such as The Netherlands, Ireland, Lithuania, UK, Austria, Sweden, Czech Republic and Poland), and that the phenomenon can only be handled efficiently at Community level. They underline the key role of prevention over damage reparation, and call for scientific improvements and exchange of experience in fire risk evaluation technologies.

2. Current fire hazard mapping practices in Europe

For a fire to spread it is required that fuel moisture and temperature are at an adequate level [4]. A forest fire hazard index synthesises this information into a set of indicators, or even a single value, providing a measure of ignition probability. Several fire danger rating systems have been into operational use since the first half of the 20th century, most of them adopted on a national basis. Those developed and currently used in Portugal, France, Italy, Canada and Australia are essentially based on meteorological input [5]. In these models, weather conditions over a period of time are used to produce indirect estimates of the moisture content of dead fuels. However, information on live fuel status and fuels temperature is disregarded. The

National Fire Danger Rating System (NFDRS) used in the Unites States uses meteorological information in conjunction with maps of fuel types and of vegetation relative greenness [6], [7]. The latter is retrieved from time series of vegetation vigour calculated from satellite remote sensing measurements in the visible and in the near infrared. Vegetation vigour is a measure of forests' health, and its variation with time is used as a proxy for live vegetation moisture. NFDRS maps have a resolution of 1 km.
To harmonise fire information systems within the European Union, the Joint Research Centre (JRC) established the European Forest Fire Information System (EFFIS). As part of the Regulation (EC) 2152/03, EFFIS develops and delivers services supporting fire prevention. In 2007 EFFIS adopted the Canadian Fire Weather Index (FWI) System as a unified method for fire danger mapping. Fire hazard maps are processed from meteorological data and distributed to forest services and civil protection agencies. Currently, these maps have a resolution of 10, 16 or 25 km. Although valuable at national and international scale, they are inappropriate at regional level, where fire management decisions are usually made, and a spatial resolution of 1 km or better is needed.

3. Considerations on the use of Remote Sensing

Remote sensing research has dealt with various aspects of the forest fires phenomenon, leading to well established methodologies for fire detection, burnt scar mapping, and vegetation recovery monitoring. Remote sensing applications for fuel status and fire hazard mapping are still under development [8]. Indeed, current fire danger mapping methods make little use of remote sensing data. The only exception is the NFDRS, although satellite imagery is only used for the evaluation of a property that is indirectly related to vegetation moisture. Nevertheless, existing satellite Earth observation instruments have been launched in the last 15 years that potentially allow for the direct retrieval of live vegetation moisture content of both alive and dead fuels temperatures [9], [10].
This outlines a clear need for further research to fill the gap between knowledge and application, towards the operational use of remote sensing for fire hazard mapping. Given the complementary information they carry, meteorological fire indexes and satellite retrievals of vegetation moisture may be used synergistically to construct a comprehensive model of fire hazard [11], [12].

4. Remote sensing of vegetation moisture content

Vegetation moisture can be expressed in two different ways. The Remote Sensing research community is familiar with the concept of equivalent water thickness (EWT), which measures the mass of water per unit of leaf area. EWT is not suitable for use in fire danger models, since the key variable related to fire ignition and rate of spread is live fuel moisture content (LFMC), and the two parameters are not exchangeable. LFMC is defined as the mass of water per unit of leaf dry mass.
Water content in leaf tissues affects their optical properties in the shortwave infrared. This characteristic has been exploited to estimate EWT through several spectral indexes [13]–[16], i.e. simplified arithmetic models for the translation of earth observation measurements into estimates of water content. However, these indexes are not good estimators of LFMC [17], [18]. In recent papers [9], [19] the perpendicular moisture index (PMI) was introduced to exploit the spectral characteristics of MODIS sensor on board Terra and Aqua satellites of NASA Earth Observing System (EOS) programme and provide an estimate of LFMC.

5. Examples in Italy and France

The Moderate Resolution Imaging Spectroradiometer (MODIS) sensors mounted on Terra and Aqua satellites from NASA view the entire Earth's surface almost on a daily basis, recording radiance in 36 spectral channels ranging from the optical to the thermal domains. MODIS data are free of charge, and can be downlinked and processed at ground stations worldwide for the near-real-time processing and delivery of services. These characteristics make this sensor ideal for the production of fire hazard maps.
To show the potential of the PMI to produce maps of LFMC derived from MODIS imagery, three large areas in the Mediterranean were selected: Campania (13595 km^2), Italy; Tuscany (22994 km^2), Italy; Provence-Alpes-Côte d'Azur (PACA, 31400 km^2), France. Campania is an economically depressed area listed in the European Convergence Regions. It embraces a diversity of the landscape and land use/land cover (e.g. scrubland on coasts and internal hills, evergreen and deciduous woods, agricultural plains, mountains, inland cereals cultivations, a variety of abandoned rural areas) that are representative of wider areas throughout the Mediterranean. Tuscany is characterised by extremely heterogeneous morphological and land cover features. Its climate ranges from Mediterranean to temperate warm or cool following the altitudinal and latitudinal gradients and the distance from the sea. Forests cover about half of the region and are mostly placed in the inner hilly and mountainous areas. PACA is one of most densely wooded regions of France, hosting a high biodiversity. Its Mediterranean climate is characterized by wet and mild winters, while the summers are hot and dry.
Fire records from different sources were used:

- Campania: a database of more than 7700 fire records covering years between 2000 and 2008, provided by the Italian Forest Corps (*Corpo Forestale dello Stato*, CFS).
- Tuscany: a database of more than 2300 fires records between 2000 and 2007, provided by the Regional Administration of Tuscany.
- PACA: a collection of more than 9400 fires between 2000 and 2012 extracted from the Prométhée database [20].

From a qualitative point of view, maps of PMI show clear annual variability in its spatial pattern. An example of this can be noticed in **Fig. 2**, where four maps represent the values of the LFMC estimated from the PMI in the same day (the 208th) of years 2003, 2004, 2005 and 2006 in Campania. Similar observations can be drawn from LFMC maps in Tuscany (**Fig. 3**) and PACA (**Fig. 4**) [21].

Maps of satellite-derived LFMC also show clear seasonal trends. **Fig. 5** shows the example of four successive dates (every eight days) in Campania. The maps exhibit decreasing values of LFMC, capturing the evolution of vegetation condition during the dry season. Although not shown here, this pattern was observed in every year under consideration. Also in this case, similar results can be reproduced for Tuscany (**Fig. 6**) and PACA (**Fig. 7**) [21].

Fire rate of spread is affected by several factors of different nature. To isolate the role of vegetation moisture (as estimated by the PMI) from that of all the other factors, the median PMI values associated to the fires in a study area were plot against the mean value of the rate of spread (**Fig. 8**). The plots show evidence of a linear relationship between PMI and fire rate of spread [21]. Higher PMI values (and thus higher LFMC values) imply a lower rate of spread, as it would be expected in conditions of higher moisture content in vegetation. Although the regression is linear in both study areas, the regression differs, due to the different environmental and climatic conditions in the two regions. This observation was only performed in Tuscany and Campania, since the Prométhée database does not contain information on fire duration.

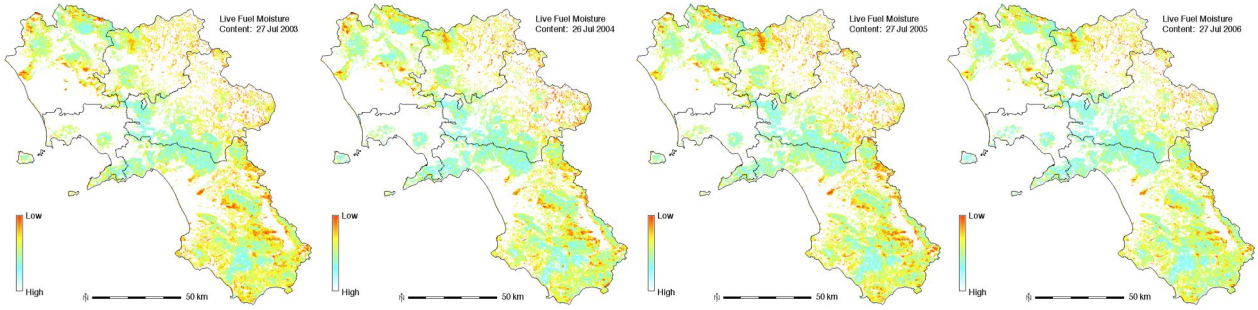

Fig. 2: Maps of estimated live fuel moisture content in the same date of four successive years in Campania, Italy.

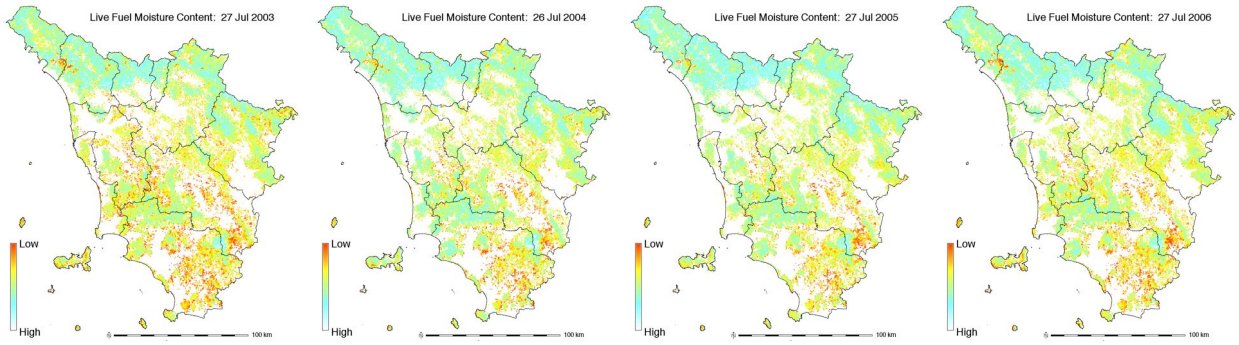

Fig. 3: Maps of estimated live fuel moisture content in the same date of four successive years in Tuscany, Italy.

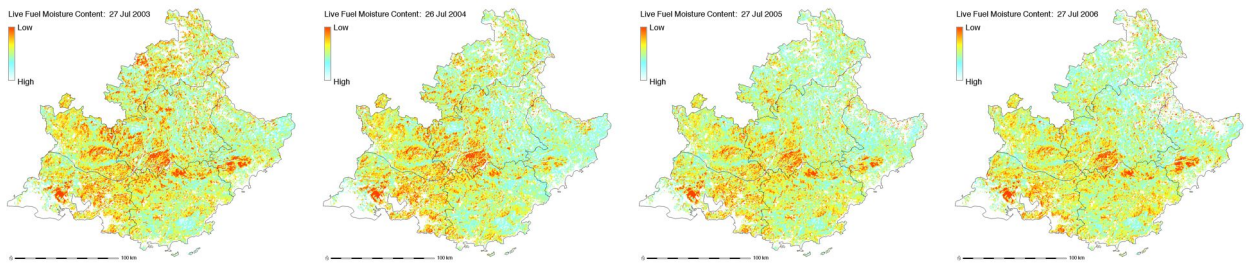

Fig. 4: Maps of estimated live fuel moisture content in the same date of four successive years in PACA, France.

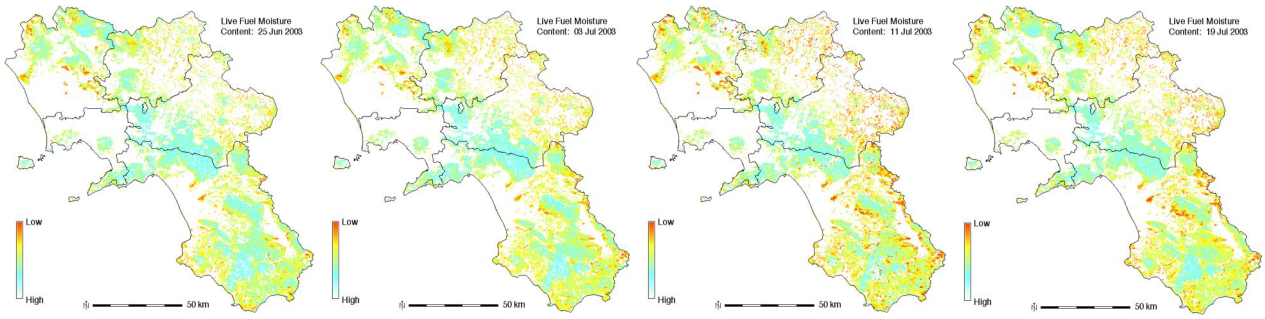

Fig. 5: Maps of estimated live fuel moisture content in four successive dates of the same year in Campania, Italy.

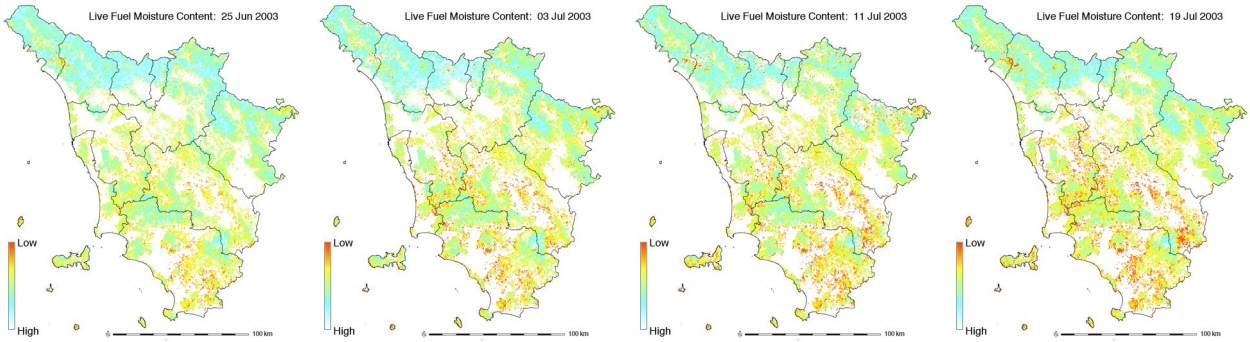

Fig. 6: Maps of estimated live fuel moisture content in four successive dates of the same year in Tuscany, Italy.

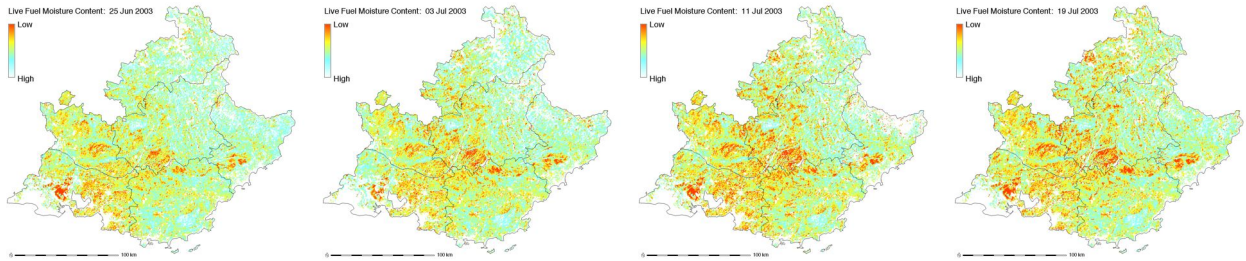

Fig. 7: Maps of estimated live fuel moisture content in four successive dates of the same year in PACA, France.

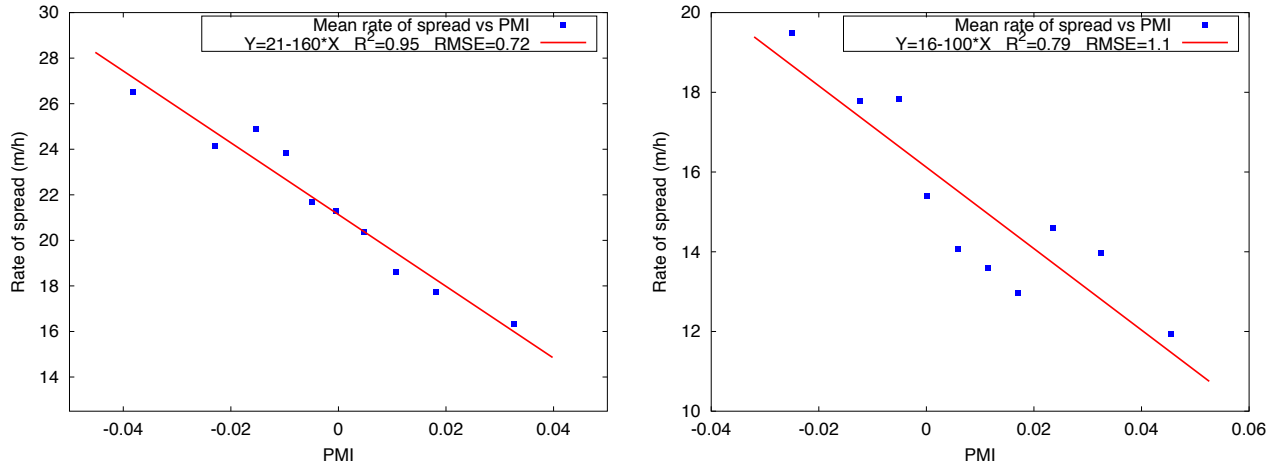

Fig. 8: Relationship between PMI and fire mean rate of spread in Campania (left) and Tuscany (right).

Vegetation water content also affects ease of inception, and indeed this results in clear trends in the number of fires with varying values of PMI. The median PMI value in 8-day compositing periods was compared against the number of fires occurred in the following compositing period, and mean tabular data were produced for each intermediate administrative unit (provinces in Campania and Tuscany, departments in

PACA) [21]. In Campania there is a clear variation of the mean number of fires with PMI (**Tab. 1**): when the vegetation moisture content is higher (the PMI is higher), a lower number of fires is observed. Similar results were found in Tuscany (**Tab. 2**) and PACA (**Tab. 3**).

6. Current and future operational instruments

The examples reported in section 5 are based on data from MODIS instrument. This choice was dictated by the need to develop the methodology against historical fire data on the longest available time frame. Nevertheless, similar results may be achieved using other sensors and satellite missions capturing the electromagnetic radiation in the wavelengths of the optical domain affected by the water content in vegetation tissues, thus providing the opportunity to directly quantify LFMC. In this section, a few of them will be described.

VEGETATION (VGT) is a family of sensors developed by European scientific and industrial partners with the aim of providing large-swath multispectral images of the land surface. VGT-1 and -2 are substantially identical instruments installed on board SPOT-4 (Satellite Pour l'Observation de la Terre-4, 1998-2013) and SPOT-5 (2002 to present) satellites respectively. They capture the reflected solar radiation in the blue, red, near infrared (NIR) and shortwave infrared (SWIR) with a swath of 2200 km and a ground sampling distance of 1 km. The two sensors allow a near to daily global coverage. VGT-P is a spectrally equivalent and much smaller sensor on board the PROBA-V (2013 to present) micro-satellite. It provides daily coverage of continental masses with a swath of 2285 km and a 300 m baseline ground resolution.

The Visible Infrared Imaging Radiometer Suite (VIIRS) is a multidisciplinary sensor capturing radiation from the visible to the thermal infrared in 22 bands. It was designed to provide long-term continuity to MODIS data and science products. The first VIIRS was launched on board the Suomi NPP (Suomi National Polar-orbiting Partnership) in 2011, jointly managed by NASA and NOAA. It provides a daily revisit of almost the entire globe, with a ground resolution of 370-740 m. A second specimen of VIIRS is planned to be launched on board JPSS-1 (Joint Polar Satellite System-1) in 2017.

Tab. 1: Relationship between the mean number of fires and the median PMI value in 8-day observation periods, for each province of Campania.

	Mean number of fires					
Province	PMI<-0.01	-0.01<PMI<0	0<PMI<0.1	0.01<PMI<0.02	0.02<PMI<0.03	PMI>0.03
Caserta	4.25	4.83	4.46	2.42	0.96	0.5
Benevento	6.80	7.56	2.58	1.57	0.14	-
Napoli	-	-	4.14	4.08	1.43	-
Avellino	6.37	9.11	7.45	1.14	1.17	-
Salerno	13.08	20.98	15.48	3.31	0.75	-

Tab. 2: Relationship between the mean number of fires and the median PMI value in 8-day observation periods, for each province of Toscana.

	Mean number of fires					
Province	PMI<-0.01	-0.01<PMI<0	0<PMI<0.1	0.01<PMI<0.02	0.02<PMI<0.03	PMI>0.03
Massa Carrara	-	-	2.37	2.28	1.28	0.69
Lucca	-	-	2.25	2.98	4.13	2.06
Pistoia	-	-	-	1.71	1.68	1.67
Firenze	-	4.73	4.83	3.43	1.75	0.67
Livorno	-	1.06	0.71	0.55	0.33	-
Pisa	-	2.26	2.51	1.70	0.64	-
Arezzo	-	4.18	4.40	1.61	1.71	-
Siena	2.81	1.79	0.93	0.36	-	-
Grosseto	3.68	2.48	1.79	0.64	-	-
Prato	-	-	-	0.70	0.69	0.72

Tab. 3: Relationship between the mean number of fires and the median PMI value in 8-day observation periods, for each department of PACA.

	Mean number of fires				
Department	PMI<-0.02	-0.02<PMI<-0.01	-0.01<PMI<0	0<PMI<0.01	PMI>0.01
Alpes-de-Haute-Provence	2.71	1.45	1.11	0.71	-
Hautes-Alpes	-	0.43	0.26	0.21	-
Alpes-Maritimes	-	4.75	5.53	4.48	4.00
Bouches-du-Rhône	9.86	10.41	7.19	7.25	-
Var	10.14	10.45	8.48	4.58	-
Vaucluse	1.34	1.80	1.47	1.11	-

"Copernicus" is the Earth observation programme established by the European Union and managed by the European Space Agency (ESA). The programme was initially known as GMES (Global Monitoring for Environment and Security), and was named after the 16th century astronomer Nicolaus Copernicus in 2012. Copernicus will be implemented through the launch of the Sentinel missions, a number of remote sensing satellites meant as the European contribution to the Global Earth Observation System of Systems (GEOSS).
The Sea and Land Surface Thermal Radiometer (SLSTR) is a wide swath sensor planned for launch on Sentinel-3A satellite by the end of 2015. A twin mission (Sentinel-3B) will be launched 18 months later. SLSTR builds on the experience of the Advanced Along Track Scanning Radiometer (AATSR) on board of the EnviSat satellite, whose peculiar characteristic was the availability of a dual-view camera almost simultaneously capturing radiation in two viewing directions. In the thermal infrared, this unique feature potentially allows the separation of vegetation and soil temperatures [10], [22]. SLSTR has a swath of 1400 km for the nadir-looking camera and 740 km for the oblique camera. This allows daily coverage of the globe with the nadir-viewing camera, and less than two days revisit time in dual-view mode. The sensor images the surface in 11 spectral channels from the visible to the thermal infrared with a ground resolution of 500 m in the visible, NIR and SWIR, and 1 km in the longer wavelengths.
The Sentinel-2 satellites A and B will carry the Multispectral Imager (MSI), a high-resolution optical sensor designed to provide long-term continuity to Landsat and Spot missions. MSI operates in 13 bands between the visible and the SWIR. Ground resolution is 10 m for visible and NIR bands, 20 m for red-edge and SWIR bands, and 60 m for atmospheric bands. Thanks to the ground swath of 290 km, the MSI will have a revisit time of 10 days. Sentinel-2A will be launched in June 2015, followed by Sentinel-2B about 18 months later. When both satellites will be operational, it will be possible to produce high-resolution fire hazard maps every 5 days.

7. Acknowledgements

We are grateful to the Forest Fires office of the Italian Forest Corps (CFS), the Italian Civil Protection and the Regional Administration of Tuscany for providing fire data in Campania and Tuscany.

Bibliographical References

[1] JRC, "Forest Fires in Europe, Middle East and North Africa 2013," Ispra, 2014.

[2] FAO, "Fire management - global assessment 2006," Rome, 2007.

[3] D. X. Viegas, Ed., *Recent forest fire related accidents in Europe*. Luxembourg: Office for Official Publications of the European Communities, 2009.

[4] R. C. Rothermel, "A mathematical model to predicting fire spread in wildland fuels," 1972.

[5] J. San-Miguel-Ayanz, J. D. Carlson, M. E. Alexander, K. Tolhurst, G. Morgan, R. Sneeuwjagt, and M. Dudfield, "Current methods to assess fire danger potential," in *Wildland Fire Danger Estimation and Mapping - The Role of Remote Sensing Data*, E. Chuvieco, Ed. Singapore: World Scientific Publishing Co. Pte. Ltd., 2003, pp. 21–61.

[6] A. S. López, "Assessment of fire potential in Southern Europe," pp. 1–15, 2002.

[7] H. K. Preisler, R. E. Burgan, J. C. Eidenshink, J. M. Klaver, and R. W. Klaver, "Forecasting distributions of large federal-lands fires utilizing satellite and gridded weather information," *Int. J. Wildl. Fire*, vol. 18, no. 5, p. 508, 2009.

[8] M. Yebra, P. E. Dennison, E. Chuvieco, D. Riaño, P. Zylstra, E. R. Hunt, F. M. Danson, Y. Qi, and S. Jurdao, "A global review of remote sensing of live fuel moisture content for fire danger assessment: Moving towards operational products," *Remote Sens. Environ.*, vol. 136, pp. 455–468, 2013.

[9] C. Maffei and M. Menenti, "A MODIS-based perpendicular moisture index to retrieve leaf moisture content of forest canopies," *Int. J. Remote Sens.*, vol. 35, no. 5, pp. 1829–1845, 2014.

[10] M. Menenti, L. Jia, and Z.-L. Li, "Multi-angular thermal infrared observations of terrestrial vegetation," in *Advances in Land Remote Sensing*, S. Liang, Ed. Dordrecht: Springer Netherlands, 2008, pp. 51–93.

[11] C. Yunhao, L. Jing, and P. Guangxiong, “Forest fire risk assessment combining remote sensing and meteorological information,” *New Zeal. J. Agric. Res.*, vol. 50, no. 5, pp. 1037–1044, 2007.

[12] E. H. Chowdhury and Q. K. Hassan, “Operational perspective of remote sensing-based forest fire danger forecasting systems,” *ISPRS J. Photogramm. Remote Sens.*, 2014.

[13] E. R. Hunt and B. N. Rock, “Detection of changes in leaf water content using near- and middle-infrared reflectances,” *Remote Sens. Environ.*, vol. 30, no. 1, pp. 43–54, Oct. 1989.

[14] B.-C. Gao, “NDWI - A normalized difference water index for remote sensing of vegetation liquid water from space,” *Remote Sens. Environ.*, vol. 58, no. 3, pp. 257–266, Dec. 1996.

[15] P. Ceccato, N. Gobron, S. Flasse, B. Pinty, and S. Tarantola, “Designing a spectral index to estimate vegetation water content from remote sensing data: Part 1 Theoretical approach,” *Remote Sens. Environ.*, vol. 82, no. 2–3, pp. 188–197, Oct. 2002.

[16] J. L. Olsen, S. Stisen, S. R. Proud, and R. Fensholt, “Evaluating EO-based canopy water stress from seasonally detrended NDVI and SIWSI with modeled evapotranspiration in the Senegal River Basin,” *Remote Sens. Environ.*, vol. 159, pp. 57–69, 2015.

[17] F. M. Danson and P. Bowyer, “Estimating live fuel moisture content from remotely sensed reflectance,” *Remote Sens. Environ.*, vol. 92, no. 3, pp. 309–321, 2004.

[18] G. Caccamo, L. A. Chisholm, R. A. Bradstock, M. L. Puotinen, and B. G. Pippen, “Monitoring live fuel moisture content of heathland, shrubland and sclerophyll forest in south-eastern Australia using MODIS data,” *Int. J. Wildl. Fire*, vol. 21, no. 3, pp. 257–269, 2012.

[19] C. Maffei and M. Menenti, “An application of the Perpendicular Moisture Index for the prediction of fire hazard,” *EARSeL eProceedings*, vol. 13, no. 1, pp. 13–19, 2014.

[20] “Prométhée: Forest fires database for Mediterranean area in France.” [Online]. Available: http://www.promethee.com/. [Accessed: 19-Mar-2015].

[21] C. Maffei, L. Bonora, F. Maselli, A. Mangiavillano, and M. Menenti, “The MODIS-based perpendicular moisture index as a tool for mapping fire hazard: indirect validation in three areas of the Mediterranean,” in *Advances in Forest Fire Research*, 2014, pp. 1017–1023.

[22] L. Jia, M. Menenti, Z. Su, Z. Li, U. L. Pasteur, B. S. Brant, and A. Ground, “Observation of directional exitance and retrieval of soil and foliage component temperatures : case studies with bi – angular ATSR radiometric data,” vol. 00, no. C, pp. 33–35, 2002.

HERITAGE and TECHNOLOGY
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Marble sculptures FRP-based reinstatement and consolidation practices

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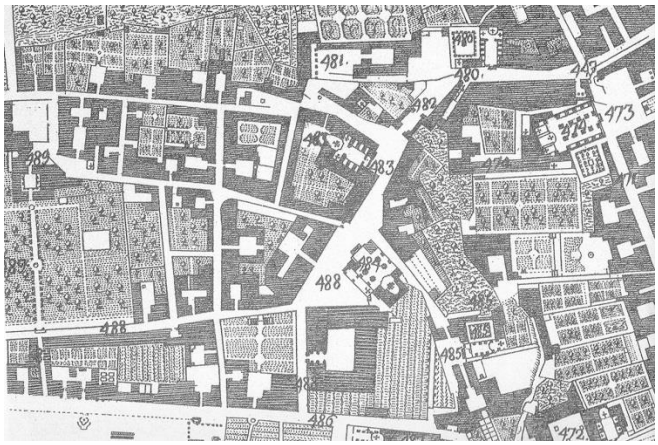
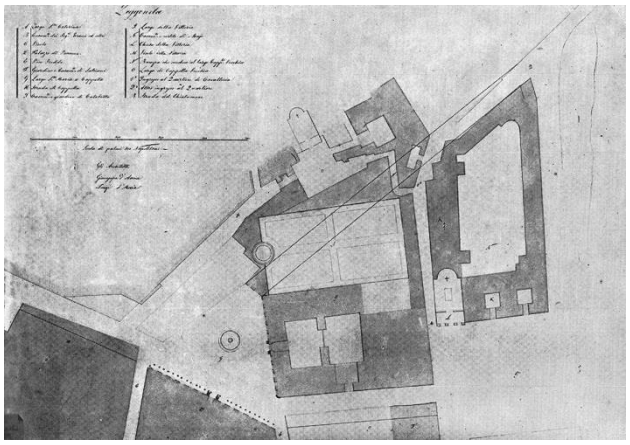
Abstract *
FRP on historic stone artifacts still now represent innovative applications, insufficiently implemented and tested, even for structural consolidation and reinstating of marble members affected with missing parts. Under agreement with Naples' Special Office for Artistic Heritage, in 2010 Department of Materials and Production Engineering of the University of Naples designed and carried on the static reinstatement and restoration to the damaged tails of the two marble lions sculptured at the base of the monumental complex dedicated to Neapolitan Martyrs. The marble elements, differently damaged and formerly restored, have been subjected to diverse material re-adhesion and re-integration procedures, expressly draft and laboratory-tested preliminary. The recovered fragments of "Leone trafitto dalla spada"'s tail have been reassembled by inserting carbon-fiber, customer-dimensioned bars fixed by epoxy resin. The vandalized portion of "Leone dall'aspetto minaccioso"'s tail, already formerly substituted with a concrete prosthesis, has been recreated by adopting an inner expanded-polyurethane bar covered with CFRP and epoxy resin, then finished by a FRP-meshed, acrylic-resin upper coat. Thanks to an in-deep understanding of the operating procedures, basing on the fabric macroscopic survey, analytic investigations and thermography analysis, the study tested and assessed the restored fragments and prosthesis current condition, as well as the physical-chemical gripping and durability performance of the composites treatments, so deriving useful ex-post comparison about this innovative research field. (M.D.)

Keywords: CFRP; composites; confinement; wrapping; laminates.

1. FRP for architectural heritage preservation
Composites have evolved since the 1950's in architectural applications starting with semi-permanent structures and continuing with restoration of historic buildings. Fiber-reinforced polymers (FRP) are very good alternatives for strengthening masonry heritage structures; they can provide them with additional strength and ductility to resist static and dynamic actions. FRP composites are being increasingly used for rehabilitation and strengthening of masonry structures, in particular, arches, vaults and domes. In the form of externally bonded sheets applied to the surface of an arch with the wet lay-up technique, introducing tension resistance, for instance FRP allows the line of thrust to fall outside the thickness of the arch, thus reducing the lateral thrust transmitted to the piers. FRP can be used in various ways in architectural heritage strengthening, by forming very high strength structural elements with limited sizes and negligible weight. Several techniques have been proposed during the last decades but, for the most, two kinds of reinforcements are implementing: i.e. embedding of rods into grooves close to the surface (near-surface mounted FRP rods) and bonding of composites laminates to the facades.
In Italy the wrapping with composites can count on almost twenty years of applications by now, providing architectural heritage the "seismic behavior improvement", although the effective reversibility of the treatments - among the main requirements of the restoration planning - still now must be properly verified on field. Differently, on marble sculptured complexes the implementation of composites still represents an innovative means of retrofitting and reinstating them, and so are any ex-post assessing procedures regarding composites durability and long-term effectiveness, which are indeed real parameters for technical understanding and better implementing them.

Figg. 1, 2. G. Carafa, N. Carletti, *Mappa topografica della Città di Napoli e de' suoi contorni* (1750-75). The square before *S. Maria a Cappella*'s dismantling (left). G. D'Auria, L. D'Auria, *Via della Pace*'s opening project (right).

As instance, it can referred to the restoration of Perugia's Major Fountain carried out in 1999. The marble elements – already formerly restored by substituting the original stone joints with new, too rigid connectors – largely affected with fractures and cracks, have been bonded at the inner face with longitudinal and transversal GFRP strips, then adequately plastered [1]. Differently, about composites for the re-adhesion of marble fragmented portions and the insertion of prosthesis, there's not much to say thus far, but for Neapolitan Martyr's Monument work here focused. (M.D.)

2. Neapolitan Martyrs' Monument design and history development

Set up between 1853 and 1868 during the overall urban and building reshaping of the triangular square environment, today known as *Piazza dei Martiri*, at whose center the monument placed, the marble sculptured complex of Neapolitan Martyrs consists of a central granite ionic column, set on an high marble stand with bronze plaques and ornamentations, whose top there is *Vittoria Alata*'s bronze statue. Around the base four marble lions set on similar stone pedestals, sculptured by four of the main artists of the nineteenth century second half, are symmetrically cross-located to celebrate Neapolitan martyrs died during the most struggles for liberty (1799, 1820, 1848 and 1860). The sculptors all – S. Lista (1824-1908), T. Solari (1820-84), P. Ricca (1803-69) and A. Brusciolano (1823-78) – have been representatives of the Classicism of the time. In particular, Lista and Solari, authors of the sculptures here focused, were among the mayor creators of Realism in art [2]. The former urban clearance – originally known as *S. Maria a Cappella*, because of the church here dismantled in 1812 (Fig. 1) – started transforming itself with the opening of *Via della Pace*, an Haussmann-shaped straight on the north-east side of the square, derived from historic building context destroying, that has been developed since 1853 (Fig. 2) [3]. Consequently, several new buildings arose along that street until the square, the most designed and constructed by the noted architect Errico Alvino, whom the new urban and building settlements of the time are here to be ascribed to. So are his projects for

Figg. 3, 4. M. Mastrilli, Prospective view of *Via Chiaia*'s renewing and widening design, 1888 (left). *Leone dall'aspetto minaccioso*'s sculpture as found before the restoration implemented in 2001 (right)






Figg. 5, 6. Several spray graffiti on the marble surfaces before and after the cleaning carried out on them in 2001.

Palazzo Nunziante and the garden in front of it at the square north-east side (1855), the widening and straightening of *Via Poerio* at the opposite side (1846), and the Martyrs' Monument configuration itself. Formerly commissioned to the architect Luigi Catalani (1852), who meant it as a granite column from *Lago Maggiore'*s with a winged victory sculptured on top to celebrate the recovered balance between Borbone's and the citizens, the monument planning, even differently located, was then attributed to Alvino (1853). He meant to place it in the current asset, but the iron fence with similar lampposts dismantled during the 1940's (Fig. 3). Following Alvino's not rhetorical-less proposal, in order to celebrate the new political conditions, the monument assumed the current shape in 1866-68, also commissioning E. Gaggiano (1837-1905) to form the bronze statue on the top. During the 1960's, when also too many building accretions and elevations occurred permanently altering the environmental features of the square, new lighting installations were located at the monument base in the grass area. Therefore, the green zone was elevated of around 20 cm, so hiding the first step of the stone stand (Fig. 4) [4]. (M.D.)

3. The 2001 restoration works: criteria and operating solutions

In 2001 a first documented restoration work has been carried on the monument materials (marble, limestone, granite, basalt and bronze) for cleaning, protecting, re-integrating and reinstating the deteriorated surfaces and vandalized members as well, by "Ambra Restauri snc" and "Associazione Culturale M. Brancaccio" [5]. There were significant biological deposits, overall black crusts, as well as soiling at surfaces, especially where protected against rainfall. There were green stains underneath the bronze members and also many graffiti produced by acts of vandalism even on marble surfaces (Figg. 5, 6), however damaged by thin cracks and limited erosion. The two tails of the sculptures by S. Lista (*Leone trafitto dalla spada*) and T. Solari (*Leone dall'aspetto minaccioso*) had been also vandalized. Only three marble fragments of Lista's artefact were recovered on the grass, while the larger part of Solari's lion tail totally missed (Fig. 4). Therefore, this tail was then re-integrated with a stainless steel-core concrete prosthesis covered by epoxy resin layers, such that this rough surface better allowed to lime-plaster the top, enriching the finishing coat with marble powder, too. A similar compost was then used for pointing joints and fissures on the damaged marble surface. The recovered fragments of the other tail were reassembled by inserting stainless steel bars within them to joint each other and to the existing upper and lower parts of the tail, fixing the bars with epoxy resin and finishing the outer surface similarly to that of the cited prosthesis (Fig. 6). Particularly, the 2001 intervention works comprised: a first light consolidation of the marble deteriorated surfaces with ethyl silicate



Figg. 6, 7. The tail of the sculpture "Leone trafitto dalla spada" as restored in 2001 (above) and the same fragments recovered on the ground in 2007, before the last intervention (below).

impregnation; the water nebulizing for the soluble deposits removal; the black crusts and graffiti chemical-pack cleaning, then completed with local mechanical removal by scalpels; the final protection with surface treatments of ethyl silicate and anti-graffiti. Also bronze and iron parts of the monument were cleaned by oxidation deposits and stains and then protected with surface coating of Paraloid B44, followed by a layer of ResWax and by a 3% solution of benziotriazole, an anti-corrosive finishing treatment (M.D.)

4. The 2010 restoration work: innovation, technology and laboratory-testing

The study of the functional and structural restoration of the statues "Leone trafitto dalla spada" and "Leone dall'aspetto minaccioso", that had their tails mutilated by acts of vandalism in 2007 has been carried out through the innovative use of composite materials and of relevant techniques. Before the implementation of the work, the characterization of all the different materials that must have been used in the restoration, as well as of their compatibility and interactions with original parts have been carried out, too.

For the tail of the "Leone trafitto dalla spada" by Stanislao Lista, it was decided to realize the reinforcement using carbon fiber bars of appropriate length and diameter. The use of carbon fibers in this application offers several advantages related to the high mechanical properties of the material and its resistance to corrosion and oxidation. Therefore, an alignment system have been created of the holes on the three original marble pieces, such as to allow the insertion of carbon bars used to recompose the tail ensuring the integrity of the original pieces. Several tests have been performed to determine the compatibility of the marble with the composite material and the resin used. In particular, they have been realized marble specimens, which have been then perforated to allow the insertion and the bonding of the carbon fiber rods. Thereafter, the bars have been subjected to tensile tests to determine the resistance of the bonding.

For the tail of the "Leone dall'aspetto minaccioso", in a previous restoration partially re-made as a prosthesis of concrete mortar reinforced with a steel-core, it has been realized a core of polyurethane foam with an external surface of carbon fiber and epoxy resin, which has been used as structural support on which the restorers have then applied the finishing layer made of a special acrylic resin, having appearance totally similar to Carrara marble of which the monument is made. Such intervention methodology allows a strong

reduction of the weight of the element inserted, with a consequent lower load on the connecting section to the statue. (D.B.)

4.2 Preliminary laboratory testing and material properties assessing

Before the implementation of the designed restoration solutions, the characterization has been carried on of all the materials that had to be used in the project and of their compatibility with historic sections and environmental conditions. For the surface coating an acrylic resin has been selected made by two components, a latex "Plasticrete P-CAST A02" and a powder component "Plasticrete P-FILLER ART white".
The first aspect to have to check has been the adhesion between the composites and the resin used for the surface coating of the new tail. Then two pipes in fiberglass were produced on which several tests of adhesion have been carried out. The attempt of directly applying the resin on the pipe it failed, because a slight mechanical stress caused the detachment of the two materials at the interface. To improve the adherence the surface has been blasted, to increase its roughness and thus the adhesion capability, but the interface resistance had been very low, therefore to improve the anchoring between the composite material and the surface coating, a grid within the surface coating has been used.
Several laboratory tests have been performed to choose the most suitable type of grid. Three different types of them have been proved:
• Galvanized steel grid mesh (10.0 x 10.0 x 0.5 mm);
• Galvanized steel grid mesh (10.0 x 10.0 x 1 mm);
• Carbon fibre grid mesh (10.0 x 10.0 mm).
Onto the three grids a coating layer of 15 mm of acrylic resin has been placed, having care to incorporate perfectly each grid within the resin. The grid that showed the best results was the carbon fibre one of 10.0 x 10.0 mm. Subsequently to the cited characterization of the materials, several impact tests have been carried out to evaluate the material resistance to external stress. The machine used for impact testing was Charpy impact test suitably modified. The metal disposal is made of two metal discs and a flat impacting surface, having impact surface equal to 2205 mm^2. The pendulum rod has been dropped from various heights.
The rod and the impactor have been weighed separately, obtaining an overall mass equal to 3.340 + 5,66 = 8,99. It has been calculated for the different positions of the pendulum the potential energy corresponding, multiplying the mass with the gravitational acceleration for the height. Thus, the energy values have been derived in relation to the starting positions of the pendulum.
For values referred to a starting height of 70 cm, the breakdown occurred for all five specimens, because of four longitudinal fractures which extended throughout the length of the specimens. However, the presence of the grid allowed the four pieces to stay together, anyway. The impact testing has been forcedly performed to verify the material resistance to external stress. The value obtained here is of 61,80 Joule. In the case, we analysed the most common situation among the most demanding conditions: a man that hits the monument with a hammer or a stone. It has been then calculated the energy deriving from the situation described using the formula:

$$E = ½ mv2$$

Tab. 1. Charpy impact testing outcomes

Position (cm)	Energy (Joule)	Test 1	Test 2	Test 3	Test 4	Test 5
10	8,829	-	-	-	-	-
20	17,658	-	-	-	-	-
30	26,487	-	-	-	-	-
40	35,316	-	-	-	-	-
50	44,145	-	-	-	-	-
60	52,974	-	-	-	-	-
70	61,803	Break	Break	Break	Break	Break

$m = m_0 + m_b$;
m = mass of the object used to hit, assumed as concentrated at the centre of the hand (m_0 = 2 kg).
m_b = mass of the arm concentrated at the centre of the hand (m_b = 7 kg)
v = impact speed.
To calculate the maximum speed with which an average man may hit the monument, it has been considered

the speed capability of the human arm, referring to a professional boxer who delivers a punch without any weight in his hand, about at 7 m/s. Therefore, for an average man having an object in the hand, an acceptable value is 3.5 m/s with E = ½. 9. 3.52 = 55, 125 Joules. This value, as the maximum stress which normally the monument has to resist, is lower than the resistance value of the material experimentally obtained, of 61.8 Joules [6].
The result, derived by the use of the carbon fibre grid and acrylic resin applied for covering the surface, has been then reckoned suitable for the restoration work of the tail of the sculpture "Leone dall'aspetto minaccioso". (D.B.)

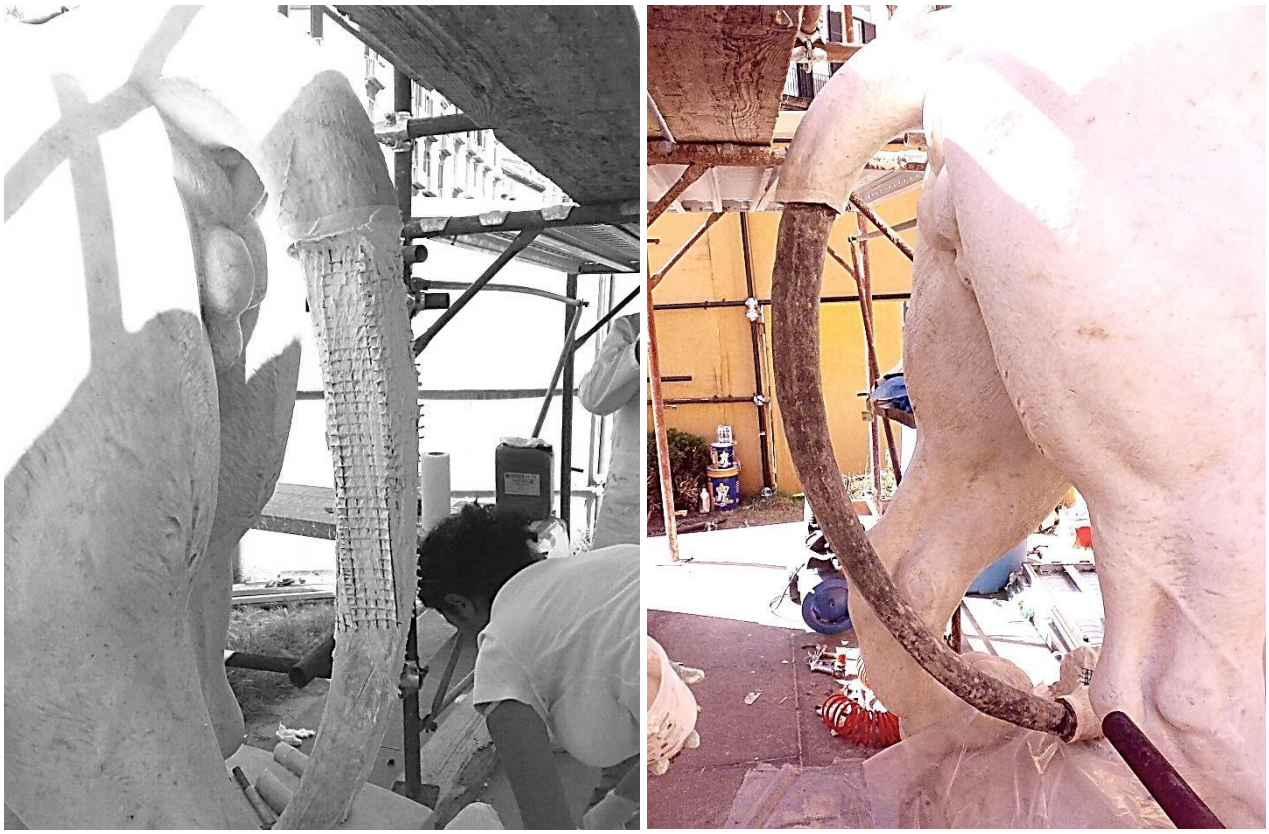
4.3 The new tail composite prosthesis forming and installing

The core of the tail prosthesis was produced by using a wooden mould shaped to follow the curvature of the original tail, in order to realize the counter mould for the subsequent creation of the tail mould. Thus, the counter mould was produced with a polyurethane foam injected into the wooden box, where the former concrete prosthesis had been previously housed. The counter mould so obtained made it possible to perfectly recreate the configuration of the former concrete tail, subsequently produced in polyurethane foam.
In order to obtain an element of reduced cross-section on which then applying a coating of acrylic resin having a thickness of 15 mm, the counter mould was covered with a layer of polyethylene having a thickness of 6 mm. Then, the mould for the final lamination of the carbon fibre has been realized, using 0.6 litres of polyurethane. Once the mould has been created, they laminate the carbon fibre fabric to realise the so-shaped tail in composites. The lamination has been produced through the superposition of four layers of bidirectional carbon fibre fabric, having a weight of 250 g/m^2, previously resin-impregnated and appropriately positioned. To ensure a perfect connection to the existing marble portions (the tuft with the adjacent section and that bonded to the lion body), it was necessary to remove from the two ends of the tail prosthesis the inner layer of polyurethane of 15 mm, which was then replaced with epoxy resin injections. This operating solution provided a support for the carbon fibre bars, in order to create a more stable connection to the monument. The new portion of the tail thus obtained weights 9 kg. This value corresponds to the weight of the inner part made of composite material (2.4 kg), added to the weight of the external coating (5.6 kg). Comparing this value with that of the former concrete prosthesis (20 kg), a reduction of 11 kg, that is about 60%, has been then obtained. (D.B.)

Figg. 8, 9. Charty impact testing procedure (left) and a comparison between the concrete prosthesis and the polyurethane one (left).







Figg. 10, 11. The application of the resin layer (left) onto the polyurethane prosthesis of the tail (right).

Figg. 12, 13. The restored element of the tail (left) after the finishing coat application (right).



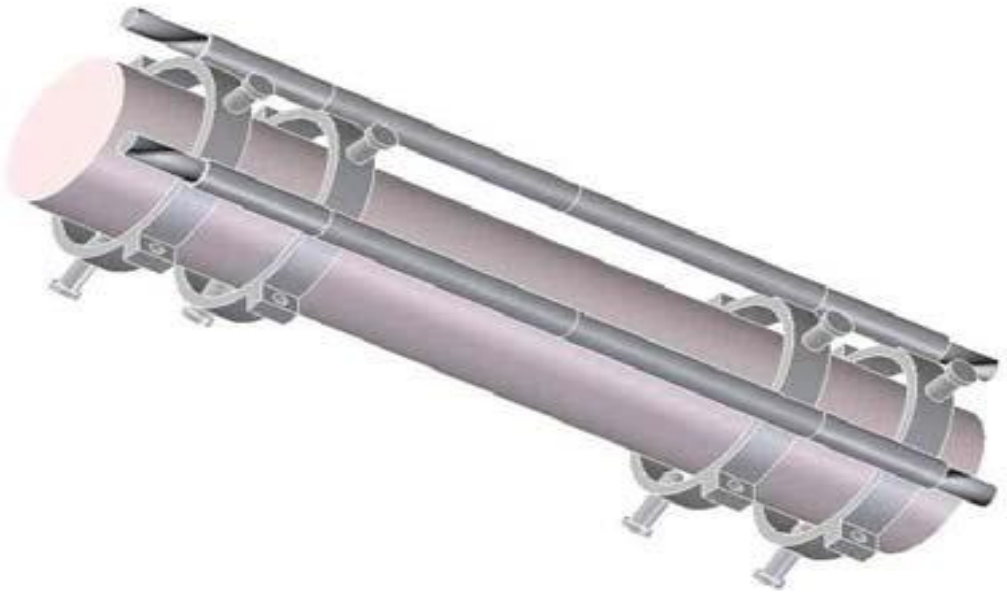


Fig. 14. The scheme of the alignment system as planned in 2010, for drilling the stone fragments of the second tail and inserting the necessary connector bars.

5. The reassembling technique for the recovered marble fragments

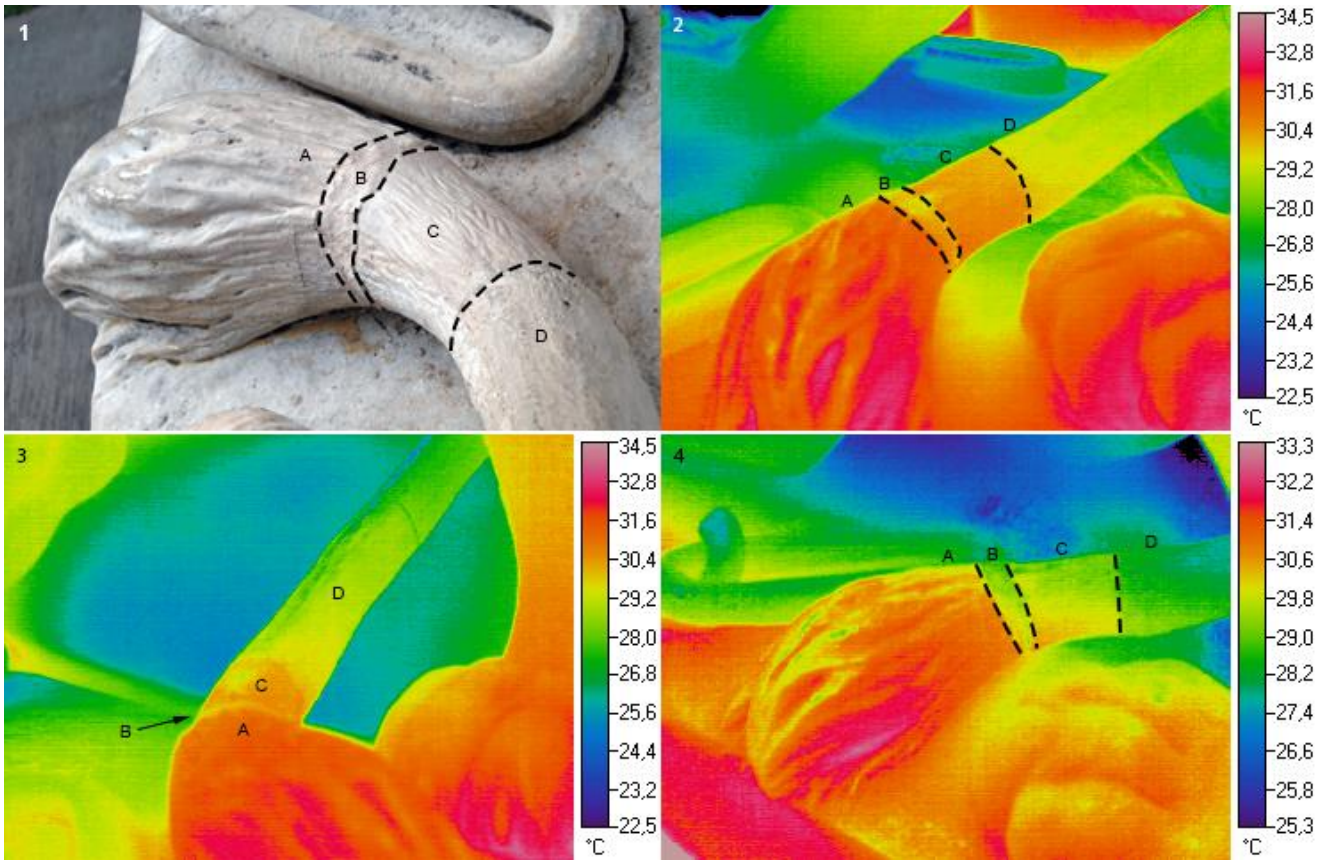
Three marble fragments of the tail belonged to the sculpture “Leone trafitto dalla spada” by S. Lista were recovered on the grass in 2007, maybe because of another act of vandalism. These fragments, that have to be reconnected each other and to the existing portion of the tail, were in number of three, all related to the lower part of the tail. They imperfectly corresponded each other by the edges, because of small missing parts around them and at interfaces. The fragments have been reassembled each other using carbon fiber bars of appropriate length and diameter inserted into them and resin-impregnated. Thus, the entire system resistance improved without any weight increases. The holes to install the connection system among the three stone pieces have been carefully aligned by using a relevant procedure, expressly planned.
A couple of holes drilled at each fracture surface has been performed by following a system of alignment, produced by blocking the recovered fragments trough four steel collars (diameter 140 mm) and two metal tracks (610 mm length) to correctly locate each bonding section (Fig. 14). Then, after having tested the holes positioning on concrete specimens, the carbon bars have been fixed by injecting into the drilled holes the CTS epoxy resin (EPO150) and an hardener solution (K151), with a weight ratio of 4:1. Several laboratory tests have been also carried out on some marble specimens, specifically made to assess epoxy resin tensile resistance, as well as the interaction properties within the overall constructive system. (M.D.)

6. The restored tails “as-found condition” surveying: approaches and outcomes

More than four years later the described works completion, on-site macroscopic investigations onto the restored portions of the sculptured tails, treated as indicated above, and the comparison of their current condition to that of the former marble elements clearly demonstrate the good performance of the last restoration activity. Indeed, the “as-found condition” survey of the cited sections only reveal some light and well delimited zones of surface degradation and weathering, as interesting the only finishing layer of the topcoat, especially where the reassembled fragments and the adjunct prosthesis joint the remaining parts. Also several, superficial, thin fissures and hair cracks are here sometimes to be recorded, while displacement or detachment patterns cannot be observed. Few differential erosion zones, sometimes even associated with very small lacunas at the topcoat, are also visible at the naked eye, corresponding to peeling at the surface of jointing sections, that have been stabilized with the cited acrylic impregnation on them during the last restoration work. Probably, the described peeling at the surface depends on the biocide solutions used on marble portions in 2001, when also a brushing had been carried on them, thus maybe providing them some extra mechanical stresses. Several original marble surfaces on the bodies of the lions now reveal the particular sort of soiling, generally meant as a specific deterioration of stone surface formerly treated with water repellents, as it was in the case in 2001. Therefore, water pathways are now limited to narrow stripes, where algae and biological colonization also have developed preferentially. Besides, some portions of the marble sculptures, not more along the tails, now show thin, veil-like soiling by atmospheric dust and also several limited crusts and black crusts at surfaces protected against rainfall.
The thermography substantially confirmed the condition described, only highlighting the jointing edges positioning of the polyurethane prosthesis (Fig. 16) and of the reassembled fragments (Fig. 15). Thus, the

thermal images comparison of the investigated surfaces of the two restored tails discloses an overall sufficient performance of durability of the prosthesis and the re-assembling system, although it must be said the coating and the finishing layers thickness makes difficult to survey and document possible detachment and/or delamination patterns within the solids. On the other hand, superficial differential erosion of the jointing areas onto the two tails also confirms the light texture alteration and discolouring of the finishing layer – treated as indicated with acrylic resin and anti-graffiti solution – at the bonding sections, lightly altered by atmospheric pollution and weathering action, without compromising the compatibility and effectiveness of the cited innovative operating procedures (M.D.).

Fig. 15. Leone dall'aspetto minaccioso. Comparing thermal images of the tail tuft.
The end of the tail (1) has three material discontinuities. The thermal images, taken at time 0 from two points of view (2 and 3), show a different temperature distribution in the tail four sectors. The image 4, taken after 30 minutes, shows a greater thermal delta between the area 'A' and the other ones, due to the tuft is an original marble fragment sculptured in the statue base too, while the blocks 'B, C and D' are free on the sides. (Pasquale Argenziano, 2015).



*Abstract and Sections 1, 2, 3, 5 and 6 are by M. D'Aprile (M.D.); Section 4 is by D. Brigante (D.B.)

[1] MARCONI, Paolo, PUGLIANO Antonio. *Il restauro della Fontana Maggiore di Perugia.* In AA.VV. *Manutenzione e recupero della città storica. Conservazione e sicurezza,* Roma: 1999, pp. 487-498.

[2] VALENTE, Isabella (ed). *Il Bello o il Vero. La scultura napoletana del secondo Ottocento e del primo Novecento*. Castellammare di Stabia: 2014.

[3] BRUNO, Giuseppe, DE FUSCO, Renato. *Errico Alvino architetto e urbanista napoletano dell'800*. Napoli: 1962, pp. 23-27.

[4] GRAVAGUOLO, Benedetto, GRAVAGUOLO, Giuseppe. *Chiaia*. Napoli: 1990, pp. 52-53.

[5] AA. VV. *Restauro del Monumento ai Martiri Napoletani*. Napoli: 2001, Ed. Ass. Culturale Mario Brancaccio.

[6] BRIGANTE, Domenico. *New Composite Materials: Selection, Design, and Application*, Springer Ed.: 2014

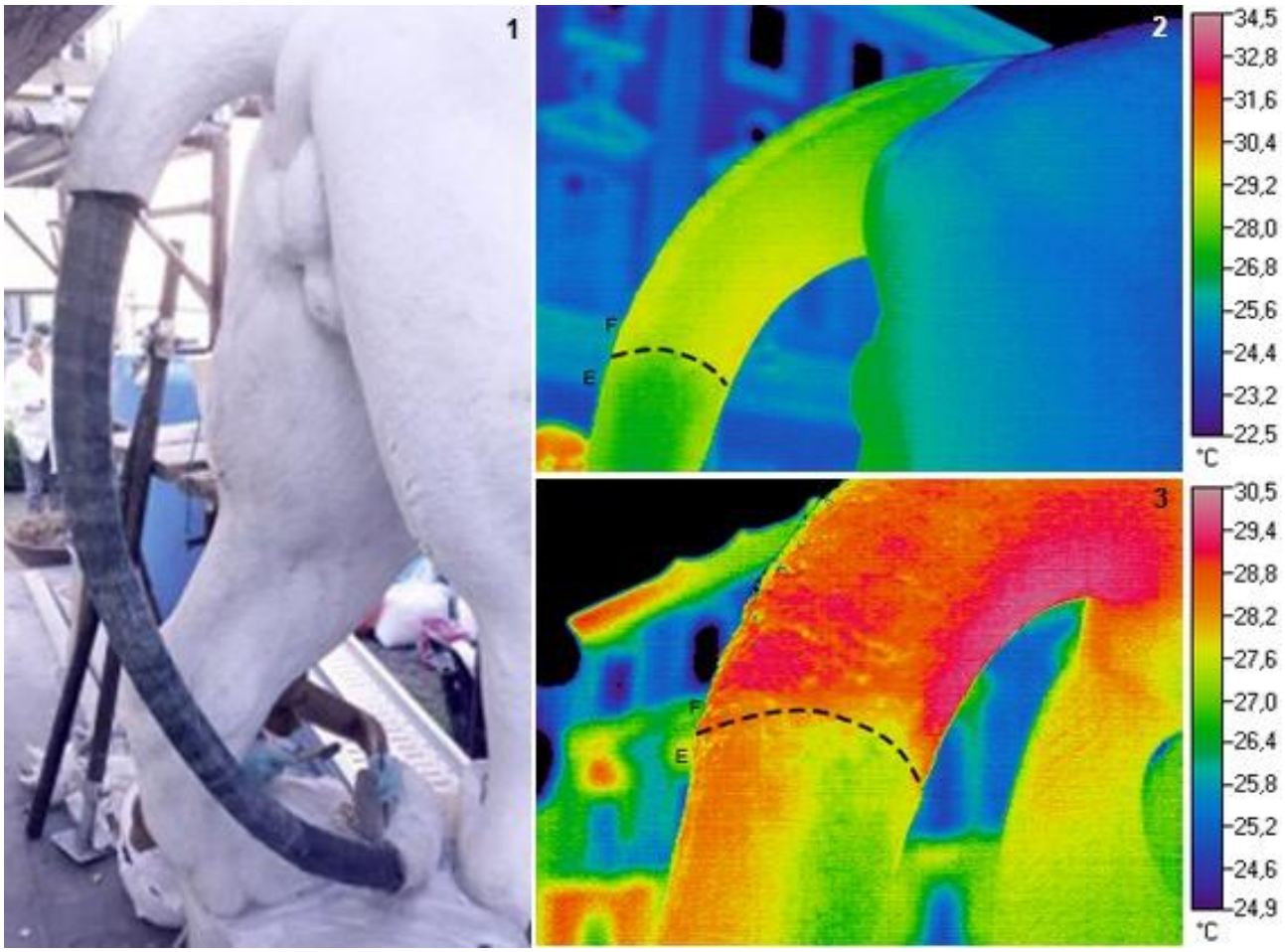
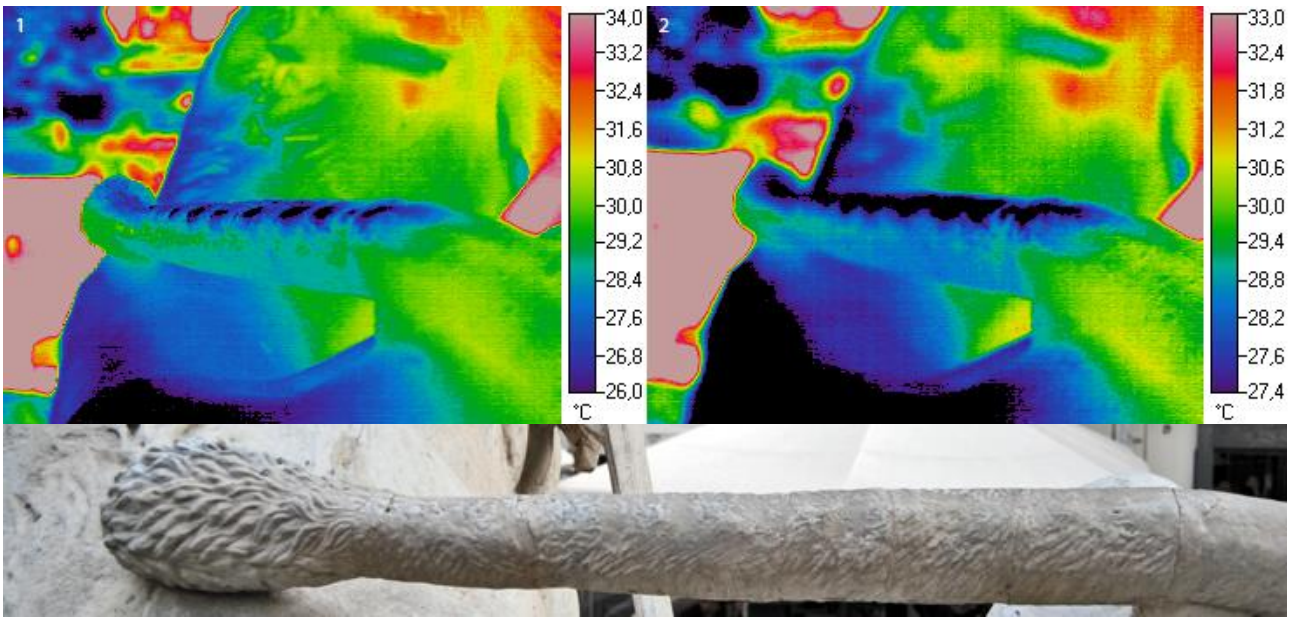


Fig. 16. Leone dall'aspetto minaccioso. Comparing thermal images of the apex of the tail.
The image 1 documents the construction of the tail prosthesis. The images 2 and 3, taken at a distance of 30 minutes, highlight the margin between the prosthesis (E) and the apex of the tail (F). In both images, there is a thermal delta of 0.5 ° C between these two parts. (Pasquale Argenziano, 2015).

Fig. 17. Leone trafitto dalla spada. Comparing thermal images of the tail.
Although the straight section of the tail is composed of several elements, the thermal images (1 and 2), taken at a distance of 30 minutes, do not show any thermal delta comparable to the remaining parts. (Pasquale Argenziano, 2015).



HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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NEW FIBER COMPOSITE MATERIALS FOR CULTURAL HERITAGE CONSERVATION

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Abstract
New fiber composite materials are presented in this work. They have been obtained by treating the surface of the fibers with a silane reactant used in the compounding stage to connect vegetables and mineral fibers to the other chemical components of the final composite materials. The silane reactant links on the surface of the fiber forming strong covalent bonds through the Si atoms. The other end moiety of the silane reactant carries an ammine group which is able to bind to epoxides in a copolymerization process. In such a way the fiber themselves becomes part of polymer networks which have much better mechanical properties with respect to the composite materials obtained by simply dispersing the fibres into polymer matrices. The observed physical and mechanical proprieties of these fiber composites candidates them to have future interesting applications in the field of conservation of cultural heritage.

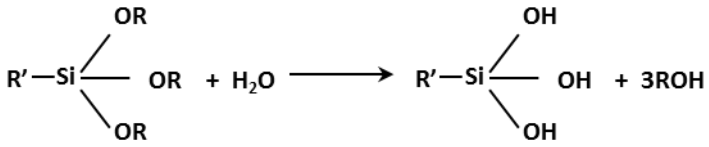
1. Introduction
A great interest has grown, in recent years, for eco-compatible materials which could be used in conservation and restoration of historical buildings and monuments. Several regional and national governmental institutions did reserve funds and intervention lines to promote the development and use of new materials, more safe for the environment. On the other hand, the introduction of new materials in the field of cultural heritage restoration and conservation presents some peculiar difficulties. Not only the materials need to have good technical and mechanical properties, but must be respectful of the principles that have been promulgated in various restoration charts and reasserted in all sector debates.
Today the term bio-compatibility used with respect to building materials, is often associated with composites obtained from natural products such as wood and vegetable fibers most of which are still in phase of development and testing. Among the main products appeared on the market, the following ones deserve particular interest with respect to building applications:
- Hemp bio-bricks, produced by combining the woody part (canapulo) of the hemp steam with lime water and appear to have a lover density with respect to mineral bricks, good mechanical properties, thermo-acustic insulation character, transpirability, optimal thermo-hygrometric equilibrium.
- Bricks recovered from paper fabric waste water are mixed with clay and finely extruded as bricks.

When conservation of historical monuments and buildings are taken into consideration research efforts need to be done to develop restoration product having some peculiar properties such as:
Good mechanical properties
- Low weight
- Durability
- Reversibility (easy to be removed if required)
- Well defined permeability to oxygen and humidity
- Long life
- Good stability with respect to biologic degradation

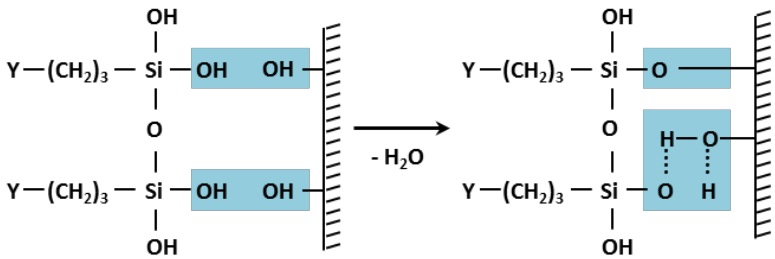
Composite materials where natural vegetable and mineral fibers are mixed with polymers are in principle good candidate to achieve the above mentioned properties. Chemical and Physical properties of composite materials can be in fact graduated by varying the nature of components, their percentage and the fabrication processes.
Researches on natural fibers/polymer composites, developed almost everywhere in industrialized countries, have shown that the simple addition of vegetable or mineral fibers to polymers do not leads to the improvement of the mechanical properties as requested specially from automotives industries (1). It is now well understood that the failure of this approach is mainly linked to the hydrophilic nature of the natural fibers that lowers the compatibility with hydrophobic polymers largely used in automotive components, such as polypropylene (PPR) and polyethylene (PPE), polyurethanes and so on. Cellulose fibers contain indeed many hydroxyl groups (-OH) which strongly interact with water but are rejected by the hydrophobic surface of polymer giving a very poor adhesion at the interfaces (1-2).
Efforts have been made to overcome this problem mainly by using coupling agents to improve the compatibility and adhesion between polar wood fibers and non-polar polymer matrices both by coating the fibers by hydrophobic media and forming bridges of chemical bonds between the fibers and the polymer matrix (2). Many examples of this strategy relate to the use of the maleic anhydrite and similar compounds to compatibilize natural fibers with polypropylene and polyethylene. Other examples concern the use of silane compounds to increased the interfacial adhesion between fibers and polymer matrices.
Recently new types of vegetable fibers have been introduced in the scenario of natural fibers that can be conveniently used in combination with polymers to obtain improved composites (3-9). This new fibers are obtained from Spartium Junceum (SJ) plant: a vegetable which is endemic in Mediterranean countries. Here we present new polymer composites obtained from cellulose fibers extracted by Spartium Junceum (SJ), Portland cement (PC) and epoxy resin precursors. An innovative process of composite preparation has been developed. The vegetable fibers as well as the mineral cement particles, have been previously treated with 3-aminopropyltri-ethoxysilane, in order to link its silane moiety with the surface hydroxyls groups of both types of fibers, and leaving free reactive ammine terminal ends able to link the fibers with the epoxides precursor by covalent chemical bonds. The mechanical properties of these composites have been investigate. The particular valence of these composites in the framework of conservation and restoration of historical buildings is linked to the fact that the composites before the final curing is in a viscous plastic state that can be shaped as a plaster on the surface the surface that need to be restored, and can be shaped in any particular morphologic state.

2. Experimental

Vegetable fibres have been extracted from SJ plants by digesting the vegetable in a 5% by weight sodium idroxide solution, for half hour at a temperature of 80°C. Cellulose fibers separate by simply washing the digested vegetable in fresh water. Fibers have been dried in an oven till constant weight at 80°C. SJ Fibers have been grinded by a RETSH-ZM 200 mill at dimension of short cylinders having a diameter of about 20 micrometers and a length of 120 micrometers. PC particles had an almost spherical shape with average diameter of 50 micrometers. Both these types of particles have been functionalized with the 3-aminopropyltri-ethoxysilane. This operation has been performed in a solvent free process. Cellulose and cement, mixed in the desired percentage, were inserted in an home-made reactor where they have been kept whirling stirred and humidified with nebulized water (10% of water with respect to the total weight of fibre components). 5% (w/w) of the functionalizing silane reactants, was then added into the reactor as micrometer-sized droplets. The preliminary fibres humidification was required in order to hydrolyze the silane ethoxy groups, next to the surface of the fibers were the water molecules were absorbed, according to the following reaction scheme:



The product of this reaction, the 3-aminopropyltrihydroxysilane, could than react with the fibers hydroxyls according to the following scheme:



The Y group in the scheme is the ammine group –NH2. Fibers, functionalized according to the above reactions, were mixed, by an appropriate mixer, with two epoxy precursor: the Diglycydil ether of bisphenol A (DIGEBA) and the hardener diethylenetriammine (DETA) which were always used in the 2:1 proportion. The mixture was injected into a stamp and pressed to a pressure of 1.8 bars. Final curing of samples was achieved at 25 °C. The laboratory steps used to prepare the composite are summarized in Fig.1.
Mechanical properties of the bio-materials were measured by using a universal testing machine (MTS Criterion s42) equipped with 5kN load cell and three point bending kit. In the bending tests, the load was applied with a rate of 50 mm/min. During the test the crosshead displacement Y and the applied load P were measured.



Fig.1 A - vegetable(white) mineral fibers (dark) and mineral fibers; Band C - home made stamp

2. Results and discussion

Table 1 summarizes the mechanical properties of the composites analysed, as a function of the composition of the various components of the mixture.

Tab.1 - Composites formulation and their mechanical properties.

N° Sample	SJ %	PC%	DIGEBA %	DETA)%	Mod El. E(MPa)	Flex. Strenght σ(MPa)
1	60.00	/	26.66	13.33		
2	38.43	19.32	28.41	14,20	2424,83	24.69
3	29.12	29.11	28,23	14.12	8716,60	18.26
4	19.59	39.22	27.93	13.96	10583,65	23.26
5	9.91	49.53a	27.20	13.60	20273,27	72.99
6	/	61,05	26.00	13.00	15285.04	58.23

Data reported in Table 1 show that the mechanical properties of the polymer composites strongly depend on the composition of the precursor mixture. Interestingly, the elastic modulus and flexural strength increase as the concentration of functionalized SJ fiber decreases and that of the mineral particles increases. Nevertheless, composites containing only Portland cement, show worst mechanical properties with respect to the composites containing 10% of vegetable fibre, highlighting the significant role played by the vegetable fibre on the final properties of the composites.
Even if the data presented in this paper are preliminary, it can be stated that the combination of mineral and vegetable functionalized fibers, in polymer composites, leads to improved materials. Since these materials are obtained by fast curing fluid viscous precursor mixtures, their application in the context of restoration cultural heritage buildings, appears to be an open opportunity.

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References

1. Lu JZ, Wu Q and Harold SM.(2005). Chemical coupling in wood fibre and polymer composites: a review of coupling agents and treatments, Wood and Fibre Science 2000, 32 (1): 88 – 104.
2. John Z Lu, Qinglin Wu, Ioan I Negulescu. Wood-Fiber/High-Density-Polyethylene Composites: Coupling Agent Performance, Journal of Applied Polymer Science, 96: 93–102.
3. G. Chidichimo, A. Aloise, A. Beneduci et al., Polyurethanes reinforced with Spartium Junceum fibers. Polymer Composites. (In press) Available online ASAP.
4. G. Danieli, G. Chidichimo, P. F. Greco, P. Nudo, A. Aloise e A. De Rango, Impianto automatizzato per l'estrazione di fibre vegetali da piante. Cs 2014 A00002, 26, 06, 2014.

5. G. Chidichimo,A. Aloise, A. De Rango, M. Venneri, G. Pingitore, G. Esposito, Compositi di vermene ginestre e processi per la loro realizzazione,Italian Patent, N° 102015000007277, 02, 03, 2015.
6. G. Chidichimo,A. Aloise, A. Chidichimo, V. Maltese, A. Beneduci, A. Senatore, F. Dalena, Compositi di fibre naturali funzionalizzate e processi per la loro realizzazione, Italian Patent in Application.
7. Chidichimo G., Alampi C., Cerchiara T., Gabriele B., Salerno G., Vetere M. , Physical chemical process for production of vegetable fibres. Depositario: Università della Calabria. World Patent, WO2007102184A2 2007.
8. Cassano R. , Trombino S. , Bloise E. , Muzzalupo R. , Iemma F. , Chidichimo G. , Picci N. , " New broom fiber (spartiumjunceum l.) derivatives: preparation and characterization". Journal of Agricultural and Food Chemistry, 2007, Vol. 14, n. 55, pp. 9489-9495.
9. Cerchiara T., De Rose R., Santagada G., De Filpo G., Chidichimo G., “SpartiumJunceum retting by Clostridium Felsineum and analysis of fibre”, Polymer Fibres, 2004, Manchester (UK), 14-16 July 2004.
10. Cerchiara T., Chidichimo G., Ferraro R., Vuono D., “ Use Of Spanish Broome canvas: effect of enviromental conditions”, J. Cultural Heritage, 2009
11. Gabriele B. , Cerchiara T. , Salerno G. , Chidichimo G. , Vetere M. , Alampi C. , Gallucci M. C. , Conidi C. , Cassano A. , " A new physical-chemical process for the efficient production of cellulose fibers from Spanish broom (Spartiumjunceum L.)". Bioresource Technology, 2010, Vol. 101, n. 2, pp. 724-729

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Sustainable reutilization of the *pombaline system* essentially based on the properties of the "gaiola pombalina"

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Abstract

On the 1st November of the year of 1755, a tremendous earthquake took place in Lisbon with terrible repercussions on the urban design of the capital transforming society and royal court's life. The catastrophe, consisting in the earthquake, along with multiple replicas, tidal waves and fires affected especially the lower sections of the city (near Tagus river) has taken around 10 000 human lives. The Marquis de Pombal, Sebastião J. de Carvalho e Melo prime-minister to King D. José I, requested to military engineers and architects, working in the kingdom in the reconstruction of the city, to conceive and test a constructive system that could optimize the capacity to resist to earthquakes. That system would later on, by royal decree, be implemented as a regular practice, especially in the lower central part of the city, in correspondence to the lands mediating between the then so-called Valverde valley and Terreiro do Paço monumental square.
Even professionals tend to think that ancient tectonic systems do resist the action of seismic occurrences. In the present article, our aim is demonstrating that this type of constructive systems demonstrated outstanding results in the recent past, namely the earthquake that took place in Turkey (1999) and introducing a particular rehabilitation case-study in Lisbon's downtown (Baixa). The subjects of materials reutilization and recycling are also implicit in our thesis.

Keywords: earthquake; sustainability; re-utilization; pombaline construction system; "gaiola pombalina".

1. Introduction

Today, in Portugal are up for debate and analysis, by the academic community, strategic issues of recovery and urban renewal. This question of housing rehabilitation raises questions of economic and environmental nature. The issue of sustainability of resources use on the planet has been now a challenge for Humankind.
It consists mainly on the question of a new paradigm for today in the scientific and academic world. How to recover old buildings structures, along with whore areas of cities, reusing old materials that are known for a long time now. Providing these latter again with a new functions and newer uses, is one of the challenges that communities have to face, focusing on the value and the priority of sustainability of the available range of resources. Not only does it consist in an environmental issue, but also an economic and real estate questions.
This same yet to solved challenge places some response problems not always easy to solve. Firstly, in culture, society is essentially predisposed to favor the new. It is a common belief that one should not reuse old material. Moreover, in many cities there are the issues related to seismic risk of occurrence.

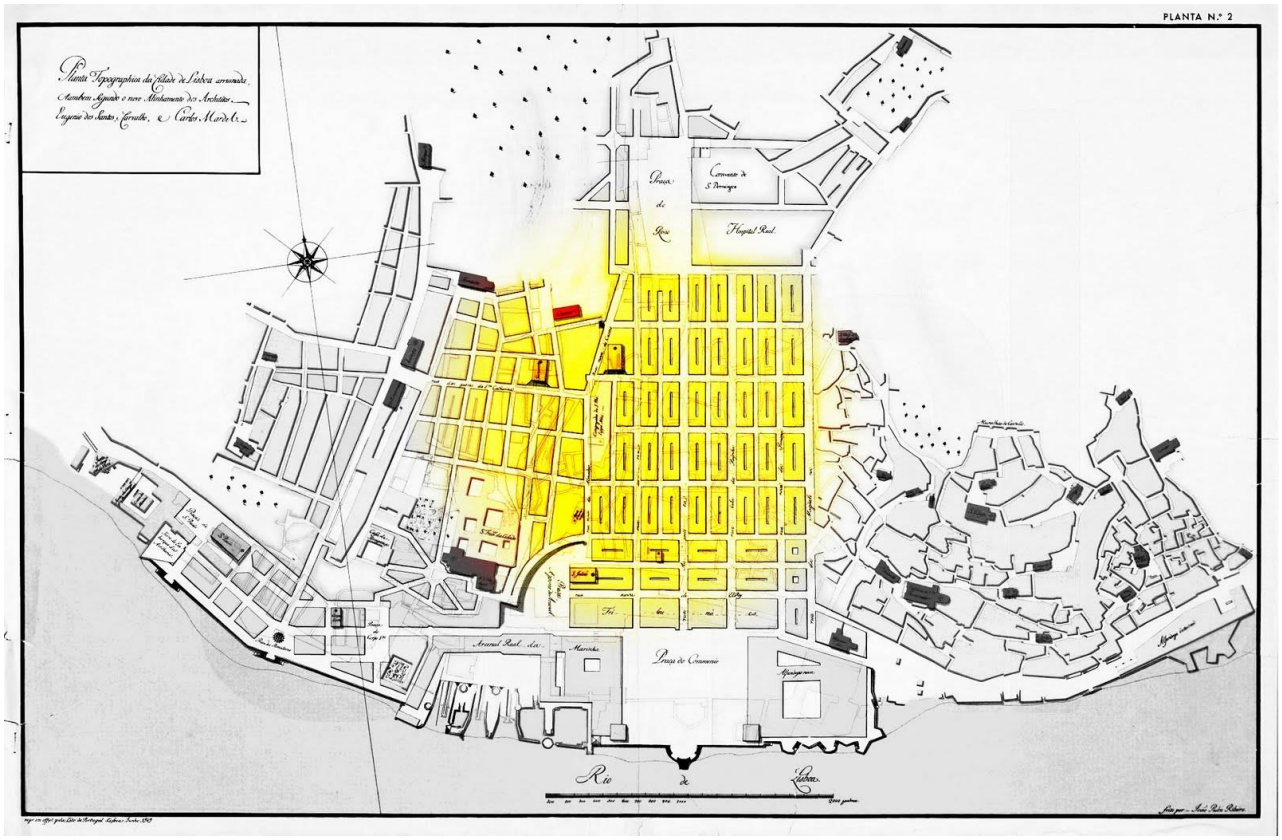

Fig. 1: 18th century downtown's area plan (Baixa Pombalina) by Eugénio do Santos and Carlos Mardel.



Fig. 2: Satellite photo of the area.

Whenever it may take place, reclamation work raises questions on of how to safeguard the seismic resistance of old buildings - a process commonly referred to as seismic retrofitting. How to intervene on an old building, built with materials and old construction systems, where presently it is usually a common thought that tectonic technology apparently does not respond to the question of the need to ensure seismic resistance of buildings.

Seismic retrofitting is the modification of existing structures to render them more resistant to seismic activity, ground motion, or soil failure due to earthquakes. With a better understanding of seismic demand on structures and considering our most recent experiences with large earthquakes near urban centers, the need for seismic retrofitting is generally well acknowledged. In

old buildings, where demolition is sealed, seismic retrofitting presents integration difficulties, and sometimes even a whole impossibility to be put to practice.
With this article, we are disclosing some research undertaken by us on seismic behavior of "pombaline" system, a constructive process used during some decades of the 18th and 19th century in downtown Lisbon, after the earthquake of 1755, and at the same time trying to present the case of a practical recovery of a public building of the period, conducted during the year of 2010. The investigation in question shows that the system has seismic resistance and, surprisingly, answers and checks the current Community codes and standards for seismic resistance requirements for existing buildings.
The practical case we are aiming at presenting here is related to the recovery of the structure of a building belonging to the Ministry of Finance which has been built in the year of 1780. In fact, it is a building which is 230 years old. This recovery kept the original construction system - the famous "Pombaline cage". In this recovery case, the only new materials that were used both in the topcoats of the walls and on the covers of floors, concealing the underlying old material.

2. Urban planning and building geometry of the *pombaline system*

Lisbon's downtown was rebuilt after the earthquake of November the 1st of the year of 1755. It was a considerably violent earthquake, judging by the damages that destroyed most of the city, causing the death of thousands of people. The then Prime Minister of the Kingdom, the Marquis of Pombal, commissioned architects and engineers to rebuild the city, demanding that they might conceive a building system, so that it would have the capacity to withstand earthquakes.
His sentence became famous expressing that earthquakes are not inevitable, but one should find a solution to avoiding and contain the falling down of buildings. Engineers and architects then developed a whole innovative construction system for its own time, known by *pombaline system*, keeping the memory of the Marquis' name. This system was developed from the assumption of the urban design based on an individual lot, of rectangular shape (Fig. 1). In the construction of the building, the characteristic features are the perimeter walls of the building façade, built in masonry with a thickness of about 1,0 m, connected by front vertical wooden interior beams, according to the shape of a St Andrew's cross, filled and coated with mortar of clay and ceramic and stone aggregates (Fig. 2). These latter materials were collected from the debris, resulting from the collapse of buildings caused by the action of the earthquake.
In order to describe briefly the system we may consider vertical front "pombalinos" that are tied and connected to other wooden beams, which are inserted inside the perimeter walls of masonry building façades. The wood trusses act as vertical diaphragms which, working together with the floors also made of wood, form a three-dimensional wooden "box", the system that is usually referred as "pombaline cage".
In order to characterize the seismic performance of the system within the physical context of a *pombaline* structure, applying a specific research to its behavior during the occurrence of an earthquake, we intend to present in this article the main conclusions we have reached through it. Along with these, not only are we describing the details of the results but also the mathematical methodology, already exposed in another article that has already been published by us.

3. Behavior of old buildings' systems

Reutilization as a concept is mainly considered as a way of saving material resources. By recycling, you can give "new life" to the various building materials, reusing them in the project and thus contributing to defend some principles of sustainability. Even economically, the issues implicit in reutilization bring many advantages by reducing some of the costs related to the overall budget.
There is generally a predisposition to consider that ancient building systems are not able to resist to the actions resulting from an earthquake, since they include materials or systems with a considerable rigid behavior. In the case of the system we have been studying, that assumption would be totally unfounded. Some older types of construction systems not only reveal surprisingly efficient seismic behaviors, but also demonstrate to be provided with a broader sense of resilience.
In the recent past, over the occurrence of some earthquakes, as was the specific case of the earthquake in Turkey in 1999, old buildings exceeded the behavior of modern buildings constructed in reinforced concrete in what concerns the resistance to rupture.
In that particular occasion, buildings designed according to modern codes of reinforced concrete regulations collapsed, while the old adjacent buildings - *himis*, built with ancient practices without any scientific validation, however, did not. In Turkey, most of the traditional wooden houses are produced with a structural system technique known by "himis". It is a genuine structural system that has had a very widespread usage because the building technique is selective and can be adapted to various types of planning, at the same time.
In Turkey and neighboring countries, even the traditional forms of construction for dwellings are being replaced, with new buildings that incorporate steel and reinforced concrete, the chances of survival of their occupants, as a consequence of a strong earthquake has not improved. Over the last half of a century, that traditional way of building has been replaced by the techniques involving the use of reinforced concrete.
One of the most recent earthquakes has, demonstrated tragically, that the initial promise of this new equipment has not been attained because of the failures in the entire building delivery process. Attempts to improve the quality of concrete buildings have been frustrated by an inability to affect what can be considered as an unsophisticated and unregulated industry.
A closer look at traditional Turkish *himis* construction may bring about some important lessons, not only in the field of cultural heritage conservation, but also in the introduction of creative approaches to hazard mitigation in contemporary buildings as well. Masonry elements in *himis* are quite different from the traditional bearing masonry walls. There, the timber frame remains an important element, providing the armature for the masonry infill. Masonry is generally composed of brick or of a thin membrane of rubble stone set, in either a thick mud, or lime mortar.

4. Origin and development of "pombaline system" *(gaiola pombalina)*

After the earthquake of 1755, little was left of the old buildings in the most affected areas of the capital of the kingdom. Therefore, those damaged structures were demolished with the intent of rebuilding a whole new city, with new buildings. According to the Marquis of Pombal and his Engineer in Chief of the Kingdom, Manuel da Maia, main concerns and directives about seismic safety, made architects and engineers that were then in charge of the tasks of planning the reconstruction of the city, started testing and developing new solutions.
They concentrated on a set of design features, shapes and materials, aiming at improving the seismic behavior of structures, in order to obtain not only a better horizontal resistance actions, but also greater energy dissipation capacity. Formally, the main characteristic of the new *pombaline* buildings was its geometric regularity in plan and in height, for the embedded resulting buildings presented symmetry according to their two main axes.
In the design of those buildings, we should essentially highlight two formal characteristics i) *pombaline* front walls that are arranged generally, according to two orthogonal directions of the building, though not always, fitted with a wooden trusses engaged and filled with ceramic material (generally with a mortar of clay); ii) main exterior walls are in stone masonry, containing a wood structure embedded, in the inner surface of the massive sections of the walls.
The combination formed by the internal truss working with the stone masonry façade is usually called as *pombaline cage*, due to the large amount of wood used in the construction of both types

of walls and to their wooden three-dimensional arrangement. This three-dimensional wood structure forms a sort of “cage” that is considered the greatest innovation of *pombaline building system*. The true authorship of this system is attributed to the Architect Carlos Mardel, who even tried to test properties with a model in a natural scale this same system at the *Terreiro do Paço* Square.
In the interior of buildings, where this same tectonic technique is applied, there can be found, in addition, some partition walls without any structural function along with walls, made of solid wood trusses, oriented accordingly to the two orthogonal directions and meticulously connected to those main masonry walls.
The above referred walls, and wooden floors, clearly demonstrate the intention to provide buildings with the capacity to resist horizontal impulses. In order to respond, not only to this requirement, but essentially to understand the functional phenomenology of the *pombaline system*, we have conducted an investigation directed to its seismic behavior.
The results obtained in this investigation point out, among other aspects, to the surprising conclusion that a *pombaline building* usually responds quite effectively to seismic actions. Even nowadays, we can still build buildings using the *pombaline system* for it complies with modern seismic regulations. From the results thus obtained, we can conclude on the seismic resistance of *pombaline system* being based on the stabilizing effect, essentially provided by the self-weight of masonry walls, or putting this into other words, by the effect generated by their own thickness.
Using the dimension of “thickness” can be a kind of primitive way to introduce pre-stress in the wall, limiting the development of traction efforts, thus preventing the effect of cut at the base of the building itself.
Complementing that stabilizing effect, the thickness of the masonry external wall, and considering its relatively large size (in average above 0.80 m), also works as an element that confers the wall the capacity to be deformed, since it allows that after the breaking of joints, blocks continue to move, thus dissipating energy and redistributing internal working balance, even without reaching the last stage of rotation and leading consequently to a final collapse ("rocking" effect). It is a way of providing ductility to the wall, taking advantage of the inelastic capacity that thickness would tend to enlarge.

5. Case-study of a “pombaline” building recovery in Lisbon’s downtown (“Baixa Pombalina”)

The Ministry of Finances currently owns a *pombaline* building, in downtown Lisbon built after the earthquake of 1755, which is about 230 years old now. It has been abandoned and suffered physical decadence for three decades now. Public leaders of the Ministry have successively postponed the decision about rehabilitating the building programmatically. Demolishing it and rebuilding a new building was the most defended party, however there was a problem about classification and architectural heritage, protection of values that the institution should pursue, because the building is located right at the center of downtown Lisbon called Baixa), an officially classified area. Probably for some lack of courage, the decision has been delayed until 2009. The then Director-General of Finance took the much acclaimed and courageous decision to rehabilitate the building, keeping at all costs the *pombaline* constructive solution.
In the works, the *pombaline* building system has then been kept structurally, recovered with appropriate techniques to wooden elements that make the system. The masonry walls on the facades were kept, which were in relatively good condition, as seen in the photos below. Only new and contemporary materials were employed to coat the surfaces.
The whole recovery operation can be considered quite a success. Under the point of view of the seismic performance, the building responds to all the codes and regulations currently in use, as mentioned above, as well as Portuguese regulation. The new coatings, allowed an upgrade in what concerned the functional aspects of the building, adjusting it to new contemporary values. As can be verified by appreciating the following images, the users of the building do not even notice the difference between that one and new buildings. In daily use, users do not feel or notice, that are in the interior of a building with a structural and constructive solution, under which lie visible coatings, materials and systems, already with two centuries of existence.



Fig. 3:Exterior of the Ministry of Finance building.



Fig. 4: Vestibule and main entrance to the building.



Fig. 5: Interior aspect of rehabilitation works.



Fig 6: Interior aspect of rehabilitation works.



Fig. 7: Interior aspect of rehabilitation works.



Fig. 8: Interior aspect of rehabilitation works.



Fig. 9: Interior aspect of rehabilitation works.



Fig. 10: Interior aspect of rehabilitation works.

At a conceptual and operational level, this case study demonstrates and proves that we can intervene in classified heritage areas, not only reusing and recycling materials, but also implementing old construction systems that can be several centuries old.
To conclude, and to express entirely the message that we want to bring to this forum and to our peers is that it is possible, through a scientific and technological point of view, as well as desirable, in terms of the values of protecting the architectural heritage, to reuse old building systems, totally in accordance and compliance to the stringent codes and to actual regulations.

Bibliographical References

COBANCAOGLU,T., 2001. “Himis”, construction system in traditional Turkish wooden houses”. C. MODENA, P.B. LOURENÇO, P. ROCA, eds., *Structural Analysis of Historical Constructions* Guimarães Editores, Guimarães, 2001, pp. 799-805. ISBN 9780415363792.

FRANÇA, J.-A., *A Reconstrução de Lisboa e a Arquitectura Pombalina*, Biblioteca Breve, Instituto de Cultura e Língua Portuguesa, ed., Lisboa, 1977.

MORAIS, A. J., “Sistema Pombalino: Caracterização Estrutural e Comportamento sísmico”. Artitextos. Faculdade de Arquitectura, Universidade Técnica de Lisboa, Lisboa, 2006, vol. 3, pp. 87-107. ISBN 972-97354-7-6.

ROSSA, W., “A Cidade Portuguesa”. P. PEREIRA, coord, História de Arte Portuguesa, vol. III,. Círculo de Leitores, Lisboa, 1995, pp. 296-304. ISBN 972-42-1225-4.

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The Roman Theatre in Trieste
Digital Analysis and 3D Visualizazion

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Abstract
The topic of the research, developed at the University of Trieste, is the geometrical analysis, the digital reconstruction and the advanced communication of one of the main ancient buildings of Trieste, the Roman Theatre. As the building was destroyed in some parts and some of relevant elements – such as the *scaenae frons* – are not present today, we decided to try to reconstruct the building taking as reference the researches made by historians in order to simulate this architecture in the period it was done. Starting with the digitalization of existing survey drawings, we created two 3D models: the first one describing the actual state; the second one representing the plausible solution of the whole complex form.
The technology was used for the verisimilar reconstruction of it, to manipulate it with a 3D stereoscopic real-time system, to be visualized inside the 3D Virtual Room of the Area Science Park in Trieste, but also investigating the Augmented Reality procedure to allow navigation with smart-technologies.
After the definition of the final model, we sampled some materials from the archeological site and then we associated them to the geometry of the theatre. So it was possible to define the *Cavea* and the *Scalaria*, completing the structure with the *Proscenio*, the *Iposcenio*, the *Tribunalia*, and the perimeter wall, were we can find the holes for the structure of the *Velum*, to cover the people observing the scene.
The final step was the definition of an interactive path, to visit virtually the theatre, as if we were observing a spectacle in the ancient period.

Keywords: architecture, digital reconstruction, 3D modeling, 3D visualization, Augmented Reality,

1. Introduction
The Roman Theatre in Trieste (Fig. 1) is located in the center of the town, and its construction started probably in Julio-Claudian period, between the end of the I Century B.C. and the first half of the I Century A.C. The most important and recent studies on it were done by Prof. Monika Verzár-Bass [1], who published a book in 1991, that contains a lot of documentation and some survey drawings made by the architect Maurizio Bradaschia. When it was built the coastline was very close to the theatre, and the cavea, realized using the natural slope of the hill, could contain 3500 persons. The theatre was destroyed in the past and only starting from the studies of the architect Pietro Nobile in 1814, it was possible to consider its presence in the town. In 1937-38 there were some excavations that allowed to bring to light the great part of it, although at the same time there were some interventions without considering the correct interpretation. The aim of this research was to study the theatre in the conditions in which it is now, the possible configurations it had when it was

built, verifying them with new advanced techniques of digital simulation, such as the interactive stereoscopic visualization allowed by Virtual Reality (VR) and the interaction with the 3D model offered by Augmented Reality (AR).



Fig. 1: The Roman Theatre in Trieste.

2. The Analisys of the Theatre

Before starting the digital reconstruction we tried to analyze every single element of the theatre, thanks to the book of Verzár-Bass [1]. In details, the parts that were reconstructed using the digital modeling are: the *cavea*, with the *scalaria*, the *vomitoria*, the *sacellum*, the *versurae*; the *scenae frons*, for the stage set; the *porticus post scaenam*. The theatre now is presented with the *summa cavea* (Fig. 2) – the upper part of the cavea – totally absent and covered by grass, while the *ima cavea* – the lower part – was restored following the references of the traces of the wall during the excavations. The *cavea* is divided in four parts by the *scalaria*, from the orchestra to the bleachers. Due to the configuration of the terrain, the theatre has only two *vomitoria*, that allowed people to enter the *cavea*. The entry to the building is located not in the middle, but sideways.





Figg. 2, 3: The *summa cavea* and *ima cavea*; *Orchestra*, *pulpitum* and basis of the *scaenae frons*.

The two *tribunalia* – spaces over the entry to the orchestra – are not equal, so, probably, they had different functions. The *orchestra* was found without the original flooring, but, due to some small fragments of red stones, it is possible to suppose there were a rich colored one, such as we can find in some other roman theatres of the same period. The *orchestra*, limited by the *pulpitum* and by a semi-circular step in sandstone slabs, has a diameter of about 17.8 meters (Fig. 3). The *pulpitum*, restored on the original traces, is characterized by the presence of rectangular and semicircle niches. Some parts of the *scaenae frons* (Fig. 4) were conserved, so it was possible to restored it in a correct way.

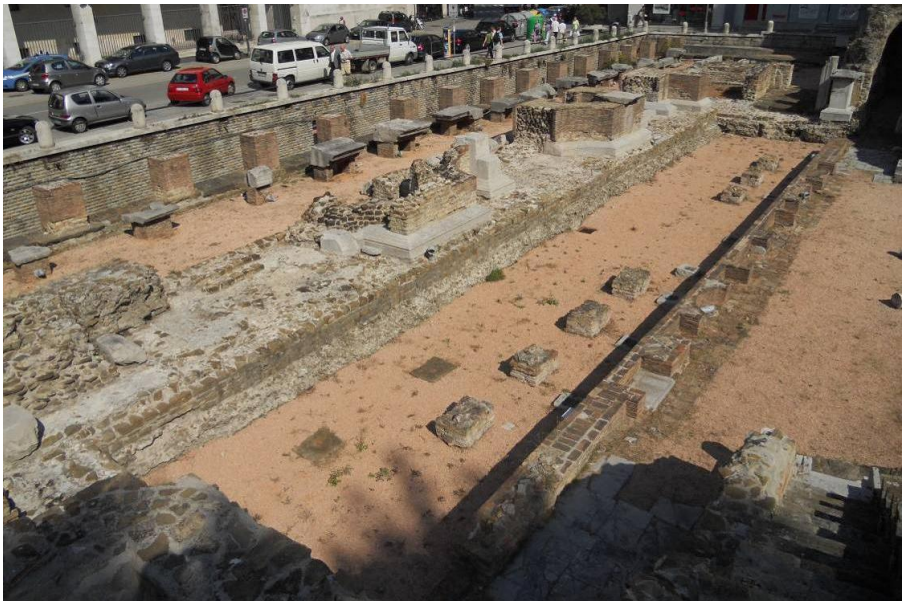

Fig. 4: Traces of the *scaenae frons* and *iposcenio*.

The scheme of the scene façade is based on the presence of a semi-circular exedra in the middle, where there is the *valva regia* (main door) and two rectangular exedras at the sides, corresponding to the *valvae hospitals*. These two were used as the entrance for actors onto the stage, directly on a *proscenio*, usually realized in wood, located on the *iposcenio* in stone. The perimeter wall wasn't conserved in its original extension, but it is possible to find in the external side ten corbels in the original location, as basis support for the flagpoles of the *velum*, the coverage from the sun rays to the people sitting in the *cavea*. As the flagpoles need usually two corbels – one at the base and one in the upper part – the wall certainly was higher than the actual configuration for about one meter.



Fig. 5: Perimeter wall with corbels as base support for the flagpoles of the *velum*.

3. Survey drawings

As the aim of this work wasn't the survey of the theatre, but the 3D modeling and the digital reconstruction of it, with the intent to develop a system to simulate with advanced communication instruments, we considered the drawings already realized, by the architect Maurizio Bradaschia (Fig. 6), using topographic and photographic technology. Although it was done more than twenty years ago, the quality of drawings is very high and it is possible to start from them for the modeling of the theatre, analyzing the differences with the preceding drawings by Pietro Nobile (1814) (Fig. 7) and with some others drawn at the end of the excavations (Fig. 8).

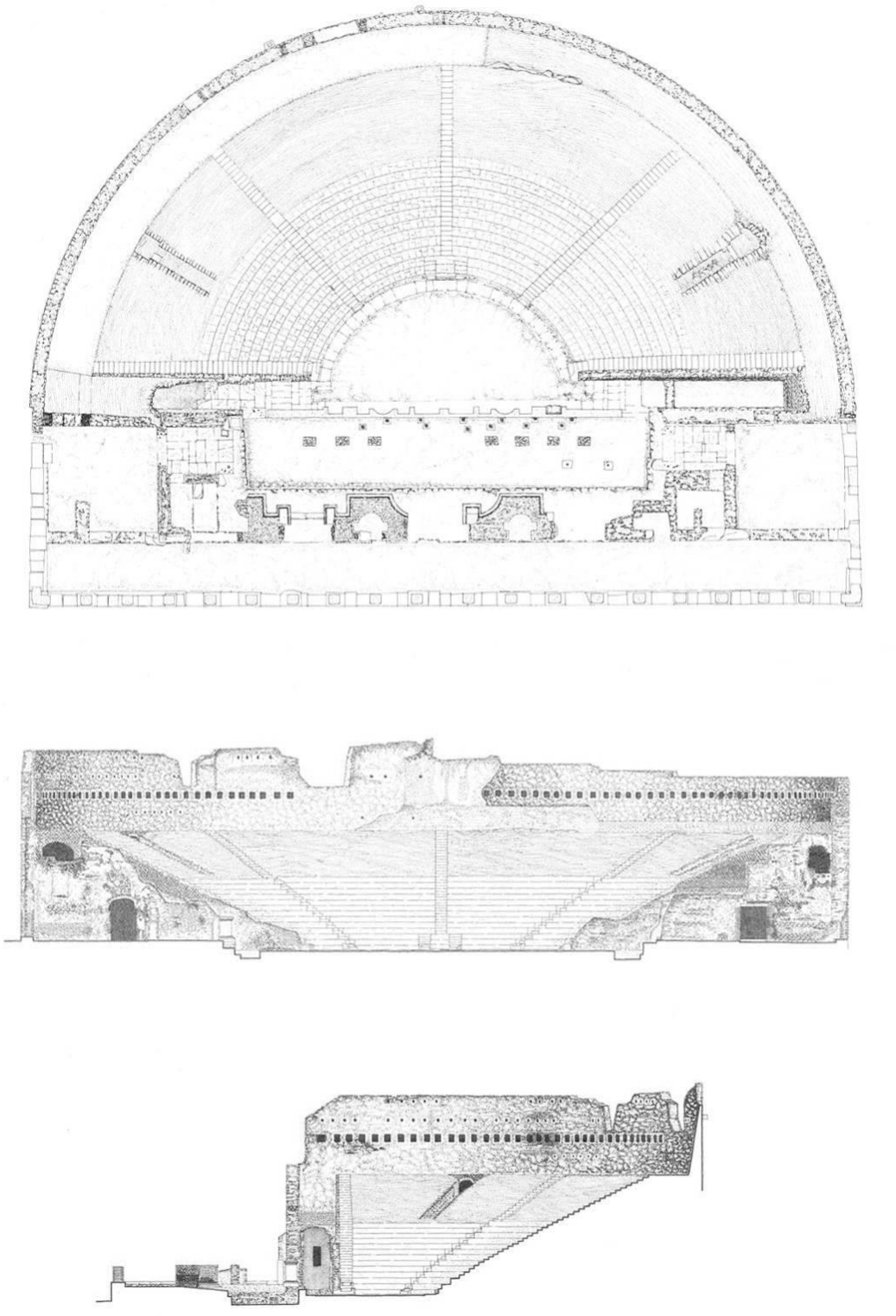

Fig. 6: Plan, elevation and section of the theatre (drawings by M. Bradaschia).

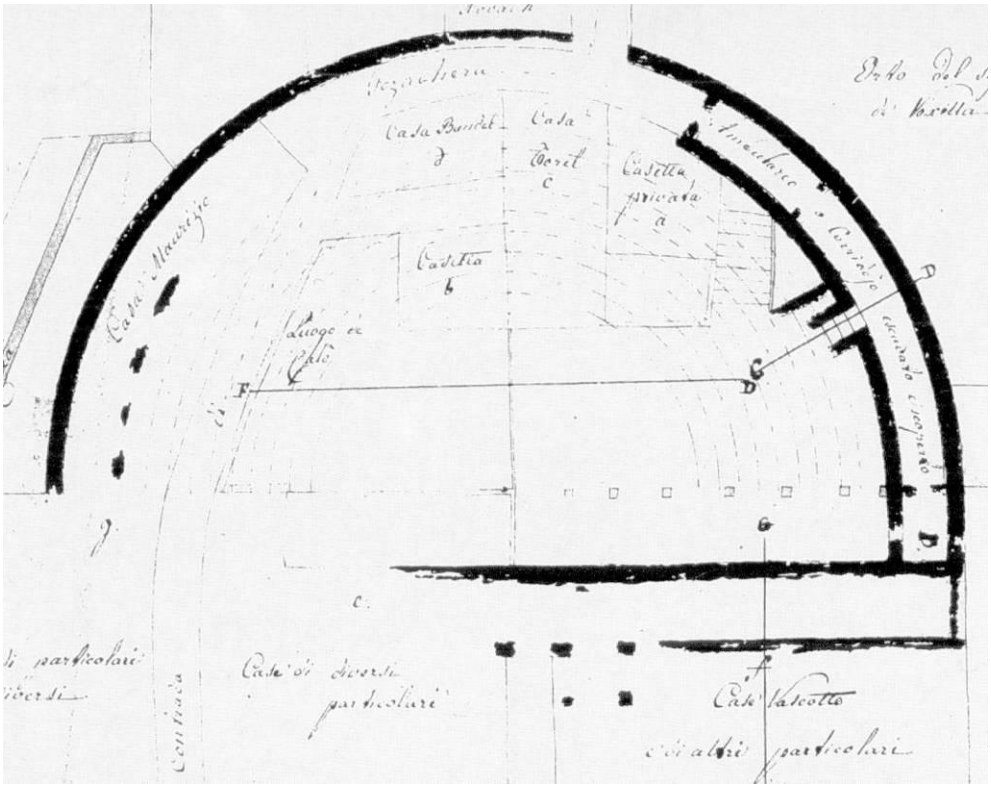

Fig. 7: Survey drawing by Pietro Nobile (1814).

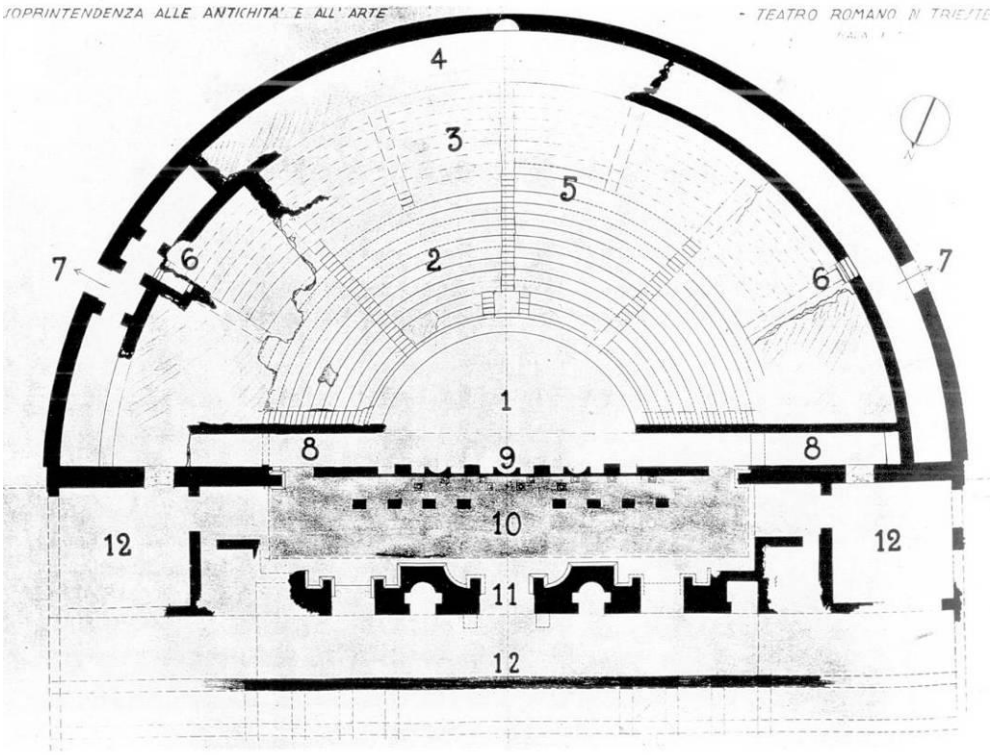

Fig. 8: Survey drawing after the excavations.

All these information were also compared with the historical photographic documentation published by Bradaschia [2] and with the consideration upon the form of the theatre as it was described by Marco Vitruvio Pollione in his treatise *De Architectura Libri Decem* [3]. In fact the scheme of the Roman theatre was a typical architectural form, well known by architects and engineers, which history was rich of variations. It was derived by the Greek one, and described by Vitruvio in the V book of *De Architectura*. As we know his treatise was without illustrations, so the description was only made in textual form. But the rigorous construction of the

geometry of the theatre, allow us to do some consideration regarding the genesis of the morphology in order to arrive to the final form.

4. Geometrical analysis

Vitruvio starts writing how to draw the *cavea*, its subdivision in triangular sectors and how to define the position of the scene elevation. In details the vitruvian rule provides to draw a circle and four equilateral triangles inside it. The vertexes of the triangles help to identify the position of the *scalaria*. But Vitruvio told also that this rule could be applied only to some theatres, because the diameter of the *cavea* can influence the number of *scalaria* that is possible to put in the space. In particular the geometrical construction is accepted only for those theatres having a diameter greater than 60 meters, because for those smaller the number of *scalaria* do not allow an optimal use of the surface of the *cavea*. The studies of Luis Moranta Jaume [4] on the geometry of Roman theatres in Spain, confirm the hypothesis that for the theatres with diameter smaller than about 60 meters, the form is generated by three equilateral triangles and not four. In the case of the Roman Theatre of Trieste the diameter is about 64 meters, approaching more to the solution of a small theatre than of a big one. The best construction, in fact, is the one considering only three triangles inscribed in the circle. To have another confirmation, we can verify that superposing the geometrical form to the plan of this theatre, we can find that two of the three axes of the *scalaria* are placed perfectly in correspondence with the vertexes of the triangles, and the third one is very close to the right configuration (Fig. 9).

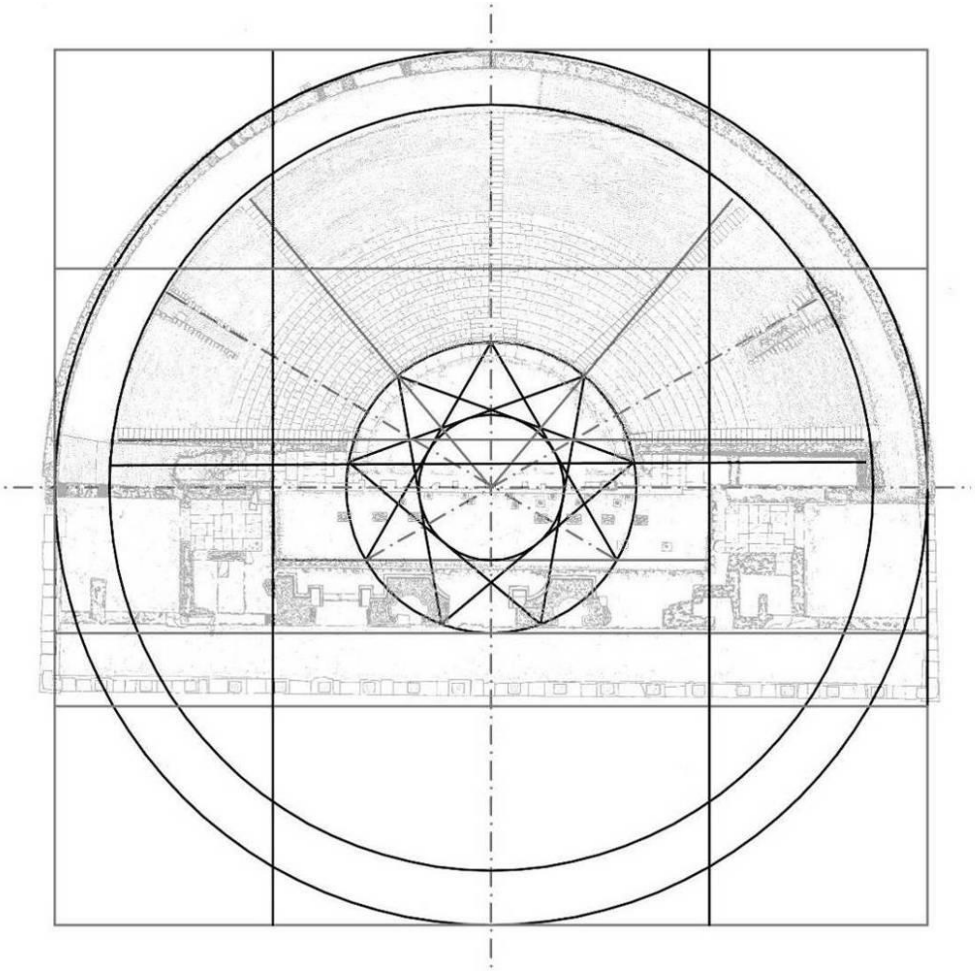

Fig. 9: Geometrical analysis of the Roman Theatre in Trieste (Drawing by L. Miniussi).

5. Digital model of the theatre

After the iconographic analysis of the documentation, we started with the procedure of digital modeling of the theatre. As the aim was the reconstruction of the possible configuration of the original theatre, we had to compare all data we found. In particular the first step was to draw the bi-dimensional representation of the theatre, from the survey drawings by Bradaschia. Over the plan we started to superpose the hypothesis made by Verzár-Bass in his book [1], and tried to dimension the volume referring to some other theatres of the same period and typology. A database of case studies were prepared trying to identify the appropriate element to add to the model. In particular we consider the Roman Theatre in Volterra, in which it is possible to identify the *tribunalia*, having a form similar to the Theatre in Trieste; then the Roman Theatre in Leptis Magna, having the flooring that could be compared to the one in Trieste; the Great Theatre in Pompei, with a perimeter wall that could be associated with the one in Trieste. Then we began the digital construction of the tree-dimensional

model of the theatre, considering what we found before, for example the height of the perimeter wall. The construction was in fact finalized to realize a verisimilar communication of the theatre with an advanced system of visualization (Fig. 10).

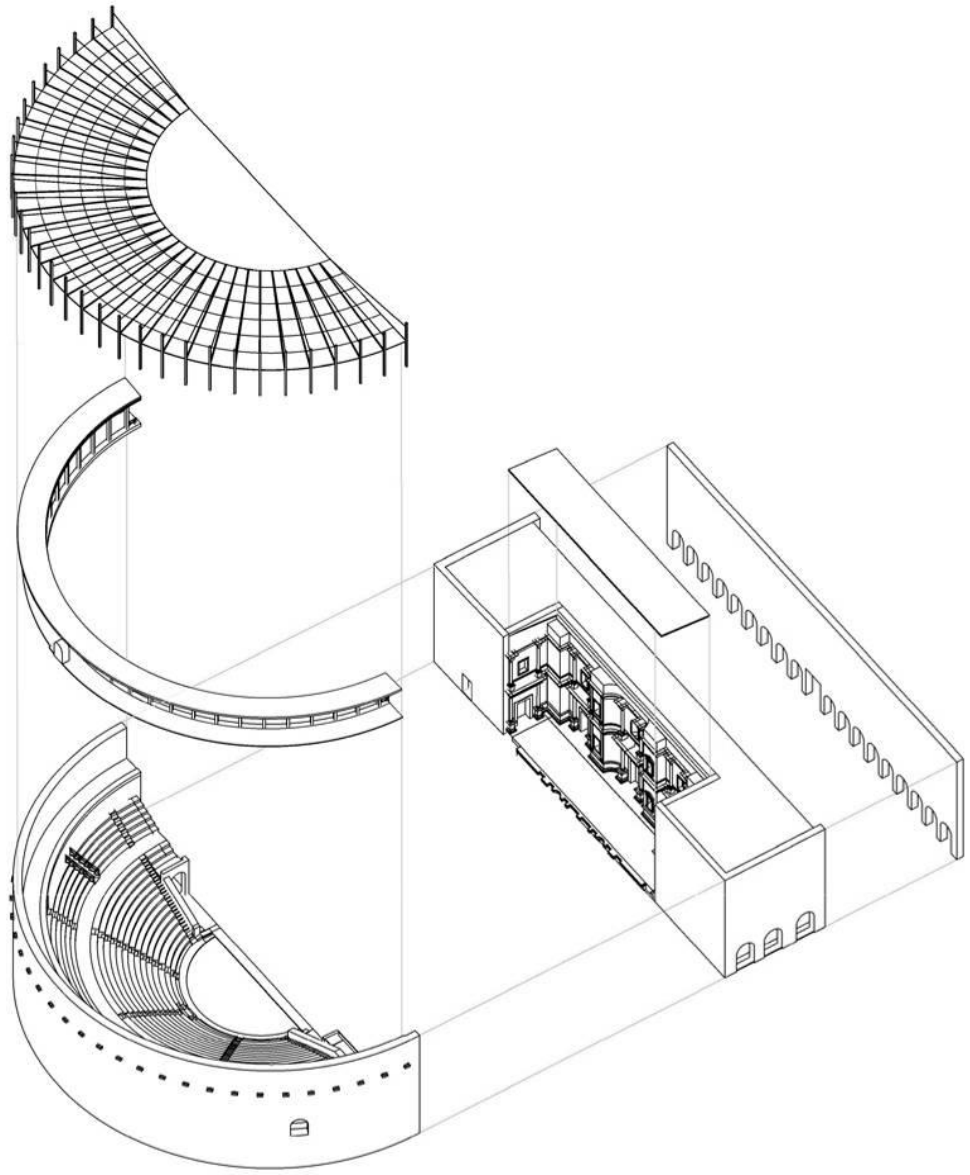

Fig. 10: Isometric representation of the single parts of the theatre (Drawing by L. Miniussi).

Some tests were made before applying textures and verisimilar procedures inside the real-time system, to control the volumetric aspect of the single parts, using the most diffused algorithms of global illumination rendering software (Figg. 11, 12, 13).

6. Advance communication

The final step of the research was the translation of the digital model into some systems which allow the user to perceive in a direct way the real impact of this interesting architecture. In detail we decided to work with a Virtual Reality System based on a real-time software and a stereoscopic visualization to navigate inside the space, and with a Augmented Reality System to simulate the model as if it was physically constructed in scale. For what concerns the VR, although the experience of 3D visualization is very diffused, thanks above all to the 3D cinemas that are now diffused all over the world, the VR allows the user to navigate in real-time inside a scene or around a model, giving the possibility to create an explorative path as if a person is moving in a real world. We decided to use this system because in this case the idea was to communicate the data of the research during some public events in order to transmit the information to some group of people interesting in architecture and archeology. Although the model was converted without great problems, it was necessary to recalibrate all the textures and in some cases, the maps were made ex novo, adapting to every surface of the model (Fig. 14).

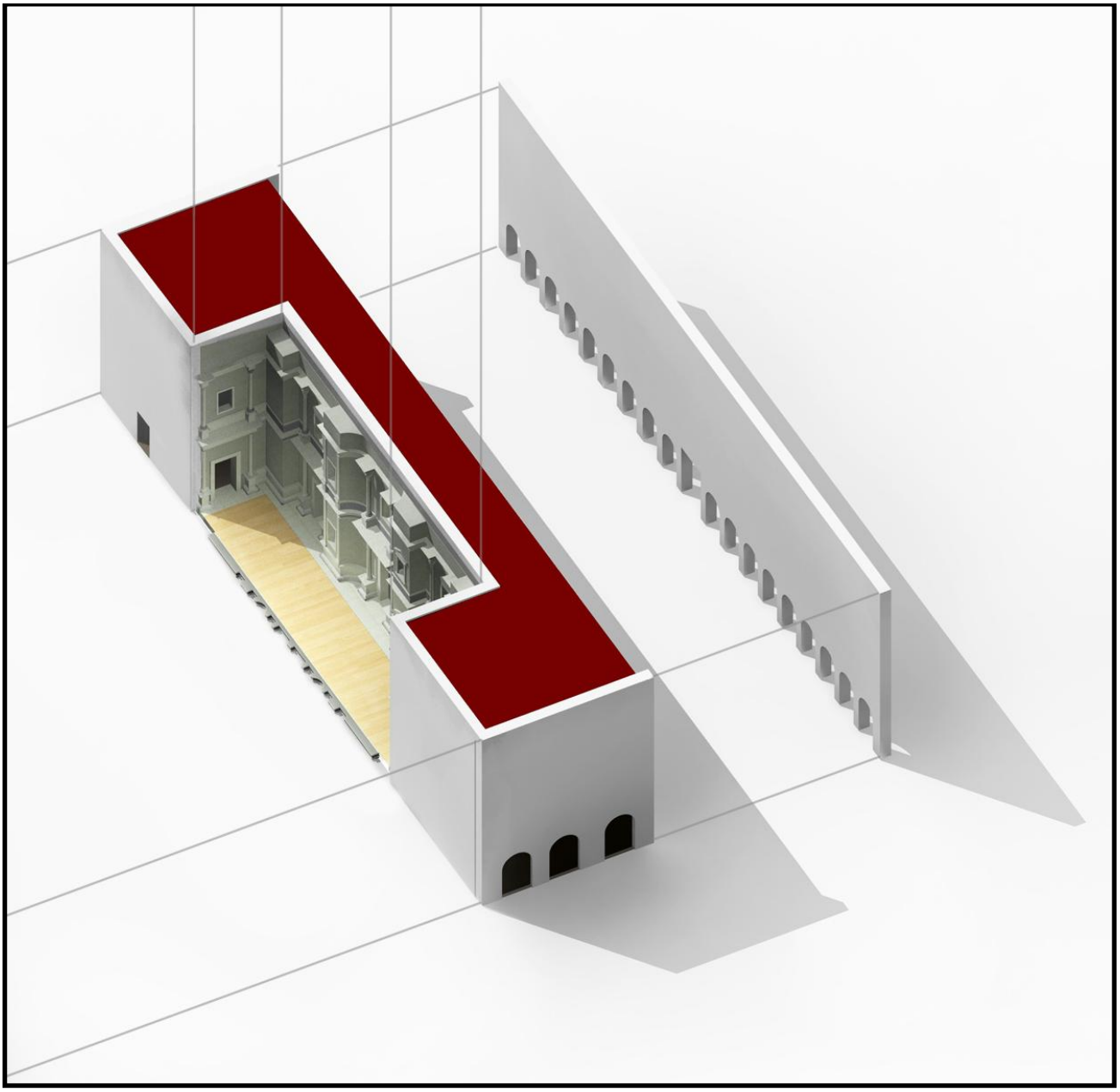

Fig. 11: Isometric representation of the *scaenae frons* (Rendering by L. Miniussi).





Figg. 12-13: Perspective views of the theatre (Rendering by L. Miniussi).



Fig. 14: The model of the Roman Theatre projected in the 3D Virtual Room in Area Science Park, Padriciano-Trieste (Arsenal).

The final level of the research was to try to use an Augmented Reality System to allow everyone to visit the digital theatre through the interface of a tablet or a smart-phone. In this case it was necessary to reconsider the complexity of the model – some parts were constructing in a very detailed way, i.e. the capitals, the moldings, etc. – as in this case the system transmits the database of information via internet. So a simplification was done, but, thanks to appropriate texture mapping procedures, the quality of the model remains still very good. So it was possible to associate a QRcode to the textured model – prepared with the algorithm of render baking - and in an advanced test an image, to visualize in real-time the dynamic model on the screen (Fig. 15).

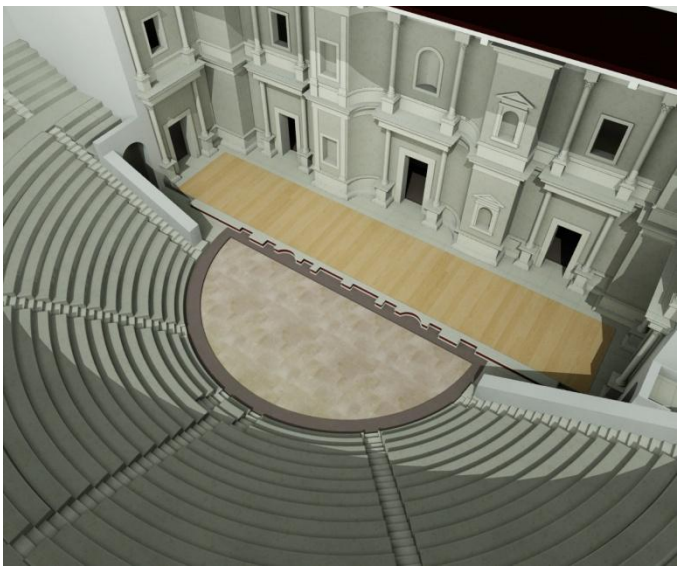

Fig. 15: View from above of the digital model of the Roman Theatre using Augmented Reality System.

7. Conclusions

This research allowed to visualize one of the possible original configuration of the Roman Theatre in Trieste, after having analyzed the geometry, and having compared all the documents about it. The use of the advanced visualization system was fundamental for moving inside the model in real-time and to simulate the perception of the people sitting inside the *cavea*. Then, thinking about smart-technology, the research tried to apply the results obtained for an expensive system – the VR one – to a low cost application, in order to disseminate to a large part of population the outcomes of an experimental investigation. The finality of this activity was also to define a procedure to be applied to all the ancient buildings in Trieste, in order to create an interactive archive that could be explored by researchers, students, citizens and occasional visitors.

8. Acknowledgement

This research started with a degree thesis in Sciences of Architecture at the Faculty of Architecture of the University of Trieste by Lisa Miniussi, supervisor Alberto Sdegno, tutor Paolo Casari and then was developed during research activity at the Department of Engineering and Architecture of the same university, with the collaboration of the firm Arsenal for what concerns the know-how on the use of the Virtual Reality System. For the advanced visualization we used the 3D Virtual Room in Area Science Park in Padriciano-Trieste. Finally it is under development an application for using the 3D model with Augmented Reality Systems; this research is financed by the University of Trieste, Department of Engineering and Architecture, F.R.A. 2013, titled *Augmented Architecture*, directed by Alberto Sdegno.

Bibliographical References

[1] VERZÁR-BASS, Monika (ed.). *Il Teatro Romano di Trieste. Monumento, storia, funzione. Contributi per lo studio del teatro antico*. Roma: Istituto Svizzero di Roma, 1991. ISBN 88-7140-042-9

[2] BRADASCHIA, Maurizio. Il rilievo nella ricostruzione formale. In VERZÁR-BASS, Monika (ed.). *Il Teatro Romano di Trieste…* cit., pp. 351-355.

[3] GROS, Pierre (ed.). *Vitruvio De Architectura*. Torino: Einaudi, 1997. 2 voll. ISBN88-06-12239-8

[4] MORANTA JAUME, Luis. *El Teatro Romano De Palma: Una Hipótesis Y Sus Primeras Comprobaciones.* Palma: Colegio Oficial de Arquitectos de Baleares*, 1997.* 57 p. ISBN: 8492103663

[5] CORALINI, Antonella, SCAGLIARINI CORLAITA, Daniela (eds.). *Ut natura ars. Virtual Reality e archeologia*. Imola: University Press Bologna, 2007. ISBN 88-86946-80-5

[6] PAPPALARDO, Umberto. *Teatri greci e romani*. Verona: Arsenale Editrice, 2007. ISBN 978-88-7743-326-8

[7] SHERMAN, William R. CRAIG, Alan B. *Understanding Virtual Reality: Interface, Application, and Design*. Amsterdam: Morgan Kaufmann Publishers, 2003. ISBN 978-1558603530

[8] SDEGNO, Alberto. Unbuilt Palladio. New Technologies for the Representation of 'Antico' in Palladian Architecture. In "The New Review of Information Networking", vol. 12, N. 1, pp. 109-118, May 2006. ISSN 1361-4576

[9] SDEGNO, Alberto. 3D Reconstruction of Classical Architecture. in AAVV, Proceedings of *CAADRIA 2003 Conference,* Taiwan: Patumthani, 2003, pp. 449-55. ISBN 974-9584-13-9

[10] SDEGNO, Alberto. Between Design and Survey: Interpretative Problems in the Study of Drawings for Digital Modelling. In "MIA Journal", vol. 0, N. 1, July 2006, pp. 39-50 ISSN 195-6363

HERITAGE and TECHNOLOGY
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Pressure of Tourism on Heritage and Technologies for an inclusive Society

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Abstract
The heritage enhancement contains in itself a contradiction that seems irreconcilable: on one side they have to broaden its accessibility, on the other they have to limit damages caused by tourism.
An elitist tourism cannot constitute the solution, but alternative types of fruition could in part come in aid, thanks to ICT and georeference.
Nowadays, technologies not only are directed to replace the real experience, or to enhance it, but even to simulate it by entering parameters of physical reality. Therefore, in this field they are developing “virtual tourism” projects, that will lead to a wide accessibility of cultural heritage, in view of a true "inclusive society" able to reach even the weaker segments of the population – in the same time, the indiscriminate use of heritage could be reduced.
The natural evolution of these projects may even involve the landscape, urban and architectural design (e.g. the transport planning, or innovative infrastructures). This kind of approach, that requires and combines humanities and technical skills, aims to make available and accessible not only the historical, architectural and artistic heritage in itself, but also intended as system.

Keywords: virtual tourism, accessibility

1. First and second generation of virtual tourism
The heritage enhancement contains in itself a contradiction that seems irreconcilable: on one side they have to broaden its accessibility, on the other they have to limit damages caused by tourism.
In its turn, tourism is often elitist while Cultural Heritage belongs to all.
Therefore, in this field they are developing “virtual tourism” projects, that will lead to a wide accessibility of cultural heritage, in view of a true "inclusive society" able to reach even the weaker segments of the population – in the same time, the indiscriminate use of heritage could be reduced.
The so-called virtual tourism is the umpteenth expression which is opposed to something real. Even in this particular application context we can already mention first, second and third generation of virtual tourism
The first one is nothing but a special version of e-commerce, and no doubt has changed a lot (if not revolutionized) the way you plan and organize trips: the user can customize a holiday package including transport, accommodations meals, visits to museums, tickets for shows and participation in trade fairs. And all this by choosing price ranges, comparing services and offers, and customizing them accordingly.
Virtual tourism second generation has made his own the potential of geo-referencing: the user can not only view the services offered in its range (and possibly book them), but also - with the help of special app - receive news, be guided in thematic tours of his choice, and so on. So not only more services “upstream of” the trip, aimed at its organization, but also services "during" the journey, to accompany the visit and support it from the point of view of content.
Almost obvious consequence has been the evolution given by “augmented reality”, with specific apps connected to QRcodes, where the information apparatus comments and complements the visible reality. That’s a true, communicative mediation in real time.

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2. Third generation of virtual tourism

Another development, with different features, stands in between second and third generation of virtual tourism: that's inevitable advent, also in this field, of social media.

The tourists and visitors community grows and exchanges views directly, further reducing the role of intermediaries. The availability of a huge photographic documentation (see the case of Flickr, website owned by Yahoo group, and other similar) and many comments and opinions (from TripAdvisor to several blogs that you can hit on in your personal search) has enabled a greater awareness and self-determination of the trip experience.

There have been some cases where these communities close the loop, so to say: achieving real contacts between people. See, among others, the "Angels for travelers" initiative, a large-scale project: it collects people available as local guides – or for simple suggestions on the places in which they live. They're also available to real encounters once the tourist has physically reached the place [5].

As regards the third generation of virtual tourism, it doesn't consist only in the preparation and organization of the real experience; no more *support* in real time of real experience, but - as the term "virtual" itself suggests - *replacement* of real experience.

At this point, therefore, a new route is opened, although already foreshadowed by many products, but this is not a déja vu. What does exist for some time, in this field, is indeed the construction of a virtual world (not existing in the real world, or existing in the past but now disappeared - typical application in the archaeology field): here, through keyboard before, and later through more and more natural interfaces, the user can move around by performing a real visit.

In these cases, the tourist is almost always played by a sort of avatar: see the testbed performed for the Virtual Museum of the Ancient Via Flaminia (multiuser virtual reality application, installed in 2010 in the National Roman Museum at Diocletian Baths, with the coordination of the CNR [6]. Other times, the visitor can move around in person in virtual environments: among the first applications, see the famous case of the Queen Nefertari tomb, on the occasion of exhibition "Nefertari: Light of Egypt" carried out in Rome at Palazzo Ruspoli in 1994. The virtual reconstruction of the monument, by now inaccessible, was carried out with a system developed by ENEL and Infobyte, with the CNR contribution, in a room with projections to be observed with stereoscopic glasses. The visitor was able to literally move around the environment, where depicted figures came alive, going beyond the opportunities of a traditional visit.

Still other systems exploit *kinect* and similar instruments to transmit in the virtual world the physical movements of the visitor, thereby adapting the visuals that come his way. For obvious reasons, it is necessary to establish a sort of "movements abacus" that correspond to different situations (advancing, turning, stopping etc.). This is an experience limitation, in terms of immediacy: one of the first cases was the experimentation carried out within the European project V_Must (coordinated by Sofia Pescarin, CNR, 2013) at the Vatican Museums, which proposed the interior of an Etruscan tomb as it appeared originally (with items that you could actually observe in the museum showcases).

But the challenge of the "virtual tourism" third generation is still different: it must get to allow the visitor to (virtually) move in the *real place* and in *real time*. No need to rebuild worlds, real or imagined.

Why this goal? Today more than ever, only a few sections of society can afford to travel. Not only for income reasons, but also because they haven't the time, or they haven't the health. Not to mention the security issues related to places where, for example, war actions are in operation and where in fact it is not recommended to travel.

Moreover, it is simply impossible in just one life to visit all the places that our planet offers. If, however, it was possible to do it from your own home, a few trips would be made available at least in virtual mode.

A first, remarkable experiment in which real journey and virtual journey seem to coincide is the "virtual journey on the Trans-Siberian Railway" (Moscow-Vladivostok: virtual journey on Google Maps) [7], originated by a collaboration between Google Maps and the Russian State Railways. A simple camera records the landscape from the window of a train compartment for all the more than 9,000 kilometers of the trip. The virtual tourist can also hear sounds and noises typical of the journey - the noise of the rails, the radio that is proposed in the wagon. He can also "go down" at the stops he prefers, where elements of natural or cultural interest are pointed out.

However, natural limits of the project (in itself, extremely interesting) place it halfway between traditional documentary and "virtual tourism" last generation.

The challenge - we said - is more complex because it aims to give back as much as possible the subjectivity of the travel experience, with the opportunity to look towards you like (while the Trans-Siberian Railway camera is unmovable) and to move "there and now" while remaining physically "here". The point is, therefore, to introduce a real avatar, i.e. not a virtual character but a "device" that is physically in place, able to move around for us according to our commands.

On this track, interesting experiments have already been carried out. Very recently (August 2014) has been presented the project After Dark by the research team of Ross Cairns, David Duke and Di Tommaso Lanza,

in collaboration with the Museum Tate Britain in London: it proposes the use of robots on the ground (according preset trajectories but also with remote control) to visit the museum at night. In this case, the robot can simulate the visitor who walks in the rooms.
The most advanced lines of research are currently focused on the use of drones precisely on avatar's stead. Researchers David Mirk and Helmut Hlavacs (University of Vienna, Research Group Entertainment Computing) have recently written about Using Drones for Virtual Tourism, addressing in particular the interface issue. You can view their experiment on line [8].
While recognizing the great interest for outdoor visits, whose fundamental problem seems to remain the security and the stringent regulations recently adopted, our research group is currently exploring the opportunities for indoor visits.
While the exterior is, almost always, visible without limitation, the access to interior spaces of monumental, architectural and artistic heritage is instead subject to greater constraints: because of lack of staff, or lack of security conditions, or visiting hours, and others. A virtual tour is therefore justified even more.
From the technical point of view, the challenge is very interesting: the matter is to re-create in a closed and confined environment a microgeodetic reference system, to allow remote control by virtual visitor: all the more important when you consider the protection of the cultural heritage itself.
The availability of an intuitive interface, as natural as possible, in addition to the enrichment with a didactic augmented reality - will allow everyone a visit experience truly immersive, and certainly even more exciting thanks to the possibility to fly.
It should of course face a number of related issues. The drone must tend to the smallest possible footprint (although the first experiments contemplate large spaces, one can envisage a future in which the environments will be more limited, and in the same environment will have multiple drones simultaneously), and the video system plays a very important role: it must be sophisticated (360 degrees), allowing to appreciate details even at very large scale.
The recent appearance on the market of spherical cameras is of particular interest: thanks to the recording system, they allow the user to see again its visit, but simulating another angle of view and different angles of the head.
Of course, devices for UAV must meet the highest demands of lightness, without restricting the output quality and sharpness. It's clear that another key node is the flight autonomy, however an indoor tour even if very short can imply a very interesting experience.
Tourists can shoot photographs as in the physical reality, storing them directly on the memory of their your devices (not only laptop but also smartphone, tablet … or a couple of stereoscopic glasses, in the near future).

3. Related issues

Predictable critics concern both the impossibility of replacing the real experience in all respects, and the supposed "damage" for the tourism industry.
To the first we reply that the real experience is irreplaceable and it will do, at least for now. Nevertheless, we repeat that tourism is a privilege. Thus this virtual experience can be an important tool for a truly "inclusive society" from the social point of view: it can ensure the enlarged access to cultural heritage – an issue that insistently recurs in the Horizon 2020 program. Not only: sometimes, especially in indoor environments, there may be different types of barriers that effectively exclude whole sectors of visitors. Therefore this form of tourism, in some cases, will allow access to artistic and architectural heritage otherwise not available for certain people.
To the second we reply that - as in many similar cases could be verified - this new form of tourism far from cause difficulties to the real tourism industry, could instead support and enhance it. In general, in fact, the opportunity to preview places and landscapes can stimulate the interest to really visit them. Virtual tourism may in fact be a formidable promotional tool, also acting as a "pre-visit", the last stage of a journey organization more and more aware.
In conclusion, we believe that not only this new form of virtual tourism is now within the reach of our technical capabilities, but it also represents an effective response to certain social and cultural issues.

4. Needed researches

The natural evolution of these projects may even involve the landscape, urban and architectural design. As this kind of approach, that requires and combines humanities and technical skills, aims to make available and accessible not only the historical, architectural and artistic heritage in itself, but also intended as system – researches in this sense are needed. How could we provide infrastructures able to support this technology? How could we integrate the transport planning with it?

Virtual tourism has to be organized as *experience,* and necessary technology is *already available.* We don't need another amazing innovation, but we've to really exploit what already exists. Very often innovation runs faster than its exploitation, so we've lost many occasions. We assist to many interesting experimentation, but we very rarely see their full implementation.
As the real tourism is *holistic experience,* through territories that constitute actually complex systems, research has to study how to reproduce without excessively impoverish them. Also the *space perception* matter is an interesting field of research: what are the features of the *immersivity* effect?
And increase of data sharing (e.g. data related to systems as primarily Google Earth, Google Maps and Street View - now in common use) which scenarios opened and could open even more?

Bibliographical References

[1] CAPPELLINI, Vito. *Electronic Imaging & the Visual Arts: EVA 2014 Florence,* Firenze: Firenze University Press, 2014

[2] GEROSA, Mario; MILANO, Roberta. *Viaggi in rete. Dal nuovo marketing turistico ai viaggi nei mondi virtuali*, Milano: Franco Angeli, 2011

[3] PIETRONI, Eva. *Ricostruzioni del Patrimonio culturale: il museo virtuale della via Flaminia Antica* in RAMI CECI, Lucilla. *Luoghi e oggetti della memoria*, Roma: Armando, 2011

[4] RICCIARDI, Francesca. *Il viaggio dell'innovazione. Informatica, beni culturali e turismo,* Milano: Vita e Pensiero, 2005

[5] http://www.angelsfortravellers.com/site/it/index

[6] https://www.v-must.net/virtual-museums/vm/livias-villa-reloaded-2014

[7] http://www.google.ru/intl/ru/landing/transsib/en.html

[8] http://www.youtube.com/watch?v=17gTWCJ_Nnw#t=44.

HERITAGE and TECHNOLOGY
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The spatial-temporal journeys and the urban filters

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Abstract
The city of Naples has always distinguished for its particular typological condition, where the relationship between the public space and private space was constantly manifested by a symbolic space system of accesses to the historic built. This system is interposed between the urban pattern and the road building by establishing a spatial relationship that doesn't limit its communication skills to the simple two-dimensionality of the curtain wall, but is considered to be the first of several elements of a continuous spatial sequence represented by streets, entrance hall, courtyard and staircase. This visual-perceptual filter, as well as in residential construction is recurred, also in the choral architecture of the city, where, compared to residential building, is inverted, and finds in the staircase the first element of a space-time path that is interposed between the road and the architecture. The aim of this following search is the survey and the representation of this first connecting element between the road and the choral architecture, giving back the identity's character of the examinated reality.

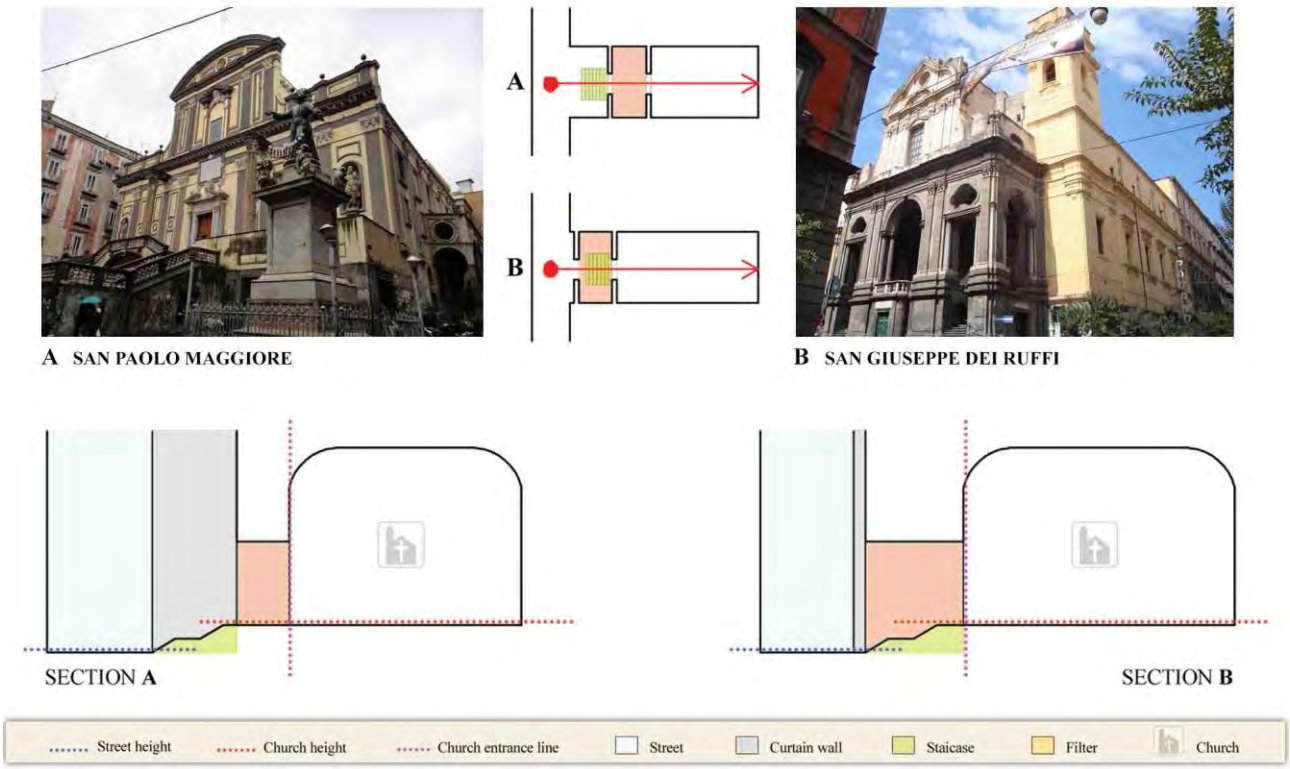
Keywords: Churches, urban filters, sketches, space-time path, cataloging.

1. The city of Naples between public and private space
The remaining condition of the urban places in the oldest part of the city of Naples make most of the time, the last of a specific historical process, which it has characterized the town for a long time, defining the main things of its appearance. In this view, the city of Naples, has always being marked for its particular type, where the link between public and private space is constantly shown by a spatial emblematic system of access to the historical buildings.
This access' system places in the middle of the street pattern and the buildings creating a spatial relation which doesn't limit the channel of communication at the simple two-dimensional walls, but it happens to be the first of many elements of a spatial series amount to the street, entrance hall, court yard and staircase.
Once we have found this interesting “spatial mechanism” which acts like a filter between the outdoor space of the street or the square and the inside of the residential buildings, and having revealed the scenographic role of the access's system in the scan's spatial perceptive fruition described by them, made us think about the link between this “act scene” construction, thought as illusion fascinated and of the marvellous feeling that it arouse us.
A sort of innate tendency to interpret the street, the square and the city as a scene where we act the daily routine, always characterize the link between the Neapolitans sensitivity and the city where the custom of mediating the space and the perceptive filters between the public and private space, we can find this tendency in the residential buildings and the religious architecture as well.
The neapolitan residential architecture can't show us an architecture composition on the front of the buildings because the streets are too small, that's why all of the expressive value is focused in the “proscenium” composed by portal and the front of the staircase.
To give an expressive mark to their front all the religious buildings were built far from the street. This architecture trick makes a valley where there is a church that isn't visible until the pedestrian walks right in front of it.
If true, then, the portal is the main character in the neapolitan historical building, the churches' entrance built far from the street stands for another important component which leads stabilizing the environmental link

between the street and the religious building (built in a different way from the residential houses), often shaded from the view by spatial elements (portic and staircase). These churches" entrance makes more complex and involving the spatial and perceptive view fruition.
The most used designed typologies are the ones with the presence of a filter system placed between the street and Church in a always different way according to the particularity of the space. The staircase is the first element of the spatial series which starts from the street and ends to the Church and it has the main role of lifting the front"s church, holding it up respect to the square and the street.
A suggestive example is shown by the San Nicola Church" s entrance, where we can access by an elegant double flight baroque staircase built in piperno stone (fig.1).
The location of this Church is unique designed, highlighted by extremely big windows at the entrance sides and where the nuns could observe life in the streets without being seen.
The front is composed by three parts: the lowest part is composed by two corinthian colums at the portal sides and separated from the wall and, in the highest part by two pillars near the underlying colums.
At the sides of double flight staircase, there are two “bassi” occupied by small shops since 1706 as we can see from gravestone in front of the entrance which make us understand that the religious jurisdiction starts from the last step of the stairs.
The small widening where is located the front Church and the small staircase, are the symbol as a result of such a small space where the architectural composition it isn"t limited by a small dimension"s manufacture but it was increased the expressive value.
The staircase is usually located out of the churches like San Paolo Maggiore"s Church, but there are other examples where the staircase is included in a filter system. This system is represented by emptiness of the first order or by an added body in front of the Church (fig.2).
These elements give to the view"s pedestrian a sense of lightness creating a sensorial path even more entangling. If we want to mention the most famous examples of this Church system, we can remember San Giuseppe dei Ruffi, Sant"Aniello a Caponapoli and Santa Maria alla Sapienza churches.



1: San Nicola a Nilo Church, San Biagio dei Librai street



2: Difference between different access systems: **A** San Paolo Maggiore basilica; **B** San Giuseppe dei Ruffi Church (idea and drawings by V. Cirillo, 2015)

2. The old Naples center G.I.S. cataloguing clerical assets

The oldest center of every town has precious historical memories on its birth, art and community traditions especially for Naples, a city very proud of its famous cultural and moral heritage; a heritage that stretches between itineraries connected to the faith, as everyone that saw it at least once in their life the churches, bell tower and the chapels that adorn the most beautiful streets of Naples.

This heritage don"t receive the right kind of caution and it risks the abandonment by people, this indifference carries away irreplaceable scraps of our history.

I have done a cataloguing of all the clerical assets to value these treasures inside the cardo-decumani boundary of the Naples center. In this boundary i found all the churches that belong to the oldest part of Naples. Some of them were opened or closed, others were having measures restoring and some others were deconsecrate.

If we match our knowledge to a technology information and communication platform which gives us back the knowledge, enforced, applied to a part of the territory, we will transfer not only a heritage of information but also a list of solutions to protect, enhance or restore the habitat"s man.

Through G.I.S. it was possible to create and manage a real information system, where all available information, from the macro to the micro-scale, are always readily accessible. By querying the database is designed and made today possible the immediate management of all data stored, their implementation, the real time information"s construction plans resulting from the queries made, the formulation of new questions based on the responses received, the construction of interpretive hypotheses.

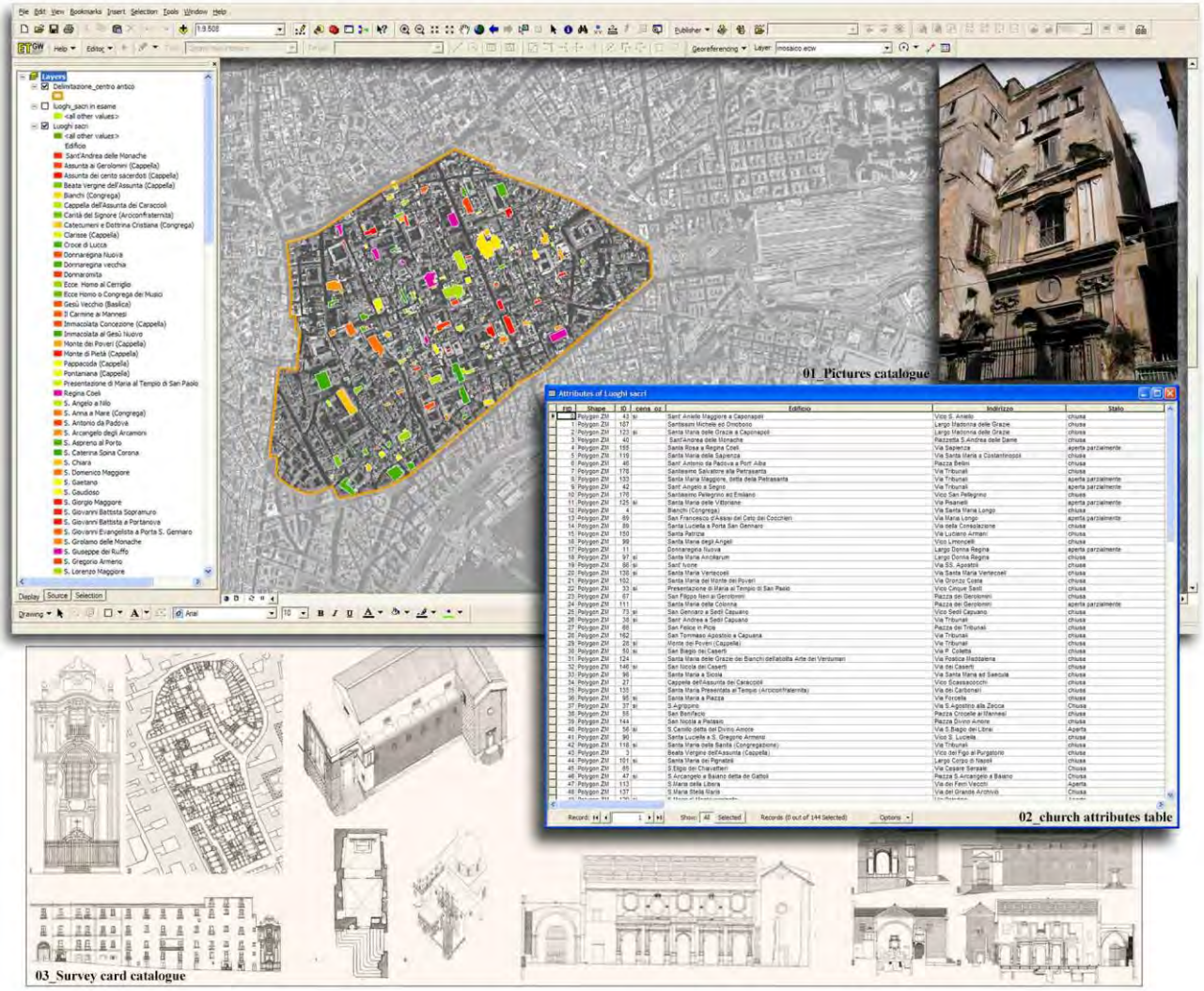
They also can be excellent tools to support design practice and management of assets and programming choices of conservation work. To sum up in a formula their effectiveness can be said that through the G.I.S. the knowledge of an object always temporary, as part of the information system also complex and of considerable size, can be always integrally provided, interrogable, comparable, reinterpretable and implementable. It is a tool which, in other words, helps to manage the complexity of reality, the endless process of knowledge, through the possibility of associations informative unimaginable till today.

The cataloging is an analysis tool orderly and systematic extremely necessary to frame in a timely and synthetic reality system particularly complex. The aim is to make it easy to consult the cognitive data of the object in question, for purposes which may vary from the realization of more depth research on some of the points discussed, the collection of readily available data for purposes to be determined from time to time. The subject"s cataloging, described here, are ecclesiastical cultural objects of the ancient center of the city of

Naples, consisting in an urban fabric very stratified, articulated by a road network, that complaint, in recognizable manner, the urban plan of ancient foundation (fig .3).
Bounded the old town center in the G.I.S. platform, were later identified and cataloged all the religious buildings falling into it. For each religious building were compiled cards, which contain the data on the geographic classification, the time of foundation, the religious order which they belonged, and history summary of the most important evolution or transformation times of cultural objects concerned. Cataloging so defined was made according to the following themes:

1. Religious building
2. Address
3. State (opened or closed to people)
4. Bonds
5. Survey
6. Foundation time
7. Religious order which churches belonged

In these cards was also attached the illustrative materials, made in historical maps, architectural survey and photographs which illustrating the religious buildings at present.



3: Cataloging G.I.S.: Delimitation of the old center of Naples; identification and cataloging of religious buildings falling into it; photographic cataloging of religious buildings; attribute table; cataloging of architectural surveys (Italo Ferraro, "Atlante of the historic city, Naples, 2003).

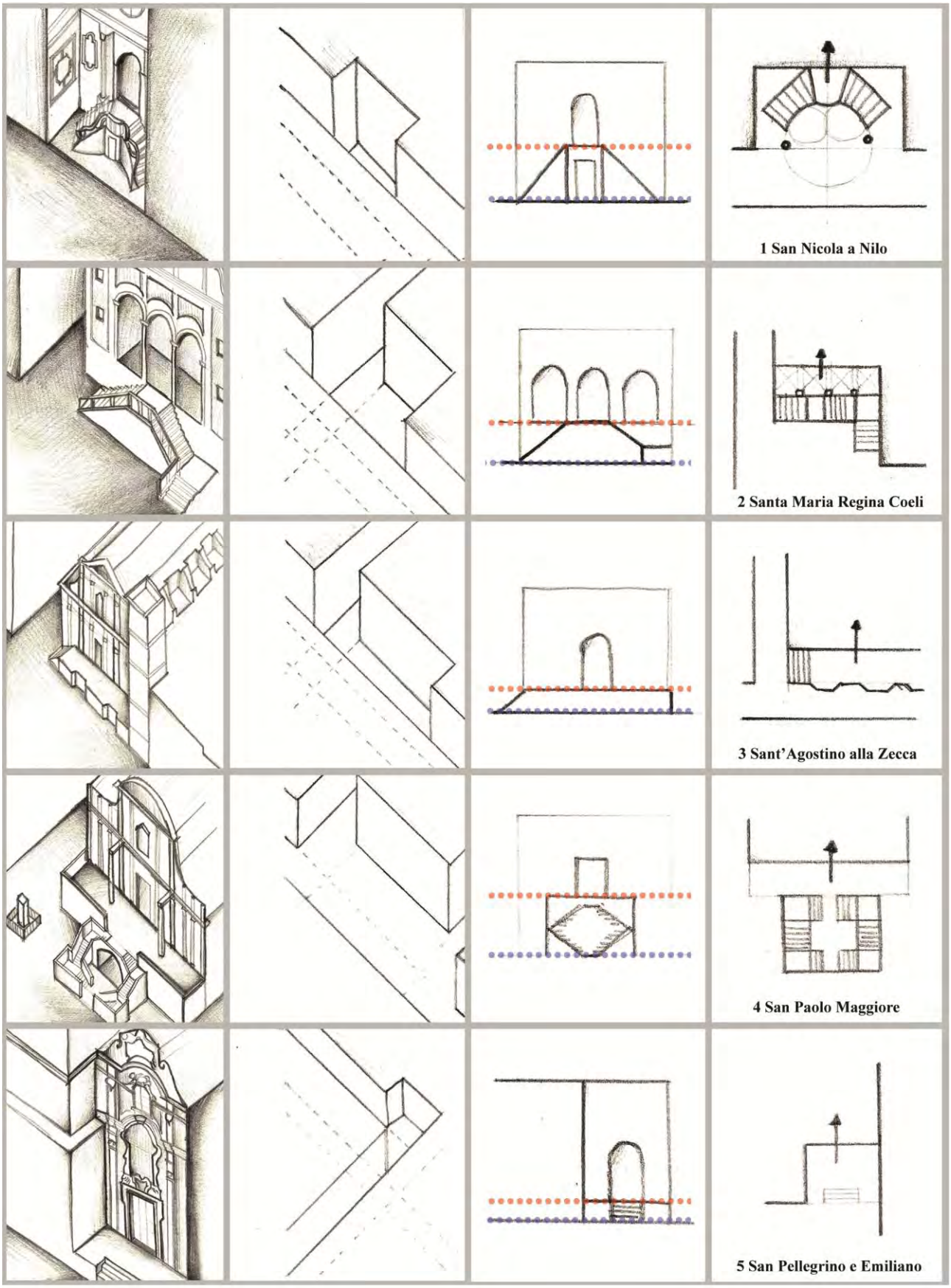
The next step to cataloging, through the knowledge and control of the territory on the G.I.S. platform allowed the reading and querying of all religious buildings in the database. By virtue of this has been possible to identify the churches that had the following characteristics: the fronts set back from the street line; the superelevation with respect to the road surface and the system‟s access presence to the churches always different depending on the specific case. The religious buildings following proposed not represent the totally examples of the Neapolitan scene with the characteristics described above, but they are a sample illustrative method used (Fig. 4).
The religious buildings identified are respectively: San Nicola a Nilo, Santa Maria Regina Coeli, Sant‟Agostino alla Zecca, San Paolo Maggiore, San Pellegrino ed Emiliano, San Salvatore alla Pietrasanta, Santa Maria presentata al Tempio, Sant‟Aniello a Caponapoli, San Giuseppe dei Ruffi, Santa Maria della Sapienza Church.



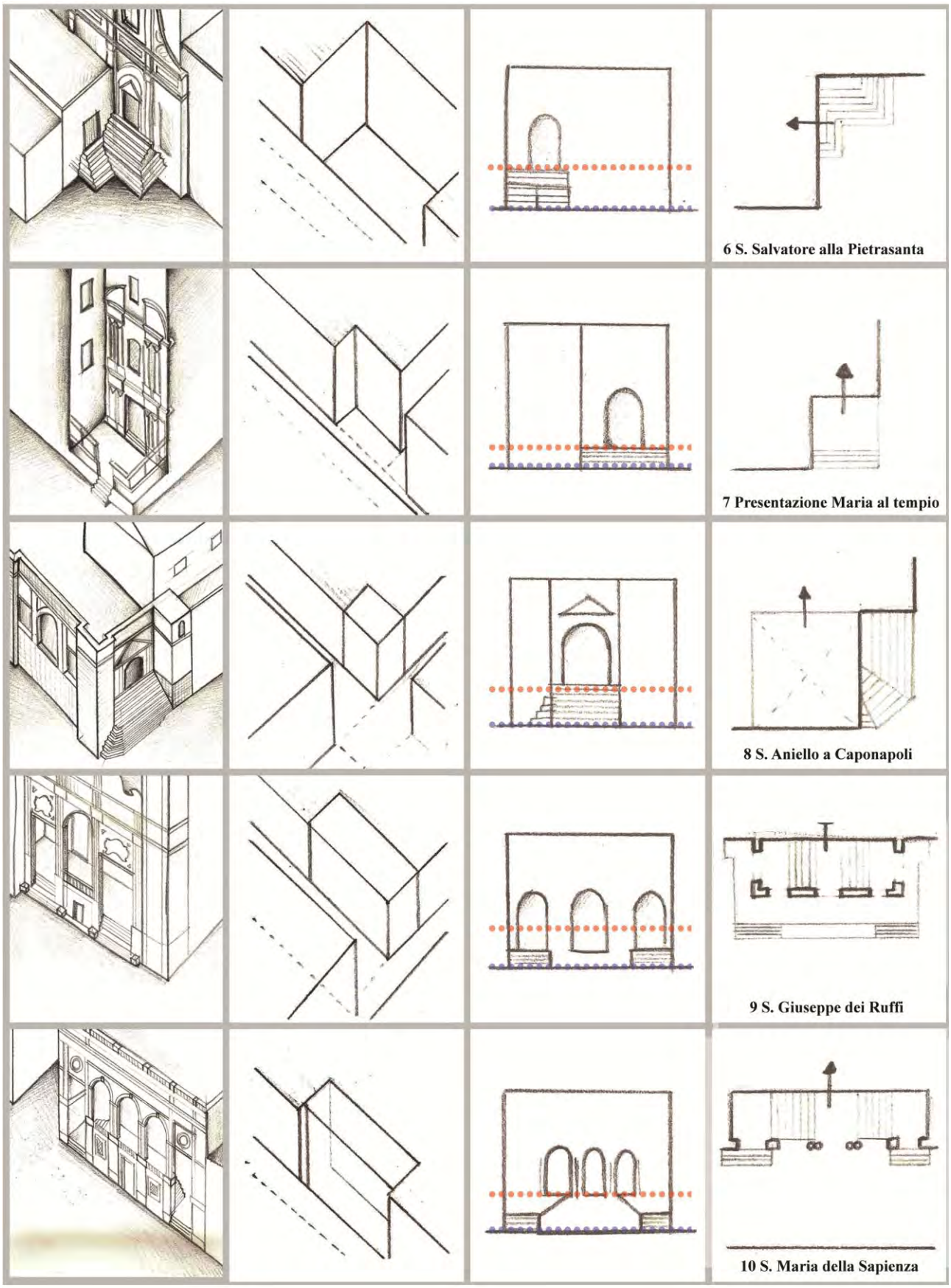
4: 1. San Nicola a Nilo; 2. Santa Maria Regina Coeli; 3. Sant‟Agostino alla Zecca; 4. San Paolo Maggiore; 5. San Pellegrino ed Emiliano; 6. San Salvatore alla Pietrasanta; 7. Santa Maria presentata al tempio; 8. Sant‟ Aniello a Caponapoli; 9. San Giuseppe dei Ruffi; 10. Santa Maria della Sapienza Church

3. The survey on sight as integration and support for the architectural survey

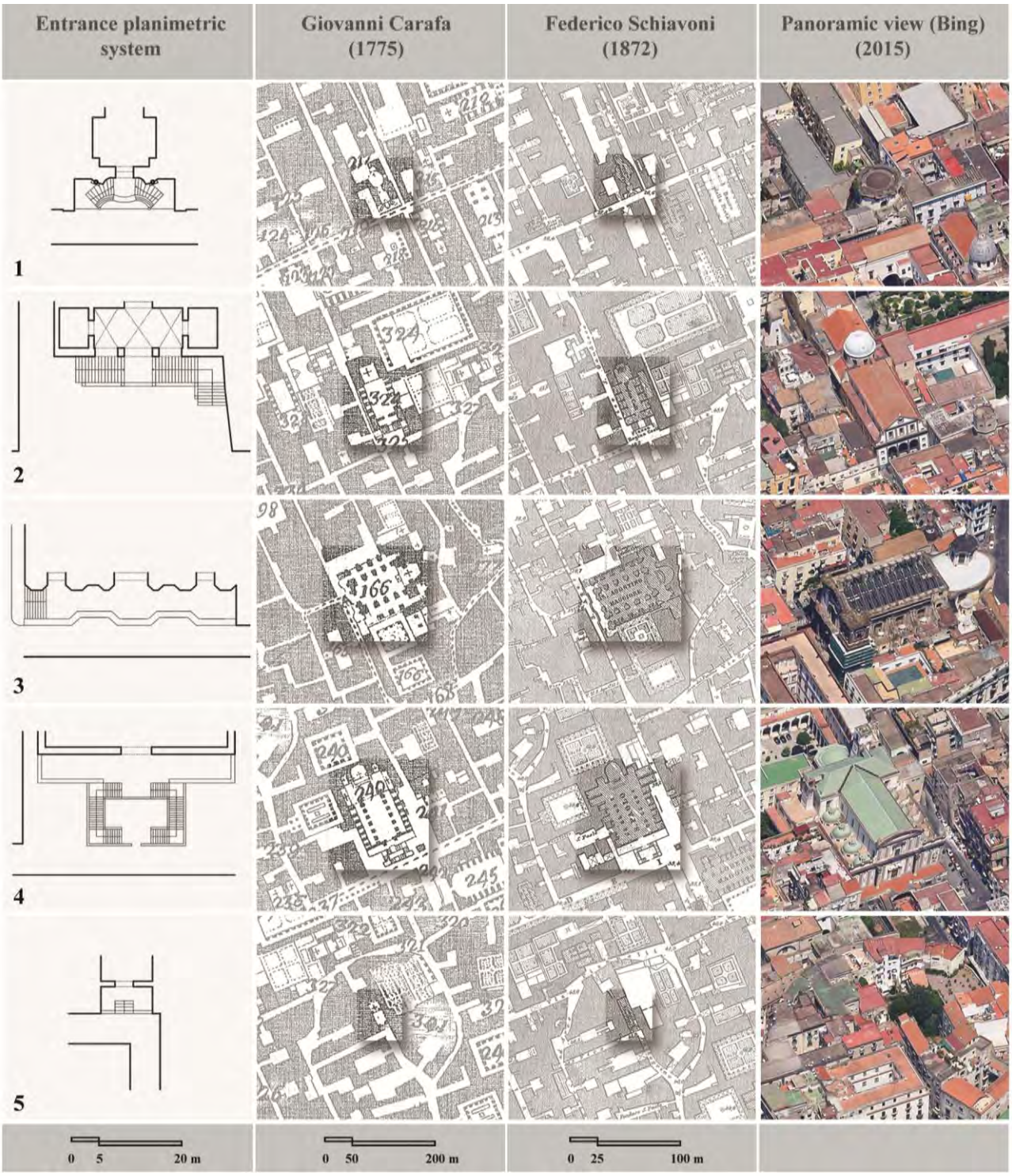
The analysis of system access to religious buildings was performed in the first seat through the use of life drawing emphasizing the importance of the experience that takes realizing the survey on sight of a organism: this experience allows to relate directly with the building constructed, to learn the ways and methods used for its construction and at the same time to understand the design process that underlies it. For survey we don‟t intend a copy of an object in the passive sense, but a complex interaction with the architecture to be able to describe, synthesize and storytelling through design. The latter is a direct and effective language, with strong capacity for synthesis that allows you to switch from space to plan for makes graphic the existing reality through a critical discretization detector.
In the operations done to make a survey on sight its most serious challenge is the transition from three-dimensional to two-dimensional reality of the paper: the sketcher mentally outlining the image to be reproduced, analyzes the subject, compares it with patterns like existing in its memory and sets the graphical summary. The sketcher addresses the general proportions of the building to control the relationships between the main dimensions: tries to identify, within the composition, one or more abstract forms, a kind of "unit measures" to be compared with the size of the object same.
Sometimes, in this stage, we can help with the pencil: placing themselves at a distance that allows you to frame the subject completely, we sight the building with the pencil placed vertically or horizontally, outdistancing his hand from the body and a half closing eye to determine "how many pencils" are in a length or height. This process will contribute to the definition of the general proportions is the symmetries of the analyzed subject, both rhythmically recurring elements, or logic, within the composition (Fig. 5-6).
The architecture reading is performed through different visual parameters and variables according to the different characteristics of the buildings. The categories more recurrent are: linear elements, the elements plans and volumes (simple or complex).



5: Access system analysis through survey on sight: 1 San Nicola a Nilo; 2 Santa Maria Regina Coeli; 3 Sant'Agostino alla Zecca, 4 San Paolo Maggiore, 5 San Pellegrino ed Emiliano Church (idea and drawings by V. Cirillo, 2015)



6: Access system analysis through survey on sight:: 6 S. Salvatore alla Pietrasanta; 7 Presentazione Maria al Tempio; 8 S. Aniello a Caponapoli; 9 S. Giuseppe dei Ruffi; 10 S. Maria alla Sapienza Church (idea and drawings by V. Cirillo, 2015)



7: Access systems comparison between the current status and historical maps (idea and drawings by V. Cirillo, 2015)

4. Conclusion

The survey confirms itself as a process and instrument for knowledge and documentation of architecture, the city and the territory. It is practiced as a critical tool to provide adequate confidence. Unfortunately its exercise isn't properly common to guarantee the knowledge and documentation of all the assets and land. Documentation will in time be replaced or supplemented by a survey on time. As long as this does not happen, however we can count on it and, above all, on the fact that its existence corresponds to an interest toward the building to which it relates. The commitment of the immediate future should be to outline an overall conceptual framework in which the principles and criteria considered for architecture can be extended to the territory by identifying the possible forms of general knowledge useful to promote and disseminate them.



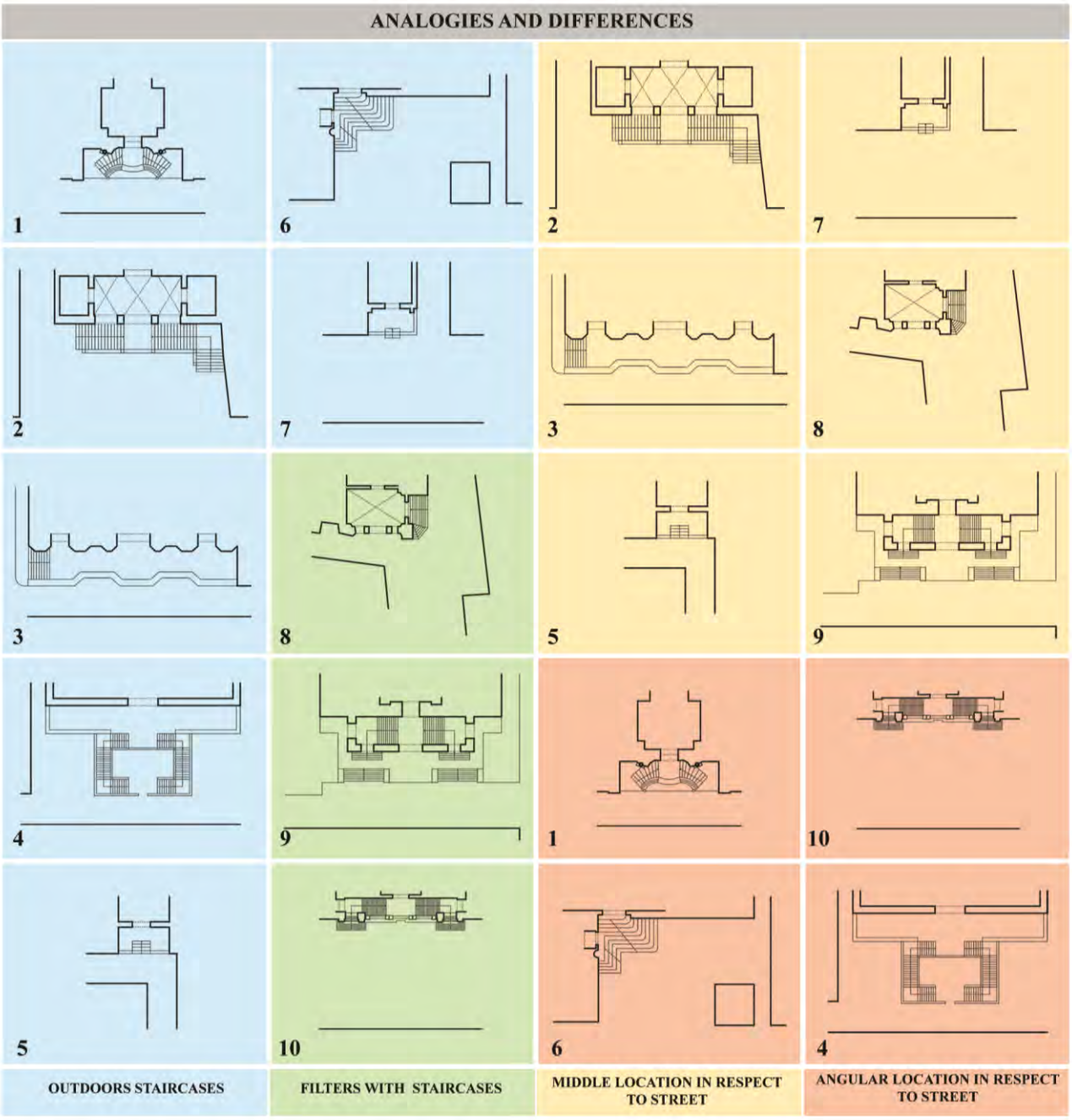
8: Access systems comparison between the current status and historical maps (idea and drawings by V. Cirillo, 2015)

Bibliographical References

[1] PANE, Roberto. *Il centro antico di Napoli: restauro urbanistico e piano di intervento*, Napoli, ESI, 1971.

[2] SAVARESE, Lidia. *Il centro antico di Napoli: Analisi delle trasformazioni urbane*, Napoli, Electa Napoli, 1991.

[3] ZERLENGA, Ornella. *"Chiesa di Santa Maria regina Coeli: il rilievo del sistema degli accessi",* in Fra le mura. Dai portali al verde nascosto (a cura di Filomena Sardella), Napoli, Elio de Rosa, 1998, pp. 79-92.



10: Analogies and differences of access systems to religious buildings (idea and drawings by V. Cirillo, 2015)

[4] ZERLENGA, Ornella. *"Staircases as a representative space of architecture",* in Carmine Gambardella, "Best practise in Heritage Conservation Management from the world to Pompeii | Le vie dei Mercanti", XII Forum Internazionale di Studi, Aversa-Capri 12-13-14 giugno 2014, Napoli, La scuola di Pitagora, Napoli, 2014, Collana „Fabbrica della Conoscenza" (direttore C. Gambardella), n° 46, pp. 1632-1642, ID 226, ISBN 978-88-6542-347-9 (international Scientific committee; blind peer review).

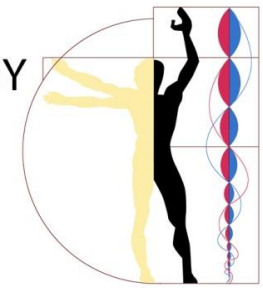
[5] ZERLENGA, Ornella. *"Memories in stone",* in Carmine Gambardella (a cura di), "Heritage Architecture LanDesign | Le vie dei Mercanti", XI Forum Internazionale di Studi, Aversa-Capri 13-15 giugno 2013, Napoli, La scuola di Pitagora, Napoli, 2013, Collana „Fabbrica della Conoscenza" (direttore C. Gambardella), n° 39, pp. 245-255, ID 061, ISBN 978-88-6542-290-8.

[6] ZERLENGA, Ornella. *Criteri e metodi per rilevare, conoscere e rappresentare livelli differenziati di complessità. Il sistema degli accessi al costruito storico residenziale napoletano*, in "La normazione nella rappresentazione dell'edilizia", Atti del Convegno, Roma 22/24 settembre 1994, Roma, Kappa, 2000, pp. 307-310 (ISBN 88-7890-376-0).

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE

XIII International Forum Le Vie dei Mercanti

Aversa, Capri 11-12-13 June 2015



New heritage: Architecture and biological sciences

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Abstract
Architecture and biological studies are a blend of research necessary to meet the new needs of the contemporary spaces as places for human health. People always established a different relationship with nature and in relation to this report has differently represented in the art's production and architecture. There is a need of an architecture that condense homogeneously an issue that is not just technology, is not only formal or typological, but structural and ethical for people and society.
An artefact is not a simple set of parts or a system of elements. Only by comparing a building to human society you can see the connection that links the components same to unity. Nature is a matrix of each project. A building is sustainable as it uses the book of nature as a decalogue for planning, in the plasticity with which the material is processed and the form of his compositions writes relationship with nature in relation to the project construed in all of its forms.

Keywords: organism, design, nature, territory

The Architecture uses many different disciplines, Vitruvio in his work "De Architectura" (15 b.C.) indicates the architecture as the first between sciences because it contains all sorts of human knowledge. In book I of the "Architect education" says: "the architect needs to be a men of talent, focused on his discipline: because neither talent without discipline nor discipline without talent can create a perfect creator. He has to be well educated, expert in design, erudite in geometry, knowledgeable of optic science, maths, history, he should not ignore medicine, philosophy and music and he has to be an expert of law and astronomy […]"
"Organism" is the word used to compare all the things created by the man to the structure of the human body and it is the same Vitruvio that starts the anthropomorphic interpretation, paying homage to the Aristotel's theory of Mimesis that justifies everything in their consonance to the human body.
The analogy between our body and a building is very surprising; its structure assures support as the skeleton in the human body; walls correspond to muscles, giving shapes and strengthening the body; plaster and tint are similar to the skin, a protective element of the body.
And,"what is the city but the people?" William Shakespeare rhetorically asked. A city has a deep impact on the people that inhabit it -squares, houses, streets have an effect on the peoples way of living and eventually become part of the people identity, as often people living in a city become similar to the city itself. The fate of a community is without doubt guided and determined by the richness and the outfit of its own territory.
The condition of a society that struggles to find common identity values condensed in recognizable images is a well known condition that characterizes this age and affects every kind of production and science. The scientific and cultural mutation that we indicates with the word "sustainability" is represented and solved in pieces leaving unsatisfied the necessity of an architecture that faces a problem that is not just formal or typological but ethic and essential in the man and in the society: the relationship between man and Nature. An architecture that faces this issue today has also to communicate the new ethic implications connected to it and the needs of psychological wellness that, from the altian turn until today, is a necessary quality of contemporary architecture.
Nature has always been an important formal and functional reference point for the man; the Greeks individuated a model of perfection and harmony in the natural organisms, and many of the technological progresses comes from the close observation of natural events: biomymesis is a clear example of how nature is seen as an inspiration. Architecture and nature are always been complementary and correlated, to



Fig. 1: Anthropomorphic interpretation

the point of creating a solid connection that improves our quality of life; a potential that is often overcome by the logic of economy and profit that dominates over the users wellness and over the respect for the environment. Today more than ever than architecture considers the natural world as a model for building design, the only capable of suggesting examples of economic effectiveness and sustainability.
If everyone of us would stop to observe nature more, would understand that the first real architecture resides in the ecosystem and consequently he would become more sensitive about the exploitation of the natural resources. Nature offers a fundamental contribution in satisfying the essential needs of plants and men, playing a fundamental role in the architectonic project: the spreading of urban greening is an example, given that the environment major menace is becoming the urban areas expansion.
The architect has an evident obligation: the shape of a space can influence the social, economic and moral behaviours, more than just host the actions the space suggests and stimulates them, strengthening the interaction between man and nature. Even stronger is the responsibility when user is a growing young man, that looks for inputs for is correct development, receiver of positive stimulus as well as negative ones. The own body perception and the perception of the external space develop simultaneously during the childhood, so much that the personality development is strongly related to the maturity of these perceptions. The LANDesign/Ali-Ment-Azione® research project (Projectist and Leading researcher Prof. Sabina Martusciello, Prof. Maria Dolores Morelli, Department of Architectures and Industrial Design, SUN),in order to solve the Architecture-Agricolture. Alimentation emergency, has put into effect a system of “regenerative strategies for city parts or urban systems aimed at recovering, regenerating and reusing”.
LANDesign/Ali-Ment-Azione® favours an open and constant dialogue between schools, companies, food farming and green economy associations, promoting and divulging the Mediterranean style, expression of an identity in which the territory is the weave and the climate is the warp, formed by its raw materials (water, salt, fish, cereals, olive, vegetables, honey, milk, grape).
Qualità/LANDesign/Ali-Ment-Azione® stimulates creative processes aimed at the territorial safeguard and at the public health. As declared by the project Leading Researchers “the project's core is E-DUCO/PRO-DUCO.
E-DUCO (in his double meaning of “educo”, italian word for education, and “e-duco”,from the latin, that means to take out, to gather from the earth) and PRO-DUCO (to promote, to generate, to realize). The project targets to educate and sensitize people towards land recovery themes and its local redesign trough knowledge, caution and culture”. The culture of participatory design has a very strong influence on the society and is a fundamental criteria in doing Architecture. A Project that won the IQU prize in 2015 judged as a complex work of coordination and local integration. The schools participating in the Project are localized in different urban contexts, from suburbs and ex-industrial zones, to the cities historical centers, “a relevant estate to recycle and to value in order to reduce the land consumption opposed to the culture of building expansion”.
To reflect, to share, to design, to do, to promote, to take care of this heritage of land and men, this are the concrete action of LANDesign®; Local, because the project has its roots deep into the ground, extracting

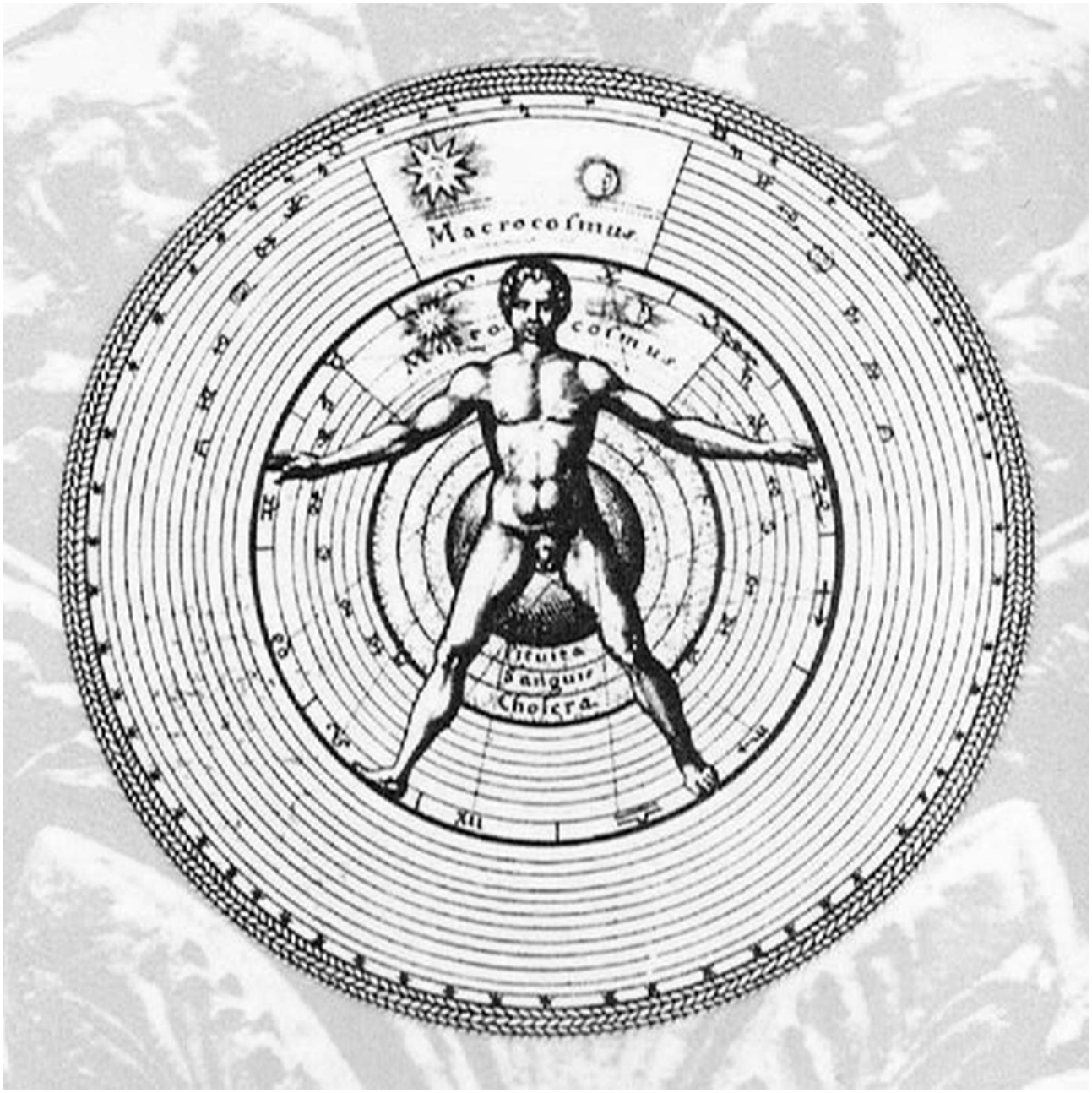

Fig. 2: The relationship between man and nature

ideas to redesign it from itself; Area, intended as common ground, public, limited and not renewable, that can be seen, sensed, heard, perceived and enjoyed; Network, network of ideas and incentives for people that wants to Do something about their LAND trough the Ali-Ment-Azione® intended in the triple division of ALI, immaterial, creative component, associated with MENTE (mind) that organizes, structures and conform tradition and innovation and AZIONE (action) to promote the result achieved activating co-productions: cities degraded areas become resources, raw material to regenerate places with fruit and vegetable gardens giving back an ethic and aesthetic value to the land, co-projecting to the prototype products that answer to the 6 requirements: function ,form, doability, economy, ecology and emotion.



Fig. 3-4: Applied research project LANDesign Ali-ment-azione



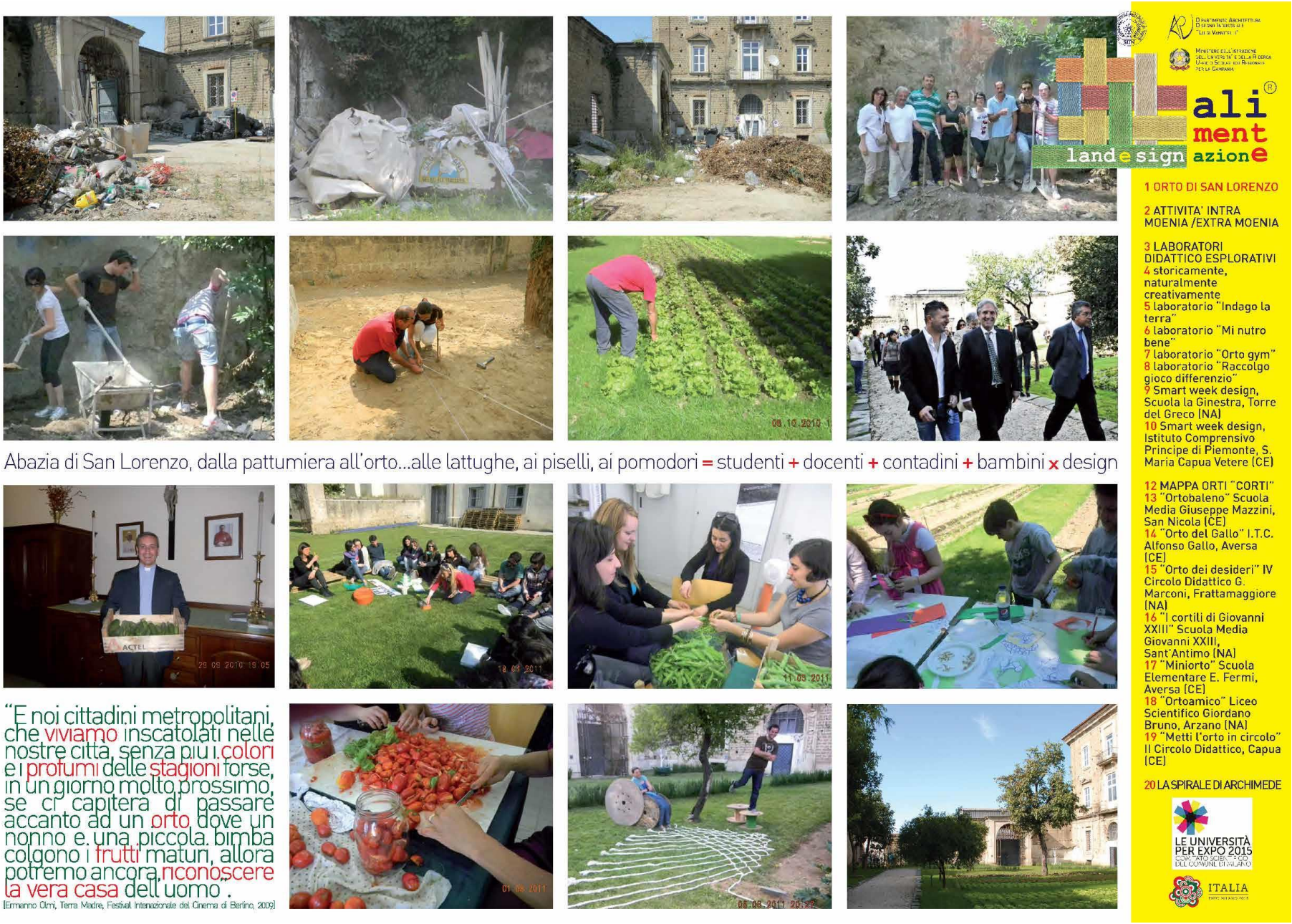

Fig. 5: Activities intra and extra moenia

Bibliographical References

[1] MARTUSCIELLO, Sabina. *Il luogo etico.* a cura di M. Givannini e D. Colistra, in Spazi e culture del mediterraneo, Kappa, Roma 2006.

[2] MARTUSCIELLO, Sabina. *, Rilievo multicriteri@: l'elemento ordinatore della rappresentazione.* Edizioni Scientifiche Italiane, Napoli 2003.

[3] Marco Vitruvio Pollione, *De Architectura, Libro I della Istruzione degli architetti*, 15 a.C.

HERITAGE and TECHNOLOGY
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Ordinary maintenance in the Venice "minor". Problems in nontrivial resilience

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Abstract
Often you are confronted with large and small monumental restoration, without realizing that, alongside the monuments, the minor building fabric enjoys a growing insecurity. In Europe, the traditional urban fabric, guarantees and substantiates the context of the major works through the restoration work carried out from the silent population.
The decline in the population of the Italian Historical centres, generally large, however, creates new worries about the possibility, economic and social, to operate conservative spontaneous action, while the assumption of general public intervention and preservative constraint, represent a dystopia, rather than a reasonable aiming point.
Through considerations of a historic building for residences bourgeois and popular, which included medieval warehouses, we will try, with technical considerations, drawings and graphics, to highlight the social significance of popular action in the restoration and its fragility against the constraint facing forms and uses.
In particular the difficulties of organization of the condominium complex, the different owners of estates, the complexity of the urban system and the contrast between rigid positions of protection and the more possibilist conservative positions, with the dangers that even in these exist, can represent both a challenge and a hope in urban planning.

Keywords: Old Towns, Conservation, Refurbishment, Resilience, Urban Planning

1. Introduction
The minor building fabric for the residence and the work of the European cities, and Italian in particular, is characterized by a strong stratification of styles and constructions superimposed over the centuries. This fabric ensures and substantiates the context of the major works, made by the unknown authors of the Middle Ages and by the great architects of the Renaissance and the Baroque, through the restoration work carried out from the silent population. The important conservative action of the residents has ensured the continuity of the settlements and their resilience.
It has, however, a counterpart: the loss of the original architectural forms and, sometimes, the modification of the same urban texture, that changes under the pressure of the new needs, in relation to transforming of the economy and society over the centuries. It would have been possible to maintain the great monuments of the past if the population had moved away from the previous cities to found new ones? And why should it be possible now or in the future? Especially for the monuments that will not enjoy international funds or attention, because less important ... and they are many. Imagine what would be Venice, Florence or Rome, and the thousands of historical centres in Europe and North Africa or South America, if they consist of only churches and noble palaces. Perhaps, in the best case, they would be like Bagan in Myanmar and Angkor in Cambodia, who have lost their population remaining fantastic ruins, very expensive to maintain anyway, despite the tourism that feeds them. How many of these golden ruins we can afford in the world?
The idea of being able to protect the urban forms of the past through a strict preservation is dystopian and foolish, both at the level of international institutions, often far removed from the way of thinking of the local people, and at the level of local regulations, which together with an excessive property tax generate discouragement in the population and small owners of historicized buildings. And this especially in those contexts in which the properties are embedded into each other in complex and articulated condos for age,

shape and social reasons. In many large historical Italian centres this situation is more urgent and problematic than it might seem at first glance. Even if it looks worse in many other parts of the world.
Maybe we should renegotiate the model of preservation of the last hundred years.

2. The dimensions of Italian historical cities

Josef Macek shows in Italy in the late Middle Ages, the cradle of urban renaissance in Europe. «The cities of the Italian Renaissance had surpassed all other European cities mainly by the number of inhabitants. Beyond the Alps only in very exceptional cases inside the city walls were concentrated more than 20,000 inhabitants. We recall in this regard that Prague in the Hussite period, in the fifteenth century, was, with its 30,000 inhabitants, at the head of the city beyond the Alps. In Italy we find many of these large cities. Rather than make a long speech, you better take a look at the following chart of the major Italian cities of the thirteenth and fourteenth century:»

*city**	*yers**	*Number of inhabitants**	*Density inh./Km²*	*Km² Historical Centre*	*Number of inhabitants in the Historical Centre***	*Density inh./Km² Historical Centre*	*Km² Comune (Lagoon waters excluded)*	*Inhabitants Comune*	*Density inh./Km²*
		(approx.)							
Venice	—	90000	11278.20	7.98	62933	7886.34	158.17	264919	1674.90
Genoa	b.XV	85000	75221.24	1.13	23000	20353.98	240.29	593853	2471.40
Milan	1288	62500	6463.29	9.67**	96315**	9960.19	181.76	1353882	7448.73
Florence	1340	60000	5263.16	11.40**	67170**	5892.11	102.32	377021	3684.72
Siena	—	40000	23529.41	1.70	11096	6527.06	118.71	52883	445.48
Bologna	—	40000	8869.18	4.51**	52839**	11715.96	140.86	386171	2741.52
Rome	—	30000	2183.41	13.74	124998	9097.38	1287.36	2872086	2230.99
Padua	1320	30000	5769.23	5.20	27047	5201.35	93.03	210494	2262.65
Pavia	1250	30000	3300.33	9.09**	22560**	2481.85	63.24	72046	1139.25
Naples	1278	25000	—	6.58	—	—	117.27	989845	8440.74
Palermo	—	20000	8000.00	2.50	21489	8595.60	160.59	676340	4211.59
Vicenza	—	20000	8810.57	2.27	12466	5491.63	80.57	113352	1406.88
Modena	1306	16000	5280.53	3.03	26193	8644.55	183.63	185985	1012.82
Lucca	1331	15000	8474.58	1.77	8962	5063.28	185.79	89204	480.13
Pisa	1228	13000	5038.76	2.58	12861	4984.88	185.18	89659	484.17
Orvieto	1292	11000	—	0.92	—	—	281.27	20830	74.06
Rimini	1371	10000	12658.23	0.79	6046	7653.16	135.71	147500	1086.88

* By Josef Macek (the data from Macek are very cautious). Other data by author survey.
** Also including neighborhood and green areas surrounding the historical districts (inside the city walls: Florence 5.35 Km^2, Pavia 1.81 Km^2, Milan 9.01 Km^2, Bologna 4.16 Km^2).

Tab. 1: The inhabitants of some Italian cities compared during Renaissance by Josef Macek, and their historic districts today by author survey.

«To this list of cities with more than 10,000 inhabitants should also add other cities in northern and central Italy, such as Verona, Ferrara, Mantua, Piacenza, etcetera.» [1]
It seems obvious to think that some of the Italian cities, especially in the centre and north, have been for about three centuries, from the thirteenth to the fifteenth, among the largest cities in the world.

city	1300 c.	1400 c.	1500 c.	1600 c.	1700 c.
Bologna	50,000	40,000	55,000	63,000	63,000
Florence	110,000	37,000	50,000	75,000	72,000
Genoa	70,000	50,000	75,000	71,000	80,000
Milan	150,000	100,000	100,000	112,000	125,000
Naples	33,000	30,000	150,000	280,000	220,000
Palermo	50,000	20,000	55,000	105,000	110,000
Rome	30,000	30,000	55,000	102,000	135,000
Venice	110,000	85,000	102,000	150,000	138,000

Tab. 2: The inhabitants of some Italian cities compared over centuries by Carlo Maria Cipolla. [2]

Obviously a demographic comparison today would make little sense, given the technical and cultural distance that separates us from those eras. Nevertheless, if a quantitative comparison is difficult, you could not say the same of a qualitative comparison.
It is sometimes difficult to determine which is the part of town that you can actually define the Historical Centre. We mostly refer to the part of the city within the walls, where they were easily identifiable. Regarding Venice is also considered the Giudecca, but not other islands, nor the historic parts of the communal mainland. For Naples and Pavia we consider the city in and out the walls in the beginning of XIXcentury.
The number of residents of old city centres has grown to the early twentieth century. Well beyond the values recorded in the historical periods in the table (Rome 156,000 in 1750, Venice 149,476 in 1760 [3] [4] [5], 174,808 in 1951 Population Census). So, usually, they decreased in the second part of the century, even dramatically, as in cases of major cities like Rome and Venice, but in Milan and Genoa too, and also in many other cities like Rimini and Siena, for an example. This is obviously due to the adjustment of lifestyles.
Particular, however, seems to be the case of Venice, of which we are concerned in this paper.
Note that the population of the non historical parts of Venice is not so large (264,919 - 62,933 = 201,968), especially when compared to the rank of the city in previous centuries. The ratio of the population of the Old Town and the population of the entire city, compared to other cities, is than higher (Venice 23.75%, Genoa 3.87%, Milan 7.11%, Florence 17.82%, Bologna 13.68%, Rome 4.35%, Padua 12.85%, Palermo 3.18%, Vicenza 11.00%, Modena 14.08%, Lucca 10.05%). Unlike what is usually believed, would then be the population of the mainland districts of Venice to be undersized compared to the average, and not that of the Old Town. With about 60,000 inhabitants, the historical centre of Venice stands up well to the impact of the changes compared to all the historical centres of Italy. Not so the new part of the city. Often considered another city (Mestre and Marghera, which actually has developed as a result of the growth of Porto Marghera, true modern port of Venice, or the Lido, on the other side of the lagoon, overlooked recently), and so neglected for a long time especially for functions that a centre of the value and history of Venice would have to exercise in the new developing areas. So Venice has lost, as a whole, important functions compared to cities in Italy and in the region (Verona and Padua, but also Treviso and Vicenza) and it has impoverished.
The process of protection and safeguard of historical Venice and its Lagoon has required more and more attentions for the ancient city and has forgot the whole system, considered mainly by the point of view of the environment. And that certainly for the great values at stake but unfortunately also for the enjoyment of a tourism increasingly coarse and hasty. So, today, the old city of Venice, even if with million and million tourists a year, looks increasingly marginalized from the real economy and not the fulcrum of a thriving city. At the same time Mestre and Marghera, are underdeveloped in front of the role that they could play for transportation and the facilities of industrialization and tertiarization (outsourcing). Finally it should be noted as the density of the historical centre and, mainly, of the whole city, is low compared to other regional capitals. This is also a sign of the weakness of the capital city of the Veneto region and of the North East of Italy, today. It pays for the lack of effective connections through the Laguna that, from the fundamental place of connections, of life and economy has become a barrier between the old town and the new districts. And the most important tertiary is gone from the lagoon, disinheriting the new urban areas and leaving only the branches of the tourism, of the transports, and of the public administration to sustain the city's economy.

3. Ability of public and private

The Special laws for Venice were enacted following the tragic flood of November 4, 1966. At that time there had been a rise in the level of the tide of 194 cm above the mean sea level, with a water level ground 110-150 cm, which flooded all the ground floors of shops and houses and brought down the protections of the lagoon to the sea, causing a state of emergency and danger to the ancient city. The intervention strategy was quickly defined using the Report about Venice that UNESCO predisposed in 1969. [6] [7]
The first Special Law of the Italian State for Venice was the Act n°171 of 16 April 1973, "Interventions for the safeguarding of Venice". By the government of the Venetian Republic was recalled the fundamental concept of unity and physical continuity of the lagoon as a problem of national importance; to ensure the protection of the environment; in respect of the components of the landscape, archaeology, history and art of the city and the lagoon; providing for the protection and preservation of the hydraulic equilibrium by air pollution and water pollution; ensuring socio-economic vitality.
The regulatory system has been characterized by the summing up of competencies of state, regions and local authorities. After ten years, the Act of 29 November 1984 n°798, "New interventions for the safeguarding of Venice" or second Special Law, was promulgated. It introduced the Coordination Committee, Direction and Control (*Comitatone* or Big Committee) and the Consorzio Venezia Nuova, which would have oversaw the construction of the defenses of the lagoon known as MOSE (*MOdulo Sperimentale Elettromeccanico or Experimental Electromechanical Module*), not yet completed, but in advanced state of construction.
The last special law for Venice was the Act n°139 of 1992, which reiterated the need for further coordination and integration of the activities of the different actors on the lagoon area.

With respect to the general problem of the protection of the territory, but also with particular regard to the problem of the restoration of the real estate town, Act n°171/73 also established the "Commission for the Safeguard of Venice" (Commissione per la Salvaguardia di Venezia), a collegial body composed of about 20 representatives of various institutions, which have been assigned the task of advising and binding requirements on all construction projects and land transformation inside the lagoon boundary (title II, art. 5 and 6).
There will be immediately difficulties, due to fragmentation and overlap of competencies, the bureaucratic red tape of the proceedings, the shortage of funding for minor building. Despite the ongoing struggle between the Commune and the Commission for the control of building permits, the Commission continues to subject to its opinion all building permits in the Venice area, binding opinion to the municipal building committees. And this for minor buildings too. Recently, the City has appealed to the Regional Administrative Court. (TAR) to reiterate that with the adoption of PALAV (Piano di Area della Laguna e dell'Area Veneziana or Plan of Area of the Lagoon and the Area of Venice) and subsequent urban planning the competence of the Commission in the matter has no reason to be.
But it is not only this kind of battles between administrative bodies to make it difficult to apply the principles of law. Especially for the restoration of the minor Venice. That of the lower middle class and the people.
Speaking of restoration and protection of the traditional settlements, we can not forget the needs of their promotion and upgrading over time. Also because only the traditional urban fabric, guarantees and substantiates the context of the major works through the restoration work carried out from the silent population. The same decline in the population creates dysfunctions in the popular action of restoration with not understandable effects on the future. The excess of constraints, fees and taxes on housing, brings us directly the idea of fragility of the old cities in front to new ways of living in the urban context. So the capillarity of restructuring is well supported by only speculative demands of tourism, and not of the population leaving the settlements. But tourism alone can not make a living city. So the urban scene becomes increasingly artificial, almost ridiculous. Even the 60,000 Venetians remained, which however are not few people for living in the ancient city, have a limit of endurance.
Practices for applying for funding for restoration with the special law are slow and difficult. And the building regulations are already in itself very restrictive and burdensome for the population. Sometimes they are interpreted strictly by officials overly scrupulous, which use the constraint to apply to monuments even to that applied to ordinary residences, often already been much altered over the centuries. Often they are so prohibited internal transformations to housing, which can be vital for its functionality. Also for the second bathrooms needing expensive septic tanks, arriving absurd to force the rebuilding of the old septic tanks if it makes a new, totally independent and distant from previously, linked to different baths.
Capital funding or tax breaks are given only on the basis of lists of merit. And these lists predicted low scores for all those who had other properties in the city. So, sometimes, are favoured people with properties in other municipalities and penalized the great mass of the petty bourgeoisie. It 's so difficult to finance the owners of one or two apartments for rent that should restore their homes. The rents of these apartments in Italy barely allow their maintenance and can not provide additional revenue for the expensive restoration of the first house. It comes to the absurd that the owners adjust the houses of the tenants but not his own.
To this we must add the fact that for many years the Special Law for Venice was not refinanced for expenditure items regarding minor renovations, on capital account or remission of taxes. Today only a national law, not targeted to the historical centre , allows the relief of half the cost for restoration on taxes, but in ten years. And this law shall be temporary. Maybe next year there will be no more, given the problems of spending review of state and local entities in a critical period like this.
The public seems hardly able to refinance special laws for great historical cities, and also seems difficult to implement best practices in planning for the recovery of historic districts through participated urban planning, as was the case with some urban renewal programs (PRU and PRUSST) during the last decades (as with the island of Ortigia in Syracuse, whose recovery seems still remained suspended, for many parts of the settlement).
But if the state and the municipalities seem in distress, individuals are no different.
Private individuals, and especially the middle class, are faced with many problems in order to continue to live in the historic centres and to restore or renovate their homes. Here some of these problems.
The historical centres become more removed from ways of life of the contemporary. The historical centres are sectarian and have led to citizens of historic places and citizens “other”. The citizens “others” lived worse just in the beginning, now they live better (more services, mobility, trade). The gap between the historical district and town is a dynamic process, it makes no sense to fix time x in which the differences were created.
Nobody agree to live in the past, functions and models continuously change. The buildings constituting the historical centres are increasingly expensive to maintain, because of materials that change. The buildings constituting the historical centres are increasingly difficult to maintain because one can't find workers skilled to work with the old materials and using ancient techniques. The special laws to financial support of the restoration can not cover all the so-called Historic Places. The tourism monoculture protect objects but not the soul, anyway if a town does not have tourism does not save the old city. It is not true that there are

historical places of A and B levels, because there are also standard C, D, and so on, and probably these will be lost forever.

4. "Preservation" and "conservation"

Some time ago I wrote: «The "Stones of Venice" have produced almost mythological images, as is well known, in the nineteenth-century visitors. Their immanence and their materiality have always clashed with a dreamlike symbolism, which often discern fantasy from reality is difficult, due to the layering of stories and legends. How can we forget the Corte Sconta of Ugo Pratt?

The fascination that these dynamics lead on the normality of planning instruments and on the building regulations, ... ,bring, in their rigidity, even more serious economic, cultural and genealogical social destructions of the same possible transformations of the stones of Venice.» These dynamics translate sometimes the arising signs from mythological fantasies in immovable symbols or absolute constraints, for unlikely protections. «The theme of the dynamics of conservative system and the preservation of the static structure is an eloquent strong antithesis in the disciplines of the territory, land use and building restoration. Conservation against preservation, preservation against protection, protection against utopia, utopia against reality, reality against abstraction, abstraction against fantasy, fantasy against dystopia, dystopia against experimentation, experimentation against whim, whim against dream, dream against nightmare, nightmare against the project.

Everyone can invent his own chain of synonyms and antonyms. But we must note that outside of banal dualism between good and evil, the "positions" that take these chains of words is quite different from the positions prefigured by the received ideas, that are often stiffened ideologically, precisely due to lack of re-form of the chains. In this context the conservation acts as protection of architectural heritage, thanks to reality, able to deal with fantasy, and the dream come true for the purpose of obtain project (design). It is the project (design) for a duration of the dear stones, not sacredness petrified. The project is not then whim. Dystopian whim, for stiffening of utopian abstraction in the preservative myth. The project (design) is, in this view, continuous illation of experimentation, which, sometimes, takes place phenomenologically in the reality, realizing the dream, and, some other times, remains just on paper, the only evidence of a complex and unique experience.» [8]

Any building requires a certain time for its construction. After about the first 10 years, begins the decay of the non-structural works, such as windows, gutters, plaster and other, requiring routine maintenance. This first phase of the ordinary decay would be followed by, after about 30 years, or to the fortieth year from the building, a slight phase of structural decay, which becomes heavier after another 30 years. We call this phase of extraordinary decay. After 100 years of life of the structure, without any restoration, there would be a period of instability and collapse.

One must, however, take account of the fact that there is always a structural decay, hardly visible, which continues to manifest itself even in the presence of regular maintenance works. This process is unavoidable and tends to age the good, but also gives it a certain aura of antiquity.

However the building degrades over time, up to an asymptote that must be maintained with continuous restoration work. The asymptotic line can be interpreted here as a line of stability of the building that we delude ourselves to be able to maintain long.

Here we consider this illusion typical of the "preservative" phenomenology, intended as that of the obsessive protections full of constraints.

It clashes, however, with the needs and demands of the population. In time you modify, in fact, also the usefulness of the building for those who live or work in it. The usefulness of the buildings generally falls to zero. But sometimes in long periods, of some centuries.

If for the reuse we apply the slogan: "as it was and where it was", that is like if we had designed a building restored, but devoid of changes that actualize it and without change of use, here we say that we apply a "preservative" protection. In this case the real utility is very low. [9]

The action of protection can only try to improve the usefulness in current use, which allows the maintenance of the building over time. It is clear that this speech is not about the monuments but the minor building.

Maximize the utility of use of buildings, so, means losing some of their relations with the world from which they derive, for recover some other, in continuity with the world we face. The change in intended use and the renovation are therefore vital signs. Without them, the building would be forsaken and would collapse.

We can here intend the "conservation" as opposed to the "preservation", in the ability (cultural, continuous, and without breaks) to interpret through the instruments of the restoration, renovation, restructuration and change of use, the utility of the buildings to changes of the society.

The conservative utility will decline over time anyway, but with less speed. It will drop less than the case in which the building had been preserved always the same and for the same original use. The utility of "conservative" type is therefore higher than the utility of "preservative" type, if we consider the adjective "conservative" as synonyms of cautious, prudent, careful and the adjective "preservative" in a more stiff way, that is inelastic or inflexible, for the safeguarding of the assets.

The preservation is thus an utopia for most of the buildings of minor importance, designed for residences, offices, laboratories or shops in the old towns. The real utility of conservation, with soft changes (new bathrooms, use of materials similar to those of old, small renovations), is therefore greater than that of a restoration excessively rigid which would ultimately generate the abandonment of the minor buildings.
Beyond a certain threshold of dropouts, this would put the whole city in crisis, creating dystopia. I fear that this is happening in many Italian cities nowadays.
The task of recovery then becomes the regeneration, for the purpose of use, of objects whose use was surely different, in a world that was configured in a completely different way, to bring them to interact synergistically with other objects, structures and infrastructures, in a contemporaneity able to integrate them with functions that will mainly respond to today's models.
Ultimately, the "to be or not to be" of such objects, in a context of recovery and regeneration, depends on their contemporary functionality and their insertion or re-insertion in relational and systemic landscapes.

5. A case in minor Venice

If we want to keep the population in the old town, we must ensure the habitability. In complex and stratified buildings seems easier keep the residence. Because they do not turn easily into Hotel. They are, however, layered and intersected over the centuries, and therefore difficult to restore.
In a very complicated case, in the figures, the owners did not know each other. And so the renters. The restoration seemed impossible and you could not constitute a Condo.
The fall of plaster in a very narrow street (calle), led the Commune to notify that the owners were obliged to make sure that the building had to be safe for passers, within 30 days. So they got to meet. And they discovered they were 34 owners with 24 properties in a real estate complex composed by 4 intersected blocks.
Many of them were residents, but many residents elsewhere (in other districts or cities), and these last owners rent out these apartments or use them as a second home. Under four roofs there are five staircases and twelve entrances, counting the two from the canal (Rio de la Madoneta). But even more heterogeneous are the properties and uses. An accommodation on the fourth floor north, left by a deceased old lady to a religious order, leaked water from the roof, and is not rented. Another, on the second floor west, is of a nice Chinese family, and none of the other owners knew them. Another apartment on the third floor east, has been converted into a Bed and Breakfast. Many are rented. Other are used as second homes, or owned and inhabited permanently by citizens of Venice. The ground floor is divided into several shops, along Calle de la Madoneta, and storehouses, and there is also the headquarters of a firm of restoration for buildings. The largest warehouse, currently vacant, which probably gave its name to the street from where you enter it, Calle del Magazen, is owned by two Venetian brothers, and it was the chocolate factory of their grandfather.



Fig. 1: Condominium in Calle de la Madoneta and Calle del Magazen. Ground floor with storehouses and shops (left), first floor and mezzanine for apartments (right).



Fig. 2: Condominium in Calle de la Madoneta. Fourth floor for apartments (left), floor of private garrets, related to the underlying flats, corresponding to the four roofs (right).

“Magazen” come from an Arabic word. Dar el Makhzen is, in Fez (Morocco), the name of the royal palace of the Merinids or Sultanate Palace. So you understand that in Arabic the word “makhzen” (storehouse, deposit, warehouse), is not as trivial as it is in Italian the word “magazzino” today. For this meaning in Arab language is more used “mojdouda” (storehouse, ..). On the other hand the word “makhzen” mean more properly shop, store. So in ancient times our Calle del Magazen was perhaps closer to the original meaning. The Venetians of the Middle Ages and the Renaissance were great merchants who were spread throughout the Mediterranean. The way of live in Venice in that time was very different from today. The “individuality”, with separate entrances even in accommodation for the poor people, that means many staircases, and the “comfort”, for which the bed is in first place, before any painting of any author, in the notary's inventories for inheritance, were characteristic of the late sixteenth century Venice, where wellness was very important at all levels of society.

«In 1581 the citizens were throughout 7,209 - less than a thousand more of the patricians - and accounted for 5.3% of the population.» [3] The patricians were about 6,500, or 4.3% of the population. [4] Out of a population approximately 168,000 inhabitants in 1563, there were only 9% of citizens and patricians, and only some of them will have been able to practice mercantilism.

Many of these people were not from old families with Byzantine palaces which had a “fondaco” (warehouse) on the banks of the Grand Canal in XI, XII and XIII centuries. The opened space with columns in the porch of the “fondaco”, along the shores, with the two side towers, would have disappeared in the following centuries, with the enlargement of the buildings on the upper floors. This “fondaco” continued inside the building with a T-shape to the so-called "portego da basso" or "portego de soto" (downstairs porch), compartment adapted to distribute the goods in the warehouses behind the front blocks (towers) on the ground floor of the building.[10] This had correspondence with the “portego de sora” (upstairs porch), which distributed the rooms as a large hallway or corridor and then became the salon of Renaissance palaces.

However, it is likely that those who did not own a warehouse, could resort to forms of association along the smaller canals, still close to the Grand Canal. And, anyway, there were minor palaces, owned by citizens and nobles, even along the inner shores of smaller canals. Probably our "Magazen" had a nature of this kind. The Calle de la Madoneta is closed at the first floor by a XIV-XV cenury arch eastward and at second floor by a gallery westward, with one room of the building over the street for three levels. This is the tipical shape of a courtyard of houses for people during XII-XIII c., but our building is surely built in XVII-XVIII c. for flats to rent. At least this is its typical shape. [10] And it was refurbished during XIX and XX centuries.

Was the Calle de la Madoneta a courtyard in ancient times? Was this street a closed courtyard between two twin buildings for popular residences, as surely was Calle del Paradiso in San Lio? The bridge de la Madoneta, leading to Campo San Polo, is crooked because it connects different courtyards that were born separated and, at some point in history, have been opened to the public passage and were joined diagonally? And last but not least, was the northern “calle” that we can see in the maps, the way of the

“magazen” to the Rio de la Madoneta that goes in Canal Grande? Has been this street closed to private use by the builders of the last block, in north-west side of our condo, in XVIII century?
If so, then, the courtyard of the existing building would be perpendicular to the previous system of courtyards and houses, and the wings of the building would have been rationally constructed with renovations and with successive overlaps above existing buildings. The fragment of the mezzanine shows, moreover, a building type in which the merchant, or the citizen of ancient professions ("apothecaries" or pharmacists, grocers, doctors and lawyers) had usually managed his own accounting and offices, between the store and the residence in the XIV and XV centuries. Is it a remnant of some previous structures, linked to the old “magazen”?



Fig. 3: The arch in Calle de la Madoneta with scaffoldings (left). The renovation of a flat of the condo, with a perplexed girl in the construction site (right). “Every restoration is also a destruction”: notice that you removed the ceiling plastered and the floor, which had very damaged.

Was the Magazen, that we deal with, the chocolate factory of our friends? And what about the strange corridor leading to some little private and irregular warehouses, and that conduces to the outside staircase in the court, useful to access to the first floor on west side, entering from east in Calle del Magazèn?
All these questions await an answer, that perhaps will never come.
What will be, however, is the desire of the people to renovate their homes. And this often contrasts with the laws, the regulations and, above all, with the lack of money and the difficulty in raising funds to finance the special law for Venice or to implement other tax relief.

6. Conclusions

At this time of writing, I confess, and I give up. One of the apartments is for my daughter, astonished and desolated in the photograph. But the final result was smashing.
However, the expense was considerable, even if the work were done carefully, avoiding to change what is already working. This is also a good way to preserve the aura of the past by not erase it with restorations too heavy. However, a good restoration in Venice costs on average between 1500 and 2000 euro per square meter. That is more than the new construction in the urban and peri-urban areas of the Mainland or the Lido. And the new intervention, we face as a condominium, to redo the plaster and part of the roof, it could add up to more than 400 000 euro. For some it might incur debts with mortgage loans with banks. The work was partially initiated, with the scaffolding to make the streets safer for pedestrians. I hope we can finish, as expected.
It is clear that adding up all the similar situations in the old town, which is very wide, we realize that the problem is not simple. Also because, often, it is not easy to constitute the statutory Condo, which would legally required above 8 condominium properties. So the typical individualism of the Venetians, and the Italians in general, emerges in the refusal to have a Director. As we mentioned in ancient times they used separate entrances in homes, even when they were part of large buildings, multiplying the doors of entry.
Every Italian city has its own problems. They are very different in climate, topography, ways to make of the population, form and materials used to build the homes. Venice certainly amplifies them most, and this

becomes significant, as the tip of an iceberg that for much remains submerged and that invests the ancient cities all over the country.



Fig. 4: The same apartment after the restoration, with old and new typical Venetian floors in slaked lime and characteristic furniture.

The ancient cities contribute to the tourist attraction to the gross domestic product of the country. But for this, like any resource, they can't be exploited without being regenerated. Nor can leave to the citizens the burden of facing alone the greatest difficulties of their maintenance, if compared to the contemporaries districts.
In the future it is unthinkable that historical centres isolated in a lagoon, in the middle of agricultural areas or on a mountain, can function as they once did, and how they did until now with great difficulty.
So that the restorations have a social and economic sense, that is able to make the structures of the city resilient in the long run, we must:
1 - avoid the isolation of the historical sites from the rest of society, avoiding the false claim of purity of their surroundings;
2 - integrate historical centres with contemporary cities and the new cores and new downtowns;
3 - support the restoration and the regeneration through appropriate contributions and remission of tax, regardless of the differences in income and class between the owners;
4 - revive the ancient materials and their modes of production and utilization, lowering production costs;
5 - improve public transport within the urban areas of more ancient origin, by implementing even in these metros and trams and reducing the traffic of cars;
6 - encourage in the old city the retail business and professional activities and services.
Of course not all remedies can be traced to these few sentences. The reality of urban planning in the Historical Districts of our cities, the policies and the governance of them are much more complex of these simple sentences. Nevertheless we must review the logics of the recent past, which have not given great fruits, even if they usefully have served the protection and the preservation. But this is not enough.
The memory of the ways of life in the old centres does not seem to be strong in the new generations. Perhaps it has always been so. But in Italy today there is a lot more effort than elsewhere to find a convergence between old and new models of life, perhaps because the old model of historic downtowns was very strong. That's why we need to restart from a few strategic points. Looking to the past, as we always did, but with a very strong glance to the future too.

Bibliographical References

[1] MACEK, Josef. Il Rinascimento italiano. (Translated by KUBISTOVA CASADEI, Hana. Edited by PERINI, Leonardo. Foreword by GARDIN, Eugenio). 2ª ed. Roma: Editori Riuniti, 1981. 454 p., at p. 78. (Italská Renesance, Praha, 1965). CL 63-0254-8.

[2] CIPOLLA, Carlo Maria. Storia economica dell'Europa pre-industriale. Bologna: Il Mulino (UPM), 1997 [1974]. 383 p. ISBN 88-15-05635-1.

[3] PALUMBO FOSSATI CASA, Isabella. Dentro le case. Abitare a Venezia nel Cinquecento. (Translated by GAGNOR, Gianmichele). Venice: Gambier & Keller, 2013. 327 p. (Intérieurs vénitiens á la Renaissance. Editions Michel De Maule, Paris, 2012). ISBN 978-88-96224-32-8.

[4] BELTRAMI, Daniele. Storia della Popolazione di Venezia dalla fine del secolo XVI alla caduta della Repubblica. Collana Ca' Foscari, Istituto di storia economica, 1. Padova: Casa Editrice Dottor Antonio Milani (CEDAM), 1954. 237 p.

[5] TREBBI, Giuseppe. La società veneziana. In: COZZI, G., PRODI, P. (edited by). Storia di Venezia, Dalle origini alla caduta della Serenissima, vol. VI, Dal Rinascimento al Barocco. Roma: Istituto dell'Enciclopedia Italiana «Givanni Treccani», 1994, vol VI, p. 129-213.

[6] MARIUTTI, Giulia. La legislazione speciale per Venezia e per la sua Laguna. (Alma Mater Studiorum - Università di Bologna). Bologna: Dottorato di Ricerca in Diritto Amministrativo, Ciclo XXI, coordinatore Franco Mastragostino, relatore Stefania Vasta, 2012. 151 p.

[7] AMOROSINO, Sandro. Il governo delle acque. La salvaguardia di Venezia: una storia amministrativa italiana. Roma: Donzelli Editore, 2002, 93 p. ISBN 88-7989-742-X.

[8] PEDROCCO, Piero. Principi di realtà e fantasia nell'urbanistica contemporanea (Principles of Reality and Fantasy in Contemporary Urban Planning). In AA.VV: Society, Integration, Education: Utopias and dystopias in landscape and cultural mosaic. Proceedings of Sabiedriba Integracija Izglitiba. Rēzekne: Rēzeknees Augstskola, 2013, vol III, p. 177-187. ISI (WOS) 000327802500016. ISSN 1691-5887.

[9] PEDROCCO, Piero. Riqualificazione urbana e territoriale attraverso la conservazione dinamica degli ambiti sanmicheliani. In AA.VV., CUSTOZA, Gian Camillo (edited by). Giornate di studi sanmicheliani. Securitas veneta ed architettura fortificata sanmicheliana: conoscenza, restauro, valorizzazione e recupero. Michiel da San Michiel circa il fortificar la Città di Udine e altri luoghi della Patria del Friuli. Verona: Knemesy, 2013, p. 205-227. ISBN 978-88-96370-12-4.

[10] TRINCANATO, Egle Renata. Venezia Minore. (New edition by BALISTRERI TRINCANATO, Corrado; BALISTRERI, Emiliano; ZANVERDIANI, Dario). Sommacampagna (Verona): Cierre edizioni, 2008. 464 p. ISBN 978-88-8314-460-8.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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HafenCity Hamburg

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Abstract
The contemporary city requires new strategic development guidelines that tend to curb urban sprawl, limiting the use of land, regenerating the existing reversing the processes of abandonment and decay, acting on the urban voids and disused structures. The sustainable re-use of parts of the city now abandoned, is an important opportunity for the development of the city itself.
Currently in Europe the largest urban regeneration operation is underway in Hamburg, Germany. The city, situated on the river Elbe, is the second most populous city in Germany after Berlin. The main port of northern Europe, had until the beginning of the nineties a development similar to that of other large European cities, spreading and incorporating several neighboring villages. The Hanseatic capital has taken a green turning in urban development policies, redeveloping brownfield sites and the most degraded neighborhoods, strengthening the network of public transport, of bike lanes, increasing green spaces open to the citizens, until you obtain, in 2011, the title of European Green Capital from the European Commission. HafenCity, this is the name of a great intervention of urban regeneration of a vast abandoned dockland area of 155 hectares in Hamburg. The project is the result of a complex process of consultation which was attended by planners, architects, institutions, political parties, universities, artists, experts in sustainability, energy management, urban traffic and various associations.

Keywords: regeneration, sustainability, city, Hamburg, HafenCity

1. Introduction
Urban regeneration is the starting point of the processes of structural change of the government of the city and territory and is one of the main drivers of the process of renewal of the policies of urban intervention.
In recent years have changed profoundly the dynamics of the development of European cities, cities in which demographic growth is reduced but are constant and in some cases are growing the processes of fragmentation and land consumption. However, the transformation of economic dynamics have caused the abandonment of large industrial areas or even port and commercial areas and the consequent formation of urban voids, areas that over time have become increasingly degraded. Hence the need to rethink the ways to design the city, taking advantage of the internal available areas and giving greater importance to green and public spaces.
New players, public and private, interacting with one another in coordinated actions, realize the regeneration intervening through new rules and new ways of interaction with the natural and built environment.
Urban regeneration is thus not only a structured intervention of urban and architectural planning, is a process of participatory planning, of mediation between the objectives of public and private interest, is an innovation process of intervention techniques and forms of political, economic and social cooperation, of overcoming the administrative and bureaucratic problems.

2. Hamburg
Hamburg, with its 1.8 million inhabitants is the second largest city in Germany after Berlin for the population and the first in Europe for per capita income.
Located at the point where the rivers Alster and Bille flow into the Elba, in northwestern Germany, Hamburg is a City State. It is crossed by a network of channels called Fleete and the city center is developed around two artificial lakes: Lake Binnenalster, and Lake Außenalster.

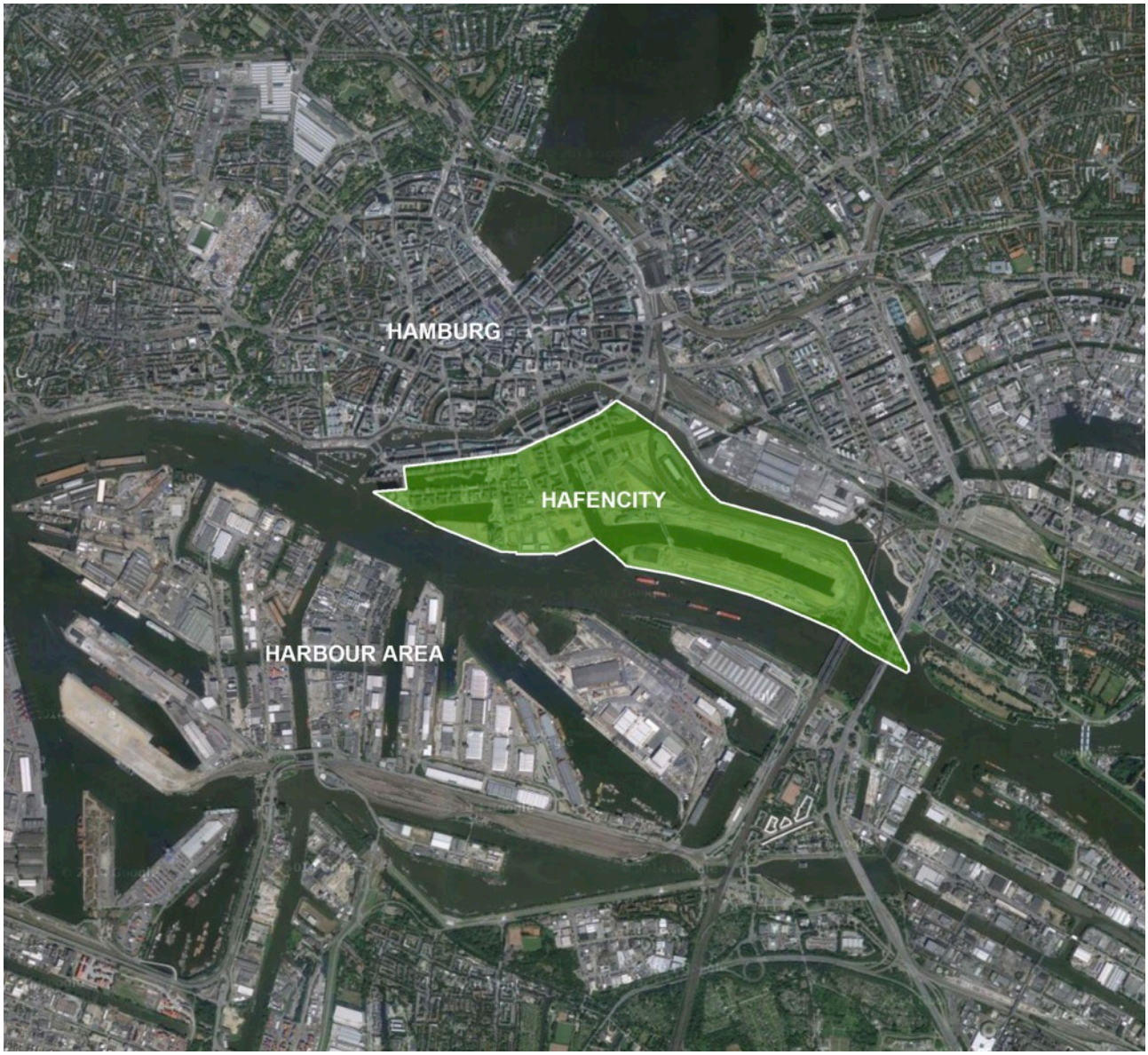

Fig. 1: Territorial framework

His wealth has built over the past two centuries, especially on heavy industry and trade, activities that have a strong influence on the quality of the development of the urban fabric. Until the nineties of the '900 the city had expanded enormously, until incorporate the small neighboring towns of more recent foundation. The port, from the middle of 800, had grown throughout the twentieth century, succeeding in covering a very wide area and become one of the most important in Europe.
At the end of the last century, however, the city has given a new direction to the urban development policies, a turning green implemented through the redevelopment of brownfield sites and most degraded neighborhoods, strengthening the network of public transport, the bicycle paths, increasing of public green spaces, today 20% of the city area, the use of renewable energy sources.
This green policy has allowed to obtain, in 2011 to Hamburg, the title of European Green Capital, for the assignment of which the European Commission considers twelve basic parameters:

1. Local contribution to global climate change
2. Local transport
3. Green urban areas
4. Sustainable land use
5. Nature and biodiversity
6. Quality of local ambient air
7. Noise pollution



Fig. 2: Neighborhoods

8. Waste production and management
9. Water consumption
10. Waste water management
11. Environmental management of the local authority
12. Communication strategy

Hamburg was also one of the first cities to sign the Covenant of Mayors, the main European movement that involves the local and regional authorities that agreed to increase energy efficiency and use of renewable energy sources in their territories, they want to reach and exceed the target of 20% reduction of CO2 emissions before 2021 .Today, CO2 emissions per person in the German city are been reduced by approximately 15% compared to 1990, with an annual energy savings of 46,000 MWh.

3. HafenCity

HafenCity, literally "port-city" is currently the largest intervention of sustainable urban regeneration in Europe. It is the project of recovery and reconfiguration of the original nucleus of the port of Hamburg, located south of the historic center, just a few hundred meters from it, a vast area of 155 hectares. The port, now the second in Europe for dimension, built from the mid-800, extends along the banks of the Elbe and has incorporated over the years some villages located on the shores of the river.
The project of HafenCity is the result of a complex work of cooperation in which they participated various



Fig. 3: Unilever headquarter (Photo G. Ruggiero)

stakeholders such as urban planners, architects, government agencies, political parties, citizens, universities, artists, and various associations.
The conditions of the process of ideation, design and realization of HafenCity are an exception, difficult to repeat in other cities of Europe and of Germany itself. The public ownership of soils and the public coordination of creative and executive process have allowed optimize and speed up the steps.
The project is managed by a company of transformation public that acts as a private company, the HafenCity Hamburg GmbH, which has among its tasks also the transparency of the entire process, the achievement of the goals imposed by the Municipal Administration, the control of the executive phase and management of the sale of the property.
The company uses a set schedule on short, medium and long term by building only what is actually required by the market, thus expanding the realization times from 10 to 25 years, avoiding financial risks for investors, ensuring quality of urban spaces and allowing the financing of the new port in the Altenwerder.
HafenCity, built where once there were silos and warehouses for the storage of the goods, is located less than a kilometer from the center of Hamburg and therefore the museums, the city hall, the railway station and other services are within easy walking distance. Viceversa this proximity to the city center will ensure the use of the services of HafenCity also by the citizens of the rest of Hamburg. Once completed in 2025, in fact, the city-port will be an addition of the nearby old town, in continuity with it for the dimensional scale and complexity, which is guaranteed by the presence of multiple functions and the quality and diversity of architectures, designed for competitions which were attended by important architecture studios.
HafenCity is therefore a natural addition of the historic center, a natural extension towards the Elbe river and a bridge towards south. The harbor area, until recently fenced and clearly separate from the city, it opens fully to the outside, giving back to Hamburg its important part, transforming an area off-limits in an integration project between north and south, between center and periphery, allowing you to move the barycentre of the city to the south.
The new city is designed to become a district of short distances, thanks to the creation of passages between buildings that allow cyclists and pedestrians to take shortcuts. While it is possible use the car in much of the



Fig. 4: HafenCity Universität (Photo G. Ruggiero)

area, on the other hand is given greater weight to the possibility of moving on foot, with about 70% of pedestrian paths entirely separate from driveways.
The plan for the regeneration of the port area, designed after several preliminary plans developed in the eighties, involves the construction of 5,800 homes and 40,000 jobs. Already in the fourth Hamburger Bauforum of 1989 was addressed the issue of transformation and reuse of the areas around the basin Sandtorhafen and in 1997 a feasibility study was prepared by a public commission for urban development, the environment, the economy and transport. This study is placed as a base for the urban competition organized between May and October of 1999, won by the German-Dutch grouping Hamburgplan / Kees Christiaanse / ASTOC. The winner masterplan was approved in February 2000 after being slightly modified in some parts. The main feature of the plan is its flexibility. The master plan, the fundamental part of the "method HafenCity", when necessary, can be modified by urban or architectural projects that define interventions in particular areas. The modifiability therefore guarantees the achievement, as effectively as possible, of the fundamental objectives, which are:

A. Continuity between the old town, new interventions and adjacent neighborhoods.
B. Social, architectural and functional mixitè.
C. Enhancement and use of typological characteristics of the port facilities, in particular their relationship with water.
D. Usability and the quality of public spaces.
E. Construction of pedestrian and cycle paths that promote accessibility and mobility between different areas.

After the selection of the master plan, have been called for the project of Elbphilharmonie, a Landmark of HafenCity, the Swiss architects Herzog and de Meuron, for the Science Center, the Dutch studio OMA of Rem Koolhaas, for the Hamburg-America Center, the American Richard Meier, for the Hamburg Cruise Center the Italian architects Massimiliano and Doriana Fuksas. Other important interventions have been entrusted to international architects who have elaborated projects able to dialoguing with the context



Fig. 5: Residences in Am Sandtorkai (Photo G. Ruggiero)

ensuring a high quality, achieved thanks to huge investments utilized, about 6 billion private and 2.5 billion public, these partially refinanced by the sale of same lots.These investments were followed by the arrival of important clients such as the multinational Unilever and The Spiegel Group, attracted by the ultramodern design of office buildings and the context particularly favorable. Greenpeace also decided to establish its headquarters here, and different public agencies and functions of particular public interest have settled in HafenCity, such as the University, which will bring about 2,000 students of architecture or the Elbephilarmonie that will be one of the most important concert halls in Europe and new landmark of the city. Citizens begin to live here or just to enjoy the new spaces created, attracted by a young and dynamic environment. The area of Oberhafen, the former district of deposits, has already attracted the attention of numerous artists while in the Übersee have opened boutiques and luxury restaurants.

4. Überseequartier

HafenCity adopts an urban plan based on module of the neighborhood and the dynamic articulation between open spaces and buildings, in fact it is divided into 13 neighborhoods interconnected to each other by paths, canals and bridges, and in each of which there are squares and terraces on the canals and between buildings. The different areas are currently not all finished, the development in fact will last until 2020-2025, resulting in the end, an dimensional increase of center of Hamburg by about 40%. The heart of the entire project of regeneration of the old port area is certainly Überseequartier, in part still under construction.

The neighborhood occupies an area of about eight hectares and are planned 270,000 square meters of built area on which to deploy the various functions to ensure proper mixitè, necessary to make the whole area a place on a human scale.

The buildings will have almost all height of six or seven floors as the nearby old town and as historic buildings, their planimetric conformation will be the block with an internal courtyard. Other buildings on the other hand will have greater heights, such as to make them panoramic points and new urban landmarks. A balanced social and functional mixture will be assured by a strategic choice and distribution of functions such as homes, offices, schools, restaurants, shopping areas, green areas. The new waterfront and the relation of open spaces and buildings with water, will assume a key role in this area as well as in the rest of HafenCity.



Fig. 6: Überseeboulevard (Photo G. Ruggiero)

The design of the external areas, with bicycle and pedestrian paths and squares has been entrusted to the Spanish BB + GG who gave great importance to the places for leisure and socializing. In Überseequartier have been placed other functions at the service of the entire city, as the Hamburg Maritime Center and the Hamburg Cruise Center. The center of the neighborhood is the Überseeboulevard, a pedestrian curvilinear street, defined by the continuous facades of buildings, on which there are shops, bars and restaurants, such as the shopping street Groβe Johannisstraβe in central Hamburg.

5. Conclusions

In conclusion, we can therefore say that HafenCity, with its neighborhoods already completed, others under construction or yet to be realized, is the greatest example of sustainable urban regeneration in Europe, able to transform, recover and enhance an important area of the city, improving the quality of living of the entire Hamburg.
An exceptional example of urban renewal, characterized by the quality of the method and management transparency, democratic participation in decision-making and flexibility of the master plan, modifiable according to the needs encountered during implementation of the interventions.
These are the main quantitative data useful to better understand the scope of ongoing actions:

A. Total area of interventions: 155 hectares, of which 126 on land and 29 of wet docks and canals.
B. Building gross area of approximately 2.27 million square meters of which: 676,000 for residences, 213,000 for commercial activities, 1,100,000 for offices, 285,000 for culture, research, hotels and leisure.
C. 5,800 apartments for about 12,000 inhabitants.
D. 40,000 new work places.
E. 10.5 km of footpaths.
F. 27 hectares for public car parks, squares and promenades.
G. 99% of the building lots of public property, controlled through HafenCity Hamburg GmbH.
H. Volume of investments: Private 6 billion, public 2.5 billion.



Fig. 7: Sandtorpark in Elbtorquartier (Photo G. Ruggiero)

Bibliographical References

[1] ABRUZZESE, Alberto, BONOMI, Aldo, *La città infinita*, Milano, Bruno Mondadori, 2004, ISBN 9788842496410.

[2] AUGE', Marc, *Tra i confini: città, luoghi, integrazioni*, Milano, Bruno Mondadori, 2007, ISBN 9788861590137.

[3] BECCHI, Ada, INDOVINA, Francesco, *Caratteri delle recenti trasformazioni urbane. Osservatorio città*, Milano, Franco Angeli, 1999, ISBN 9788846413635.

[4] FULVI, Francesco, *La sostenibilità come fattore di ripresa economica. Panoramica sui quartieri sostenibili in Europa*, *Gazzetta degli edili*, n.4. 2008.

[5] European Commission, Directorate General for Regional Policy, *Cities of tomorrow challenges, visions, ways forward,* Brussels, *2011,* ISBN 9789279213076.

[6] ICLEI, *Carta delle città europee per un modello urbano sostenibile*, Aalborg, 1994.

[7] http://www.hafencity.com

[8] http://www.pattodeisindaci.eu

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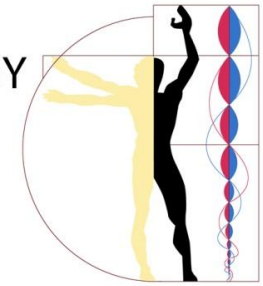

Survive the Saracoglu District - Saving the Architectural Heritage of Ankara

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Abstract
Today, urban and architectural heritage of metropolitan cities have been transformed by urban renewal projects in Turkey. Ankara is one of the cities that have been exposed to this rebuild process. Actually, the city, which is at the center of Anatolia was well planned when it was chosen as the capital of new Republic. In other words, Ankara located in the middle of Anatolian steppe was planned and built from scratch together with the establishment of the Republic. In the formation period, Saracoglu district (Namık Kemal District) built for the settlement of state employees is one of the most significant areas that stenghtens the new plan of Ankara. This district as one of the outstanding urban heritages of the Republican era is attempted to be destroyed by the way of urban renewal projects which are very popular attempts to shape the cities in nowadays construction industry in Turkey. At this point, the aim of this study is to emphasize the value of Saracoglu district for Turkish civil architecture and the city of Ankara. District is a treasure right in the center of the city with its fauna, natural environment, historical, cultural and architectural values. The objective is to ensure the preservation of the district by pointing to the several suggestions of social and professional organizations to keep the settlement alive and to prevent the destruction of collective memory.

Keywords: Saracoglu District, Republican period, Turkish civil architecture, preservation

1. Intoduction
The preservation and rehabilitation of the city centers and the historical settlements in these centers have been taken not much attention in the planning processes of the cities especially in developing countries. In fact for the definition of natural, historical and architectural settlements that have a certain value for its context and its community, several principles or guidelines were set and adopted by international organizations. These attempts have focused on the protection of cultural, historical and architectural heritage of towns or cities around the globe which are under several threats. However, besides the values having importance globally, each country has to keep its national heritage alive to sustain its own identity and national values. The responsibility of the countries is to make short and long term plans and to set principles for application within the framework of its own conditions. In the national basis, although Cultural and Natural Heritage Preservation Board has established and worked actively in Turkey, a comprehensive agenda can not be established to conservation and preservation of urban heritages. One of the settlements in which this situation can easily be observed is Saraçoğlu District (Namık Kemal District) in Ankara. The district was designed and constructed in the early years of the Republic of Turkey to provide residences for state employees in the new capital of the country. With its architectural design made by Paul Bonatz - a german architect, its siteplan layout, its location in the city center and its represented values, the settlement has unique character for not only architectural discipline but also the collective memory of the society. However, due to its location in the city center, this area has become a focal point in the arguments of urban renewal projects which are very popular attempts to shape the cities in nowadays construction industry in Turkey. Especially, after 2010, the demolition and reconstruction of area has occupied the agenda. Several arguments and counter-arguments have been mounted by different parties. In this framework, the aim of the study is

to remind the importance of Saraçoğlu District as an urban heritage of Ankara and thus to ensure that the area has been saved considering the public interest.
The study firstly expresses the atmosphere of the time when the Saraçoğlu District was designed and constructed for what kind of purposes. To feel the atmosphere is valuable to understand the meaning of the settlement. Study continues with the section explaining the basic characteristics and main features of the district. Afterwards, what kind of administrative decisions have been taken about the preservation or renewal of the district and how social and professional organizations have react are mentioned in the following section. The paper concludes with considerations on the need for the preservation of the district and expresses the revitalization approaches to survive the urban character and the everyday life of the community.

2. The atmosphere of the time

From 1923 to 1950s can be read as a construction process of a new state between Turkish War of Independence and Second World War, although Turkey was not a belligerent of the Second World War. The idea of establishing a new state dominated every discipline at that time. In other words, any kind of physical production sought for a national character which was not defined yet. Architectural approaches of the time followed a parallel ways that can be easily understood from the words of Sibel Bozdoğan: "What gives this period [1908–50] its coherence, its deep structure under the surface of visible stylistic shifts, is the strong political and ideological charge of architecture in the service of nation building. During this period, style was not an autonomous aesthetic realm. It was a powerful vehicle through which political leaders and professional architects sought to imagine the nation where it did not exist. This is a point frequently missed by architectural historians, who tend to divide the early Republican period into three stylistically defined phases: the first national style (Ottoman revivalism), the international style (the New Architecture), and the second national style (vernacular and classical references). These terms, which suggest a switching back and forth between the poles of a national-versus-international dichotomy, obscure the fact that regardless of changes in formal expression, nationalism was the driving force of Turkish architectural culture between 1908 and 1950" [1].
In this time period, especially after the late 1930s, the architecture of the time was defined through the third stylistic period that Bozdoğan repeated as 2nd National Style. There are two reasons why the driving force was again turn to a nationalistic conception. First one is the outbreak of the Second World War. The local construction industry and contemporary construction materials did not exist in the country. Nearly all materials and technology was imported from European countries. After the War, due to the interruption of imports, the country begun to use its own sources and made changes in the building code to provide the usage of the local materials and techniques. The limitation of this local sources evoked a recession in the construction sector. Only constructions to meet the state's needs were realized like housing for state employees and buildings of public institutions [2], [3], [4]. Besides the economical restrictions, the sociological restrains had effects on the heading towards the nationalism. The warfare surrounded the country led to the attempt to form a basis for national solidarity. The consciousness of national solidarity not only begun to enter economical and community life but also caused to form the architectural thought in the basis of nationalism [2], [3], [5].
The second reason is the growing importance of nationalism, which started in Europe, throughout the world since the early 1930s. The architecture was used to represent the power of the state in order to have an effect upon the community. This perspective begun to be harmonize with the revolutions of new republic that strengthen the Turkish national consciousness, therefore national approaches got off the ground in the architectural field [3], [6], [7]. Especially, the views of the architects on the housing of the period show that they interpreted the subject through the principles of populism. The design principle of housing is "to make a beautiful residential architecture" which is able to solve problems of people through design [8] by not only protecting the basic culture and traditions of user [9] but also taking advantage of new scientific and technical developments [10]. Therefore, the houses produced in limited number for state employees were appreciated through the original design of architect based on the values of its user, its context and its cultural environment.
Due to the financial bottleneck of the country after these wars, housing problem became more important than any other period. Even though state tried to solve the problems of planning and housing with several laws up to the 1930s, it could not become an actor in the production of housing due to the organizational ineptitude and economic insufficiency [11]. After 1930s, on the other hand, the state began the 'housing acquisition support' for its employees as a financier and also to prepare master plans for cities. Besides urban planning, housing production became one of the issues that the government begun to be concerned with; despite that the first examples were small-scale developments. Physical development of Ankara, declared as the new capital of the new state, and the surrounding cities followed a relatively more and fast improvement than other provinces. Together with the relocation of the government in Ankara, the housing demand of the top governmental officials tried to be compensated by these new public housing developments. In 1944, with the "Officer Housing

Law" numbered 4626, the Ministry of Public Works was authorized by attempting to construct houses for officials [5]. In the framework of national architectural approaches and new laws, one of the generated settlements is Saracoglu District. After taking a quick glance at the general characteristics of the period, to define the basic features of Saracoglu District is essential in order to perceive the importance of the area for the city, citizens and the discipline of architecture.

3. Saracoglu District (Namık Kemal District)

In Jansen plan, the old city center (Ulus) was connected to Çankaya with an axis (with a Boulevard). By placing Gençlik park, Güven park, Kızılay on this axis and green strips on the Atatürk Boulevard, Jansen tried to develop a system of parks in the city center. Kızılay was identified as the governance center of Ankara and "residential districts" were estimated at the both sides of Boulevard [12]. Saracoglu District was planned one of these residential districts at the west part of the Boulevard and very close to Güven Park. Area is surrounded by four roads (Müdafaa Road, Kumrular Street, Necatibey Road and Yahya Galip Road). Saracoglu District was designed by German architect, Paul Bonatz who came Turkey in 1944 and taught at the Faculty of Architecture in İstanbul Technical University between 1946-55. He designed and constructed many buildings in Ankara such as Saracoglu District and Technical Teacher Education School. His design intentions were mostly based on local traditions and national values. Thus, he easily found a convenient place for his designs in the architectural approach of the time. The construction of district begun in architect's first year in Turkey, some of the buildings were completed in 1945 and whole construction was ended in 1946. There are 75 adjacent blocks and 434 housing units composed of six types. Several types of units with their number of rooms and their planimetric variety enable a positive diversity for users.



Fig. 1: Location of Saracoglu District

This settlement has another positive characteristic about the position of the blocks according to the topography. Blocks have two, three or four floors and highest blocks were located at the highest point of the area. District was crowned by the tall buildings, whereas, two or three floor buildings were placed at the lower parts. Therefore, architect provided the best vista for every block [13]. Besides the topographic approach, the planimetric alignment of the blocks in the parcel is promising. Bonatz tried to apply Siedlung type of settlement which was district of houses with gardens developed for workers in Germany around 1920s and 30s [14]. The garden is also a key feature for Turkish architecture. In his essay *La maison Turque*, Sedat Hakkı Eldem wrote about the significance of garden as such: "The Turkish house, in fact, is first of all comfortable… wardrobes everywhere and for everything… fireplaces could be found in any room and for the coldest regions, plaster and ceramic tile stoves were housed in the wall niches and with the chimney outside. The attention to the comfort and the physical comfort went together with the need for a constant contact with nature. The love for nature, therefore for the garden, is innate in every Turkish, and the Turkish house must absolutely involve a part of nature…" [15]



Fig. 2, 3: Greenery in district [16].

In fact, in Ankara, districts formed by individual houses with gardens were practiced like Bahçelievler, Güvenevler and Tasarruf Houses. Contrary to the plan of individual houses, Bonatz designed row apartments in order not to sprawl to the site in Saracoglu Distict. Each block group was situated at the periphery of the parcels in order to leave the rest of the area to the green. The open spaces providing to gather residents were created by the help of courtyard like green areas. This approach strengthened the relations and thus led the formation of collective memory [5].
Besides the organization of blocks in the area, the inclusion of several different functions in the district except of housing blocks supports the Siedlung approach. District was composed of row houses, play garden, primary and secondary school, a social building which functions as a Public Library now, and an office building used as a District Governorship. These buildings were placed near Güvenpark, between housing blocks and city center. Therefore, a hierarchical order was created from public buildings through houses from public to private.



Fig. 4, 5: District Governorship and School buildings [5], [16].

When all this organization principles were considered, the layout of the district was considered to contribute the development of the city in existing architectural literature. As for the form of the buildings, common though was that the main design principles of the blocks were came from the image of Turkish house. In the façades, cantilevers of first floors designed like bay window, narrow rectangular windows, wide eaves and lattice patterned railings made from metal sheet were utilized to create a resemblance with Turkish house. Although the outside look sustained the national image, the interior organization was far beyond the traditional formation. Bonatz mentioned this dilemma that “every time, interior space was sacrificed to external volume in order to achieve to form a similar façade to the old Turkish house” [17]. The separation of interior and exterior became the key criticism for the design of the buildings. The incompatibility of the interior organization to the family life and the economic housing principles [13] caused the loss of raison d'etre of Turkish house and to reduce the conception only to the image. From a different point of view, although architect did not develop a new commentary to interior in the basis of traditional approaches, he proposed modern interiors by creating seperate rooms for every function [5]. Not only with its interiors, but also the block organizations with

open courtyards for citizens, he tried to create modern urban relationships between public buildings, public open areas, greenery and private housing settlement.



Fig. 6, 7: Housing Blocks [18].

Saracoglu district is a unique settlement in terms of its location, its design principles and the values represented. It has a capacity to revive the city center which has been dilapidated by mostly trade utilization. Furthermore, the settlement is one of the first examples of the civil architecture of Republican period that represents the formal state authority. Thus, it is regarded as one of the most significant architectural heritages of Republican period. This district has several potentials to survive the center by protecting public welfare and to preserve the national heritage.

4. Studies for Preservation of the District

Saracoglu District has a privileged position in both architectural literature and also in political and governmental discourse since its establishment. After 1980s, the capacities of the cities enlarged by increasing production volume in construction sector in the light of the adoption of neoliberal politics. As asserted in the urban management literature, central governments have tried to correlate themselves with global economy through cities, especially through city centers [19], [20]. In Turkey, the importance of city center has been taken on a new significance after the earthquake in 1999. The existing built environment, especially the old settlements has to be questioned after this disaster. The renewal projects begun in 1980s have changed its scale after 2000s. City centers have become construction sites where old settlements have been reproduced under the name of urban transformation. Saracoglu District is at the center of this new discussions and applications. In this part of the study, the administrative and structural decisions about the district and the counter arguments are tried to be traced.

1979_ District was determined as “First Degree Urban Protected Area” by decision numbered A-1610 of Board of Real Estate Antiquities and Monuments High Council. Furthermore each of the houses and trees in the site were registered separately.

1993_ With the decision numbered 2877 of Ankara Cultural and Natural Heritage Preservation Board, the area was determined as “Second Degree Urban Protected Area” and the boundaries of the protected area were defined.

1994_ The government of the time tied to make a law about selling the state lodgings. Saracoglu District was in the status of state lodgings and that law was going to affect the district directly.

1994_ The campaign against the initiative of selling the district was run by Ankara Chamber of Architects and the President of the Republic veto the bill.

2002_ Ankara Chamber of Architects was prepared a project named “Building Identity and Inventory Project”. The main objective of the project is “documenting the architectural history and culture of the city Ankara” [21]. The inventory of Saracoglu District was taken and thus “the architectural identity card” of District was prepared.

2005_ The inventory of district was turned to a publication and exhibited in national and international mediums not only to express the contextual importance of area but also to strengthen the place of the district in collective memory.

2009_ Ankara Chamber of Architects produced suggestions for the area and expressed city dreams about the area in their manifest named “Stop the Sultanate”. In the manifest, suggestion for the area was described as: “Kızılay becomes a cultural and art center; the inner streets of Kızılay are pedestrianized; the pollution of signs is ended; the tram line is installed. . . . The Houses in Saracoglu

District are arranged as dorms for students and artists. Kızılay becomes a place, which lives day and night, and thus comes alive" [5].
2010_ Building Identity Meeting was organized on Saracoglu District in Ankara Chamber of Architects to find a place for district in the urban and public agenda.
2013_ The area of Saracoglu District was declared as "area under disaster risk" according to the Law on Transformation of Areas Under Disaster Risk by the decision of Council of Ministers numbered 2013/4248. The law came into force in May 2012. By the law, anywhere in the city, the transformation of buildings or settlements seen as risky for disasters was legitimized. Law removes all legal obstacles for destruction and forcibly evacuation of buildings sequestered in order to be transformed. Furthermore, it deactivates the laws which stipulate the protection of natural, cultural heritages and environmental values.
2013_ Ankara Chamber of Architects and Chamber of Urban Planners sued against the risky area decision. The aim of the counter claim is the removal of the protection shield of the district by the declaration of risky area, although each of the houses and trees in the district were registered separately.
2013_ State Council reversed the judgement of Council of Ministers about the identification of Saracoglu District as an area under disaster risk.
2013 March_ Ankara Chamber of Architects run a national idea competition named "City Dreams". Main aim is to introduce new ideas for the build and natural environments having spatial and contextual characteristics in Ankara and to help the reformation process of the city. Furthermore, by the competition, the goal is to gather all actors in the city to participate in the project processes on Ankara. The working area of the 8th stage of this competition was determined Saracoglu District with the thought that the need of preservation and socialization of the area having significant role on formation and evolution of a new capital.
2013 July_ The results of the competition were released and shared with the community.
2013 September_ The results of the competition were presented to the President of the Republic.
2013 September_ After meeting with the president, Ankara Chamber of Architects, Ministry of Environment and Urban Planning and Ankara Chamber of Commerce came together and begun to work cooperatively for shaping the future of district. Main objective of the future decisions is to preservation of district and preservation of public usage by not making any demolition in the area.
2013 November_ The tripartite meetings were ended by the new declaration of Council of Ministers. Council again proclaimed the district as "area under disaster risk".
2014 January_ As in 2013, history repeats itself. Ankara Chamber of Architects and Chamber of Urban Planners sued against the decision of the Council.
2014 August_ Together with the new decision promulgated in official gazette, all allocations of the area was removed to impart the district to the economy and Ministry of Finance, TOKİ and Privatization Administration was primarily authorized by making projects in the district. The decision means that a public space which is one of the cultural and architectural heritages of the Republican period is going to sell to the private sector initiatives only for providing resources for the state budget.
2014 October_ Ankara Chamber of Architects, Ministry of Environment and Urban Planning and Ankara Chamber of Commerce again came together and reach an agreement to organize a national idea competition for the future of district and its surrounding.
2014 November_ State Council reversed the judgement of Council of Ministers for the second time. The legislative intention was "the area has not any qualification of an area with risky buildings; there is not enough determination about this issue; however, in the determinations made show that necessary conditions were not occurred to be declared the district as risky area; the identified shortcomings are deficiencies that can be corrected".
2014 December_ A workshop was organized by Turkish Associations of Architects, Creative Initiative and Architectuur Lokaal named as Elephant Cage in Ankara. The aim of the workshop was to create a dialog ground and to make collaborative designs for existing planning problems for understanding the interior dynamics of spatial planning processes in Turkey and Holland. The case investigated in Turkey was Saracoglu District. The five architect groups from Turkey and Holland worked on the area and tried to develop ideas about the future of district. The timing of the organization was critical to increase the public participation and awareness about the transformation process of the area.

5. Conclusion

After 1980, financial sector became more prominent when compared with other production sectors including the formation of built environments. The dominance of the financial sector, technological improvements and the rapid developments of communication tools have become to modify the structure of construction sector. The political ground and administrative decisions have been formed by approaches that value market conditions above everything, thus it can be observed that some public rights have fallen into the hands of private sector [22]. A parallel attempt can easily be realized through the approach of administrative level to the residential area at the center of the city -Saracoglu

District. By giving all authority on the future of the area to Ministry of Finance and Privatization Administration indicates that the area is privatized; thus, district is reshaped through the acquisition of income rather than the public interest. However, the area formed in the first dates of the Republic and it is one of the primary applications of the city formation process. Furthermore, it is the first mass housing area produced by state and a rare residential settlement of Republican period. As a crown property, district has unique characteristics with its design principles, architectural typology, cultural and natural landscape, public spaces and functional organization; and area is still inhabited by urbanites. In addition, the area is seen as a common heritage of Germany and Turkey. Due to the architectural design of the settlement by a German architect, Gothe Institut and Chamber of Architects have worked on the area to survive this unique common heritage. In the basis of society and public interests, protection of historical and cultural values, natural and architectural heritages is obligation of governments. In this context, professional chambers and several associations of architects have been struggled since especially 2013 to rebound the area to the city. Only one solution can be realized for the area. That is the preservation of the area without demolishing any of buildings or uprooting a single tree. District which is a treasure with its fauna, natural environment, historical, cultural and architectural values, has to be preserved for the livability of city and collective memory. Without Saracoglu District, city losses its center composed of a library, a school, a residential area, a public park with huge greenery and old trees, briefly city losses its 70-year memory.

Bibliographical References

[1] BOZDOGAN, Sibel. *Modernism and Nation Building: Turkish Architectural Culture in the Early Republic*. Seattle: University of Washington Press, 2001. p.294.

[2] ALSAÇ, Üstün, İkinci Ulusal Mimarlık Dönemi. In HOLOD, Renat, EVİN, Ahmet, ÖZKAN, Süha, *Modern Türk Mimarlığı*, Ankara: Chamber of Architects Publication, 2007, p. 99-108.

[3] SAGSÖZ, Ayşe, MİDİLLİ SARI, Reyhan, ELMALI ŞEN, Derya, AL, Selda. 1938-1960 Yılları Arası Cumhuriyet Dönemi Türk Mimarlığı. *Turkish Studies,* 9/10, 2014, p. 941-955.

[4] SARIOĞLU, Mehmet. *"Ankara" Bir Modernleşme Öyküsü (1919-1945)*. Ankara: Republic of Turkey Ministry of Culture Publication, 2001.

[5] BAYRAKTAR, Nuray. Bonatz'ın "Türk Evi" Sevgisinin Biçimsel Aktarımı: Saracoglu (Namık Kemal) Mahallesi. *Arrademento Mimarlık*. İstanbul: Boyut Publication, 2011, p.66-76.

[6] ALSAÇ, Üstün. *Türkiye'deki Mimarlık Düşüncesinin, Cumhuriyet Dönemindeki Evrimi*. Trabzon: KTÜ Faculty of Construction and Architecture, 1976.

[7] SÖZEN, Metin. *Cumhuriyet Dönemi Türk Mimarlığı*. Ankara: Türkiye İş Bank Culture Publication, 1984.

[8] ÜNSAL, Behçet. Ar ve Memleket Mimarlığının Kronolojisi Üzerine Düşünceler. *Arkitekt*, 6, 1935, http://dergi.mo.org.tr/detail.php?id=2&sayi_id=48, Accessed at March 23, 2015, p. 182-187.

[9] KOZANOĞLU, Abdullah Ziya. Köy Evleri Proje ve Yapıları İçin Toplu Rapor. *Arkitekt*, 7-8, 1935, http://dergi.mo.org.tr/detail.php?id=2&sayi_id=75, Accessed at March 23, 2015, p. 203-204.

[10] ERKAN, Seyfettin. Amele Evleri, İlkokul, Mutfak ve Çamaşırlık Binası. *Arkitekt*, 9, 1935, http://dergi.mo.org.tr/detail.php?id=2&sayi_id=82, Accessed at March 23, 2015, p. 253-258.

[11] SEY, Yıldız. Cumhuriyet Döneminde Konut. In SEY, Yıldız. *75 Yılda Değişen Kent ve Mimarlık*. İstanbul: Tarih Vakfı Publication, 1998. p. 273-300.

[12] YAZMAN, Derya. Planlı Geçmişten Plansız Geleceğe, 2.Jansen'in Ankara İmar Plan. *Arkitera.* 2009. http://v3.arkitera.com/news.php?action=displayNewsItem&ID=46008, Accessed at March 23, 2015

[13] SAYAR, Zeki. Saracoglu Mahallesi. *Arkitekt*, 3-4, 1946, http://dergi.mo.org.tr/detail.php?id=2&sayi_id=71, Accessed at March 23, 2015, p. 56-59.

[14] TEKELI, İlhan, Almanca Konuşan Plancı ve Mimarların Erken Cumhuriyet Dönemi Ankara'sının Planlaması ve Konut Sorununun Çözümüne Katkıları Üzerine. *Goethe-Institut.* 2010. http://www.goethe.de/ins/tr/ank/prj/urs/geb/sie/trindex.htm, Accessed at March 23, 2015.

[15] ACCIAI, Serena. La maison turque. *Firenze architettura,* 1, 2012, http://issuu.com/dida-unifi/docs/fa2012-1, Accessed at March 23, 2015, p. 96-101.

[16] Web: http://www.mehmetakinci.com.tr/ankara-saracoglu-mahallesi-ve-kent-dusleri.html

[17] URAL, Somer. Türkiye'nin Sosyal Ekonomisi ve Mimarlık, *Mimarlık*, 1-2, 1974, p. 5-7.

[18] Web: http://www.goethe.de/ins/tr/ank/prj/urs/geb/sie/sar/trindex.htm

[19] MCGUIRK, Pauline, M. Neoliberalist planning? Rethinking and re-casting Sydney's metropolitan planning. *Geographical Research,* 43, 1, 2005, p. 59-70.

[20] SALET, Willem. Rescaling territorial governance in the Randstad Holland: the responsiveness of spatial and institutional strategies to changing socio-economic interactions. *European Planning Studies,* 14/7, 2006, p. 959-977.

[21] Web: http://www.mimarlarodasiankara.org/index.php?Did=6016

[22] NEWMAN, Peter, THORNLEY, Andy. Fragmentation and centralisation in the governance of London: influencing the urban policy and planning agenda. *Urban Studies*, 34/7, 1997, p. 967-988.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
Aversa, Capri 11-12-13 June 2015

"School Project EXPO 2015": LANDesign BREEDING-GROUND Salerno

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Abstract
As part of the concrete actions of the Research Group [Landesign®: Ali-ment-action / diaeta Mediterranean] (Head of science prof. Sabina Martusciello Prof. Maria Dolores Morelli) Department of Architecture and Industrial Design "Luigi Vanvitelli" Second University of studies of Naples with the Department of Pharmacy, University of Salerno, the Directorate-General MIUR Campania, the Garden of San Lorenzo of the Second University of Naples in collaboration with the Department of Education of the town of Salerno, has been banned Competition [diaeta Mediterranea: landesign / Ali-ment-azione® - NURSERY SALERNO] FOR EXPO 2015 for schools of all levels in the town of Salerno, to support, promote and disseminate the chain-University Scuola Aziende-through entities CONCRETE ACTIONS redevelopment of abandoned spaces (external or internal) of the schools of all levels: for example, a green fallow converted to garden or orchard and / or an interior space unused prepared for new use. Schools in synergy with university students will also present projects of Ali-Ment-action in response to the issues and objectives of Expo 2015. The results of the Competition [diaeta Mediterranea: landesign / Ali-ment-azione® - NURSERY SALERNO] FOR EXPO 2015 will be on display from May in the Italian Pavilion which has chosen the entire Project Research Group as the face of the School Project.

Keywords: Keywords, no more than five (Arial – 10 pt – Lower case letters – Justified)

The applied research project [Mediterranean Diaeta: LANDesign/Ali-ment-azione]® is testimonial of "School Project Expo 2015" and "University for Expo 2015"; it has got a special mention of MiBACT and OSCAR GREEN prize by Coldiretti. Moreover, the committee has contracted a Memorandum of Understanding with MIUR Campania and achieved results will be disclosed into Italian Pavilion for EXPO 2015 in Milan.
From 2011 till today, reached outcomes underline: the participation of 1.120 over graduates; the acceptance of 350 schools at every levels and 18.000 involved students in 450 workshops; 20.000 people which take part to the recovery of abandoned spaces into scholastic structures; 220 scholar areas changed in SHORT ORTI (vegetable gardens) with 200.000 square meters of modified ground; 880 days dedicated to educational project; 500 prototypes realized inside the food chain.
The applied research project [Mediterranean Diaeta: LANDesign/Ali-ment-azione]® is a scientific and multidisciplinary platform fixed on the feeding meant (according to Italian lexicon) in the action of de-composition than re-composition about three necessary ingredients for an healthy and food habit: Wings – immaterial component and/or evocative element made of memory, colors, emotions, woven into Mind which organizes, articulates and makes us aware about that we eat with the mouth, the eyes, the ears, the nose, the body; finally there is the Action as an essential manner to pro-mote and to diffuse our achieved results thanks to the synergy of all actors involved in this virtuous process.
The aim is supporting an open and permanent dialogue with the schools, the consortiums, the companies, the associations of agro-food sector or of green economy promoting and divulgating Mediterranean lifestyle as expression of an identity where the territory is the plot meanwhile the climate is the warp, as a basket of primary stuff (water, salt, fish, grain, olive tree, vegetables, milk, honey, grapevine) proposing a development model based on cultural, social, historical, culinary, food, environmental, landscape qualities necessary to the publishing of a real food culture through a systemic approach careful to the products, to the subjects and to their linked relations.

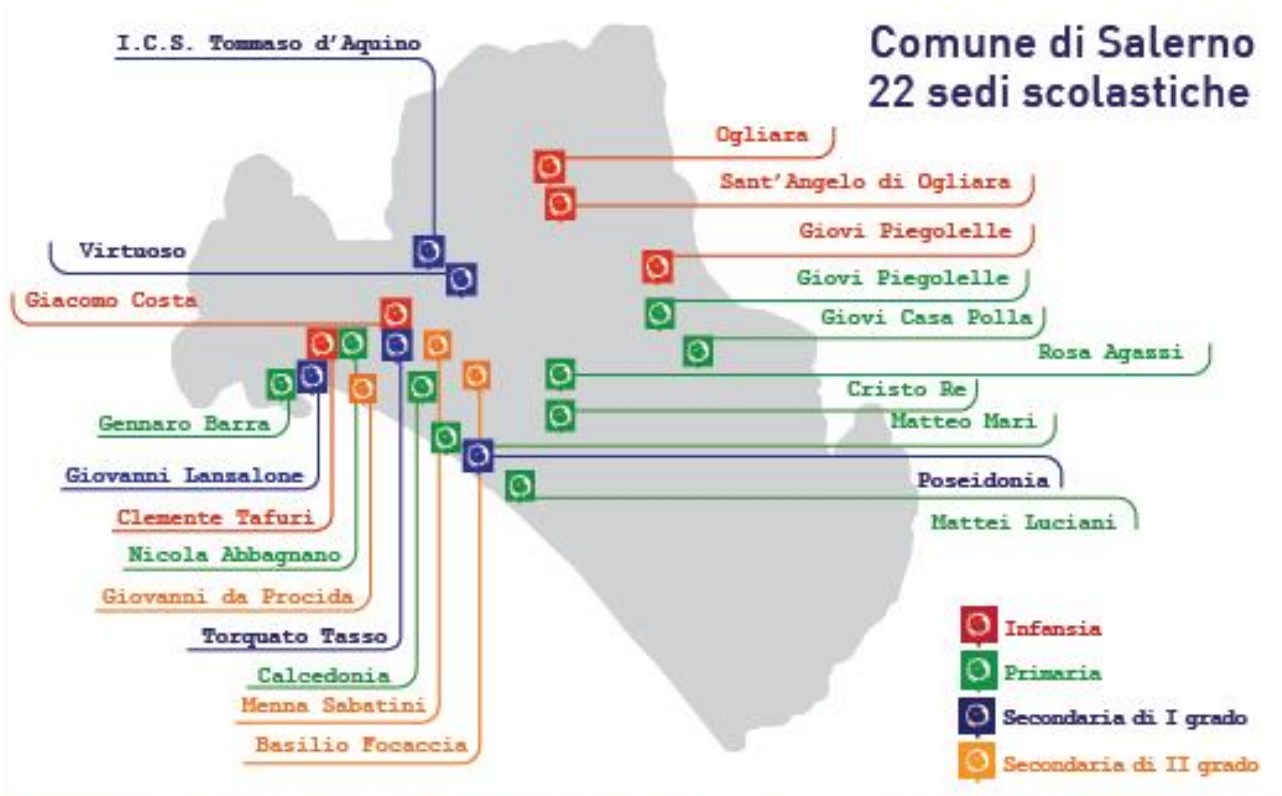


In range of concrete actions of the applied research project [Mediterranean Diaeta: LANDesign/Ali-ment-azione]®, the Department of Architecture and Industrial Design Luigi Vanvitelli, Second University of Studies Naples with the Department of Pharmacy, University of Salerno, General Committee of MIUR Campania, the Orto of San Lorenzo, SUN, in synergy with Salerno' Public Educational Department, has declared a contest, called Mediterranean Diaeta: Landesign/Ali-ment-azione® - Breeding Ground Salerno for EXPO 2015, addressed to the schools at every levels in Salerno to support, promote and disclosure the chain University – School – Company – Authority for food projects answering to the themes and the purposes of Expo 2015.
All educational institutes have subscribed to competition announcement [Mediterranean Diaeta: LANDESIGN ALI-MENT-AZIONE]® Breeding Ground Salerno for EXPO 2015: 22 headquarters (from preschool to secondary school) localized in different urban sites, from peripheral areas to no longer used industrial ones until to the schools into historical center, realizing, inside the walls of their buildings, a vegetable garden-orchard and/or recovering an abandoned inner spaces (technological greenhouses) or

participating with cross activities inclined to the re-development of outside places (murales or decoration for example) to structure a virtuous chain, a branched system of cultural transmission that it can be identified in the logo Breeding Ground Salerno

This hard but wonderful work, lately honored with special prize IQU 2015 (urban innovation and quality) proclaimed by Maggioli, has been presented to the contest “Biennial festival Public Space 2015 – A journey into the districts of best practices” published by INU and CNAPPC where a scientific and multidisciplinary team has worked together in a systemic way. Thegroup is composed by scientific supervisor, : Prof. Sabina Martusciello, Prof. Maria Dolores Morelli, Prof. Carmine Gambardella, director of Department of Architecture and Industrial Design, SUNA, Prof. Luca Rastrelli, manager of LICA Laboratory, University of Salerno, Prof. Paola Capone, professor of Modern Art History and Graphic Arts, UNISA, with Prof. Eva Avossa, Public Educational Assessor in Salerno, scholastic managers, teachers, over graduates, students, families and companies.

From the “Doctor Orto” to the ’“Orto of the Smile”, from the ’“Orto of the Sun” to the “Orto of the generations”, from the co-design of children with three years old to eighty grandparents with an high civic sense together to scientific and municipal components, the companies, It is involved a real and authentic breeding ground activity. So, the chance has been, not only the recovery and the promotion about a significant environmental heritage in order to reduce the consumption of territory in contrast to expansion culture of constructed spaces, but also the design and the prototype of fashion and art objects (food design stuff, educational games, ecological dresses and jewels, etc.) originated by this chain Ali-Ment-Azione to reflect, share, draw, make, divulgate human and thing resources heritage. This is true action of LANDesign ®.











EXPO
MILANO 2015
NUTRIRE IL PIANETA
ENERGIA PER LA VITA







Orto delle generazioni





La nostra scuola paritaria "Cristo Re", gestita dalla cooperativa sociale "Disegniamo un sorriso", ha la fortuna di essere ubicata in una zona centrale della città di Salerno ma, allo stesso tempo, ancora ricca di verde. In particolare i due plessi scolastici, relativi alla scuola primaria e a quella dell'infanzia, sono circondati da 6000mq di terreno in parte attrezzato come aree di gioco all'aperto, in parte lasciato come boschetto; il rimanente destinato ad agrumeti, frutteti e orto. Ormai già da diversi anni, per favorire il contatto con la natura e i suoi prodotti, il rispetto dell'ambiente attraverso la sua conoscenza e la pratica di sane abitudini alimentari, la scuola svolge attività di cura e gestione di un grande orto scolastico "l'orto incantato" composto da dieci vasconi adibiti alla coltivazione di verdure, ortaggi e piante aromatiche. Quest'anno, in occasione del progetto EXPO 2015, la scuola ha deciso di implementare maggiormente non solo il suo spazio destinandone circa 20mq ai fiori, ma anche ampliando i soggetti coinvolti in tale esperienza. Infatti, oltre alla fattiva partecipazione degli alunni della sez. Primavera, della Scuola dell'Infanzia e Primaria, le educatrici, i docenti, il progetto ha coinvolto genitori, nonni e esperti del settore. Tanto che lo spazio dedicato alla realizzazione del progetto è stato rinominato "l'orto delle generazioni". I bambini hanno vissuto attraverso una serie di azioni concrete diversi momenti significativi che hanno scandito l'intero percorso progettuale. L'esperienza è cominciata nel mese di ottobre con la piantumazione di insalate di varie tipologie e bulbi di piante aromatiche come sedano e cipolle; nel mese di novembre, insieme a genitori e nonni, hanno raccolto quello precedentemente piantato e seminato semi e bulbi di diversi fiori (girasoli, amaranto, iris e tulipani); attraverso un calendario settimanale ogni classe della scuola primaria aveva il compito di andare a verificare la crescita, provvedere all'innaffiatura se necessaria e soprattutto ad estirpare le erbacce; tutti i cambiamenti sono stati annotati su un "diario di bordo" mentre le esperienze fissate attraverso disegni, foto e filmati. Prendendo poi spunto dalle 5 finalità suggerite dall'oggetto del concorso, ogni classe ha elaborato un prodotto materico che concretizzasse le esperienze sensoriali suggerite (ascoltare, gustare, …): la classe I ha raccolto tutte le erbe aromatiche e le piante odorose che ha trovato nel giardino, nell'orto e nel boschetto della scuola realizzando una bacheca con sacchetti e scatoline per esporle; la classe II ha creato una simpatica filastrocca sull'insalata; la classe III una storia ; la classe IV ha realizzato un plastico per approfondire la tematica dei rifiuti rilasciati in terreni coltivati; la classe V studiando la stratificazione del suolo ha costruito un plastico. L'osservazione nell'orto ha consentito ai bambini di conoscere anche l'ecosistema del suolo attraverso l'incontro con grilli, lombrichi, chiocciole e mantidi religiose.

Lali ment azione landesign

responsabili scientifici
Prof. Sabina Martusciello
Prof. M. Dolores Morelli

DIFARMA

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Prof.ssa Paola Capone
Prof.ssa Enrica De Falco

studenti
Rosaria Parisi

Ministero dell'Istruzione dell'Università e della Ricerca
Ufficio Scolastico Regionale per la Campania

Cristo Re

dirigente
Manrico Gesummaria
plesso
Cristo Re
grado
Infanzia-Primaria
indirizzo
via Moscani
popolazione scolastica
152
classi coinvolte
I-II-III-IV-V; 2-5 anni
alunni partecipanti
152
referente progetto
Prof.ssa Paola Auletta

comune
Salerno
assessorato
alla pubblica istruzione
dott.ssa Eva Avossa
azienda
Alpega

EXPO S ITALIA



Orto corto 4

popolazione scolastica 150
alunni coinvolti 75
spazi esterni 10691 mq
orto corto 520 mq

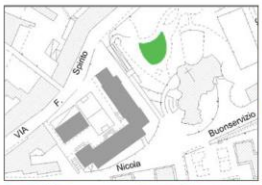
Alunni partecipanti

Barrella Attilio, De Mattia Bruno, Di Lascio Alfonso, Di Pasquale Antonia, Enciu Oricchio Flaminia, Gentile Ylenia Anna, Gesummaria Stefano, Lamaida Eros Maria, Lombardi Salvatore, Luise Flavio, Paolillo Renato, Perera David Atilio, Poto Francesco, Proto Salvatore, Risi Gennaro, Santoro Raffaele, Sica Francesco, Venutolo Alberto, Vitolo Gianluca, Ansalone Francesco, Bove Giammarco, Giordano Francesca, Lavita Pierfrancesco, Lambiase Maria Rosa, Paganini Martina, Pessolano Gaetano, Roscia Marco, Tafuri George Biram, Vicinanza Franco, Alfano Chiara, Concilio Francesco, Cotugno Gianfranco Maria, Domini Federico Rocco, Falcone Gaia, Luise Dario, Magaldi Ryan, Magrini Matteo, Manzione Serena, Miozza Alessandro Eloy, Nunziante Cesaro Delia, Risi Eleonora, Rulli Gabriele, Ventre Antonio, Annunziata Raffaele, Aspino Alessia, De Pascale Giulia, Di Fiuri Giorgio, Di Mango Carmelo, Fiorillo Giulia, Gerbasio Angelo, La Vita Carla, Lomolino Nicholas, Malatesta Francesca, Moscariello Adriana, Parnese Benedetta, Porzio Federica, Porzio Matteo, Puca Raffaella Maria, Santoriello Gianpiero, Santoro Emanuele, Saracino Camilla, Volpe Gabriele, Annunziata Martina, Baldi Dario, Cortese Raffaele, Di Domenico Giovanni, Di Ruccio Noemi, Giordano Bruno Lucio, Lombardi Raffaele, Macchiarulo Angelo, Montemurro Giulio, Omero Giuseppe, Rizzo Francesco, Rulli Giuseppe Maria, Russo Roberto Maria



Doctor Orto







l'Istituto ha partecipato al Concorso Progetto Diaeta Mediterranea Landesign/Ali-ment-azione- Vivaio Salerno per Expo 2015 rivolto alle scuole del comune di Salerno che prevedeva facendo leva sulle sane abitudini alimentari e comportamentali di proporre un'idea-progetto di riqualificazione di uno spazio abbandonato della scuola. Essendo il nostro Istituto ubicato a ridosso della villa comunale di Fratte abbiamo preso in adozione una aiuola di tale villa e abbiamo sviluppato li la nostra idea-progetto. A questo punto per dare concretezza al nostro progetto abbiamo istituito un gruppo operativo coaudiuvato dagli studenti della 2° Università del Dipartimento di Architettura e Disegno Industriale all'interno del quale le attività sono state articolate un seminari e laboratori. Hanno partecipato al progetto gli alunni della 2° e della 3° della scuola secondaria di primo grado. Per l'idea da realizzare i partecipanti si sono ispirati alla storia della Scuola Medica Salernitana rielaborando il tutto . Hanno fatto accurate ricerche sulle piantine che potevano essere benefiche all'organismo ripercorrendo i passi della scuola di medicina più conosciuta del mondo occidentale. Insieme agli studenti dell'Università hanno disegnato nell'area individuata la sagoma di un omino. All'esterno gli operatori del Verde Pubblico hanno tagliato il prato in eccesso mettendo in evidenza il corpo dell'omino. Si sono costruite quindi delle cassette nel nostro laboratorio di falegnameria e colorate all'esterno si sono posizionate fuori dall'omino per piantarvi le nostre piantine salutari che sono state collocate in direzione degli organi le cui patologie esse vanno a curare . E quindi insieme all'associazione Alpega ,che gratuitamente ha messo a disposizione le sue competenze ,sono state piantate il rosmarino, il peperoncino,il finocchio,la scarola e la cipolla. Lo scopo di tale progetto è stato di ampliare le conoscenze sul mondo dell'alimentazione e il fine benefico di alcune piante officinali . I ragazzi non avrebbero potuto immaginare che piante di uso così comune potevano essere anche così salutari e hanno concordato nel dire che il progetto si è rivelato molto formativo e senz'altro da oggi in poi hanno capito come mangiare in salute e tutelare il diritto ad una alimentazione sana e necessaria per tutti gli abitanti della terra.

Lali ment azione landesign

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I. C. S. Tommaso d'Aquino

dirigente
Dott.ssa Annalisa Frigenti

plesso
San Tommaso d'Acquino

grado
Secondaria di II grado

indirizzo
via Nicola Buonservizi

popolazione scolastica
285

classi coinvolte
IIa-IIIa

alunni partecipanti
43

referente progetto
Prof.ssa Marina Martinelli

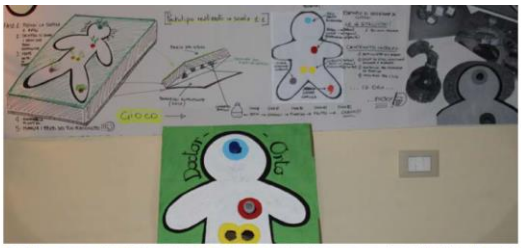
comune
Salerno

assessorato
alla pubblica istruzione
dott.ssa Eva Avossa

ente
Verde Pubblico

azienza
Alpega

ITALIA







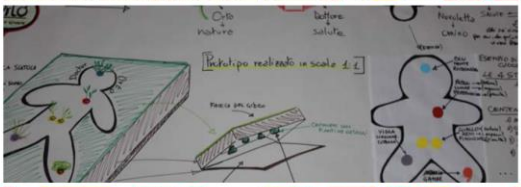


popolazione scolastica 285
alunni coinvolti 43
spazi esterni 2058 mq
orto corto 210 mq













Gioco Design

Alunni partecipanti

Bizzantino Aniello, Bonadies Giulia, Buondonno Asia,Canoro Francesca Pia, Carbonaro Marianna, Carleo Antonio, Casella Sara, Cuccurullo Elena, Cueto Homer, De Maio Alfonso Marco, Di Gilio Gerardo, Formisano Annamaria, Liguori Barbara, Mancusi Francesca, Manzo Margherita, Mulinaro Gianmarco, Palmieri Giuseppe, Romano Martina, Russo Barbara, Senatore Vittoria, Sessa Eros, Sica Ludovica, Torraca Dante, Dell'Università Giovanni, Ferro Andrea, Giordano Matteo, Giordano Pietro, Guarracino Marika, Izzo Manuela, Landi Davide, Liguori Antonella, Mele Flora, Perrelli Carla, Pezzuto Michele, Pizzano Marco, Rivera Trejo Josuè Daniel, Rizzo Giovanni, Sabatino Andrea, Sangiovanni Antonio Cristian, Saviello Paola, Sellitto Noemi,Vicinanza Ilenia,Vlad Timeea Gabriela



HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
Aversa, Capri 11-12-13 June 2015

"Universities for EXPO 2015": LANDesign in Mostra d'Oltremare

Sabina MARTUSCIELLO[1]
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Abstract
As part of the concrete actions of Research Group [Landesign®:ali-ment-azione/Diaeta Mediterranea] - Head of Science Prof. Sabina Martusciello, Prof. Maria Dolores Morelli, Department of Architecture and Industrial Design Second University of Studies Naples, Department of Pharmacy University of Salerno, General Manager of MIUR Campania, the Garden of San Lorenzo SUN - in Overseas Exhibition of Naples from the month of May 2014 - was established the chain University + School + Institutions + Companies. The Overseas Exhibition "Mostra d'Oltremare", purified from the ideological apparatus, is one of the most successful examples of Littorian Architecture in Europe, 720.000 square meters made up of a heritage trees and buildings protected by the Ministry of Cultural Heritage and Activities. The Research Project Team has recovered historical vegetable garden - orchard, redeveloped the building located into the Cedars Garden with a experimental intended use: as a place for disclose wings – mind - action (ali-ment-azione) through the five senses plus one, the good way, hybrid actions between creativity (wings) science (mind) and food (action). Diaeta (Diaeta is a part of roman house for welcome, relationships), il "Mediterranean Kiosk" hosts exhibitions, performances, seminars and International Interuniversity Master [Mediterranean Diaeta: LANDesign/ali-ment-azione] ®. This project has been chosen as testimonial "University for EXPO 2015" and the goals will be shown in Italian Pavilion for the acceptance to the theme "Feeding the Planet, Energy for Life".

1. Introduction

The applied research project [Mediterranean *Diaeta*: LANDesign/Ali-ment-azione]® (Scientific Directors: Prof. Sabina Martusciello, Prof. Maria Dolores Morelli, Department of Architecture and Industrial Design Second University of Naples and the Department of Pharmacy University of Salerno, testimonial "University for Expo 2015" and "School Project Expo 2015", special mention MiBACT, third prize winner "ARS-ART which realizes social employment" Contest by Accenture' Italian Foundation, prize "OSCAR GREEN" by Coldiretti to spread local culture, its regeneration and its traditions answering to the memo of MIUR "Guidelines for food education in Italian school" (n°7853 of 14/10/11) and to regional law n.6 of 30/03/12, Recognition of Mediterranean Diet, Unesco' immaterial heritage. In May 2015, It has got the second prize by POLI. Design of Polytechnic Institute in Milan for "New and innovations format of pizzerie" an International Contest of Design with the participation of 187 projects come from 12 countries of the world. In the same month the Project has got the prime special prize for "partecipated Design" by Contest IQU Innovation and Urban Quality.
The goals from 2010 to may 2015 are:
1,280 university students
18,000 scholars at every levels involved in laboratories
350 schools involved of Campania
450 esplorativ educational laboratory on ali-ment-azione
20,000 students involved in the "orti corti"
220 outdoor spaces of the schools recovered as "orti corti"
20,000 square meters recovered
980 days dedicated to the educational project
500 prototypes of the design students on ali-ment-azione



landesign

alimentazione®

risultati 2010/2015

1280 studenti universitari

+

18.000 allievi coinvolti nei laboratori

:

350 scuole aderenti della Campania

x

450 laboratori didattico-esplorativi

+

20.000 allievi coinvolti negli "orti corti"

x

220 spazi recuperati come "orti corti"

= 200.000 mq recuperati

980 giorni dedicati al progetto educativo

500 prototipi sul tema

1.2 Mediterranean Kiosk

The stand is situated in the Cedars Garden within Monumental Overseas Exhibition of Naples and represents the practical action of the applied research project [Mediterranean Diaeta: LANDesign/Ali-ment-azione]®.

The Mediterranean Kiosk provides Mediterranean cuisine and pizzeria, from farm to fork at km 0,048 (the walking-distance of a snail in one hour). It's a call to eating, walking, living, in a slow way, to re-establish a new focus on gestures and values shadowed by the hyperactivity of a consumer and fluent society.

In the Kiosk, the topic is feeding and nutrition, not only from the organic point of view but also from the poltical, ethical and intellectual way. Nutritional education and foods resources are the main theme also for the design students.

The interaction, between undergraduates and scholars at every levels, actives a virtuous process about edible food awareness towards an holistic approach.

Inside a civilized and human community, eating isn't only a biologic need to feed and nourish themselves but also a cultural need: eating by choosing and cutting down the usages in regard to the world and its resources. Starting from didactic experiential reflection, it's possible to investigate a real dimension lighted up of anthropologic and ethic features.

Furniture solutions are diversified from 0 to 101 years, using revolutionary and sustainable materials and technology; hailing the children, we have recycled boxes and frames of regional garden centers later changed in stackable seats and tables measured depending on the age. For the adults, we employ wavy cardboard' furniture resulting from the transformation regional pulping mill of Formaperta characterized by foldable elements certificated FSC®, COC® e EPD®.

Mediterranean Kiosk is a replicable format, like an activity of virtuous chain in accordance with 3F plus 3E (form, function and feasibility + economy, ecology and emotion) linked to the food: the users become co – makers and co – designers declinable in every different places, to publicize the value of the food, the culture and local products. The food is culture when is produced, when is prepared, when is savored (M. Montanari).

The pizza, a boomerang of water and flour, colors and tastes, memory and perfumes, custom and sounds, piennolo (it is a grape tomato grown in Campania in particular near Vesuvio) and passion, is the symbol of hybrid actions between creativity (wings), science (mind) and food (action).

The Kiosk is configured like a Mediterranean diaeta, in other words as a space of roman house designed for the hospitality and relationship, a place where we spread the pizza' culture, we organize exhibitions, landesign seminars, didactic and creative workshops about agriculture, food and cuisine for the International and Inter-academic MASTER [Mediterranean Diaeta: LANDesign/Ali-ment-azione] ® e-ducating to the feeding of five senses plus one, good sense.



CHIOSCO MEDITERRANEO

PIZZERIA E CUCINA CON PRODOTTI STAGIONALI NEL RISPETTO DELLA DIAETA MEDITERRANEA A KM 0,048*

* DISTANZA PERCORSA MEDIANTE DA UNA LUMACA IN UN'ORA

ORTO D'OLTREMARE

LE VERDURE, GLI ORTAGGI, SONO RACCOLTI QUOTIDIANAMENTE NEL NOSTRO ORTO RECUPERATO NELLA MOSTRA D'OLTREMARE.

CUCINA MEDITERRANEA

IL CHIOSCO E' UNA DIAETA MEDITERRANEA: DIAETA E' LO SPAZIO DELLA CASA ROMANA DESTINATO ALL'ACCOGLIENZA, ALLE RELAZIONI, ALLA CONDIVISIONE DEL CIBO.

CULTURA DELLA PIZZA

BOOMERANG DI ACQUA E FARINA, COLORI E SAPORI, MEMORIA E PROFUMI, RITO E SUONI, PIENNOLO E PASIONE.

DEGUSTAZIONI & LABORATORI

AZIONI PER EDUCARE ALL'ALI - MENT - AZIONE DEI CINQUE SENSI PIU' UNO: IL BUON SENSO.

DESIGN

MOSTRE, PERFORMANCE SEMINARI "DAL CUCCHIAIO ALLA CITTA'" RECUPERANDO L'INVITO DELLA CARTA DI ATENE 1933.





CHIOSCO MEDITERRANEO, PIANTA E PROSPETTO LATERALE.
GIARDINO MONUMENTALE DEI CEDRI MOSTRA D'OLTREMARE



Progettisti Sabina Martusciello | Maria Dolores Morelli
chef Salvatore Genovese | *chimica degli alimenti* Luca Rastrelli
con la pennellata del maestro Francesco Pernice

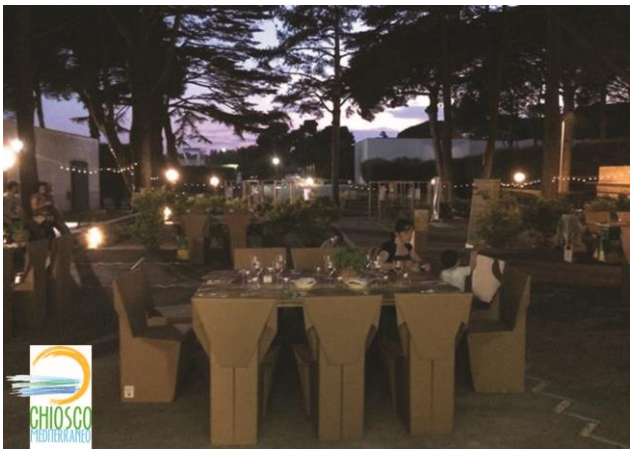
Gruppo di lavoro Antonello Vitolo | Carmela D'Ambrosio | Rossella Bicco
Fabrizio Solla | Miriam Gioiello | Giuseppe Sepe

Sezione di appartenenza ☑ OPENING ☐ CONCEPT

PREMIO 5 stagioni
CONCORSO INTERNAZIONALE DI DESIGN PER PROGETTARE IL FUTURO DEI LOCALI PIZZERIA
NUOVE APERTURE, SPAZI E CONCEPT INNOVATIVI

In collaborazione con POLI.DESIGN Consorzio del Politecnico di Milano


CHIOSCO
MEDITERRANEO


CHIOSCO
MEDITERRANEO


PIZZERIA
E CUCINA MEDITERRANEA
A KILOMETRO 0.018*
CHIOSCO
MEDITERRANEO
CUCINA
MEDITERRA
CULTURA
DEGUSTAZIONI
ORTO
D'OLTREMARE
DESIGN
CHIOSCO
MEDITERRANEO


CHIOSCO
MEDITERRANEO

ORTO D´OLTREMARE

CHIOSCO MEDITERRANEO





MOSTRA D´OLTREMARE
Isola delle Passioni

CHIOSCO MEDITERRANEO **ESTATE**
DALL´ORTO AL CHIOSCO
LA PIZZERIA E LA CUCINA DELLA MOSTRA D´OLTREMARE
(presso la fontana dell'esedra, nel giardino dei cedri)

PROGETTO SCUOLA EXPO MILANO 2015 IO CI SONO

ITALIA EXPO MILANO 2015

ali® ment azione

landesign

DIPARTIMENTO DI ARCHITETTURA E DISEGNO INDUSTRIALE SUN

MINISTERO DELL'ISTRUZIONE DELL'UNIVERSITA' E DELLA RICERCA UFFICIO SCOLASTICO REGIONALE PER LA CAMPANIA

MOSTRA D´OLTREMARE



passioni

università + scuola + impresa

responsabili scientifici
del Progetto di Ricerca Applicata
Prof. Sabina Martusciello
Prof. Maria Dolores Morelli

SABATO 10 MAGGIO 2014 ore 9,30 > 12,30
Isola delle Passioni
MOSTRA D'OLTREMARE NAPOLI, RISTORANTE DELLA PISCINA

Premiazione
CONCORSO NAZIONALE PER LE SCUOLE di ogni ordine e grado
[diaeta mediterranea: landesign/ali-ment-azione]

ore 9.30 Cerimonia di premiazione dei progetti vincitori e selezionati
... e i semi, i fiori, i frutti si mescoleranno agli strumenti, in particolare
setacci e tamburi e arricchiranno una piccola storia musicale di Napoli
concerto della Nuova Orchestra Scarlatti

ore 12.00 Inaugurazione dell'Orto di San Lorenzo Oltremare
con i bambini delle scuole partecipanti al Concorso

SUN L'Orto di Sanlorenzo

TerraOrti FORMAPERTA sabox Alpega legacoop Alessandro Scarlatti





FONTANA DELL´ESEDRA
ORTO D´OLTREMARE
CHIOSCO
GIARDINO DEI CEDRI + MEDITERRANEO
TEATRO E AUDITORIUM MEDITERRANEO

Progettisti Sabina Martusciello | Maria Dolores Morelli
chef Salvatore Genovese | *chimica degli alimenti* Luca Rastrelli
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Gruppo di lavoro Antonello Vitolo | Carmela D'Ambrosio | Rossella Bicco
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Sezione di appartenenza
☑ OPENING
☐ CONCEPT

PREMIO 5 stagioni
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PROGETTARE IL FUTURO
DEI LOCALI PIZZERIA
NUOVE APERTURE, SPAZI E
CONCEPT INNOVATIVI

In collaborazione con POLI.DESIGN Consorzio del Politecnico di Milano


CHIOSCO
MEDITERRANEO


CHIOSCO
MEDITERRANEO

1.3 International Interuniversity Master [Diaeta Mediterranea: LANDesign /Ali-ment-azione] ®

The MASTER is promoted by the Department of Architecture and Industrial Design of Second University of Naples, Department of Pharmacy of the University of Salerno, Facultad de Ciencias Forestales Agrarias y la Universidad National de la Plata (FCAyF-UNLP) Buenos Aires, European Community, Overseas Exhibition of Naples, Italo-Latin American Society of Ethnomedicine (SILAE), Legacoop, MSC cruises, Sabox Sustainable Packaging, with support of PADIGLIONE ITALIA EXPO 2015, "UNIVERSITIES 'FOR EXPO 2015" with administrative seat at Department of Architecture and Industrial Design SUN.
The Scientific Committee is formed by teachers and professionals with different skills, from design to medicine, from pedology to food chemistry, agronomy from the economy, from marketing and wine.
This Master is aimed to the training of the first EXPERTS IN MEDITERRANEAN DIETAE. Like the “diaeta” - a space in the Roman house for reception and relationships - the Master is the place for reformulating the relations between man and environment, food and health, land and design, content and container, as well as for scientific research and innovation to develop services and products of food production chain: ali-ment-azione® = ali (literally “wings”): creative ingredient + mente (literally “mind”): scientific ingredient + azione (literally “action”) : productive ingredient.
Through an innovative educational model [landesign/ali-ment-azione] and by a multidisciplinary approach, participants will be trained to the management of the food production chain in its formal and functional, medical and nutraceutical, wine and food and culinary, anthropological and symbolical, ecological and emotional aspects. The resulting products will be useful to implement new distribution and sale circuits and supports.
The Master is theoretical-practical with visits and exercises at agricultural holdings and food companies, and fashion design, marketing and communication.
Participants will acquire the title of EXPERT IN DIAETA MEDITERRANEA, which is aimed to employment in food, nutraceutical, gastronomic, design, fashion, tourism companies as well as to the setting up of new agricultural and green economy enterprises.
Like the “diaeta”, the space of the roman house designed to reception and relationship, theInternational Interuniversity Master [diaeta mediterranea: landesign/ali-ment-azione] of the Department of Architecture and Industrial Design SUN and of the Department of Pharmacy UNISA is the place of re-formulation of the relationships between man and environment, food and health, land and design, content and container, of the research and scientific innovation for the development of products and service of the food production chain: [ali-ment-azione] ali = creative ingredient + mente = scientific ingredient + azione = productive ingredient.
The Master is a response to the teaching and training EXPO 2015 claim as great emergency: AAA Architecture Food and Agriculture will therefore be presented in Milan EXPO Italy Pavilion on 28 June 2015 and the opening ceremony is always made to EXPO Italy Pavillon on 16 October, a World Food Day.

CUCINA MEDITERRANEA

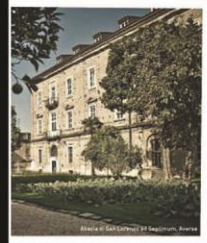
CHIOSCO MEDITERRANEO

PROGETTO SCUOLA EXPO · ITALIA EXPO MILANO 2015 · Dipartimento di Architettura Disegno Industriale | SUN · Ministero dell'Istruzione dell'Università e della Ricerca Ufficio Scolastico Regionale per la Campania · FORUM

landesign

16 ottobre 2014 ore 9:30>12:30
Giornata Mondiale dell'Alimentazione
Palazzo dei Congressi, Mostra d'Oltremare Napoli

ali® ment azione





Nell'ambito delle Celebrazioni Ufficiali Italiane per la Giornata Mondiale dell'Alimentazione (World Food Day-GMA) che quest'anno ha come tema l'agricoltura sostenibile e familiare, il MIUR CAMPANIA e il Dipartimento di Architettura e Disegno Industriale Seconda Università degli Studi di Napoli promuovono di concerto con EXPO 2015 Padiglione Italia la "Giornata ali-ment-azione 2014"

Saluti
CARMINE GAMBARDELLA
Direttore Dipartimento di Architettura e Disegno Industriale | SUN
LUISA FRANZESE
Direttore Ufficio Scolastico MIUR Campania
ANDREA REA
Presidente Mostra D'Oltremare di Napoli

LANDesign ali-ment-azione
SABINA MARTUSCIELLO | M. DOLORES MORELLI
Responsabili Scientifici del Progetto

EXPO 2015 PROGETTO SCUOLA
PATRIZIA GALEAZZO
Project Manager "Vivaio scuole" Padiglione Italia -Expo 2015

Intervengono
LUCA RASTRELLI
Direttore Laboratorio di Idrologia e Chimica degli Alimenti | UNISA
SALVATORE GENOVESE
Chef Coordinatore ali-ment-azione
PIERLUIGI PECORARO
Consigliere Ordine Nazionale Biologi
LEONARDO MASSA
Commercial Manager Italy Spain and Portugal MSC Crociere
EMILIO FERRARA
Direttore OP Terra Orti
MASSIMO PELOSI
Vice Presidente LEGACOOP Campania
ALDO SAVARESE
Presidente Rete Packaging Sostenibile

Contributi
MARCO EHLARDO
Referente ActionAid Campania
FRANCESCO LANGELLA
Coordinatore Laboratorio Regionale "Città dei bambini e delle bambine"

I dirigenti e i docenti interessati di tutte le Istituzioni scolastiche della Regione Campania sono invitati a partecipare

CHIOSCO MEDITERRANEO

e' un'azione concreta del Progetto di Ricerca Applicata

[diaeta mediterranea: landesign/ali-ment-azione]®

del Dipartimento di Architettura e Disegno Industriale della Seconda Università degli Studi di Napoli e del Dipartimento di Farmacia dell'Università di Salerno. Il Chiosco e' una Diaeta Mediterranea:
diaeta è lo spazio della casa romana destinato all'accoglienza, alle relazioni ed alla condivisione del cibo,

attraverso **l'esperienza con la terra: l'orto e i prodotti della dieta mediterranea**



Mostra d'Oltremare, Ristorante della Piscina, 1940





MOSTRA D'OLTREMARE
CHIOSCO MEDITERRANEO

GIOVEDI' 24 LUGLIO
PESCE FRITTO AL CHIOSCO

+ENTRÉE DELLO CHEF
+VARIAZIONI DI FRITTURA DI PESCE AZZURRO
+INSALATINA A KM0
+CALICE DI VINO IN ABBINAMENTO
+DESSERT

SIAMO NELLA MOSTRA D'OLTREMARE

Progettisti Sabina Martusciello | Maria Dolores Morelli
chef Salvatore Genovese | *chimica degli alimenti* Luca Rastrelli
con la pennellata del maestro Francesco Pernice

Gruppo di lavoro Antonello Vitolo | Carmela D'Ambrosio | Rossella Bicco
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Sezione di appartenenza ☑ OPENING ☐ CONCEPT

PREMIO le 5 Stagioni
CONCORSO INTERNAZIONALE DI DESIGN PER PROGETTARE IL FUTURO DEI LOCALI PIZZERIA
NUOVE APERTURE, SPAZI E CONCEPT INNOVATIVI

In collaborazione con POLI.DESIGN Consorzio del Politecnico di Milano

CULTURA DELLA PIZZA

CHIOSCO MEDITERRANEO



Etichetta delle conserve di pomodori realizzate nel Chiosco Mediterraneo e certificate dal laboratorio LICA dell'Università degli Studi di Salerno



"il cibo è cultura, quando si produce, quando si prepara, quando si gusta."
(M. Montanari)

Dall'Orto d'Oltremare alle papille gustative

l'Orto è ubicato nell'area denominata "giardino storico" della Mostra d'Oltremare.
I prodotti coltivati sono utilizzati nella pizzeria.

↓

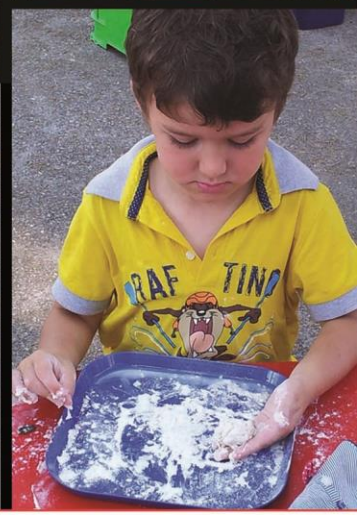
alla pizza km 0,048

(0,048 km/h è la velocità media dela lumaca)

con la direzione gastronomica dello chef Salvatore Genovese.







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DEGUSTAZIONI & LABORATORI

CHIOSCO MEDITERRANEO



PIZZE MEDITERRANEE & Laboratori Ali-ment-azione

Lunedì ORTO IN MOSTRA vendita, in cassette, dei prodotti stagionali dell'orto.
+ COOPERATIVA TERRA ORTI

Martedì LA SALUTE VIEN MANGIANDO degustazioni e serate culturali " alimenti & salute". Il percorso degli aromi e dei sapori e le caratteristiche organolettiche degli alimenti. Le spezie e il mediterraneo. la cucina degli stati latino-americani. + SILAE SOCIETA' ITALO-LATINO AMERICANA DI ETNOMEDICINA

Mercoledì SAPERE/SAPORI presentazione e vendita sul tema " Agricoltura, Alimentazione, Landesign"

ali® ment azione

Giovedì MASTER laboratori di cucina per il MASTER INTERNAZIONALE INTERUNIVERSITARIO [Diaeta Mediterranea]

Venerdì DESIGN in MOSTRE presentazione dei progetti degli studenti di Design e Comunicazione SUN sul tema agricoltura, alimentazione.

Sabato/DOMENICA IL PANIERE DELLA DIETA MEDITERRANEA eventi per la promozione, degustazione e vendita dei prodotti della Dieta Mediterranea. +LEGACOOP







Progettisti Sabina Martusciello | Maria Dolores Morelli
chef Salvatore Genovese | *chimica degli alimenti* Luca Rastrelli
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DESIGN

CHIOSCO MEDITERRANEO













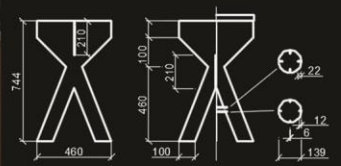

PIZZA-IN-PIEDI
Tavolino ricavato da quattro fogli di cartone a doppia ondulatura. Nel rispetto dell'ambiente, gli elementi sono incastrati e il piano d'appoggio è il contenitore da asporto per pizze.
Le proprietà del cartone permettono un'elevata modularità.
(Design by Michele Rinauro)

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HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
Aversa, Capri 11-12-13 June 2015

The influence of colours on the sound environment perception

Virginia PUYANA ROMERO[1], Giuseppe CIABURRO[1], Luigi MAFFEI[1]
(1) Department of Architecture and Industrial Design, Second University of Naples, Abazia di S. Lorenzo, Aversa, Italy
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giuseppe.ciaburro@unina2.it
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Abstract
The human perception of the environment is influenced by the colours. They can arouse a positive or negative response to the stimuli, so as to affect the behaviour of the subjects or compromise their performance. An appropriate combination of colour visual stimulation can improve the attention ability and develop the cognitive skills contributing to the multisensory perception of the environment.
The relationship between noise annoyance and the appraisals of spaces characterized by different chromatic composition has been dealt with in several research studies. The discussions are based on the assessment of the effects of disturbance caused by environmental noise perceived in indoor (transports, rooms...) and outdoor areas (urban, rural ...).
Different approaches to the association between colour and sound environment have been evaluated in this research work in order to show an overview of the literature written in recent years.

Keywords: colour perception, audio-visual interaction, sound environment, noise annoyance

1. Introduction
The nervous system integrates the information received from the different sensory modalities (such as sight, sound, smell, touch, taste and self-motion) and interprets them. The multisensory nature of perception makes it difficult to evaluate the contribution of each sensory modality in the interpretation of a specific stimulus. Instead of considering the contribution of all the sensory modalities, the cross-modal perception assessment is a simplified approach that involves the interactions between two or more different sensory modalities [1]. Although the research on cross-modal perception is widely spread in some fields, there is still a long way to walk in order to get a better understanding on the brain's process of organizing and interpreting information from sensory experiences.
The audio-visual interactions are recently being studied in applied acoustics and more specifically, the effect of colours on the sound perception. The studies are intended to evaluate the perception of a specific sound or sound environment in relation with the colour of the object that produces it or the atmosphere in which can be heard. Laboratory tests are used in most of these studies in order to verify the influence that a specific colour has for example on the perception of the sound produce by a mean of transport [2],[3],[4] or a source of renewable energy [5]. The tools most frequently used in these tests are audio registrations and visual materials (photos or videos) or Immersive Virtual Reality scenarios [5],[6].
From Goethe's theory of colour there have been many researchers that have tried to explain the influence of colours in relation to many performance and affective processes. The theories developed based only on visual stimuli can be the base to understand some of the cognitive processes implied in the audio-visual interaction. The objective of this article is to show an overview of different research studies about visual perception and audio visual interaction in relation with the colours.

2. Visual perception

Colours can arouse a positive or negative response to the stimuli, so as to affect the behaviour of the subjects or compromise their performance. Two different approaches can be considered from the point of view of the colour evaluation; the colour as a descriptor of certain features or emotive states, and the colour as a tool used to arise a reaction, emotion or to affect performance.

Diverse disciplines as advertising, commerce, physics or psychology have tackled the perception of colour from a theoretical or empirical point of view. In architecture and urban design, the colours have been the leitmotif of many research works and interventions. Kandinsky and Klee focused their investigations on abstract surfaces of solid colours [7]. Itten however defended the use of colour as words within a language, and the perception of the colours as the comprehension of the language through the interaction between the words. He also investigated the figure-background relationships as the combination of proportion and shape with some colour features such as opacity, brightness, intensity or saturation [7]. As Goethe did, Itten also developed a colour wheel (Fig.1). Together with Albert Munsell's colour system are examples of organized colour ranges that are still used nowadays.



Fig. 1: Goethes' colours wheel (left), Johannes Itten's colour wheel; Farbkreis (center) and Munsell colour system (right)

Regarding Itten's research works there is a correspondence between the proportions of the golden section and the gradations for the three basic colours. The neoplastic artist Van Doesburg however remarked the role of colour in modelling the whole space [8], and as Mondrian did, defended the conception of a building into a type of art in which the aesthetic asceticism was the balance in the colour-form composition. [7]

Colours are also present in the investigations on urban design. Marcolli for example suggested that the perceptual phenomena related to colour was manifestation of a colour-space topology. He developed his theoretical and practical contribution into four different areas; physiology, physics, chemistry and symbolism [7].

In psychology and scientific applied literature the perception of colour has been tackled from different perspective. In empirical works the need to decrease the number of factors that can affect the results, evaluating for example a unique context or using a small colour range, makes it difficult to extrapolate the outcomes to other situations or features rather than the evaluated ones. Furthermore, the results of the evaluation of the same parameters in similar conditions are not always equivalent among the different research works, and even sometimes they are contradictory.

A review of the environmental colour impact upon the human behaviour carried out by Nurlelawati Ab. Jalil et al.[10] analyse 40 studies from 1964 till 2011 and gather them on the basis of the main topic. Four categories emerge from the studies evaluated in that research, namely emotion assessment, performance evaluation, physiology assessment, and actual or made up scenario. The research works about the emotional assessments, study the effects that the colours of the context or of specific objects have on the emotional state of a subject. For the evaluation of the emotion assessment, the main instruments used were the Profile of Mood States (POMS), the original Multiple Affect Adjective Check List (MAACL) or their revised version, and the Positive and Negative Affect Schedule (PANAS). The performance evaluation tests were associated to different aspects such as achievement tasks, learning performance, factor related to task, IQ test, motor task, and productivity. The physiological measurement evaluation covers the quantitative assessment and visualization of physiological functions in relation with chromatic stimuli. Regarding the review carried out in [10], several methods have been used to measure the physiological changes towards colour stimuli in relation with the evaluation of the performance or the emotional reactions such as the study of the prefrontal cortex activity associated to mood-cognition, the electrical activity in brain or the study of the hemodynamic responses in the prefrontal cortex [10]. Most of these studies focus more on the specific validity of the methodology for a certain subject assessment rather than in the significance of the physiological reactions. The scenarios in which the tests are performed can be outdoor or indoor, real or simulated. Most of the real

scenarios considered in the review [10] are offices and working areas, followed by schools, daycare centers, museums, coffee shops, clinics, hospitals, or shopping malls but none of them in urban open spaces. The rest of the tests were made in laboratory or in made up settings [10].
From a theoretical perspective, some research studies have followed the theory developed by Yerkes-Dodson and its variants [11],[12]. Regarding this theory, longer wavelength colours (red, orange) are considered arousing, whereas shorter wavelengths colour, such as green or blue, are considered relaxing [12],[13]. Some of the researches based on that theory have also observed that longer wavelength colours produce a negative effect on the performance of complex tasks. However, there is no consensus on the postulates of Yerkes-Dodson theory. In fact, the validity of the arousal effect on performance task, especially of longer wavelength colours has been questioned by many theorists [14],[15]. For example, Kwallek and Lewis [11],[17] found that red has more arousal effects, which causes less error made in a certain task in comparison with white. In contrast the study developed in [19] concluded that blue colour has the most arousal effects and the highest rating for performing activities environment [5].
The authors of [18] defended that the colour preference is based in the neuronal mechanisms that encode colours. The outcomes of the study reveal that there are two factors that strongly corresponds to the retinal cone responses to the stimuli that underlie human colour vision: S–(L+M) ('blue–yellow') and L–M ('red–green'). The tests performed to both British and Chinese adults about the "red-green" cone-contrast perception suggested that women preferred reddish, and men preferred greenish hue contrast against the background [18]. More specifically, these researchers argued that the women prefer redder colours because their visual system is specialized to be attracted to fruits against a background of green foliage as a consequence of a socio-biological mechanism related to the hunter-gather societies[18].
There is a recent theory called the Ecological valence theory [17],[20], which proposes that the colour preferences are determined by their combined affective response to environmental objects and events associated with each colour. [20]. This association is suggested to have an ecological and adaptive function: preferences for blues elements are associated with positive reactions towards certain objects or situation (e.g. clear sky and clean water) opposite to the yellow range colours that are associated with negative reactions (feces or rotten fruit).Therefore the preference for a certain colour is highly related to the affective value of situations or objects that people associate with that colour. Although this theory seems quite reasonable, it is however very difficult to prove.
There are other researchers that postulate that colour carry different meaning according to the context, producing different emotions, thoughts and behaviours [13]. Some other research works defend the existence of universal sex differences in the colour preferences [18], or universal mechanisms that guide these preferences [20]

3. Colour influence on the audio visual interaction process

Visual stimuli can influence the perception of the loudness and condition the subjects' attitude towards the sound source significantly. The audio-visual interaction has long been considered through different approaches to establish connections between what a person sees, hear and feels simultaneously. Although the perception of loudness depends on the physical properties of sound, such as level, duration or spectrum, several studies suggest that the visual factors and in particular the colours play an important role on its appraisal.
Patsouras et al. [2] carried out series of experiments on the train passage made to a representative sample of the German population. They found that the sound of a train played simultaneously to the display of images of trains with different colours was rated by the participants with different perceived loudness. In particular, the image of the train in red colour caused a perception of loudness higher than the one in green colour, with a difference of the 12%. This perception was however very subjective, and the participants' judgment was often very distinct from each other; the differences between the colours resulted significant for some of them and irrelevant to others.
Rader et al. [3] studied in depth the subjective differences highlighted by the previous study performing a test to a representative sample of the Japanese population and compared the outcomes with the ones of German sample obtained in [2]. Also in this case images of trains characterized by different colours were shown while acoustic stimuli were played. The Japanese subjects detected a higher influence of the visual stimuli, registering differences between the cases evaluated up to the 100%. For the Japanese, as well as for the Germans, the red colour was associated with the higher perceived loudness.
Fastl [4], performed two different test in relation to the railway traffic noise: in the first test the visual stimuli were displayed through still images and in the second one, through moving images. Images coherent with the played noise (train) and images belonging to a context clearly different (tree) were shown. In the tests with moving images, the video was taken first from a fixed position, and after from a position in motion such as from a speeding car. The results clearly show that although reproducing an identical acoustic stimulus, the addition of visual inputs usually reduces the perceived loudness. Regarding this study, the use of different colours affects the loudness perception: green objects appear to induce a decrease in the perceived loudness compared to the same objects proposed in red. With the recording equipment in fix position, still

images can also reduce the perception of loudness an average of about 2.5%, while the moving images can induce reductions in perceived loudness of about 5% compared to the real one. In general the author argue that the more realistic the situation is, the greater the possible reduction of the perceived loudness (for the same acoustic stimuli, induced by the visualization of images).

In contrasts to the previous studies, Menzel et al. [21] did not found evident interaction between visual stimuli and perceived loudness. A possible reason of that difference on the results with the previous tests can be found comparing the methodology used. In this research work, for the evaluation of the perceived loudness the subjects were asked to concentrate on the sound stimuli, while in the previous studies no precise instructions were given. The request concentration on the sound stimuli can reduce the attention on visual factors such as the colours. In the study of Menzel et al.[21], subjects were also warned that the sound stimuli were only going to be reproduced once without possible repetitions. This fact can induce the participants to pay more attention to the acoustic stimuli. Other factor that can affect the lack of interaction found can be due to the kind of visual stimuli presented. The colours were not associated to the real object that produced the sound, but to solid coloured cardboards.

In a later study, Menzel et al. [22] confirmed differences in the sound perception of a car passing when images of sport cars with different colours were shown. These differences correspond to a change in perceived loudness of about 1dB, with maximum difference of about 3dB compared to the real one, consequently confirming previous researches about the influence of colour on the evaluation of loudness. In this study, images of red vehicles seem to arouse greater loudness perception than images of green or blue vehicles. The author explained the changes in the perceived loudness with the attributes traditionally associated to the sport cars; the image of a red sport car reminds that is equipped with a robust and noisy engine, which can lead to perceive higher levels of loudness than sport cars with atypical colours such as blue, green or dark green.

Cox [23] used web experiments to attract a high amount of participants. Such a procedure requires accepting less control on the experimental conditions, but can however increase the number of participants. To make the experiment more attractive, he did not evaluate the perceived loudness but the awfulness of the sounds. In order to examine the interactions between sound and vision, different visual stimuli were displayed, while the participants were asked to make a judgment on the auditioned sounds. In this test, the visual stimuli did not normally affect the judgment on most of the sounds. Only in some specific cases, the image reinforced the negative judgment. The author explained this fact arguing that the images remove the ambiguity in the identification of the sound and increase its awfulness. The influence of the website colour was also evaluated. It was concluded that more relaxing hue, brightness and saturation features of the website colour causes a more negative judgment on the sound. For example, the website green or blue coloured makes the sounds be appreciated as more horrible in comparison to a red website.

Menzel et al. [24] also conducted a series of studies that focused on the type of visual stimulus (abstract images, images of objects), on the presentation (monitor, projection screen) and on the connection with the acoustic stimulus (plausible / implausible scenario). The authors argued that some colours are able to increase or decrease the perceived loudness, although that effect shows a wide variability among individuals. Some subjects were not influenced by the visual stimuli presented, while other subjects had overestimated or underestimated the volume of the sound stimulus in ranges from about 1% to 5% with a maximum of 9%. Colours such as red or pink seem to cause an increase in the perceived volume, while the gray or green show the opposite phenomenon, supporting the results of previous studies. Compared to the displayed of abstract colours images, the use of coloured objects images seems to amplify the differences especially when using colours with high and low chroma. As regards the various types of visual stimulus presentation (still images / moving images / size), comparable results were obtained: For the three cases, most of the subjects were not affected by colours during their judgments on the perceived loudness. However, in each experiment about one third of the subjects showed variations in the loudness appraisal that depended on the presentation of the colours, increasing the perceived loudness with bright red and pink colour and decreasing with grey and light green.

Song et al. [25], through a laboratory study made to 30 subjects conducted in a semi-anechoic chamber, evaluated the influence of colour and brightness on the assessment of the traffic noise annoyance. The subjects were asked to evaluate the annoyance caused by audio-visual stimuli that consisted of six different abstract colours (red, green, yellow, blue, cyan and purple), three different intensities of brightness and five fragments of sounds resulting from road traffic noise with different noise levels. As a result, the authors argue that brightness is not a significant factor on the evaluation of the annoyance caused by road traffic noise. However, the interaction between colour and noise level has an effect on the assessment of the annoyance: Between 45 dB and 65dB, the noise annoyance evaluation was affected by the colours shown; in particular, red colours had more significant influence in comparison with other colours evaluated.

Kim, et al. [26] measured the influence of abstract solid colours on the perceived loudness and noise annoyance. Two experiments were conducted; in the first one chromatic (red, yellow-red, yellow, green-yellow, green, blue-green, blue, purple, blue, purple, red-purple) and achromatic colours (gray, white) were displayed on a screen while different levels of pink noise (from 40 dB to 90 dB) were auditioned through a

loudspeaker. The outcomes highlighted that the colour influences the perception of the perceived loudness and the noise annoyance. When the visual stimuli were closed to red or white, the sound stimulus was perceived as significantly louder and noisier. When they were proposed green or blue, the noise was perceived as significantly softer and quieter. In the second experiment, it was analysed the effect of colour saturation on the perceived loudness. The effect of chroma was found to be significant only for the red range. The results showed that the perceived loudness increased when the red colour saturation increased and decreased when the colour saturation decreased.
Ma et al. [27] through laboratory tests explored the variation of noise annoyance resulting from different levels of road traffic noise auditioned in indoor environments. The results showed that by varying the brightness of the room, also changes the perception of annoyance from road traffic noise. However, the effect of colours on the evaluation of the annoyance was not proved to be significant although there was an interaction effect between colour and brightness on the overall annoyance appraisal. Therefore, the authors defend that by improving the combination of colour and lighting conditions, the annoyance produced by the road traffic noise in indoor environment can be reduced.
As we have seen, many researchers have evaluated the perceived loudness when sounds were presented simultaneously to the visual stimulus produced by the real sound source that produced them. In such conditions have concluded that visual information can increase / decrease the intensity of the perceived loudness. On the bases of these outcomes, Aizawa et al. [28] built a model of loudness that took into account of the audiovisual interaction. They proposed a new equal loudness curve considering the effect of the colour on the basis of experimental results of audio-visual stimuli consisting of sinusoidal sounds and colour samples.
Maffei et al. [6] studied the effects of the visual characteristics of the acoustic barriers on the perception of noise. They analysed different factors, such as the aesthetic features of the barriers, the visibility and size of the sound source and the noise levels. Virtual scenarios were presented to participants using the Immersive Virtual Reality to provide an environment with auditory and visual characteristics easily modifiable. The results of the ANOVA statistical analysis showed that in the case of transparent barriers, the perceived loudness and the annoyance were rated lower than those of opaque barriers; these differences increased with the increase of the noise level. Regarding other the visual aspects there were less obvious statistical differences, although the scenarios characterized by barriers of green colour seem to elicit less noise. The analysis on the aesthetic features has shown that in this context the opaque barriers are considered visually more unpleasant then the transparent ones.
Cirafici et al. [29] analysed the effects of metro interior chromatic dimensions on the acoustic, visual and comfort assessment. Four colour combinations were used for the inner metro wagon decoration to examine the subjects' appraisals: beige, blue, yellow and red schemes. Twelve 3D graphic virtual reality scenarios of a metro were presented during the tests. The participants were asked to judge the interior colours, sounds and general atmosphere, evaluating sound volume and annoyance. For the four colour schemes used, no interaction of colour with sound volume and sound annoyance assessments was found. Both evaluations were only influenced by acoustic parameters. However, the semantic differentials used for the assessment were influenced by the colour scheme. The study revealed for example that the beige metro was judged more relaxing than the blue one and more harmonious than the blue and yellow. Nevertheless, the blue colour scheme was considered less harmonious than the red one.
Maffei et al. [5] evaluated the effects of audio-visual stimuli on the opinion of the environmental impact of a wind farm built in a quiet area. Through the creation of different scenarios by means of the Immersive Virtual Reality, the contribution of the audio-visual components on the overall impact of the wind farm was evaluated. In particular the attention was focused on the distance, the number of wind turbines and the colour of the blades. The results showed that the distance factor has the strongest influence on the individual reactions. Regarding the manipulation of the factor number of blades, the results showed that this visual component has a weak effect on the individual reactions. Finally, with regard to the manipulation of colour, the results showed that different colours of the blades affect the auditory perception. Green and white turbines are preferred to brown and red ones in terms of general evaluation, integration with the environment, sound pleasantness, loudness, annoyance and visual pleasantness.

4. Discussion

The items analysed showed that the visual stimuli have a significant influence on the perception of the noise; this influence is however very subjective. The interaction between visual and auditory stimuli depends on the factors that attract more the attention of the subjects, resulting decisive when it is focus on the visual stimuli. In contrast, when the subjects are asked to pay attention on the auditory stimuli the visual ones becomes less relevant, because any input coming from the visual system such as the colour information of the image proposed is reduced in relative importance compared to the acoustic stimuli. Colours represent a key component within the visual stimuli and are able to affect the perception of loudness if they are associated with objects that make the scenario realistic. For example, the experience of real life reminds us that sport cars are built to reach high speeds, are equipped with a powerful and therefore noisy engine. Also sport cars

are traditionally associated to specific visual attributes, such as red livery. Both facts could lead to a higher perception of sound intensity [22]. Besides there are different colour features that affect noise perception: hue, brightness and saturation. The brightness and saturation are sometimes more decisive than the simple change of hue. Thus, noise annoyance can be reduced in the indoor environment improving the lighting conditions of the context and creating an appropriate combination of hue and brightness. Finally considering other aspects of the visual stimuli, moving images have stronger effects than those fixed, as well as images coherent with the sound source respect to abstract images.

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Bibliographical References

[1] LEWKOWICZ, David J., GHAZANFAR Asif A. "The emergence of multisensory systems through perceptual narrowing". Trends Cogn. Sci. (Regul. Ed.), 2009, vol. 13 (11): p. 470–478. doi:10.1016/j.tics.2009.08.004. PMID 19748305.

[2] PATSOURAS, Christine; FILIPPOU, Thomas G.; FASTL, Hugo. Influences of colour on the loudness judgement. In AA.VV. Proceedings of Forum Acusticum 02. Sevilla, 2002.

[3] RADER, Tobias; MORINAGA, Makoto; MATSUI, Takanori; FASTL, Hugo; KUWANO, Sonoko; NAMBA, Seiichiro. Cross-cultural effects in audio-visual interactions, Transactions of the Technical Committee of Noise and Vibration of the Acoustical Society of Japan. Tokyo, 2004.

[4] FASTL, Hugo. Audio-visual interactions in loudness evaluation. In AA.VV. Proceedings of the 18th International Congress on Acoustics. Kyoto, 2004, p. 1161–1166.

[5] MAFFEI, Luigi; IACHINI, Tina; MASULLO, Massimiliano; ALETTA, Francesco; SORRENTINO, Francesco; SENESE Vincenzo. P.; RUOTOLO Francesco. The Effects of Vision-Related Aspects on Noise Perception of Wind Turbines in Quiet Areas. International Journal of Environmental Research and Public Health, 2013.

[6] MAFFEI, Luigi; MASULLO, Massimiliano; ALETTA, Francesco; DI GABRIELE, Maria. The influence of visual characteristics of barriers on railway noise perception. Science of Total Environment, 2013, 445–446, 41–47.

[7] AMORUSO, Giuseppe. Colour Interaction within the Built Environment. Descriptive geometry and digital representation: memory and innovation. Mc Graw-Hill, 2012, p. 215-222.

[8] AMORUSO, Giuseppe. Interazione del coloure nel design. Modelli percettivi ed interfacce digitali. Coloure e colourimetria. In AA.VV. Proceedings Conference of Colour. Bologna, 2012.

[9] MARCOLLI, Attilio. “Coloure – Città. Il caso della città di Venezia” in Mario Bisson and CristinaBoeri, Variazioni sul coloure. Franco Angeli. Milano, 2006.

[10] NURLELAWATI, Ab. Jalila*;* RODZYAH, Mohd Yunusb; NORMAHDIAH S. Said. Environmental Colour Impact upon Human Behaviour: A Review. In AA.VV. Proceedings Asia Pacific International Conference on Environment-Behaviour Studies. Famagusta, 2011.

[11] KWALLEK, Nancy; WOODSON, Harrell; LEWIS, Carol. M.; SALES, C. Impact of three interior colour schemes on worker mood and performance relative to individual environmental sensitivity. Colour Research and Application, 1997, vol. 22, p. 121–132.

[12] STONE, Nancy J.; ENGLISH, Anthony J.; Task type, posters, and workspace colour on mood, satisfaction, and performance. Journal of Environmental Psychology, 1998, vol. 18, p. 175–185.

[13] ELLIOT, Andrew J.; MAIER, Markus A.; MOLLER, Arlen C.; FRIEDMAN, Ron; MEINHARDT, Jörg. Colour and Psychological Functioning: The Effect of Red on Performance Attainment. Journal of Experimental Psychology: General, 2007, vol. 136(1), p. 154-168. http://dx.doi.org/10.1037/0096-3445.136.1.154.

[14] MATTHEWS, Gerald. The effects of extraversion and arousal on intelligence test performance. British Journal of Psychology, 1985, vol. 76, p. 479–493.

[15] NEISS, Rob. Reconceptualizing arousal: Psychobiological states in motor performance. Psychological Bulletin, 1988, vol. 103, p. 345–366.

[16] KWALLEK, Nancy; LEWIS, Carol. M. Effects of environmental colour on males and females: A red or white or green office. Applied Ergonomics, 1990, vol. 21, p. 275–278.

[17] TAYLOR, Chloe; CLIFFORD, Alexandra; FRANKLIN, Anna. Colour preferences are not universal. Journal of Experimental Psychology: General, 2013, vol. 142, No. 4, p. 1015–1027.

[18] HURLBERT, Anya C.; LING, Yazhu. Biological components of sex differences in colour preference. Current Biology, 2007, vol. 17, p. 623–625. doi: 10.1016/j.cub.2007.06.022.

[19] KAMARUZZAMAN, Syahrul N.; ZAWAWI, Emma M. A. Influence of Employees' Perceptions of Colour Preferences on Productivity in Malaysia Office Buildings. Journal of Sustainable Development, 2010, vol. 3(3), p. 283-293.

[20] PALMER, Stephen E.; SCHLOSS, Karen B. An ecological valence theory of human colour preference: PNAS. In AA.VV. Proceedings of the National Academy of Sciences of the United States of America, 2010, vol. 107, 8877–8882. doi:10.1073/ pnas.0906172107.

[21] MENZEL, Daniel; FACCINELLI, Elias; FASTL, Hugo. Are absolute thresholds and loudness judgments influenced by different colours? The Journal of the Acoustical Society of America, 2008, vol. 123, 3162-3162.

[22] MENZEL, Daniel; FASTL, Hugo; GRAF, Ralf; HELLBRÜCK, Jürgen. influence of vehicle colour on loudness judgments. J. Acoust. Soc. Am., vol. 123, p. 2477–2479.

[23] COX, Trevor J. The Effect of Visual Stimuli on the horribleness of awful sounds. Applied Acoustics, 2008, vol. 69/8: p. 691–703.

[24] MENZEL, Daniel; HAUFE, Norman; FASTL, Hugo. Colour-influence on loudness judgement. In AA.VV. Proceedings ICA. Sydney, 2010, p. 175-180.

[25] SONG, Jianwei,; MA, Hui; YANG, Qing; ZHANG, Sen. Interaction of colour perception and annoyance evaluation of road traffic noise. In AA.VV. Proceedings INTER-NOISE 11. Osaka, 2011.

[26] KIM, Ki-Hong; GEJIMA, Aiko; IWAMIYA, Shin-ichiro; TAKADA, Masayuki. The effect of Chroma of colour on perceived loudness caused by noise. In AA.VV. Proceedings INTER-NOISE 11. Osaka, 2011.

[27] MA, Hui; NIE, Wenjing. Influence of visual factors on noise annoyance evaluation caused by road traffic noise in indoor environment. In AA.VV. Proceedings INTER-NOISE 14. Melbourne, 2014.

[28] AIZAWA, Kai; KAMOGAWA, Takashi; ARIMITSU, Akihiko; TOI, Takeshi. Development of a new loudness model in consideration of audio-visual interaction. In AA.VV. Proceedings INTER-NOISE 14. Melbourne, 2014.

[29] CIRAFICI, Alessandra, ALEXEEVA Natalia., SENESE, Vincenzo P. Acoustic comfort aboard transportation systems. Multisensory evaluation by means of virtual reality and subjective testing. Interaction of colour scheme and noise in the metro interior. In: Color and Colorimetry. Multidisciplinary Contributions, 2012, vol. VIII, p. 119-127. ISBN: 88-387-6137-X.

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Additive technology and design process: an innovative tool to drive and assist product development

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Abstract
The object of study regards the analysis of existing relationship between additive technologies and design process.
Additive technologies are defined by a range of technologies that are capable of translating virtual solid model data(CAD) into physical models in a quick and easy process. The data are broken down into a series of layer of a finite thickness. These layers are added together to create the physical product.
The great widespread of additive technologies, FabLab and 3D printing is leading to talk of third industrial revolution, so the aim of the work is to understand what is the true role of these technologies inside the product development process.
Very often the additive technologies are used when the design process is already closed, just to show and present the final product to market and before to start with the definitive manufacturing process. This kind of approach leads to have a partial utilization of the additive technologies potentialities, considering the possibility to work with materials of a different nature and structural behavior, the great freedom of shape and aesthetic, the opportunity to verify ergonomic and functional aspects.
Therefore the additive technologies can be used, during the design process, as a tool to drive and assist the product development.

Keywords: additive manufacturing, design process, materials and technologies

1. Introduction
The use of additive manufacturing has increased significantly in previous years. This manufacturing process is used by multiple industry subsectors, including motor vehicles, aerospace, machinery, electronics, and medical products. Currently, however, additive manufactured products represent less than 1% of all manufactured products in the U.S. As the costs of additive manufacturing systems decrease, this technology may change the way that consumers interact with producers. Additive manufacturing technology opens up new opportunities for the economy and society. It can facilitate the customized production of strong light-weight products and it allows designs that were not possible with previous manufacturing techniques. Additive Manufacturing (AM) defines a family of technologies for making objects of almost any shape from virtual 3D model data through additive processes in which successive layers of material are laid down. The main difference between AM and other conventional processing technologies is the “layer by layer additive” construction manner, which makes the AM can manufacture designed parts with extremely complex geometries without the use of fixtures, tooling, mold or any other additional auxiliary. For the AM field, we have six main manufacturing processes: Fused Deposition Modelling (FDM), 3D Fiber Deposition (3DF), 3D Printing, Stereolithography (STL), Selective Laser Sintering (SLS) and Electron Beam Melting (EBM). The FDM process, is based on polymers melts passing through a nozzle and a molten fibre is further deposited on the surface of a moving platform or merges with the previous layer where it cools down and solidifies.

Geometrical and morphological parameters of scaffold are influence by the processing conditions, namely, nozzle diameter, writing speed, extrusion rate and polymer physics (de Mulder et al 2009). In case of 3DF, it does not require temperature enabling the use of cell-laden materials to be processed. 3D printing creates tri-dimensional objects by depositing liquid binder onto a powdered bed. This liquid may act as glue or promote a reaction causing the particles to bind together. After each layer, a new powder bed in spread and the object is created by "n" cycles of this procedure. In this case, the unbounded particles aid the construction of the following layers as it provides temporary support to the object (Butscher, 2011). SLS uses IR lasers to heat up the powder beyond it is melting point causing neighbouring particles to fuse forming a solid structure. When each layer if finished, a new powder layer is placed with a mechanical roller and the exceeding material from the precious layer provides in place to support the continuance of the process (Bártolo, 2009). Finally the EBM that is a technology similar to the SLS, but it uses an electron beam as its power source, as opposed to a laser.

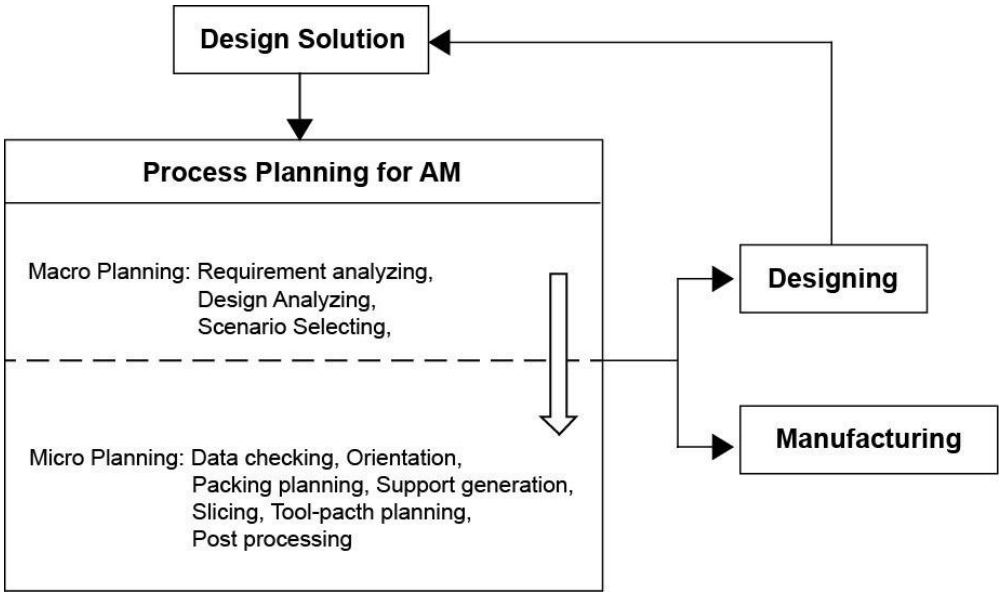
AM Technology	Material	Ref.
FDM	Amorphous and semi-crystalline thermopastics Ceramics	Chua et al, 2003 Landers et al, 2002
3DF	Natural and synthetic polymers Ceramics	
AM	Powder bulk polymers Powder ceramics	Landers et al, 2002
STL	Amorphous reactive resin Ceramics Composites Hydrogels	Corbel et al, 2011 Melchels et al, 2010
SLS	Bulk polymers Ceramic Metals Composites	Chua et al, 2011 Melchels et al, 2010
EBM	Metals (powder state)	

Tab. 1: It is summarized a list of materials for each type of scaffold technology

Compared with the design for traditional processing technologies, the design for AM has greatly increased the space of freedom for the designers. Altough, there still are a set of limitations or constraints existing in the AM processing technologies, the correct use of AM plus the knowledge of materials is the key to produce a flexible amount of products, as market requires. When designing, they should be taken into consideration. Due to the actual economic situation, the AM is the right choise that meets customers satisfaction and industrial strategies to reduce time to market and to save costs. The aim is to analyze the true role of additive technologies with a particular reference to materials, technologies, manufacture and design process.

2. Process planning structure and materials

Though AM has been widely regarded as “one button” processing technology due to its high automation, the preparation work before manufacturing should be also done by technical expert using some tools and related experience or knowledge. The preparation work contains tasks from the selection of suitable manufacturing scenarios, which include AM machine, material, machine set-up parameters etc., to 3D data checking and detailed process planning, such as orientation, support design, slicing and tool path generation. Here in based on the comparison with traditional process planning, this paper gives a two-level process planning framework for the systematic process planning in AM, which is depicted in Table. 2.



Tab. 2: Process Planning framework for AM.

Macro process planning is the first level or stage of process planning in AM. The main contents contain the manufacturability analysis, selection of manufacturing scenarios and setting up the original processing parameters. These tasks can be finished only under full understanding of AM processes characteristics and limitations as well as the design and production requirements. Hence, this process planning stage could be directly connected or associated with the conception design stage where manufacturability analysis based on analyzing the design requirements and selection of manufacturing scenarios based on functional and production requirements are both should be carried out. Micro process planning stage mainly focuses on the detailed technical aspects. The main contents include: 3D CAD data checking, repairing, scaling et al.; determination of part’s build orientation; determination of the strategy for placing or packing parts in the build platform or chamber when under multi-parts production context; support generation for some AM processes that need support structures; determination of a slicing strategy; determination of a tool-path or scanning strategy; determination of post processing strategies. Apparently, the main tasks in this micro planning stage have a very tight relationship with the detail design for AM since the results of these tasks directly determine a design’s physical realization and mechanical properties.

3. Potentialities and limitations

The AM has great potentialities to result a good tool not only to prototype or to make a small production, but especially to drive and assist the product development during the design process.
In this paragraph we will do a list of advantages and limitations linked to the use of the additive technologies for a designer.
First of all with the AM a designer can work on the form finding and design optimization, having a great freedom of shape. This approach allows to create more complex geometry than traditional manufacturing techniques(injection moulding for example). This means to have the possibility to work on the material reduction, to enhance the mechanical behavior of the designed object developing its shape, to study functionality and usability of the design, including the ergonomic aspects too. These features give the possibility to use the AM to obtain an optimized design that takes into account multiple aspects.

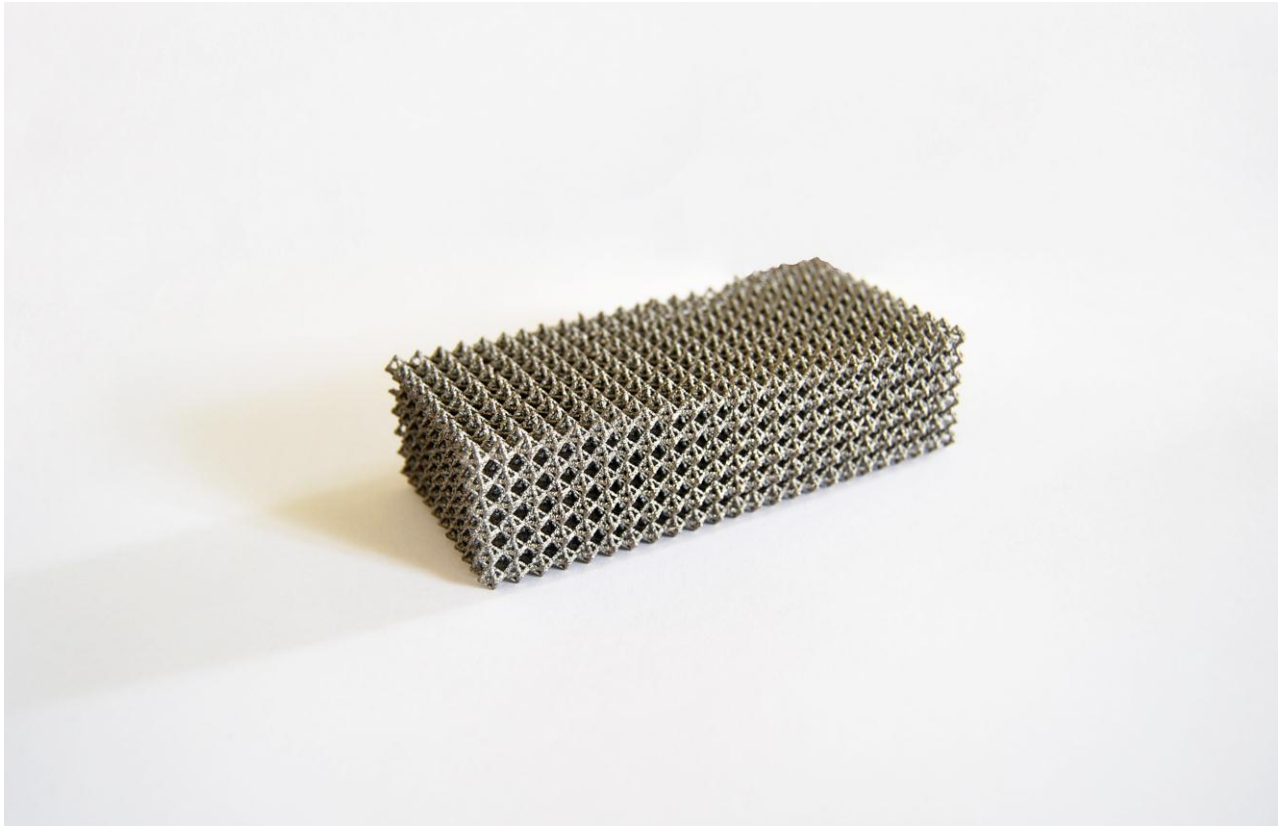


Fig. 1: EBM sintered titanium, supplied by Adler-Ortho, spa.

AM allows also to have a responsive production, in fact they offer faster lead times than the traditional manufacturing processes. This means to have the possibility to test the appeal of a product on the market(online, for example) and then to decide to start or stop its production or to modify the design.
Another benefit of the AM over the traditional machine tooling is the lower cost of manufacturing. If we compare, for example, the additive technologies to the main manufacturing process of the polymers, with AM we don't need production plants, molds or large facilities. If we compare, instead, additive technologies to the CNC milling process, in the first case we don't have material waste and so we have a cheaper and environmentally sustainable production.
The AM is also a good tool to have prototypes, low volume production and customized products that follow the needs of even more demanding users.
Another strong aspect related to the AM for the present and especially for the future is the opportunity to have shorter supply chains, having the possibility to create a network of local, regional, national manufacturing centers, in this way is not the product to travel, but its digital file. This means less cost, less pollution and shorter waiting times too.
The AM is an extremely flexible and adaptable tool. For this reason it has a large range of application: rapid prototyping, rapid tooling, automotive, aerospace, medical implants, nanomanufacturing, architecture, etc.
On the other hand currently the AM has limitations too. With AM, for example, low volume production is faster than conventional manufacturing, but higher volumes are considerably slower, so this tool cannot fully replace the conventional manufacturing processes. Another aspect to improve is related to the possibility to use a larger range of materials, although the metal sintering is helping to open up these technologies to industrial users. Finally other issues linked to the AM use are their difficulty to compete with traditional techniques on reliability and reproducibility and the grave concern regarding the protection of the intellectual property. In fact just with a 3D scanner it is possible to copy an object for reprinting it in 3D.

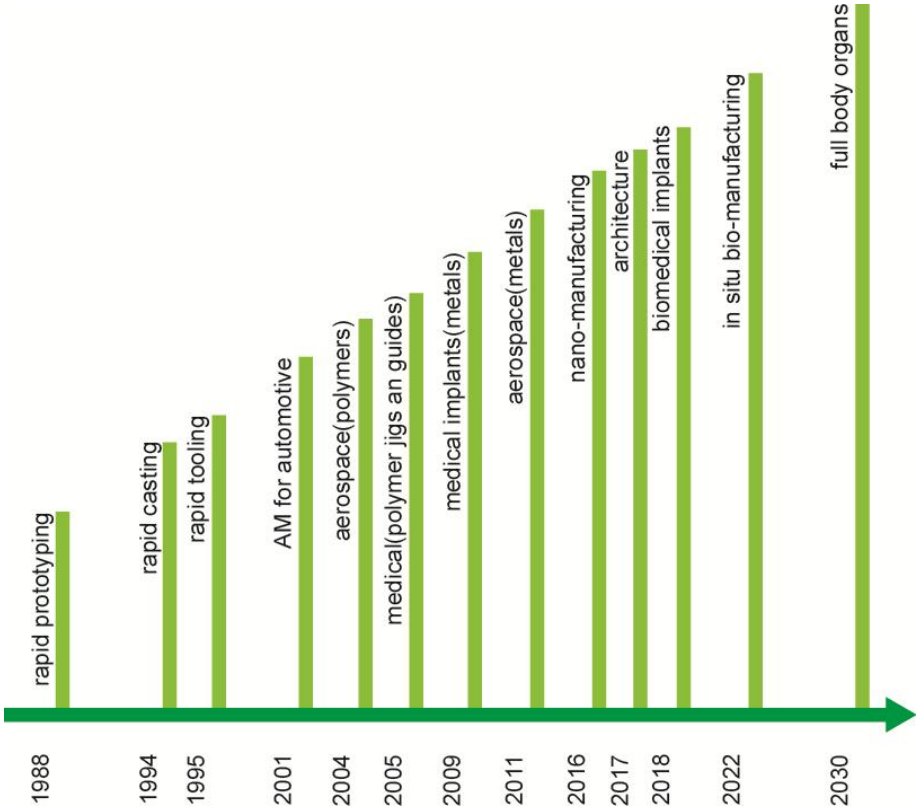


Fig. 2: Additive manufacturing timeline, courtesy of Graham Tromans

4. Concluding remarks

The purpose of the paper presented is to achieve a deeper analysis of the additive technologies and their use for the industrial design, underlining the true potentialities and weaknesses of these technologies inside the design process, with a look at the present and another at the future.
In particular the objective is to show that a smarter use of the additive technologies as a tool to drive and assist the product development is possible. Especially the great freedom of shape ensured by the AM should be exploited to design optimized and sustainable products, where less materials and weight meet better performance. The utilization of these technologies should be explored not only for aesthetic purposes and for rapid prototyping, but especially to achieve advanced functional, structural, environmental and ergonomic performances.

Bibliographical References

[1] ROYAL ACADEMY OF ENGINEERING. *Additive manufacturing: opportunities and constraints*. London: Publisher, 2013. ISBN 978-1-909327-05-4

[2] Manuscript Number: PROCIR-D-13-00847R3. ZHANG, Yicha. Evaluating the Design for Additive Manufacturing: A Process Planning Perspective. In AA.VV. A. Bernard, R. Kumar Gupta, R. Harik. *24th CIRP Design Conference.* Milano: Publisher, 2014, p. 1-8.

[3] DETC2014-34067. VERMA, Anoop. Computational Geometric Solutions For Efficient Additive Manufacturing Process Planning. In AA.VV. RAI Rahul. Proceedings of the *ASME 2014 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference IDETC/CIE 2014.* Buffalo, USA: Publisher, 2014

[4]. TOJEIRA, A. Structure Development during Additive Manufacturing. In AA.VV. S. Biscaia, T. Viana, P.J. Bártolo & G. R. Mitchell. Portugal: Publisher, 2013. [4] Publisher proceedings of a conference are cited as a monograph.

[5] KULKARNI, P. MARSAN, A. DUTTA, D. A review of process planning techniques in layered manufacturing. In AA.VV. *Rapid Prototyping J.* Publisher, 2000, p. 16-35.

[6] http://karma.aimme.es/.

[7] http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=GR/R13517/01.

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Applying Geographical Information Systems for Documenting and Managing Iraqi Archaeological Heritage: The Case Study of the Akre Castle in Kurdistan

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Abstract

The western part of the Kurdistan Region of Iraq is part of the fertile crescent of Mesopotamia and includes a large number of rock monuments dating back until 3000 BCE, showing a unique type of demographic identity in the region. While these sites have a universal cultural value, they do not receive due attention and are vulnerable to destruction. This paper presents an initiative on one of these sites, to establish a methodology for documenting Kurdish rocky monuments: *Kal'a Akrè*, also known as Akre Citadel, is a formidable fortress built on the top of a mountain during the Neo-Late Assyrian period, characterized by a network of caves, tunnels and rooms, all carved out of rock. Continuously inhabited as an administrative and military headquarter until the middle-late Islamic period, it is today the most prominent landmark of the surrounding hill town. Although this site is unique for its highly engineered construction technique, no scholarly studies have been carried out. The established methodology for documenting and assessing rocky monuments identifies physical features, actual condition and accessibility as well as their authenticity and integrity, both at the architectural scale and scale of territory. For documenting *Kal'a Akrè*, the application of Geographical Information Systems (GIS), remote sensing and laser measuring device, together with traditional historic research tools, are utilized. The documentation process includes recording location GPS points for dimensioning the structure and creating a 2D surface and a detailed database, using ArcGIS and high resolution satellite images. This will effectively support the work of heritage conservation professionals and is an indispensable platform for proposing the Akre citadel for the 2016 World Monuments Fund Endangered Site List.

Keywords: Archaeological sites, rocky monuments, citadel, GIS documentation, Mesopotamia

1. Archaeological sites in the Kurdistan region and the Akre Hill castle: historical values and vulnerability

The Kurdish region of Iraq is part of the fertile crescent of Mesopotamia and it is caracterized by a large number of archaeological sites, many of which have still not been explored, documented or publicized, despite their high cultural values and potentials. Because of this lack of attention and documentation, for many of these sites no protection measures have been untertaken, and no heritage management strategies have been implemented, resulting a significant number of endangered heritage sites. Since the early 2000s, the country/region's and the international institutions' combined efforts have been intensified to document and preserve the cultural heritage of this region as well as increase the management capacity of the Iraqi archaeological Institutions at national, regional, and local levels. Although a number of joint projects involving Iraqi/Kurdish and international universities and institutions have been implemented, historic sites in Kurdistan

region require more attention, and an effective and integrated heritage management planning approach needs to be embraced.
Among the fruits of recent joint projects involving Iraqi/Kurdish and international universities and institutions are the nomination of the Erbil Citadel as a World Heritage Site in 2014; the inclusion of Amedy City, located in Duhok province, on the Tentative Lists in 2011; and Khenis site on the World Monuments Watch list in 2013. This research will also develop, in the second investigation phase, the documention and reports for Akre Citadel, Akre city and its cultural landscape needed to qualify them for UNESCO's Tentative List as well as the 2016 World Monuments Fund Endangered Site List.

This study investigates hill forts, including rocky castles, located in the northern areas of the Kurdistan region, which were established throughout time as strongholds used for protection, military and administrative purposes. The ongoing research is creating a rock monuments' database, which collects major information for their cataloguing and protection and it is a preliminary tool for developing integrated management strategies and heritage and eco-tourism proposals.



Fig. 1: Akre Hill town and its acropolis where the citadel is located, occupying the area denoted by the frame.

In the Akre area, numerous are still the remains of ancient rocky hill forts, guard posts, and caves with rock reliefs among which are *Kal'a Akrè*, *Kal'a Kaven*, even more ancient and *Kal'a Shush*, located in Shush village, about 12.5 km to the west of Akre town. The term *Kal'a* is a Kurdish word meaning "citadel or castle" and indicates settlements of considerable importance located on the top of a hill.
Kal'a Akrè is considered the most important of these sites (See Figure 1); therefore it has been adopted as a case study for setting up the ongoing research documentation methodology. The site is configured as an acropolis, built on top of an impregnable rocky hill characterized by a group of steep-pitched ridges behind, gabling out from the main Shereen mountain chain. This fortress represented the center of power in the Akre area and, due to its defensive location, was considered, throughout time, a strategic site by rulers, as well as by invaders. [1] [2].
Today *Kal'a Akrè* dominates the historic city of Akre, which has unique hill-town settlement patterns and features rich historic and cultural sites such as the *bazaar* market in the old town and geologic formations like *Sipa* waterfall. These elements are viewed in proposals for the region as being favorable in attracting large numbers of tourists across the country, especially in summer.

The archaeological heritage of Iraq has been threatened by looting and illicit trafficking in antiquities since early 1990s [3], in particular, the archeological sites in the Kurdish region have been vulnerable to destruction even before 1991. A number of sites especially in Akre district were looted in the past and illegal excavations are evident in some of these, including Akre Citadel.
The Akre Citadel site was also used as a military stronghold before 1991; remains of military barracks are still on the site. Many of the illicit excavations could be attributed to that period. Improper use of heritage sites, such as military utilization, and their proximity to habitation increases vulnerability with destruction or damage caused by trespassing and the encroaching of rapid development. On the other side, the remote location of many archaelogical sites, on mountains and hills in the wilderness, is another component of high vulnerability to looting and vandalism. In general, a general lack of protection and effective preservation policies and laws subject these sites to a high level of vunerability [3]. Because of the great and unique historical values of the Kurdish region heritage sites, integrated approaches need to be undertaken for their effective preservation and management

A region with such an incredible cultural heritage could have considerable potentials for cultural heritage tourism, for eco-tourism, natural, and religious tourism [4], in particular Akre city's authenticity and integrity of its unique features [5] offer an advantage in attracting tourism.

Implementation of adequate preservation strategies for the city's historic sites and the improvement of their accessibility within a sustainable management approach would also drastically enhance tourism in Akre, boosting the local economy.

2. Research methodology

This research utilizes both at the scale of archaeological structure and at a larger scale - territory, a methodological approach traditionally used in heritage conservation and management developed in Italy under the umbrella of 'scientific conservation' – first - and 'critical conservation' where the study of 'indirect sources' are intersected with the study of 'direct sources'. [6]
Indirect sources include archival and bibliographical research, comparative analysis of building typologies and ornamentation and symbolism, comparative analysis of land use patterns, etc.
Direct sources involves the analysis of archaeological sites as well as the territory and and will survey: at architectural scale, structure types, their construction technology and materials, decorative elements as well as the analysis of structure proportions and, where possible, ancient measurement systems;at the scale of territory, phisical relationship between different rocky monuments, its connection with routes and water sources.
The study also follows International Charters such as 1996 ICOMOS Principles for the Recording of Monuments, Groups of Buildings and Sites, [7] as well as other documentation standards created for the inventory of immovable heritage. All these standards were developed to facilitate data sharing across political boundaries and serve as a reference for heritage organization which, as they create inventories, often grapple with identifying the optimal set of inventory data to meet the practical requirements of heritage stewardship.

2.1. GIS Documentation: criteria and adopted standards

In recent decades, modern technologies have been widely applied in the field of archaeology and heritage conservation to support inventory, documentation, evaluation, preservation, and management of historic sites, monuments and other structures. [8] In particular, the Geographic Information Systems (GIS) have dramatically improved the effectiveness of immovable heritage documentation. Archaeological sites' inventory needs databases with complex structures for processing greater quantities of data that can be efficiently integrated, modeled, and visualized to gain insight into the overall spatial dimensions of the inventoried sites. [9]
GIS technology allows the creation of extensive data setting capable of also describing in detail archaeological structures located off site, for varied reasons including difficult accessibility to and remoteness of sites and the need for better visualization of such objects that are difficult to be interpreted in the field. [10]
Use of GIS in archaeology has other advantages, beyond the ones above cited: It integrates vector (spatial) data (points, lines and polygons) with raster (no-spatial) data (photographs, geophysical data, etc.). This allows the establishment of an integrated database of an archaeological site. Thus, it provides archaeologists with a unique platform to organize and analyze large amounts of diverse archaeological data used creating models of archaeological sites [11], providing a general description of the site and detailed definition of the components and structures, or elaboration of a documentation system including site plans, pictures, drawings, topographical maps, etc. [12]
Heritage sites' documentation, undertaken through inventory and survey work and organized through GIS, can serve as a tool to make information accessible to researchers, institutions, heritage professionals, and also to the public.
GIS data processing is comprised of four main functional subsystems including: data input; storage and retrieval of data; manipulation and analysis; and, output and display of data. [13]
For the first subsystem, the data input, the team utilized the above mentioned ICOMOS international standards international standards, developed for the documentation of archaeological, architectural, and movable cultural heritage. For data implementation, the most significant adopted are: the Core Data Index to Historic Buildings and Monuments of the Architectural Heritage, adopted by Council of Europe in 1992 [14] and, the Core Data Standards for Archaeological Sites and Monuments, adopted by the International Committee for Documentation [CIDOC] of the International Council of Museums in 1995. [15] CIDOC is now finalizing a combined standard for the documentation of both archaeological and architectural heritage known as the International Core Data Standard for Archaeological and Architectural Heritage.
The adopted standards identify the core items of information that should be part of any cultural heritage documentation and inventory, and were used as a major reference for the creation of the extensive list of attributes within the GIS tabulation system, to be implemented for the Database of Kurdish rocky sites as well as for the creation of multiple layers for the output maps.
Integration of GPS/GIS technology offers an easy and cost-effective approach for archaeological surveying. [16] Besides, GIS has the ability to handle and visualize large data sets including site records and

environmental variables. It is now used for acquisition and management of geographical spatial and non-spatial (descriptive) data, and for establishing site databases.
Other digital methods such as laser scanners, remote sensing technology have proven very useful for supporting the work of archaeologists, requiring an inter-disciplinary approach and an integrated use of multi-dimensional GIS applications. [17]
This research used GIS technology for identifying locations of the site, its components and structures, determine their dimensions, and calculate distances. Data sets comprising a total of 1700 (X, Y, Z) coordinate points were collected over a period of two days using differential Leica Viva GS15 GPS. This device is easy to use, cost-effective, and accurate for the spatial needs of the field survey and has a large storage capacity [16]. It has two GPS sets, one is base set used for benchmarking and the other is a rover used for recording the points. Three benchmarks were established on the site for use as reference points for accurate recording required locations. Two of these were established in the southeast and northwest sections to allow for connection to the rover in locations that were shadowed or obstructed by rocks and other structures. One such feature was a rocky passage which was overshadowed by both high rocky sides or the prison located at the northern outer boundary of the citadel, with no line-of-sight with the base set emission scope. The collected data was projected into ESRI ArcGIS Desktop 10.2, where it was stored in a personal database that allowed the integration of spatial and non-spatial datasets. The database consists of spatial datasets including information such as location GPS points, structure polygons and areas, path lines and lengths, and non-spatial datasets including structure names, codes, and descriptions. The database was used as a repository for project mapping and visualization works. Geo-referenced satellite imagery of the study area was obtained from a local government department for digitizing the site structures based on the projected GPS points. Then, thematic feature class layers were produced representing different types of structures on the site, and a site plan was also produced to provide better visualization of the site structures and contextual relationships.

2.2. Identifying the documentation parameters

An image-based inventory of the archaeological attributes, morphology, structural tectonics, and building characteristics of the case study area was generated, integrating indirect sources and through direct surveys, including the following facets which define each attribute:



Fig. 2: Akre citadel layout. Each area composing the Akre castle is designated with a code. Each code is associated with a list of attributes characterizing the structure.

- Characteristics of structures including: 1) Structure typology; 2) Building technology (i.e. roof, walls, foundations, and other construction system, such as pillars, with emphasis on rock/stone features); condition assessment of the structures; 3) Exterior walls analysis (where existing – such as form, openings, entrances, other special architectural features such as towers, niches, material composition, and conditions; and 4) Ornamentations and details (i.e. type, location, style, composition, materials, structure, and condition).
- Morphology of the study area, subdivided in: 1) morphology of landscape (i.e. portions, vegetation type, vegetation density, water features); 2) morphology of routes (i.e. form, typology, and condition);
- Structural Tectonics including form, proportion, type, style, materials, and conditions.

A detailed database of the site components was prepared in MS Excel where each structure was given the same name and code used in the GIS database. The data in this repository is more descriptive, i.e. data that is non-spatial, including attributes such as exact geographical location in relation to other structures, description, dimensions, structure elements, and remarks.

The coding system created for referencing the citadel structures is based on the classification of the existing structures in terms of typology of structures; for example, Gates, Chambers, Underground Cells, *Mir*'s Place, *Mir*'s House, Rocky Passage and Cisterns/Wells. The site under analysis is assigned with a two-letter code – "KK" – which represents the initial letter of each the two words of its term – *Kal'a Akrè*. Each typological group or category of structure is assigned with a unique identifier preceded by the site code. For example, the three chambers (S, Mid and N), which are known as a distinguished category of structures with relatively similar forms and functions, are assigned with a unique code (KK002) as a whole unit. However, each individual chamber is identified with a different code which includes the category code followed by one numeric digit denoting sequence of the structure within the category. For example: Chamber, N is assigned code "KK0023". In addition, each individual element within each of these structures is assigned in the same manner but with an additional numeric digit representing the sequence of the element within the elements group of the structure. For example, the two pillars in Chamber, N are coded with KK00231 –which can be broken down into Site Code (KK), followed by Group Code (002), Structure Code (3), and the Element Code (1).

2.3. Technical barriers, site constraints and final outcomes

The rugged topography of the site and irregular geometrical shapes of the components constitute a major barrier for an accurate survey: almost all rocky structures on the site do not have regular shapes and dimensions - surfaces, beds, or walls, such as three rocky chambers, *Mir*' s House (*Mir* is the Kurdish title for governor), and Prison. Therefore survey activity was difficult to carry out both using traditional measurement tools and the standard GPS technology. For such irregularly shaped structures, like the three chambers, a large number of points were surveyed. GPS equipment was used to record one point for each one/two other meters of wall distance. After long time and efforts invested in the survey, the 2D drawings created with GIS have a level of accuracy needing further refinements, also considering that GPS has the limit not be able to record coordinate points for indoor locations, like in the area of *Mir*'s House, Prison and Cave, where traditional survey systems were adopted to integrate GPS data.

The elevated rocky topography of the citadel and inaccessible areas in upper northern part characterized by huge rocks render more difficult to development of a detailed 3D site models, for a better visualization of the study area. An accurate survey of a site of such complexity and irregularity of structures and shape would require a more efficient and advanced technology such as 3D laser scanner in order to create 2D drawings and 3D models with a high level of accuracy, as required by International Standards for Documentation. The 3D laser scanner provides point clouds, 3D data points that are often used to represent the external surface of an object [18]. During this phase of investigation, the team was not able to utilize 3D laser scanner technology due to its high cost and remote high location of the site.

Concerning indirect sources, a lack of adequate and reliable studies on the site can be lamented. Despite the many western archaeologists' visits and missions in northern Iraq between late 19th century and first half of 20th century, the Akre citadel was not explored or mentioned in details in any publication. The site is often cited, with fascinating, although general descriptions as part of Akre town, in Islamic travelers' writings after 639 CE. No international archaeological expeditions or studies have ever been conducted on this site. The only undertaken excavation campaign was conducted on north-east section of the site by the Duhok province Directorate of Archaeology in 2011 and its findings have not been published.

3. Complex history of the Akre castle and actual archaeological evidences

James Baillie Fraser [19], a Scottish travel writer and artist, reports in the book of his voyage to Baghdad passing through the north in 1834 that "Akre Citadel is located on top of a rock …and can only be accessed through one narrow road …." , the road is still intact in some parts nowadays.
Edgar A. Wigram and W. A. Wigram [20], British travelers, refer to the citadel during their voyage to Akre town in 1905, writing "the ruined fragments of its ancient citadel crown the highest point of the rocky ridge above."
The citadel is described as a "fortified castle on Mosul Mountain" both by Yaqut al-Hamawi– an Arab biographer and geographer of Greek origin who visited Akre town in 1207 - and by Ibn Hamdan - Arab writer. [21]
The Ottoman Empire Mosul *Vilayet* province Annual Reports of 1890 and 1894 mention it as "a special place for creating mighty people in earliest times".[22] Balistani, a Kurdish traveler who visited Akre in 1774 and 1786, describes the citadel as an administrative unit, ruled by a *Mir* and occupied by formal employees. [23]
Akre citadel is distinguished from other fortresses in the region in terms of types and density of components (See Figure 2).
Initial development of the site utilizing this rocky and elevated topography started, presumably, in 533 BCE with excavations into the bedrock aided by the use of an acid – most likely acetic acid. [24].
Buildings were gradually added to more appropriately meet the garrison and administrative requirements in the subsequent periods. This hill fort's defensive posture was further enhanced by construction of masonry outer walls (KK011) in areas where huge rocks were not available. The site could be accessed only through two rocky fortified gates supported by guard posts defending the citadel's main avenue of approach.
Main access was through the southern gate (KK0011), via zig-zag step stairs (KK017), most of which were carved out of rock and extended from the lower old town. The northern gate (KK0012) is more monumental than the southern, characterized by a cylindrical structure, carved deep into the rock. It is believed that this gate was exclusively used by the *Mir* and for military purposes.
Protection at the citadel was further enhanced through elevated rocky structures that were shaped into walls (e.g. KK0066) and provided with guard look-out openings and a water trench (KK014) at the outside northern edge. [25]
The fortress had almost all living facilities that could qualify it to be a small urban center. It was provided with military, administrative (ruling), legal, housing, living, and storage facilities, in addition to transportation network and life necessities (e.g. water, food). Most of these are carved out of rock and remains of chamber/room walls and foundations, underground storage cells and water cisterns/wells, paths and stairs are still identifiable on the site. This network of facilities, together with food, water and snow storage facilities, and farming could have contributed to achieving self-sufficiency in terms of food, water and other life requirements which enhanced its formidability, resistance, and impenetrability by invaders for an extended period of time.
The fortress was provided with its water supply through an underground rocky water channel (KK015) extended from a spring on the foothills of the opposite northern mountain using communicating vessels siphoning system made of pottery, lined and waterproofed with clay, which had also been adopted by the ancient Romans and Greeks. [26]
Water from the channel was poured into eleven underground conical wells (KK010; from KK0101-KK0113) layered with gypsum, suitable not only for storage of drinking water but functioned as a preservative – grains of gypsum help the absorption of moisture and inhibit stagnation. Water from the channel was also used for farming on the fortress plateau in the south-eastern section.
The fortress layout was designed based on its topography and functions. Buildings and road networks formed a unique architectural design at that time and were located mostly in the northern part. This area is divided through a large, geometrically-designed passage (KK0091) carved out of a huge rocky bed, withstanding the heavy weight of rocks and connecting the citadel to the northern gate. (See Figure 3).
The northwest section is more magnificent and includes the *Mir* and his entourages' living and office complexes, dining and storage facilities. The northeast section includes public facilities like the meeting hall, courthouse and military residences. The southwest section includes a meeting area – an arena around a big rocky wall (KK0081) with carved seats, and eleven water wells where arable lands are also located.
The citadel includes also a prison (KK012; from KK0121-KK0124),close to the north-east section, located outside on the northern edge, and connected with an underground tunnel network, carved out of rock and difficult to access. One of the tunnels leads to a middle point in the citadel and the other one is an escape to the outside. [27]
As noted during the survey, builders gave special emphasis to geometrical proportions and environmental aspects (levels, sun aspects and sanitation) especially during rock excavation and construction works. Almost all seats and openings especially in the *Mir*'s House (KK007) were carved in identical dimensions.
The *Mir*'s House was designed with door and openings facing east, and the prison has two roof openings – all these allow ventilation and sunlight to reach inside. An efficient drainage and sanitation system was designed with surface ditches/canals (e.g. KK016) carved out of rock for rain and storm water drainage on the ground and around room foundations, doors/windows (seams). [28]



Fig. 2: North view of the citadel: arrows point different areas composing the site, from east to west as follows: 1) Building complex foundations (KK005); 2) Chamber, Mid (KK0022); 3) Chamber, N (KK0023); 4) *Mir*'s Place (KK006); 5) Rocky Passage/Street (KK009); 6) *Mir*'s House (KK007); (7) Room Foundations (KK0042); 8) Storage Chamber (KK0031); 9) Event Arena Wall (KK0081).

4. Database for Kurdish rocky sites in Akre district

The archaeological sites of Kurdish Region of Iraq include some of the most important ancient heritage sites in the world dating back to the Paleolithic Age. Only in the Akre area, historians assess that there are over 100 ancient sites (AKREI, 2012) dating back to the 3rd millennium BCE and the Mithran period. Among these sites, several Zoroastrian religion temples and hillforts have been identified such as *Kal'a Kaven*, *Kal'a Akrè* and *Kal'a Shush*.[29] Other ancient sites include cave shelters, Neolithic sites, ancient settlements, tells (mounds), aqueducts and canals, rocky monuments and reliefs, forts and castles, cemeteries, bridges, etc.

The ongoing research focuses exclusively on the documentation of rocky sites, through the creation of the sites' GIS database. This database collects spatial and non-spatial (descriptive) information related to each site and provides a comparative analysis of the site characteristics, such as type, settlement patterns, period of occupation and continuity of habitation, construction/carving techniques and technological features, accessibility, etc.

This database is an essential tool for documenting, preserving and managing these sites, to be considered a preliminary document for setting up a sustainable and integrated management plan.

Throughout Duhok province, a high number of rocky monuments and reliefs are located.

The most relevant rocky sites in the Duhok area – listed below by type – are: 1) Aqueducts, such as at Jerwan aqueduct (690 BCE), the first monumental aqueduct in historyerected by Assyrian King Sennacherib as part of his Nineveh countryside irrigation system; 2) Sculptures/monumental rock reliefs, such as Khinis/Bavian (also canal head) and Maltai (currently Hala Mata Cave) – with carvings relief depicting the Assyrian king and the principal Assyrian gods; 3) Canals, such as Shiru Maliktha (in Bandwaye village) and Faideh subdistrict [30]; 4) Rock cut complex, at Charsteen (a Parthian cave); 5) Citadels, such as Akre and Amedi; 6) Castles; such as Shush; and 7) Caves, such as Gondk Cave. [31]

Research area covers part of this province being limited to the mountainous area of Akre district, where the study citadel is located.The developed database list counts 46 rocky sites, classified into: Fort/Khan, Rock Monument, Rock Relief, Rock Shelter, and Cave. Available historical sources report that most of Akre area sites belong to the following historical periods: Middle Assyrian, Late Bronze Age; Neo-Late Assyrian, Iron Age; Post-Assyrian, Neo-Babylonian, Achaemenid; Parthian, Roman; Sasanian; and Middle-Late Islamic. Other sites discovered in this area dateback to Hassuna, Samarra; Halaf; and Ubaid periods.

The database information collects data from the 1967Atlas/Map of Iraqi Archaeological Sites, still an invaluable source, the 1970 list of Archaeological Sites in Iraq – both documents prepared and published by the Directorate General of Antiquities of Baghdad - and 2012-2014UGZAR Project, in addition to various online resources. [32]

Each site was coded based on a single letter code (S) followed by three numbers denoting order of sites.

A topographical map of Akre district was created (see Figure 4) incorporating landscape features relevant for interpreting settlement patterns, such as elevation, historical paths, and waterways.

The created topographical map integrates different sources: base map was obtained from the NASA's Shutter Radar Topography Mission (SRTM) image. [33]

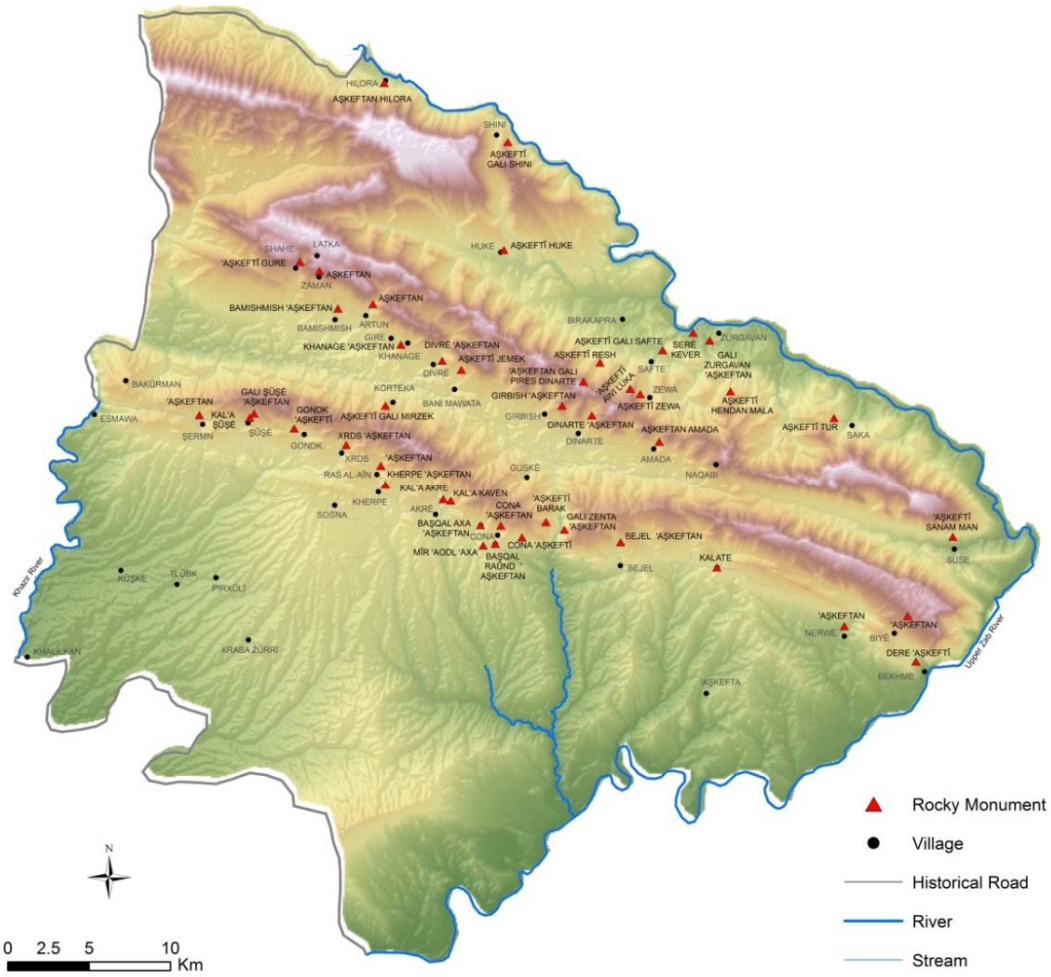

Fig. 4: Map of archaeological rocky monuments in the Akre district, showing the sites of the database.

Historical paths derive from declassified US CORONA [34] which is a recognized invaluable tool for study of ancient landscapes, site and change detection, as well as archaeological features'mapping. [35] CORONA allowed the team to identifytransportation network in the area such as foot track paths – still clear in many locations.Rivers and waterways were obtained from MapCruzin website.
The implemented database for Kurdish rocky sites in Akre district, once completed, will provide an invaluable depository of information that can be used to interpret, safeguard, and manage the identified sites, as appropriate.

5. Conclusions

Research team activity involved surveying, digital documentation and mapping of the Akre citadel through the application of GIS technology and remote sensing. GIS also included the creation of a database, still under implementation, concerning the documentation of all rocky monuments in the Akre region, first, and the entire Duhok area, later.
Research utilized a methodological approach traditionally used in heritage conservation and management developed in Italy under the umbrella of 'scientific conservation' and 'critical conservation', where the study of 'indirect sources' are intersected with the study of 'direct sources', and also included – for data collection - the adoption of international standards for documentation of immovable heritage. The extensive historical research and comparative analysis with other hill forts allowed the team to interpret the site layout and develop a better

understanding of its connection with environs and other sites in the area. However, available literature and historical sources showed that very few studies were undertaken throughout time on such an important and strategically located site, unique for its complex layout and the sophisticated construction technology – which requires further investigations - and for its actual context, surrounded by an historic hill town.
GIS potentials have been explored and utilized to map the site structures and other components, and to create a database. The project is anunprecedented initiative, essential preliminary tool for the safeguard and management of its valuable elements. However, the rugged topography of the site has made the access difficult to the site and created limitations on the use of GIS, particularly in many indoor and underground spaces where GPS transmission is not active.
Despite of the existence of such challenges, research team has adopted an integrated approach of GIS, traditional and laser measuring to survey, document and map this ancient site. Documentation was able to assess the high historical value of the site, its monumental character and the sophisticated technological solutions used for building construction, water collection and sanitation.
The northern Kurdish Region of Iraq has been endowed with a large number of historic sites that entail great potentials for this autonomous region's development. They witness its ancient history and could contribute to reinforce their cultural identity as one of the ancient part of Mesopotamia. However, lack of attention, ineffective regulations and planning, population growth and development, and looting have created combined impacts on these cultural resources and strongly threatened their existence. The implemented database for Kurdish rocky sites in Akre district will provide an invaluable depository of information that can be used to interpret, safeguard, and manage the identified sites, as appropriate, within an integrated and critical approach. The ongoing database will include not only information related to the 46 identified archaeological site characteristics in the Akre district area but also landscape and routes morphology and structural tectonics together with village/city analysis and will be an innovative instrument for the implementation of a more holistic management approach for the Akre area considered as a *continuum* cultural landscape, extremely reprentative in the history of civilization.
All these qualities together with the authentic character of the site, of the town and surrounding landscape – representative of eastern Mesopotamia, will bring the team to develop further documentation for the nomination of the cultural landscape of Akre as World Heritage Site.

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Bibliographical References

[1] AKREI, Faiq. A historical summary of Akre archaeological citadel. *Lalish Cultural Magazine*. Vol. 18-19 (2002). Duhok: Lalish Cultural Center
[2] AKREI, Hikmet. *Akre in the layers of history.* Duhok: Khane Printhouse, 2012.
[3] BRODIE, Neil, KERSEL, Moran M., LUKE, Christina &TUBB Kathryn Walker (Eds.). *Archaeology, Cultural Heritage, and the Antiquities Trade*. Gainesville: University Press of Florida, 2006.
[4] MALAIKA, Maha & RASWOL, Layla, Activating heritage tourism in Akre city by applying sustainable ecotourism approaches. *European Scientific Journal*. Special edition. Vol. 2 (February 2014). Azores: European Scientific Institute. ISSN: 1857 – 7881 (Print01) e - ISSN 1857- 7431
[5] UNESCO, The Operational Guidelines for the Implementation of the World Heritage Convention (revised English 2012, Arabic 2005).
[6] MORBIDELLI Monica, PRINCIPI Silvia. History of Architecture. Methodological lessons on the history of architecture. In: BARATIN, L. (ed.), *Instruments and Methodologies for Cultural Heritage Conservation and Valorization*, Ancona: Editrice Gabbiano s.r.l., 2012, pp. 24-37.
[7] ICOMOS, Principles for the Recording of Monuments, Groups of Buildings and Sites, 1996. . Accessed from: http://www.icomos.org/charters/archives-e.pdf ; on March 20, 2015.
[8] DURAN, Zaide, GARAGON, Dogru Asli, & TOZ, Gönül. Cultural Heritage Preservation Using Internet-Enabled GIS. *Proceedings of CIPA 2003 XIXth International Symposium,* 30 September – 04 October, 2003. Antalya, Turkey.
[9] DALLA BONA, Luke, Cultural Heritage Resource Predictive Modelling Project. *Introduction to the Research*. Vol. 1 (1994). Ontario: Ministry of Natural Resources.
[10] KARSLI, Fezi, AYHAN, Eminnur, & TUNC, Esra. *Building 3D photo-texture model integrated with GIS for architectural heritage conservation*. Commission V, WG II, 2005. Accessed from: http://cipa.icomos.org/fileadmin/template/doc/antalya/41.pdf; on November 11, 2014.
[11] ERICH, Fisher. 3D GIS archaeology in South Africa. *GEOconnexion International Magazine*. May 2005. Accessed from: http://users.clas.ufl.edu/sbrandt/3dgis.pdf; on March 2, 2015.

[12] SORIN, Hermon & JOANNA, Nikodem. 3D modelling as a scientific research tool in archaeology. In: *Layers of perception.Proceedings of the 35th International Conference on Computer Applications and Quantitative Methods in Archaeology (CAA),*April 2-6, 2007*.* Berlin, Germany, 2007.
[13] SALEH, Bassam& SADOUN, Balqies, Design and implementation of a GIS system for planning. *International Journal on Digital Libraries*. Vol. 6 (2) (2006). p. 210–21.
[14] COUNCIL of EUROPE, Core Data Index to Historic Buildings and Monuments of the Architectural Heritage, adopted by Council of Europe, 1992.
[15] CIDOC, Core Data Standards for Archaeological Sites and Monuments, 1995.
[16] BRIAN, Tomaszewski. *Investigation focus at Mexico's Aztec-period Calixtlahuaca site de-emphasizes temples and tombs*. ESRI, 2006. Accessed from: http://www.esri.com/news/arcnews/fall06articles/a-cost-effective.html; on January 3, 2015.
[17] IOANNIDIS, Charalambos, VALANIS, Artemis, TAPINAKI, Sevasti, & GEORGOPOULOS, Andreas. Archaeological documentation and restoration using contemporary methods. *Proceedings of CAA 2010 conference*. Granada, Spain, 2010.
[18] RUSINKIEWICZ, Szymon. & LEVOY, Marc. QSplat: A multiresolution point rendering system for large meshes. In: *Siggraph 2000.Proceedings of the 27th annual conference on computer graphics and interactive techniques.* New York: ACM Press/Addison-Wesley Publishing Co., 2000, p. 343-352. Accessed from: http://dl.acm.org/citation.cfm?doid=344779.344940; on March 8, 2015
[19] FRASER, James. *Voyage of Fraser to Baghdad in 1834*. Translated into Arabic by Al-Khayat, J. Baghdad: Ma'Aref Printhouse, 1964.
[20] WIGRAM, William Ainger, & WIGRAM, Edgar Thomas Ainger. *The Cradle of Mankind. Life in Eastern Kurdistan*. 2nd edition. London: Adam and Charles Black, 1922.
[21] JABO, Yousif. Analytical study: Mosul counties and biographies in Qalaa'id Al-Juman by Ibn Al-Sha'aar Al-Mousilli (654 H/1256 A.D.). *Mosoloiya Studies*. Vol. 39 (January 2013). p. 1-44. ISSN: 18158854.
[22] EROĞLU, Cengiz, BABUÇOĞLU, Murat, & ÖZDİL, Orhan (eds.). *Mosul in the Ottoman Vilâyet Salnâmes* (Translated by İLDAN, Ümit). 5th ed. Ankara: ORSAM (Center for Middle Eastern Strategic Studies), 2012. ISBN: 978-605-5330-94-1.
[23] BALISTANI, Taha. *Voyage of Kurdish Taha Balistani to Iraq, Levant, Anatolian, Egypt, and Hijaz*. Baghdad: Kurdish Cultural House, 1996.
[24] SHAREEF, Omer. Archaeology of Akre Castle. *Sipa Cultural Magazine*. Vol. 3 (2009). P. 15-17. Akre: Kurdistan Democtratoc Party.
[25] BAJLORY, Helbeen. *The Elhemidiye Kurds and their Political and Civilized Rule during the Third-eight A.H. / 9th-14th AD Century.* Master thesis, University of Duhok, 2011.
[26] SCHRAM, Wilke Driek. *Greek and Roman Siphons*. Roman Aqueducts. Accessed from: http://www.romanaqueducts.info/siphons/siphons.htm; on March 16, 2015.
[27] BUTANI, Abdul-Fattah; FAIQ, Akrei; ZEBARI, Ahmed; SADRADDIN, Dilshad. Akre: City of Springs. *Duhok Cultural Magazine*. Vol. 3 (April 1998). Duhok: Directorate of Duhok Municipality.
[28] SHAKIR, Fattah. Akre. *Hewa Journal*. Vol. 3 (1957). Baghdad, September 1957.
[29] SHENGO, Rashed. UNESCO and Akre archaeological sites. *Sipa Cultural Magazine*. Vol. 41 (2013). Akre: Kurdistan Democratic Party.
[30] JACOBSEN, Thorkild and LIOYD, Seton. Sennacherib's Aqueduct at Jerwan. In: BREASTED, James Henry and ALLEN, Thomas George (Eds.), *The University of Chicago Oriental Institute Publications*. Vol. 24 (1935). Chicago: The University of Chicago Press, 1935.
[31] KOSTAS, Kopanias, MACGINNIS, John, and UR, Jason (eds.). *Archaeological projects in the Kurdistan Region in Iraq.* Erbil: The Directorate of Antiquities of Kurdistan, 2015. Accessed from: http://nrs.harvard.edu/urn-3:HUL.InstRepos:14022526; on March 14, 2015.
[32] UR, Jason, CORONA satellite photography and ancient roadnetworks: A Northern Mesopotamian case study. *Antiquity*. Vol. 77(295) (2003): 102115.
[33] EarthExplorer. Accessed from: http://earthexplorer.usgs.gov/; on November 1, 2014.
[34] CORONA Atlas of the Middle East. Accessed from: http://corona.cast.uark.edu/; on January 3, 2015.
[35] PHILIP, Graham, DONOGHUE, Danny, BECK, Anthony, and GALIATSATOS, Nikolaos. CORONA satellite photography: an archaeological application from the Middle East. *Antiquity*. Vol. 76 (291) (2002). p. 109-118.

HERITAGE and TECHNOLOGY
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THE RECOMPOSITION OF FRAGMENTED OBJECTS: THE CASE STUDY OF ST. ANDREA STATUE AT STIFFE, L'AQUILA

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Abstract
The work that we present refers to procedures of 3D survey and automated processes of virtual re-composition and re-position of fragmented objects.
The case study is the restoration of a 15th–century painted terracotta artifact, the statue of Saint Andrew, from a church in Stiffe, a small village nearby L'Aquila in Italy. This beautiful statue was severely damaged during the 2009 earthquake when it fell to the ground and fragmented into 80 pieces 0.5-80 cm in size. Conservation treatment started in 2012 and was concluded in summer 2014.
The goal is to describe the restoration process about reassembling fragmented artwork with the adoption of 3D survey and modeling procedures.
We present some original procedures for sculpture reassembling using high accuracy instruments: acquisition of metric data through laser scanning and/or photogrammetry, 3D modeling of separate fragments, cloud segmentation using parallel sections, point color and reflectance to detect external and internal surfaces, fracture or contact regions with other fragments, contour extraction, internal volume definition.
The indications of digital reconstruction actually reduced the manual checking of matched pairs, being the fragments too fragile or heavy for safe and direct manipulation and allowed the restorers to reassemble a chaotic puzzle composed by a large number of pieces avoiding loop mistakes.

Keywords: Cultural Heritage, Matching, Reconstruction, Orientation, Point Cloud Segmentation

1. INTRODUCTION
This work refers to procedures of 3D Survey and automated processes of virtual re-composition and re-position of fragmented objects, based on our study about virtual reconstruction (Canciani et al., 2014). The skills of the research group, composed by M. Canciani, C. Falcolini, M. Saccone, (Department of Architecture, University of RomaTre), L. D'Alessandro and G. Capriotti are Mathematics, Computer Science, 3D Modeling, 3D Survey, Restoration.

2. THE ST. ANDREA STATUE AT STIFFE, L'AQUILA
A perfect example is represented by the case of the restoration of a 15th – century painted terracotta artifact, the statue of Saint Andrew, from a church in Stiffe, a small village near by L'Aquila, Italy.
This polychromed statue represents the standing figure of the Apostle dressed in a white tunic edged in gold and enfolded in a shining golden mantle whit internal blue-azurite. The scale is almost real . The saint is concentrated in reading the open book held in his left hand while the right arm has missed the original hand and the iconographical attribute of Andrew, a cross or a fish.
The noble and intense expression of the face, enframed in a fluent hair and beard, within the extremely rich and complex drapery of the tunic, reveals a clear inspiration and study of classical models, closely related with the roman-greek statuary. As for the definition of details the skill in modeling is very high, the concept of distribution of weight and gravity in the posture is absolutely perfect, in terms of internal proportion.

The statue has been recently attributed to Saturnino Gatti (Pizzoli, 1463 - L'Aquila, 1518), italian painter and sculptor active in the Abruzzi region, and considered one of the main artist of his age in Mid Italy. He began his activity under Silvestro dell'Aquila, who already was formed in Florence and was introduced by him to the environment of Verrocchio. Although the link with Saturnino is sustainable, the quality and the level of the sculpture seems to be higher than Saturnino's standard and more directly influenced by the Renaissance florentine spirit. No document actually exists about the commission of the sculpture.

This beautiful statue was severely damaged during the last earthquake in the spring 2009, when it fell to the ground and fragmented into 80 pieces, same of them large (max 80 cm) and many others smaller (down to 0,5 cm). Conservation treatment started in 2012 and was concluded in summer 2014.



Fig. 1: Fragments and partial reconstruction of the statue.

3. THE RE-COMPOSITION OF SMALL OBJECT: RELATED WORKS

The goal of this paper is to help the restorers to reassembling fragmented artwork with the adoption of 3D survey and modeling technologies. In this section we introduce previous works in specific domain: 3D Survey, Cloud Segmentation, 3D modeling for cultural heritage restoration, Reassembling artwork with 3D Models (Arbace et al., 2013), (Stanco et al., 2011) , (Callieri et al., 2004), (Corsini et al., 2010), (Dellepiane et al., 2007), (Huang et al., 2006).



Fig. 2: First reconstruction of some head fragments: analysis of horizontal plane sections and analysis of texturized fragments.

4. PROCEDURE FOR 3D SURVEY AND VIRTUAL RE-COMPOSITION

The 3D survey of fragments belonging to an originally unitary object, sculptural or architectural element, needs a series of features, relating both to the type of instrument, which must be high accuracy both the procedures to be adopted, integrated with each other and aimed at the three-dimensional reconstruction of each fragment.

The procedures for 3D survey can be summarized in:

a) Acquisition of metric data through laser scanning and/or photogrammetry.3D modeling of separate fragments (Cleaning-Aligning-Filtering).
b) Cloud Segmentation using color and reflectance to give a definition, for any single fragment, of external and internal surfaces and fracture or contact regions with other fragments. Contour extraction, using intersection between sections of internal and external surfaces and contact regions.
c) 3D Modeling for internal volume definition, original orientation of some significant fragments.

The re-composition of fragmented objects, following similar studies concerning virtual anastylosis of ancient ruined buildings (Canciani et al., 2014), (Li et al., 2005), (Thuswaldner et al. 2009) is developed through the following procedures:

a) Virtual Re-composition or Reassembling artwork. Check fragment pairs for contact regions and adjacent contours matching. Orientation and positioning of fragments in their original configuration.
b) Guideline for Re-composition and reposition. Definition of a space for brackets positioning, given the internal volume. Construction of a gluing sequence.

5. ALGORITHMS FOR RECONSTRUCTION

Given the point clouds rendering of several small fragments on a plate, we first tried to glue together the upper and lower parts coming from different surveys using smooth section curves matching. To get a segmentation of any fragment in external and internal surface contours we used different type of informations: data based on reflectance, from a laser scanner survey, and data based on the point clouds and related normals associated to each point, from photogrammetry survey. The two kind of data allowed us to give a first rough orientation in space of all the larger pieces and to make a segmentation process to get portions of a fragment made of points with roughly similar normals.

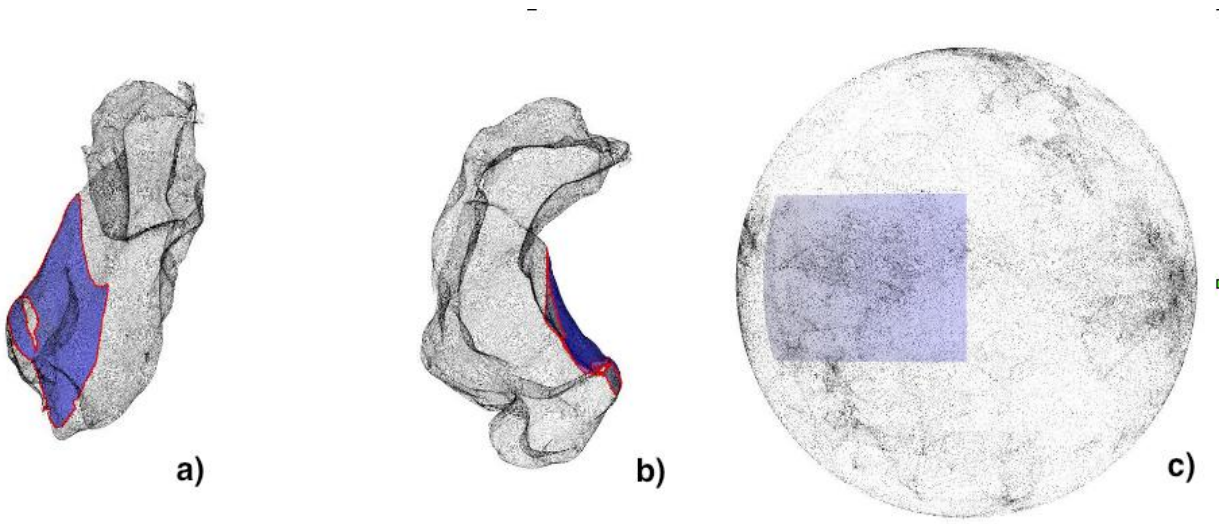

Fig. 3: a) Point Cloud representation of a fragment of the head of the statue. The blue region is a segmentation corresponding to points with normals in a small range of values and thus to a softly bended part. b) The same fragment from a different viewpoint. The red contour may correspond to a sudden change in the normal orientation. c) Gauss map of the point cloud in a) and b). The highly dense colored region corresponds to the blue bended region in a) and b).

We define the normals at each point P of a point cloud representation of a given fragment as an approximated value coming from the solution of a least squared problem: we look for a special set of points in a neighborhood of P and compute the normal to the plane that best fits these points.

An example is given in Figure 3c where a representation of a discretized Gauss map (associating to each point of a surface the representation on the unit sphere of its normal) of the fragment in Figure 3a: the black regions in Figure1c filled with many points often correspond to softly bended portions of the fragment (see Figure 3).

Note that the contours of Figure 3a and Figure 3b are not the contour of the marked spherical region of Figure 3c.
We use an automatic algorithm, using the software Mathematica 10, to find contour lines of the outer and inner part of the fragment. The process require also the detection of smooth parametric curves corresponding to plane sections and the study of their critical points. The procedure has been used in other applications (Canciani et al., 2013), (Canciani et al., 2014).

As an example we show the procedure to automatically find the contour of a color-based segmentation of a fragment (see Fig. 4): the output is a 3D explicit equation of a parametric curve which can be used for calculation related to the matching procedure.

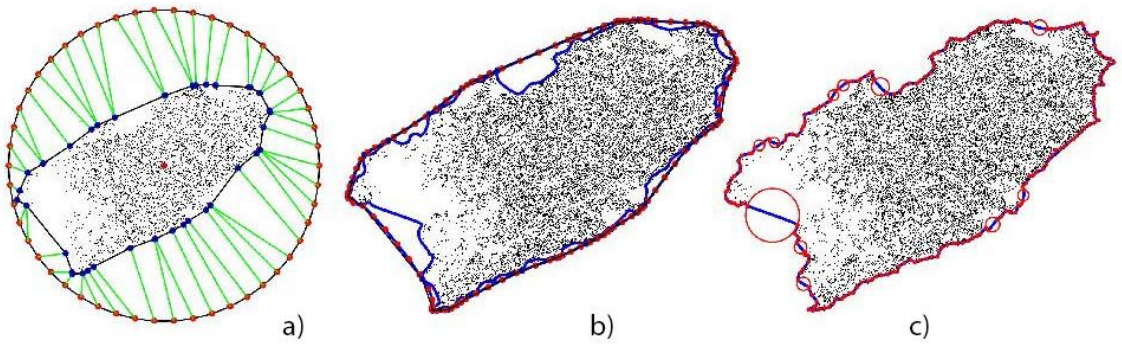

Fig. 4: 3D-contour extraction of a selected set of points: a) properly choosing the maximal circle of the circumscribed sphere connect the points of the set at minimal distance; b) take a uniform set of points on the interpolating parametric curve and iterates the procedure; c) corrections for straight portions of the limiting parametric curve.

The procedure is shown here applied to one small fragment of the head of the statue (see Fig. 5).

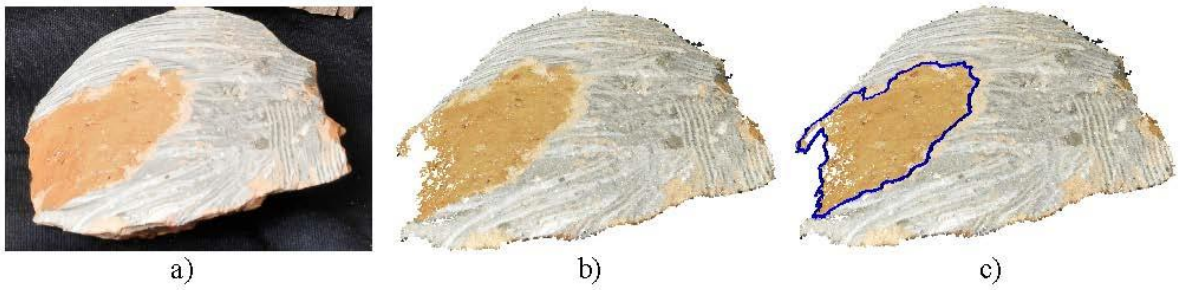

Fig. 5: a) A photo image of a small fragment and b) its 3D-model as a point cloud mapped with colors, out of a sequence of 9 photos. c) The blue contour of the broken external colored part, automatically evaluated as a mathematical 3D parametric curve.

The parametric equation of the contours allow the explicit calculation of its curvature which can be superimposed to similar plots of different contours to test complete or partial matching.

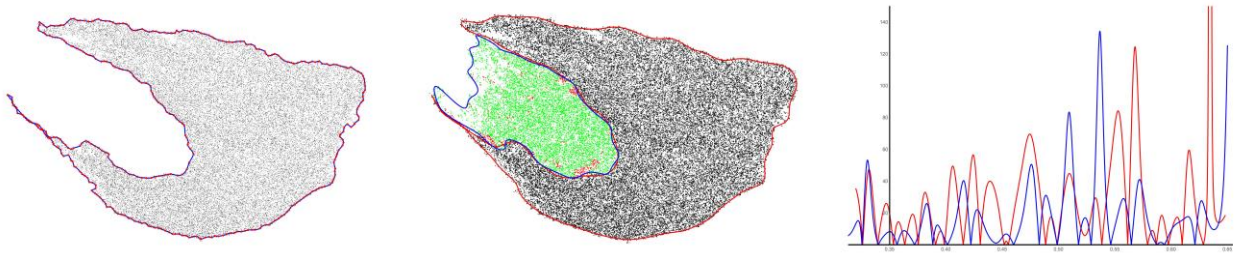

Fig. 6: a) A color-segmented part of the fragment; b) two parametric contours of the segmentation and c) comparing their curvature for related parameter intervals.

We tried to automatically group together fragments with similar external color or material properties and then tested a contour surface matching among elements of the group.
When two fragments have a matching probability higher than a given threshold we investigate their relative position with the virtual modeling (looking for intervals of similar curvature in the contours) and finally with the true pieces.
Once we have grouped together all the main pieces we virtually reconstruct a portion of the statue looking for the correct order of fragments repositioning.

6. CONSERVATION TREATMENT

The restoration project was planned in distinct operations:

- Collecting all the available data related to the statue (pre-earthquake photos, archives sources, notes and oral information from the people of the village where the statue belongs to).
- Reconnaissance of each single fragment and catalogue of all the pieces. 3 D scan all the major fragments in order to obtain a virtual reconstruction of the original shape.
- Consolidation along the edges in terms of re-cohesion of the original fictile material. Cleaning of each single piece related to the head and central part of the structure of the statue. Individuation and removal of foreign substances settled on the surface (deposit of grease dust). Special care has been addressed to find of residual of original stucco-filler, used during the assembling and/or repairing of flaws and imperfections occurred during the terracotta setting.
- Analytical-comparative study of the fragments with the digital model looking for the matching points of the edges. Searching of a logical sequence for the temporary reassembling of the fragments during the phase of orientation and positioning of each piece in its original configuration. Construction of a gluing sequence.
- Project for a new static-structure in order to stand the recomposed statue.



Fig. 7: The statue after the restoration treatment.

- Final reassembly of all the fragments.
- Insert of internal pins (stainless steel) in order to hold large and heavy portions (right arm and shoulder).

- Construction and insert of a bottom draft- shape (made in wood, 10 cm high), directly fixed into the new basement. The fixed joint blocks the statue just for gravity force, avoiding risks of lateral movements.

Aesthetics presentation: the lacunae in the support and the joints between the fragments, were filled up with stucco (composed of ethyl cellulose and wood pulp, adjusted at terracotta tone); plastic reconstruction of the missing areas (point of the nose). Pictorial reintegration in mimetic tone with watercolor applied on small filled gaps. The superficial abrasions of the paint layer were treated with watercolor glazes in order to suggest a natural "patina" tonality.

7. CONCLUSION

The main issue of this conservation project, was to use the three-dimensional modeling program in order to support the work of the restorers, in terms of simulation of sculpture reassembling. The 3D survey model was extremely useful in virtually testing possible shape of reconstruction and moreover provided a logical guide in suggesting how to proceed towards the complex puzzle sequence. The indications of digital reconstruction actually reduced the manual checking of matched pairs, being the fragments too fragile or heavy for safe and direct manipulation. At the same time the program, based on the simultaneous knowledge of global hypothesis, allowed the restorers to reassemble a chaotic puzzle composed by a large number of pieces and avoiding loop mistakes.

In the framework of a global strategy based on a close collaboration between scientists and restorers, it was possible to gather a successful result in the complete reconstruction of the statue.

The challenge of such "borderline case" found its solution in the statement of preliminary study rather than a usual empiric trials.

Bibliographical References

[1] ARBACE, L. et al., 2013. Innovative uses of 3D digital technologies to assist the restoration of a fragmented terracotta statue. *Journal of Cultural Heritage*, 14(4), pp. 332-345.

[2] ARBACE, L. , 2012. Saturnino gatti, I volti dell'anima , (De Siena)

[3] AAVV, 2014. Sant'Andrea Apostolo e Pescatore , capolavori restaurati da Stiffe a L'Aquila. a cura di Arbace L. , Catalogo mostra a Casa D'Annunzio (Pescara)

[4]CALLIERI, M. et al., 2004. Visualization and 3D Data Processing in David's Restoration, *IEEE Computer Graphics & Applications*, 24(2), pp. 16-21.

[5] CANCIANI, M. et al., 2011. *T*he Use Of 3d Models In Integrate Survey: The Church Of St. Thomas Of Villanova In Castel Gandolfo, *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci*., XXXVIII-5/W16, pp. 591-597.

[6] CANCIANI, M. et al., 2013. From point cloud to Architectural models: algorithms for shape reconstruction. *ISPRS Archives,* XL-5/W1, pp. 27-34.

[7] CANCIANI, M. et al., 2014. Virtual anastylosis of the Arch of Titus at Circus Maximus in Rome. *International Journal of Heritage in the Digital Era*, 3, pp. 393-412.

[8] CORSINI, M. et al., 2010. CENOBIUM—Putting Together the Romanesque Cloister Capitals of the Mediterranean Region. Proc. 3rd Int'l Conf. Remote Sensing in Archaeology, Bar Int'l Series, BAR S2118, pp. 189-194.

[9] DELLEPIANE, M. et al., 2007. Using 3D Scanning to Analyze a Proposal for the Attribution of a Bronze Horse to Leonardo da Vinci. Proc. 8th Int'l Symp. Virtual Reality, Archaeology and Cultural Heritage (VAST 07), Eurographics, pp. 117-124.

[10] DELLEPIANE, M. et al., 2008. Multiple Uses of 3D Scanning for the Valorization of an Artistic Site: The Case of Luni Terracottas. *Proc. Eurographics Italian Charter Conf*., Eurographics, pp. 7-14.

[11] DE LUCA, L. et al., 2011. A semantic-based platform for the digital analysis of architectural heritage, *Computers & Graphics*, 35, pp. 227-241.

[12] HUANG, Q.X. et al., 2006. Reassembling Fractured Objects by Geometric Matching. *ACM Trans. Graphics*, 25(3), pp. 569-578.

[13] LI, D. et al., 2005. 3D Reconstruction and simulating assembly of ancient chinese timber-structure building, The proceedings of CIPA 2005 XX International Sympsium, pp. 906-911.

[14] REMONDINO, F., 2011. Rilievo e modellazione 3D di siti e Architetture complesse, *Disegnare con*, 4(8), pp. 90-98.

[15] STANCO, F. Et al., 2011. Digital Imaging for Cultural Heritage Preservation, Taylor & Francis Group.

[16] THUSWALDNER, B. et al., 2009. Digital Anastylosis of the Octagon in Ephesos, *Journal on Computing and Cultural Heritage,* 2(1), pp. 1-27.

HERITAGE and TECHNOLOGY
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Democratic evaluation of architectural heritage

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Abstract
The paper is about what kind of evaluation is more suitable for architectural heritage. Adopting a theoretical-methodological approach, the author argues that architectural heritage is a complex concept as many different values are attached to it. Actually two separated – the qualitative (socio-cultural) and quantitative (financial-economic) – evaluation approaches and techniques are prevalent in architectural heritage, but as their results are not comparable, they do not provide any aid to the complex decision making. At the same time, an increasing demand for participation in public decision-making as well as in evaluation processes is coming from the civil society. As a consequence, architectural heritage evaluation is required to integrate all the relevant values emerging from the context and to include all the interests and preferences of any actor who has a stake in the project. To satisfy these requirements the author proposes to adopt a democratic evaluation process supported by a multi-criteria analysis with multi-decision-maker. Democratic evaluation – being based on justifiable and acceptable reasoning – is able to consider, at the same time, a) the multiplicity of the values as well as of the involved actors' viewpoints; b) to takes into account the dependence of preferences from the development of the deliberation process; c) to endorse the sustainability issue; and finally d) to foster the re-definition of the problems and the invention of new shared solutions.

Keywords: democratic evaluation; architectural heritage; deliberative decision making; multi-criteria analysis.

1. Introduction
In spite of the increasingly relevance recently gained by the social, symbolic anthropological aspects, at present, architectural heritage evaluation is mainly developed from two different separate points of view: the historic-artistic and the financial-economic. The first one mainly consists of the mono-disciplinary traditional studies aimed to determine the value of architectural heritage according to its cultural, artistic, historical, significance as a work of art or a record of the past. This kind of evaluation – produced by professional experts – results in-depth qualitative analysis expressed in a narrative form using a limited number of established qualitative criteria which provide information to decide, for example, whether a building deserves a "heritage" status or whether it is advisable to apply a treatment to a monument.
The financial-economic evaluation is mainly interested in establishing the public and private convenience of investments in architectural heritage conservation restoration and rehabilitation projects, so it fundamental in shaping investment decisions. The most used economic evaluation method is cost-benefit analysis which results in a – meant objective – quantitative analysis of the effects (costs and benefits) falling on the society from a conservation or restoration project whose value is measured by prices using a monetary unit. The project result is represented by several synthetic investment criteria easy to be understood and communicated.
The two different kinds of evaluation – separately performed – often provide the decision maker with different contrasting information about projects appreciation and ranking which give a little help to the decision-makers. When coherent, conducive, convergent data on cultural heritage are not available, and decision-makers have to justify their investment decisions, economic evaluation methods normally get a great advantage over the historical-artistic ones because they presents results in a seemingly objective form according to a widespread concept of efficiency accepted by society at large.

But relying on quantitative economic methods alone ignoring or disregarding other socio-cultural values because they are intractable in quantitative terms nor comparable may be dangerous. As a matter of fact, from a cognitive point of view, some important value of cultural heritage can only be expressed qualitatively through narratives. This may be one of the reasons why several investments in cultural heritage have failed and haven given rise – among all the stakeholders – to a shared request of a multi-disciplinary approach to architectural heritage evaluation, that is, to encompass and integrate the different cognitive contributions from the different disciplines – coherently with the different values involved – within the same framework.
The paper proceeds from few assumptions:

- The evaluation of architectural heritage is a complex problem as it involves a plurality of values (having different nature e.g.: cultural economic, social, artistic, aesthetic, historic, symbolic, etc.) multiplicity of stakeholders endowed with different and sometimes conflicting objectives, interests preference and points of view.
- Given the varied nature of heritage values, the evaluation of an architectural heritage project values requires a holistic (multidisciplinary and integrated) approach.
- The values of heritage depend on contextual factors (social and economic conditions, cultural trends, etc.) so a case-study research strategy is advisable.
- The multiplicity of stakeholders involved in architectural heritage requires a collaborative coordination model of decision-making open to the civil society participation.
- The long-term perspective implicit in architectural heritage concept requires to take into account stainability issues and a strategic evaluation focused on the decision-making process (not on its results).
- Participative-deliberative decision-making and long-term sustainability perspective both refute the hypothesis of exogenous preferences and ask for an evaluation process able to deal with the transformation of preferences.
- The evaluation process is to be intended as a learning process.

The paper will deal with the following items: section 1 provides a short presentation of the concept and of architectural heritage as a part of the general concept of heritage. Section 2 presents the most relevant values attached to architectural heritage distinguishing them between socio-cultural and financial-economic one. Section 3 is about the most common (qualitative and quantitative) methods to express these architectural heritage values. Section 4 is about how different disciplines evaluate architectural heritage and why an integrated inclusive approach is advisable. Section 5 presents democratic evaluation principles and main features. It also illustrates its three main components and how: the first one, participants' empowerment, is strictly linked to participation process, the second one, the deliberation process implies changes in participants' structures of preferences and the third one, multi-criteria analysis, provides the evaluation process with a logically sound structure as well as a decisional algorithm to achieve common shared solution avoiding any compensative aggregation of criteria. Section 6 makes some considerations about long-term perspective and the relevance of sustainability issue to architectural heritage decision-making and how democratic evaluation can endorse this theme. Finally, section 7 provides some short conclusions.

2. Heritage, cultural heritage and architectural heritage

The term "heritage" refers to a very wide concept that includes a large range of goods all representing some notion of a valuable inheritance from the past (recent or distant). But the range of goods included in the concept of heritage changes over time and space according to different interpretation within any one culture and a variety of dimensions: cultural, social, symbolic, identity-oriented and so on. As a consequence, heritage is a social construction, imagined, defined and articulated within cultural and economic practice, whose boundaries are unstable and blurred, due to: continuous historical additions and concept enlargement through the inclusion of additional items [2] [11] [27].
Heritage is a value-loaded concept related entirely to present circumstances, which involves a subjective interpretation of selective materials and issues. In other words, the only referent that matters is the present: it is the present that selects an inheritance (e.g.: a building, monument, material artefact, mythology, memory and tradition), from the infinity of an imagined past, interprets it as resources for current use and decides whether it is deemed valuable and should be passed on to an imagined future. The narration and practice of heritage necessarily involve a subjective interpretation of selective materials and issues.
This means that heritage – depending on the demands of the present – is more concerned with the meanings and the interpretation formulated in the present, than on its content. The inclusion of a specific element within the concept of heritage depends on and varies with the meanings it has for a community, but meanings are marked out by identity, and are produced and exchanged through social interaction in a variety of media. As a consequence, the different elements of heritage can, in turn, be selected or discarded as the interpretations and the demand of present society changes. So we can say with Graham that «if heritage is the contemporary use of the past, and if its meanings are defined in the present, then we create the heritage

that we require and manage it for a range of purposes defined by the needs and demands of our present societies».
So, if heritage is subjective and filtered with reference to the present, it can synthetically be defined as “a contemporary product shaped from history” [13].
“Cultural heritage” is a component of the heritage characterized by the association with the culture of a social group (representing a local, regional, national or international community). The term “culture” is conceived anthropologically, so that it includes “the shared values that bind a group together”, as well as, all the activities related to the creative arts. In addition, being essentially concerned with the production and exchange of meanings, heritage – like language – is one of the mechanisms by which meaning is produced and reproduced, in other words, heritage «is a medium of communication, a means of transmission of ideas and values and a knowledge that includes the material, the intangible and the virtual» [11].
According to UNESCO, in cultural heritage we can distinguish two components: “tangible cultural heritage” encompassing, for example, art objects, artefacts, buildings, sites or locations of cultural significance; and “intangible cultural heritage” represented by, for example, traditions, rituals or customs. [27]. In Western Countries, cultural heritage is mainly envisaged as the “built and natural environments” like walled cities, cathedrals, palaces, urban and rural landscape and national parks. According to this view we can provide a very simple definition of the built cultural heritage as “the buildings and monuments inherited from the past, with a cultural or historical dimension justifying their preservation for future generations, but also modern monuments whose symbolic or cultural value is high: houses or buildings designed by a kind of international elite of architects” [2].
This paper restricts attention to tangible cultural heritage and specifically to architectural heritage.

3. Values of architectural heritage

Values may be intended as morals, principles, or any other ideas that serve as guides to action (individual and collective), or be referred to the positive qualities and characteristics recognized to somethings. [19]. In this second meaning, a value is always an implicit attribute of heritage as nobody makes an effort to conserve and transmit something it does not value. So anything belonging to the heritage intrinsically and tautologically possess some kinds of value. But, on the other hand, heritage values are contingent according to the social processes of value formation, namely the values of any architectural heritage don’t emanate from the building itself, but are the result of its interaction with the contexts (that is, the physical, geographical, historical, cultural, social, economic, institutional, political conditions) and depend on the different roles that the architectural heritage plays in society. As a consequence at a given moment, values can only be understood with reference to social, historical, and even spatial contexts and according to the points of view of the observers who define and articulate the value. The contingency of heritage values does not exclude the possibility to universally held them, but it simply means that such “universality” rests on their wide and shared diffusion and not on their objective intrinsic characteristics. [19] [20].
The most frequent and relevant values considered in architectural heritage decision-making belong to two meta-categories characterized by different conceptual frameworks and methodologies: socio-cultural and economic. Such major meta-categories “do not actually refer to different, discrete sets of values”, but represent two quite distinct attitudes/perspectives in facing the evaluation issue and, from which, two alternative ways of understanding and labelling the same range of heritage values come out [19].
Note that, despite the political perspective, is probably the most relevant one in architectural heritage decision-making, no separate category for political values is included in the classification. This happens because all values attributed to heritage have a political nature, as far as they take part in the games of power that determine the fate of architectural heritage.

3.1 Socio-cultural values

Socio-cultural values are at the traditional core of conservation. In this meta-category are encompassed all the values attached to a building, or place «because it holds meaning for people or social groups due to its age, beauty, artistry, or association with a significant person or event or (otherwise) contributes to processes of cultural affiliation» [19]. According to Mason, the main values belonging to this category are:

1. Historical value: it refers to the capacity of a building or a site to convey, embody, or stimulate a (positive or negative) relation to the past. It is fundamental in defining the nature and meaning of architectural heritage. it mainly depends on several characteristics of the building e.g.: material’s age; association with people or events; rarity and/or uniqueness; technological qualities; archival or documentary potential; etc.. Historic values encompass:
   - Educational/academic value: it is related to the potential to gain knowledge about the past (e.g. through historical or archaeological research);
   - Artistic value: it is based on the uniqueness of a building or in being a good example of a category, or in being the work of a particular architect, etc..

2. Cultural/symbolic value: it refers to the shared meanings of architectural heritage not strictly related to the historical, chronological aspects. History and heritage are core elements of any culture: there is no heritage without cultural value. It encompasses:
   - Cultural value: it refers to the capacity of architectural heritage to build a cultural affiliation, as it relates to the historical, political, ethnic means of living together.
   - Symbolic/civil value: it refers to the capacity of architectural heritage to stimulate positive reflections and behaviors that build civil society by raising or strengthening civil relations, governmental legitimacy, protests, or ideological causes, etc.. It may be symbolic, or can stem from research, learning and understanding of how architectural heritage are created and evolve, and who were the actors in the process. Note that this kind of values can be interpreted both positively, as a key contributor to civil society, or negatively, as a political tool enforcing national culture or dominant elites and ideological positions.
   - Craft or work-related value: it is referred to the making process. The architectural heritage embodies the methods used to design and make it, that must be considered separately from the historical or aesthetic aspects.
3. Social value: it refers to the capacity of architectural heritage to enable and facilitate social connections not necessarily related to the historical values of heritage. In this case the different uses of architectural heritage – such as celebrations, markets, etc. – do not necessarily exploit the historical-cultural qualities of the site but, rather, its public space, shared-space characteristics. Social value also includes the idea of “place attachment” that refers to the feelings of affiliation, social cohesion, community identity etc. that any social group derives from their “home” territory.
4. Spiritual/religious value: it refers to the capacity of an architectural heritage to emanate religious or other sacred meanings or to produce feelings of wonder, awe, etc. in visitors (an extreme case may be the Stendhal’s syndrome).
5. Aesthetic value: it mainly refers to the visual qualities of an architectural heritage or of a building design that produce a sense of well-being. It has long been one of the most important criteria in labelling building and places as heritage, even though it is perhaps the most personal and individualistic sociocultural value.

3.2 Economic values

From the economic point of view, architectural heritage can be considered as a capital assets with the standard characteristics of ordinary physical capital. So we can refer to it as a stock of values or as a flow goods and services. But, due to its socio-cultural attributes, it also has few distinguish features: first, architectural heritage can be considered a public good because it produces external effects, namely it is non-rival and non-exclusive in consumption (e.g.: a historical city center can be enjoyed by a large numbers of visitors simultaneously and it also is open access as nobody must pay to visit it). Second, they are “unique and irreproducible” this means that, any “copy” you make, is never “authentic”. As a consequence, the supply of the architectural heritage cannot increase according to changes in its demand.

As opposed to what occurs for paintings or sculptures note that you cannot establish any direct, proportional relationship between the socio-cultural architectural heritage's content and its market price. In other words, the market price of an architectural heritage can be lower (in the case of a partially ruined castle) or higher (in the case of ancient palace used for representative purposes) than the market value of a "normal" similar building .

As a consequence, we cannot rely on market prices to evaluate architectural heritage but rather we have to resort to “total economic value” that includes two components [19]:

1. Use value: it refers to the direct consumers' valuation of the asset’s services and expresses the direct users’ willingness-to-pay for the architectural heritage services. So it relates (but not exactly coincides with) the market price (e.g.: the entry fees paid by visitors to historic sites). Tourism tangible revenues represent a large proportion of these direct use values.
2. Non-use value refers to the value placed upon a range of non-rival and non-excludable public good characteristics typically possessed by cultural heritage. It relates to the asset’s existence value and may represent an alternative way of looking at the socio-cultural values of architectural heritage. The main kinds of non-use values are:
   - existence value: people value the existence of an architectural heritage even though they themselves may not consume its services directly;
   - option value: people value the possibility to preserve the option that they or others might consume the architectural heritage at some future time;
   - bequest value: people value to bequeath architectural heritage to future generations.

These non-use values are also told nonmarket values because they are not registered by the market mechanism. Nevertheless, their amount can be evaluated through revealed or stated preferences methods.

4. Architectural heritage evaluation

The disciplines involved in architectural heritage conservation and restoration project have developed a wide range of different methods and techniques to express these values.

The assessment of cultural values, traditionally relies on expert (e.g.: art historians, architects, etc.) appraisal of buildings or parts of an urban fabric. This scholarly experts' and/or connoisseurs' judgements rely on qualitative methodologies of analysis focused on the formal and material composition and physical condition of the building and employ canons of taste, authenticity, historical significance, aesthetical quality, etc.. Often the research ends with a judgement expressed according to a scale of values internal to the discipline, so that it is difficult to verify the external validity of the results or to make any comparisons.

Social values may be expressed through holistic human-centered methodologies of cultural anthropology. The most relevant methods to describe and record a culture characteristic are: cognitive and observational approaches (focused on one dimension of human activity), phenomenological and historical approaches (integrating human activity with the environmental context), ethnographic and discourse approaches (including human activity, environment, and social, cultural, and/or political context). All these methodologies assume the observer's subjectivity and use a wide range of tools including individual and expert interviews, transect walks, focus groups, mapping exercises, structured observation techniques. The knowledge about social phenomena and values is normally expressed by narratives which extensively and contextually deal with causation relationship. Also, in this case, the comparison of the information produced is a difficult and even impossible task.

On the other side, economic values are expressed in quantitative terms (prices) and processed through cost-benefit analysis that makes judgements and provides a ranking of the alternatives. Prices may be appraised through market mechanism or through nonmarket economic methodologies founded on revealed and stated preferences.

The revealed preferences method quantify the preferences for nonmarket goods analyzing the consumers' willingness to pay in actually existing associated "surrogate markets". The hedonic price method, the travel-cost method, and the maintenance cost method are the most popular revealed-preference techniques. All the revealed preferences methods have a limited capacity to estimate architectural heritage value because they cannot grasp option and non-use values.

The stated preferences method uses "hypothetical markets" – described by means of a survey – to elicit the preferences for nonmarket goods. Contingent evaluation is the most popular method belonging to this group. It is able to capture use and non-use values but, it suffers from some biases, the most relevant is the "free-rider problem". According to it, people do not reveal their true preferences if they cannot be excluded from enjoying the benefits of a public good. Other biases refer to the hypothetical nature of the survey questions, or the possibility that responses are based on insufficient or incorrect information, etc..

Due to the multiplicity of values of the architectural heritage it is generally accepted that no single (neither socio-cultural nor economic) discipline can provide an exhaustive evaluation [20].

Socio-cultural evaluation can rely on many qualitative context-related analyses – based on careful observation of the problem at stake which reflect its different values from the point of view of the different stakeholders – but, such analyses are of little help in decision-making as they do not provide objective value judgements and their results are not suitable for comparison. As a consequence, in recent times, economic methods have got an increasing credibility as they provide quantitative (monetary) analytically sound evaluations that result in (pretended) objective ranking of alternatives. Unfortunately, they fail in considering many of the architectural heritage socio-cultural values that the revealed or stated preferences methods cannot grasp. Moreover, the neoclassic economic theory reduces the problem of the multiplicity of values to the definition of a system of trade-offs aimed to a compensative aggregation.

So many different and diverging appreciations of the same problem – coming from different discipline – may cause a highly risky situation where decisions have no scientific basis, but rather rely on arbitrary political reasons or simply on chance. As for conservation-restoration project a single best answer does not exist; nor an objective, technical precision is possible, nor a one-size-fits-all evaluation technique is available, decision makers experts and any other category of people involved in architectural heritage are asking for an integrated comprehensive approach to evaluation that adopts a holistic and inclusive strategy:

- performed at the strategic level;
- focused on decision-making process more that on its results;
- tailored according to the case-study research methodology (namely an in-depth contextualized and holistic research);
- integrating a number of different evaluation perspectives, methodologies and tools;
- including all the relevant values;
- including the interests, objectives and preferences of all those who have a legitimate stake in the decision;
- allowing a wider meaningful participation (with a special attention for who have nor power nor possibility to express their preferences);

- implementing evaluation rules producing non-aggregative judgements.
- adopting a long-term perspective and sustainability vision.

In recent times, some attempts to complement economic evaluation studies with qualitative information coming from socio-cultural studies and to open the decision-making to a wider stakeholders' participation have been proposed (for example, performing side by side cost benefit analysis and "participatory rural appraisal"), but a true integration still remain an aspiration because both an evaluative comprehensive-integrated approach and a structured participative decision-making process still lack.

5. Democratic Evaluation of architectural heritage

A more suitable and satisfying solution may be offered by deliberative democratic evaluation.

This new approach to evaluation originates from some recent socio-economic phenomena. First, the shortage of public funds – due to the long-standing economic crisis – and secondly, the de-legitimation of the public decision making – due to its low efficiency and effectiveness and to corruption – have caused an increasing demand for civil society's participation as well for evaluation at all stages of the public interventions, starting from the front- end phase when the values and the objectives are stated.

As a consequence, democratic evaluation is no more requested to objectively solve tactical-operative problems of finding the best possible solution but, rather to face strategic problems related to decision-making values and objectives recognizing the subjective nature of any value judgement.

According to House and Howe, deliberative democratic evaluation is a method to mitigate inequalities in power among stakeholders due to differences in knowledge, information, and discursive capacity and facility. It has two essential characteristics [24]:

1. citizens' participation in decision-making;
2. decisions are the result of a deliberative process;

and it is based on three main principles: inclusion, dialogue and deliberation.

The principle of inclusion requires that all groups with a significant interest – stakeholders – be included in both the design and conduct of the evaluation of a program or project. This does not mean – of course – that every interest, value or view concerned will be given equal weight, merely that all relevant ones should be considered.

Dialogue is an evidence-driven cognitive activity in which participants and evaluators collaboratively engage and from which the most rationally defensible conclusions emerge. Dialogue is basically a learning process, based on mutually respectful listening and communication of opinions and ideas of all stakeholders. Its main goal is the achievement of commonly shared meanings and solutions provided that an attitude of reciprocal understanding and legitimation of the different, interests, objectives and values of the participants is assumed.

Deliberation is related to the manner in which dialogue is structured and the information that is entered into it are processed. Deliberation is a reflexive, thoughtful reasoning on relevant problems at stake – including preferences and values identification and transformation – by which all the stakeholders reach findings conclusions and (shared or at least acceptable) solutions.

Supporters of traditional economic evaluations argue that democratic evaluation is operatively weak. A solution to this problem consists in a three stages implementation encompassing: an empowerment process, a deliberative process and a multi-criteria analysis which provided a judgement algorithm.

5.1 Participation and empowerment process

The empowerment process is the first indispensable stage in the efficient implementation of a Democratic Evaluation providing citizens' participation in decision-making with a minimum amount of organization. It mainly consists of a learning process about the evaluation experiment aimed to bring a population to the point of being able to evaluate and take charge of itself and "to speak with a single voice" [24].

Democratic evaluation is strongly committed to promoting participation so, as a matter of equity and accuracy, the simplest political guideline is trying to realize the widest participation and account for the views of all the relevant stakeholders [19].

The most relevant actors in architectural heritage projects are: community and other culture groups (both the general and the organized public interest groups); the market (promoters, banks); the State (politicians public administrations or institutions); experts (conservators, architects, and other – local – experts); property owners; ordinary citizens, etc.

Some of them are "at the table" where values are identified, assessed, and ranked and where decisions are made while other legitimate stakeholders are not present. Insiders are those who can participate in the process by right or might. They are endowed with some kind of decision power, such as public officials, bureaucrats, policy makers, and, to an extent, professionals (conservators and other experts) involved in the process. All the other actors with a stake in the architectural heritage in question but with little or no leverage on the process remain outside. In some instances, they have no knowledge of the process or in conservation and policy and perhaps even low interest in participation [19].

Another category of normally excluded stakeholders is represented by potential stakeholders who may in the future have some interest in the architectural heritage (future generations or who lives at a distance).
Acknowledging and fostering outsiders inclusion in decision-making is mainly a political problem as it give rise to questions about who has the capacity and the power to decide when the technical- scientific aspects are overwhelming.
Even though the empowerment of the weakest stakeholders is a fundamental process in democratic evaluation nevertheless, it is the outcome of dialogue and deliberation that requires a respectful exchange of opinions and ideas and a reciprocal attitude to change preferences in order to achieve common shared meanings and solutions. As a consequence, empowerment mainly results in a learning process endowing weak stakeholders with the capacity to understand and consciously influence the complex collective decision-making and to master the knowledge and the techniques which facilitate self-determination. This means that there is no transfer of decision-making power as it remain in the hand of the "internal" actors (without any threaten to the role of the experts), even though decision-makers are bound – by a pre-commitment – to motivate their decision when it differs from the participation process result [4].
Nevertheless, the empowerment process requires real changes in professional attitudes. Experts and evaluators need to be open to laypeople views about heritage values and decisions and embrace alternative ways of understanding value, negotiating differences, and so on [19].

5.2 Deliberative process and changes in preferences
Citizens' participation in decision-making is meaningful only if it results in concrete decisions. The deliberative process involves all the stakeholders (the market, the State, experts, property owners, ordinary citizens, etc.) in a dynamic process of the collective construction of the problem of choice of a shared solution – through dialogue and deliberation – and not as a simple confrontation of interests or an aggregation of the preferences of the majority [24].
Deliberation process requires some preconditions: meeting places where communication without domination can take place, openness, access to relevant information, and time for reflection and discussion.
Deliberation also requires that all stakeholders, first mutually recognize the legitimacy of all the values, preferences, interests and systems of knowledge at stake and secondly, share a common commitment to a mode of reasoning and decision-making based on rational and impartial argumentations [24].
The aim of the deliberative process is (possibly) innovative common shared meanings and solutions – or at least a compromise one – through changes in preferences.
The change in preferences deserves some attention as it is the trigger-mechanism that allows to create innovative common shared meanings and solutions.
According to the neoclassical economic theory, preferences play a relevant role in the problem of rational choice, but they are considered exogenous (fixed and given). Preferences formation and change remain outside the economic domain and the task to investigate on the complex social and cultural processes that lie behind them is left to social scientists (sociologists, psychologists, anthropologists etc.).
But preferences do change and not all of them can be considered minor, impulsive, uncomplicated, haphazard, publicity induced, changes in tastes namely, changes in preferences you do not argue (*de gustibus non disputandum est*).
There are also changes in preferences preceded by the formation of metapreferences. Hirschman holds that «men and women have the ability to step back from their "revealed" wants, volitions, and preferences, to ask themselves whether they really want these wants and prefer these preferences and consequently to form metapreferences that may differ from their preferences» [14]. This aspect of the process must be of concern to the economists because all changes in preferences preceded by the formation of a metapreference are changes in values. But any change in values has effects on behaviors and, as a consequence, exploring those changes in preference is worth [14].
Preferences depend on affective as well as cognitive components in a variety of combinations. They may evolve and change as a result of cultural transmission by which a socialization process transmits preferences across social groups and generations, or through an imitation process by which individuals imitate other more "successful" individuals. As far as behaviors are learned and transmitted by culture and society through families and social groups interchanges, preferences can be considered learned influences on behavior. But «Learning is more than the acquisition of information; it is the development of new means and modes of cognition, calculation, and assessment. This means that agents are building up new representations of the environment in which they operate, in place of former conceptions and habits of thought» [15]. As a consequence, the learning process developed through dialogue and deliberation strongly influences the change of preferences as well as of goals, capacities, skills, and values.
Changes in preferences require an evaluation process that allows a continuous and recurring reconsideration of the objectives, the criteria and their relative importance that – unaffordable by cost-benefit analysis – is possible using multi-criteria analysis as some relevant – even though, still quantitatively limited – operative examples of the hierarchical "Electre" method illustrate [24] [10] [4].

5.3 Multi-criteria analysis/evaluation

The third phase is the implementation of a multi-criteria analysis. The multi-criteria analysis is fundamental to democratic evaluation as it provides, first, a formal framework for the development of the deliberation process and, secondly, an algorithm for the project selection process encouraging a deliberative decision-making process to achieve a shared creative solution [24].

Multi-criteria evaluation aims to recreate the different dimensions of the decision-making problem and the different opinions of the diverse actor. It is particularly suitable for the implementation of architectural heritage democratic evaluation as it translates, in operational terms, the statement about the subjective nature of any value judgement.

Multi-criteria analysis allows to consider a plurality of values and criteria, processes both quantitative and qualitative data, includes a multiplicity of stakeholders considering different structures of preferences (using multi-decision-makers approach) without reducing the multi-dimensionality of value to one sole indicator, considers changes in preferences (structuring the deliberation processes), produces creative solutions, allows us to consider quantitative and qualitative decision criteria.

Moreover, multi-criteria analysis helps first, in setting initial goals – through the definition of the evaluation criteria – and provides suggestions on how to reach them, and secondly, in assigning the relative importance (weight) of the different criteria. This latter step is delicate as, if it might be easy that different participants agree on the evaluation criteria, objectives and values, it is very difficult that they agree on their relative importance. Weighting criteria actually means that you compare (often according to selfish interests) different values that hardly may be reassembled into a unique interpretation of the common good. The risk is that the discussion – being interested in value comparison – becomes ideological with little room for an agreement on a common, shared solution [4].

A possible solution to this problem is the implementation of a multi-criteria analysis with multi-decision-maker that associates a specific structure of preferences to each participant and develops as many evaluation exercises as the participants are. The evaluation result is a number of alternative's rankings equal to the number of the points of view considered. In this way, each actor realizes how the different alternatives are ranked, according its own structure of preference, and what are the rankings produced by different other participants' structures of preference. According to the multi-decision-maker approach the dialogue shifts from values-comparison to rankings-comparison level where both the mutual influence between participants and the transformation of preferences are possible giving room to shared, "creative" solutions [4].

The multi-criteria evaluation matrix also provides a clear and concise picture of problems and alternatives that allows an unambiguous development of the deliberative process and the achievement of a satisfying solution, namely a relatively positive one, according to certain criteria, and not too bad compared to others.

6. Sustainability

A final item deserving attention in architectural heritage decision-making and evaluation is the sustainability question. The sustainability concept was originated from ecological studies in facing problems of natural resource management. The most famous and successful definition was provided by the Brundtland Commission, according to which, a sustainable development is a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [30]. The same approach can be applied in the field of cultural heritage where we can argue that the present generation has a duty of care over its cultural assets arising from the same intergenerational concerns. This step was made in 1995 by the World Commission on Culture and Development that deemed important long-term needs of future generations for access to cultural resources [29]. As a matter of fact, the concept of sustainability – dealing with the problem of making decisions in the present but for the very long term – acknowledges the role of heritage as an inheritance to be stewarded and passed on to future generations and, in so doing, it entails the adoption of a holistic view of architectural heritages and their contexts and also requires to take account of the widest range of heritage values.

Sustainability, more than a goal should be considered an ideal, which may be used as guidelines to shape: a) the setting of project goals; b) the composition of the stakeholder group (the constituency) involved in the decision making and evaluation processes; c) the values, the objectives and the preferences against which the architectural heritage projects should be evaluated [19].

It is apparent that sustainability recall the concept of "intergenerational equity" that means, fairness in the access and distribution of resources, utility, welfare, etc. between different generations over time. This makes architectural heritage evaluation more complex due to the "absolute" uncertainty in forecasting the values and preferences that the future generations will express. As a consequence, there may be the recurring possibility that valuations, at different point of time, produce different rankings of projects.

This problem is pretty difficult to be solved according to the traditional economic approach. In cost-benefit analysis, the problem is framed on efficiency rather than on equity basis simply reducing it to the proper choice of the discount rate to apply to future net benefits flows.

An implementation of the precautionary principle may offer a more suitable solution avoiding the need to quantify trade-offs between the different benefits occurring at different times to different people.

The precautionary principle states “that decisions that may lead to irreversible change should be approached with extreme caution and from a strongly risk-averse position, because of the imponderability of the consequences of such decisions” [28]. In cultural heritage, precautionary principle advocates a risk-averse stance in decision-making potentially involving irreversible consequences such as the destruction of a historic building (due to its uniqueness, it cannot be replaced once lost) [28]. The principle does not absolutely deny the possibility to take decisions that produce irreversible negative consequences, it rather asserts that it is appropriate to exercise a higher level of care in cases where irreversibility is involved, while bearing in mind other issues relevant in cultural heritage [28].
Democratic evaluation can held the sustainability principle endorsing the precautionary principle. This means that a totally risk-averse stance must be included in the multi-criteria analysis with multiple-decision-makers entering a specific vector of weights.

7. Conclusions

Democratic evaluations performed through multi-criteria analysis are particularly useful in complex and uncertain decision-making like built cultural heritage and they are even more valuable if they are conducted in the very early stage of the project when their use can avoid disagreements and unproductive irreconcilable conflicts between actors. In fact, the multi-criteria analysis, structuring the deliberative process, provides the formal framework of the evaluation process and facilitate the decision-making. It, therefore, can 1) facilitate the understanding of the problems and solutions; 2) foster the learning through the exchange and circulation of information and knowledge; 3) increase the awareness of citizens and, in this way, it allows participants to have a clear picture of what they are doing and what tools they can legitimately use to defend their interests and their positions or their monuments; 4) allow a rational comparison of the different positions, the mutual influence and transformation of the preferences of the different actors, so that the creation of new innovative, shared solutions is possible.

Bibliographical References

[1] BAR-GILL, Oren.; FERSHTMAN, Chaim. Public policy with endogenous preferences. *Journal of Public Economic Theory.* n. 7.5, 2005: p. 841-857.

[2] BENHAMOU, Françoise. Heritage. In TOWSE, Ruth (ed). *A Handbook of Cultural Economics*. Cheltenham: Edward Elgar Publishing, 2003, (No. HCE; 32), p. 255-262.

[3] BOBBIO, Luigi. (a cura di). *A più voci. Amministrazioni pubbliche, imprese, associazioni e cittadini nei processi decisionali inclusivi*. Napoli: Edizioni Scientifiche Italiane, 2004.

[4] BOBBIO, Luigi. Come smaltire i rifiuti. Un esperimento di democrazia deliberativa. *Stato e mercato*, n. 64 (1), 2002, p. 102-141.

[5] BOYD, Robert.; RICHERSON, Peter. Culture and cooperation. In MANSBRIDGE, J. *Beyond self interest.* Chicago: University of Chicago Press,1990, p. 111-132.

[6] CARPENTER, Jeffrey P. Endogenous social preferences. *Review of Radical Political Economics.* 37.1, 2005: p. 63-84.

[7] CHAN. Kay. M. A.; SATTERFIELD, Terre.; GOLDSTEIN Joshua. Rethinking ecosystem services to better address and navigate cultural values. *Ecological Economics*. 74, 2012: p. 8–18.

[8] DE LA TORRE, Marta (ed). *Assessing the values of cultural heritage*. Los Angeles: The J. Paul Getty Trust, 2002, p. 3-4.

[9] ENGLISH HERITAGE. *Sustaining the Historic Environment: New Perspectives on the Future.* English Heritage Discussion Document. London: 1997.

[10] FLOC'HLAY, Beatrice.; PLOTTU, Eric. Democratic evaluation from empowerment evaluation to public decision-making. *Evaluation*. 4.3, 1998: p. 261-277.

[11] GRAHAM, Brian. Heritage as knowledge: capital or culture?. *Urban studies* 39.5-6, 2002: p. 1003-1017.

[12] HALL, Stuart, (Ed.). *Representation: Cultural representations and signifying practices.* Vol. 2. London: Sage/Open University, 1997.

[13] HARVEY, David C. Heritage pasts and heritage presents: Temporality, meaning and the scope of heritage studies. *International Journal of Heritage Studies*, 7.4, 2001: p. 319-338.

[14] HIRSCHMAN, Albert O. Against parsimony: Three easy ways of complicating some categories of economic discourse. *Bulletin of the American Academy of Arts and Sciences.* 11-28, 1984: p. 11-28.

[15] HODGSON, Geoffrey. The approach of institutional economics. *Journal of Economic Literature.* 36, 1998: p. 166-192.

[16] HOUSE, Ernest.; HOWE, Kenneth R. Deliberative democratic evaluation. In Ryan Katherine E.; De Stefano, Lizanne. *Evaluation as a Democratic Process: Promoting Inclusion, Dialogue, and Deliberation. New Directions for Evaluation*. San Francisco: Jossey-Bass, n. 85, 2000, p. 3-12.

[17] LEACH, Neil. (Ed.). *Rethinking architecture: a reader in cultural theory*. London: Routledge, 1997.

[18] MCKENZIE, Stephen. Social Sustainability: Towards Some Definitions. In Hawke Research Institute *Working Paper Series, No 27*. Magill, South Australia: Hawke Research Institute, University of South Australia, 2004.

[19] MASON, Randall. Assessing values in conservation planning: methodological issues and choices. In DE LA TORRE, Marta. *Assessing the values of cultural heritage*. Los Angeles: The J. Paul Getty Trust, 2002, p. 5-30.

[20] MASON, Randall; DE LA TORRE, Marta. Introduction. In DE LA TORRE, Marta. *Assessing the values of cultural heritage*. Los Angeles: The J. Paul Getty Trust, 2002, p. 3-4.

[21] NORTON, Bryan.; COSTANZA, Robert.; BISHOP Richard. The evolution of preferences: why sovereign' preferences may not lead to sustainable policies and what to do about it. *Ecological economics.* 24.2, 1998: p. 193-211.

[22] O'HARA, Sabine; STAGL, Sigrid. "Endogenous preferences and sustainable development." *The Journal of Socio-Economics.* 31.5, 2002: p. 511-527.

[23] PEARCE, David; MARKANDIA, Anil, BARBIER, Edward. *Blueprint for a green economy*. London: Earthscan, 1989.

[24] PLOTTU, Beatrice.; PLOTTU, Eric. Approaches to participation in evaluation some conditions for implementation. *Evaluation*. 15.3, 2009: p. 343-359.

[25] RYAN, Katherine E. Serving public interests in educational accountability: Alternative approaches to democratic evaluation. *American Journal of Evaluation*. 25.4, 2004: p. 443-460.

[26] THROSBY, David. Seven Questions in the Economics of Cultural Heritage. In HUTTER, Michael, RIZZO, Ilde. *Economic Perspectives on Cultural Heritage*. London: Macmillan, 1997, p.13-30.

[27] THROSBY, David, Regional aspects of heritage economics: analytical and policy issues. 2007. *Australasian Journal of Regional Studies*, Vol. 13, No. 1, 2007: p. 21–30.

[28] THROSBY, David. Cultural capital and sustainability concepts in the economics of cultural heritage. . In DE LA TORRE, Marta. *Assessing the values of cultural heritage*. Los Angeles: The J. Paul Getty Trust, 2002, p. 101-117.

[29] World Commission on Culture and Development (WCCD). *Our Creative Diversity*. Paris: UNESCO, 1995.

[30] World Commission on Environment and Development (WCED). *Our Common Future*. Oxford: Oxford University Press, 1987.

[31] ZAJONC, Robert B.; HAZEL, Markus. Affective and cognitive factors in preferences. *Journal of Consumer Research*. 9, 1982: p. 123-131.

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Cultural Landscape: Sintra, the Shock of the Past into the Future

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Abstract

This study intends to question the difficulties implied in the consequences of the operation of classification of cultural landscape, bringing about the fragilities that follow that type of classification, such as the management issues, along with an appreciation of the resulting sustainability of the classified region, along with the consequences, concerning the touristic features, and the impossibility to achieve the original purposes that were meant to be achieved through this kind of classification, due to particularities in the context of extensive complexity of financial, decisive and political factors. We bring about and center the reflections on the case of Sintra's region that has received this type of classification, according to the established and regulated parameters set by UNESCO that has been facing some difficulties, especially in the leadership and management of resources that are pertaining to local authorities (municipality) of the different protagonists involved. We question whether or not the region shows economic growth, according to the expectations involved in the original process of the legitimate application to being a part of the cultural heritage of Humanity.

Keywords: landscape, cultural heritage, cultural landscape, sustainability, romantic period; Sintra.

1. Fictional *natura naturans*: "musealizing" landscape?

One should absolutely admit that the idealized concept of *natura naturans* has never existed in any place on earth, except for the desert landscape itself. From the earlier stages of the history mankind on, it was only something that could only ever existed in literary essays of philosophical speeches, expressing different kinds of utopia.
The first museums that can be considered as such, inherited under some scopes, the features of the *cabinets de curiosités*, gathering different artifacts. These first museums were places where collections were profusely accumulated, generally exhibited and normally implied, up until the 20th century a sense of interior space.
When we abandon the scale of the "object", - that pertains to the universe of cultural heritage,- we tend to leave the issues of musealization and consider heritage classification on an ampler measure, by enlarging the field of what pertains to the heritage of Mankind in a global sense: that may the case of the Cultural Landscape figure, consecrated by UNESCO.
For some time now, there has been a political tendency to try to preserve some regions which contain at the same time natural and cultural characteristics [under de general designation of Cultural Landscapes]. These actions have been put into practice with the aid of the international organization UNESCO. The mere fact that the regions considered obtain these sort of classification, would not necessarily keep them away from suffering from difficulties or resist to the somehow to so positive consequences, generated by the fact that they become a greater tourist attraction, among other management difficulties.

The concepts of Cultural Landscape, along with that of Immaterial Heritage, go far beyond the mere practical measures above exposed, thus enlarging the concepts of Cultural Heritage and real measures can eventually be put into question. There could be put some reserves, regarding the considerably demanding consequences of these classifications, that imply and constraint the regions to the development of infrastructural projects and specific management dealing with huge financial resources.

The World Heritage Convention [UNESCO, 1992] became the first international legal instrument to recognize and protect cultural landscapes.

The Committee at its 16th session adopted guidelines to establish criteria in order to safeguard the inclusion of cultural landscapes in the World Heritage List, based on the principle consecrated by the Article 1, defining them as "combined works of nature and man." They should be expressive of the "evolution of human society and settlements over time, under the influence of physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal."

Those same landscapes "reflect specific techniques of sustainable land-use, considering the characteristics and limits of the natural environment they are established in, and a specific spiritual relation to nature. Also the protection of traditional cultural landscapes can be helpful in maintaining a certain biological diversity.

According to the Operational Guidelines 2008 (Annex 3), there are two distinct categories of cultural landscape: i) *landscape created and designed intentionally by man*, involving garden and parkland landscapes, constructed with aesthetic intentions often also associated to monumental buildings or ensembles; ii) *organically developed landscape* as a consequence of an initial social, economic, administrative, and/or religious imperative in association and as response to its natural environment.

As subcategories to these latter, there are distinct landscapes that came, suddenly or gradually, to an end recognized under a material form; continuing landscapes, playing an active process in society; or a last category as an associative cultural landscape which classification is justifiable due to powerful implications in material cultural evidence.

We might consider as we have referred right at the beginning that the concept of "natural landscape" has been for long considered somewhat "fictional", since it does not exist in western civilization since Antiquity. The "polis" [we can use the term "urbis", according to the designation of the roman period] constituted, since that same early period in the History, a concrete reality that established a counterpoint with the rural universe of the villas, scattered throughout the countryside, consisting in the productive centers of agriculture. In times of peace, these latter were autonomous units where water, soil resources and the communities they sheltered, reflected some balance along with the social relations between masters and slaves.

Later on, throughout the Middle Ages, urban *nuclei* became, - besides the religious communities in convents and monasteries scattered through the country, - as laic centers, the expression of the urges and advantages of people gathering to fulfill functional necessities, so that living in a common territory resulted in expressing not only defensive, but also commercial purposes.

In a very recent context, one can detect plenty of issues, related to the development of economies, in the context of globalization, that are still uneven throughout our westernized world, even if there is an aspiration to a kind of harmonious relation to nature, with activities performed by man, in a post-industrial context. That would support an effort to maintain a holistic relation between planet and mankind, in order to sustain the entropy generated by the extremely non planned exploitation of natural resources.

Man is aware of being in accordance to the evolution of the planet, based on the strength symbolized by the myth of Gaia. Even in this 21st century he is still searching for a return to an "ideal world", especially now that he became sure that globalization has partially demonstrated through the implications of the Theory of Chaos that individuals and society, depend on many apparently disconnected factors, pertaining to different regions of the planet.

"Sustainability", as an expression, bears a considerable weight and everyone aims at defining or demonstrating its irrefutable evidences. Nevertheless, one feels deep down that, at an increasing pace and rhythm that everything that we might call nature, along with the concept of natural landscape, is more and more compromised.

2. Cultural Landscape of Sintra: the shock of introducing the past into the future

"Lo! Sintra's glorious Eden intervenes
In variegated maze of mount and glen…
Then slowly climb the many-winding way,
And frequent turn to linger as you go,
From loftier rocks new loveliness survey…" [Byron, *Childe Harold Pilgrimage*, Chant I, stanza XVIII/XX]

Sintra was already mentioned in Antiquity by Plinius the Elder in his work *Naturalis Historia* [Ribeiro, 2014] in the description of the Mountain and the Cabo da Roca, altogether forming the *Promuntorium Magnum*: *"One may add to the characterization of this landscape the omnipresence of the mountain, geographically according to the east-west direction and plunging its roots into the vast deep ocean – where the sun daily sinks and the silvery moon hoovers over both misty woods and rocky, mountainous land. All of this has conferred to the territory an ancestral and perennial sacredness, being witnessed by the sanctuaries and archeological evidences from many periods, texts by Greco-latin authors, Arabic and Medieval sources, monastic buildings and little churches…"*



Fig 1 : The three zones of Sintra Cultural Landscape.

In this context, many regions appeal to UNESCO for the classification as Cultural Landscape, implying a diverse typology of heritage such as has succeeded in 1995 with Sintra (Portugal), literally traditionally known as the "hill of the moon". The inscription (1995, ref. 723, the area involved a property of 946 ha with a buffer zone of 3,641 ha) to such a status twenty years ago, was motivated by a conscience that this region has been a scenery for the *flânerie* of many foreign,

educated voyagers such as Beckford (1760-1844), or Byron (1788-1824), or the Prussian Prince of Lichnowsky (1761-1814), who appreciated the atmospheres, castles, villas, palaces and properties that punctuated the hilly, forest region, with a micro-climate that convoked the romantic aspirations of many since the late 18th century throughout the 19th century. The actual presence of the royal court did contribute to transform the Park and the Palaces, in accordance to the romantic *zeitgeist*, establishing a parallel between the works of Fernando de Saxe Coburgo-Gotha (1785-1851) with those of Ludwig from Bavaria (1845-86).

This study intends to question eventual fragilities of the process that may have contradicted the original objectives of the operation of classification, the strategic issues that may have not resulted after the expectations that accompanied the classification, even the sustainability of the area classified, along with the consequences regarding the tourism as a consequence, and the impossibility to achieve the original purposes of this kind of classification due to an extensive complexity of financial, decisive and political factors.

Landscape has been a kind of fiction since the polis (urbs and cities) were a reality, and the expression of the advantages of men gathering, constituting communities, living together for defensive or commercial purposes. The four books of the *Georgicas,* by Virgil, written on commission by Augustus were often interpreted erroneously as a bucolic approach to nature. In fact, some translators interpret the work as a solution for what we might today call a way to assure the supply or provision of an overcrowded city of Rome. It reflected some kind of concern about the issues of self-sufficiency of the city of Rome. The implicit concept could be related to our contemporaneous questions and goals of the cities being sustainable precisely under that same point of view.

It has been always an approach tainted by the spirit of romantic thought to think of nature as something that is essentially positive and that same convictions are related to the values of Enlightenment. Being two opposite minds, under some aspects, either Voltaire or Rousseau, wrote not only about humankind nature but also about the natural universe and the relation one can establish between Man and the environmental questions. Should then one think that Man is drastically affected or conditioned by the universe he is immersed in?

The ideal of the *natura naturans* continued did not exist, except for the many descriptions present, both in literary essays, or philosophical speeches, expressing many kinds of utopias. From the *Republic* by Plato (428-348 BC), to *Utopia*, by Thomas Morus (1478-1535), *Sforzinda* by Filarete (1400-1469), *Julie ou La Nouvelle Héloïse* by Rousseau, to the models of society proposed by utopian socialists of the 19th century, such as Saint-Simon (1760-1825), Charles Fourier (1772-1837), Louis Blanc (1811-1882) or Robert Owen (1771-1858).i

Humankind is still in this new century searching for some kind of wholeness of physical nature in an effort to maintain a relation to the planet and sustain the entropies generated by the exploitation of natural resources that is led without criteria. Man is mainly convict following a sense of pertaining to wholeness of the planet, symbolized by the myth of Gaia.

Even nowadays, man has been searching for some kind of return to an ideal world, especially nowadays that he is sure that globalization has demonstrated to be true the basic principle of Theory of Chaos, implying that both individuals and society depend on many apparently [and just apparently] disconnected factors. We have, as a population of a planet imbued of the issues raised by globalization, recently gained in complying with the founding notion that what is not related should after all interconnected.

“Sustainability” [has succeeded to the concepts related to “ecology”], as an expression that is above many other different concepts and bears, for a long time now, a considerable weight. Everyone aims at defining it or at least demonstrating irrefutable evidences of occurrences related to it. Nevertheless, one feels deep down that, at an increasingly accelerate pace and rhythm, everything that we might call “natural”, along with the mere concept of “natural landscape”, tends to be more and more compromised over the course of time.

In this context, many regions appeal to UNESCO for the classification as Cultural Landscapes, implying a relatively recent of cultural heritage. This is what happened with the application by 1995 with the authorities that proposed the region of Sintra [Portugal], etymological and traditionally known to many as the “hill of the moon”.

The inscription of Sintra as Cultural Landscape [1995, ref. 723, the area involved a property of 946 ha with a *buffer zone* of 3,641 ha] to that same *status*, some twenty years ago, was motivated by a

conscience that this region by itself is the repository of many aspects that relate both to historical and literary values.
It was a specific demand of UNESCO that there would be delimitated a transition zone that would include the lands between the center of Sintra and the Colares valley, until the coast, dominated by agriculture land, pine woods and by the presence and closeness to the ocean, constituted by different open "landscape channels".
One should also retain as an important historical factor in the importance of Sintra, as a territory where people from different origins came to occupy these lands since the Bronze Age (both mediterranean and atlantic), to the roman or the Al-Andaluz periods.
One should consider Sintra's Cultural Landscape as an "inherited conglomerate"ii, term that is meant to express the reality of human cultural heritage, and be an example of the confluence of many cultures, set in a territory, throughout the ages, and symbolizing the true "Concordia", setting the founding values of "Peace, Civilization and Progress" [Ribeiro, 2014].

3.**Emphasizing Sintra as a romantic period romantic scenery**

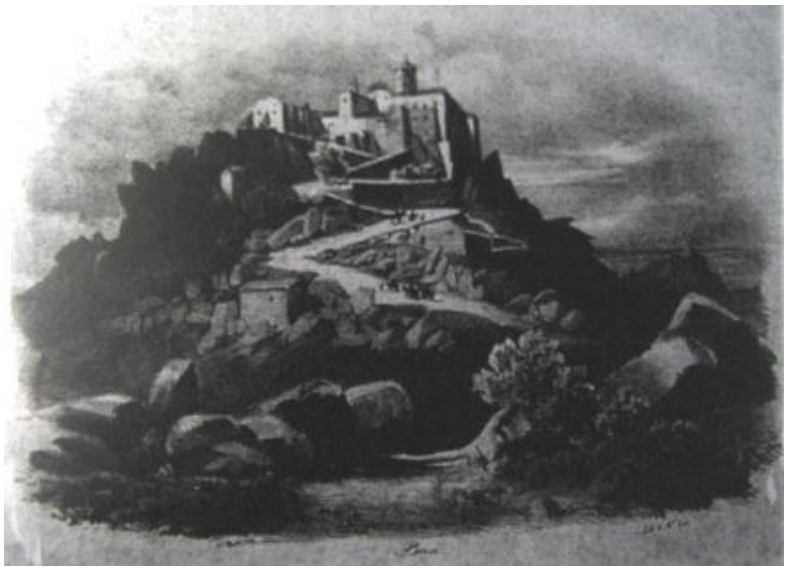

Fig. 2 : 18th century engraving depicting a view of the Nª Sª da Pena Monastery.

The architectural landmark right at the center of Sintra, the Palácio da Vila, was the result of a combination of different European architectural styles and *mudéjar* influences that probably led to some of the architectural formal options adopted when the Pena Palace was built.
It has been the scenery for the *flânerie* of many foreign, educated voyagers such as Beckford (1760-1844), or Byron (1788-1824), or the Prussian Prince Félix von Lichnowsky (1814-1848), who appreciated the atmospheres conformed by the existence of castles, villas, palaces and mansions and properties that punctuated the hilly, forestry region.
Characterized by weather conditions considered to constitute a micro-climate, Sintra's region is, more than ever, affected by a sort of humidity, dampness and nebulosity that submerges architectural manifestations under a romanticism veil, appealing to the aesthetics that were in conformity with the values of that same movement.
Sintra, in the quality of natural scenery has always convoked romntic aspirations of many educated and literate travelers since the late 18th century and throughout the following century, as well.
The actual presence and regular temporary permanence of the royal court, during some centuries, using Sintra as a summer residence, especially from the reign of D. Maria II and the Consort Prince on, did contribute to the transformation of both Palacesiii , in accordance to the romantic period *zeitgeist*. One can establish a parallel of some sort between the ideas and works of Fernando of Saxe Coburgo-Gotha (1785-1851) with those of Ludwig from Bavaria (1845-86), even if they are not exactly contemporary.

D. Fernando II, who had come from Thuringia to become the consort to D. Maria II, induced in Portuguese society, especially in the upper social classes, many different habits such as attending the Opera Theatre, frequenting the Chiado area of town which became fashionable, influencing others with his taste for collecting *bric-à-brac*, among many other transformations that one can appreciate studying many works about this charismatic figure who brought foreign influence to the Portuguese mentality.

D. Fernando was quite enthusiastic about Portuguese architectural heritage, in a time when - after the civil war that was determined by the rivalry between absolutists and liberals [representing two different parties commanded by two brothers, heirs to the throne, D. Miguel and D. Pedro] – of the property ecclesiastic buildings and monasteries passed by royal decree onto the state, with the dissolution of many religious orders. He payed with his own budget many restoration works in the Batalha and Alcobaça Monasteries, along with some other national buildings and monuments.

He also took onto his own responsibility the enterprise of rehabilitating the ruins of the Hieronymites Monastery of Nossa Senhora da Penha [or Pena] which had suffered many damages because of the earthquake of 1755, having turned into a ruin.

After having acquired the palace on the 3rd November 1838 for 761$000 réisiv, being obliged to taking care of the conservation of the monument in particular because it contained a precious church and a magnificent sculpted altarpiece by Nicolas de Chanterenne.v

D. Fernando of Saxe ordered the Baron Wilhelm Ludwig von Eschwege (1777-1858) to conceive a solution and this Engineer chose a neo-gothic solution that was rejected by D. Fernando. Then the Baron took a trip, having visited France, England, Berlin, Argelia, Cordova and Seville. From 1939 to 1853 he is in charge of the Pena's Palace works, along with the works of the old *Palácio da Vila*, in Sintra.

Raczynsky refers to the Baron as someone who is not an architect: *"[…] Il s'en occupe en animateur qui est porté par un gout très décidé qui a fait quelques études et dont l'esprit est très cultivé."vi*

The Baron based some elements in formal references such as the Convent of the Order of Christvii [Tomar], the river bastion, known as Tower of Belém and the famous Casa dos Bicos, by the Tagus, near Alfama.

We are aware that throughout Europe, there are built programs such as the castle designed by Prince Augustus, from Potsdam (1827), related in what concerns the volumetric relations, with a circular bastion at one of the extremities. Wilhelm von Hesse had built a castle in Löwenburg (1790-1801). Emperor Franz II from Austria built the Franzenburg (1798-1801). Windsor Castle went through a campaign of restoration by Jeffrey Wyatville, nephew to the architect that designed Fonthill [Beckford's property in Sintra].

We could consider Pena Palace very close to Frederic Wilhelm IV's castles in the Rhine. The Hohenschwangau, had been built some ten years earlier to the heir of Bavaria's throne. We should keep in mind that the castles of Ludwig from Bavaria were built approximately thirty years after the Pena Palace.

"There are in the Rhine and in the Bavarian Alps castles of kings and princes all of them in land that allowed an extension of much larger works , and having attained the honor of being awarded in many writings, both in prose and verse ; and yet as poor and imperfect shall they appear in their ornaments, if we compare them with delicate lacings and fantastic arabesques that in the Pena tower over the arches , and, like the ivy, intertwine around the columns, and hang on the needles or the window balustrades, contrasting admirably, with its pure white color against the dark blue of a southern sky, thus producing the same impression that dreams and Arabic songs." [Felix von Lichnowsky]viii

Landscape in Sintra, has drastically changed, especially by the intervention and the actions that were a consequence of the will of the Monarch, D. Fernando. There are engravings and other depictions that show clearly that in the decade of the 30's of the 19th century, the former road that led to the so-called Moorish Castle [Castelo dos Mouros) and the former monastery [which originated later the Palácio da Pena] was deprived of any vegetation, was very much arid.

D. Fernando, aided by Wenceslau Cifka, started, after the works in the Palace that became the summer residence for the Royal Family, the plantation of the Pena's Park, with a special care for the use of the waters that existed in abundance. They imported many species from all over the world, besides the use of the indigenous flora species of the country and proceeded to plant many

acres of mountainous land, creating a romantic setting *par excellence* for the new Palace. The Park included fountains and constructs, according to many landscape parks in England or other European countries that had their origin from the middle of the previous century. These exotic species made their adaptation to the environmental conditions, having as a result an "exuberant" development considering the physical geographic context [Ribeiro, 2014], and producing a syncretic, harmonious result that, - according to the historian J. Ribeiro, that accompanied the application to the classification, - conforms the physical feature of Sintra's Cultural Landscape.
The shades produced, after the higher trees completed their growth, generated eco-systems that allowed the plantation and proliferation ferns ix [known by the expression "fetos", in Portuguese] species. These were also found in the romantic landscape scenery, around the Palace of Buçaco (1904-1910) which received a design by Luigi Mannini (1848-1936).x
One should keep also in mind that the granitic massive mountain, where one could appreciate a landscape with huge rocks piled up in chaotic disorder, among woods consisting of oaks, water streams, has always welcomed human fixation through different *habitats,* local cult and burial sites, scattered along the different hills and slopes. These occurrences were the basis to the architectural proliferation that did take place throughout the 19th century of the architectonic typology of the *chalet*, adopted by foreign influence.
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4. Managing Heritage and passing it onto the Future, keeping away "fossilization"

This elaborate synthesis that did take place between what were natural conditions and what were projects and human action, resulted in the Cultural Landscape we are trying to dissect under different approaches.
Ribeiro in his works reflects about the difficulties that are revealed on the questions of the true management of this specific "Cultural Landscape", setting different levels and features that characterize the generated complexity: the issue of coordinating and leadership of the entities involved in the decision making field; the not so adequate national legislation to the demands of the classification by the international organization UNESCO; the principles and political issues adopted in the decisions and interventions; the difficulty in setting the primordial goals along with the difficulties in obtaining financial resources; the appropriate time schedule to the implementation of such main objectives. These relevant issues are set taking into account that the leadership of the whole process is in the hands of Sintra's municipality ["Câmara de Sintra"], the only democratic entity that has the power to manage such a vast area, integrating such a considerable area of the territory pertaining to it.
The mere fact that here is no such legislative figure consecrated by Portuguese legislation as "Cultural Landscape" is a lacuna that should be filled up and that does not facilitate political decisions. The richness of Sintra's Cultural Landscape can be considered in accordance to the concept of a heterogenic landscape, considerably populated, demonstrating a demographic diversity corresponding to and historical plurality [Ribeiro, 2014].
In what concerns the underlying image of Sintra authorities should take measures to prevent, in building or intervening in landscape, agents from adopting either contrasting solutions in the pursuit of any *architectural school* parties or to confine in the sense of only prescribing pastiche formal solutions for the purpose of classification is to legate the essence of the "atmosphere" to future generations, in an affirmation to establishing a contrast with the tendency of going "global" all over the territory. [Ribeiro, 2014]

Responsible authorities and entities should pay attention and be relentlessly not cooperative with the actions that imply the loss of criteria for judging architectonic quality and not conform to the pressures into building at any cost, especially in the *buffer zone*, where industrial buildings should in conformity to some restrictions [Ribeiro, 2014].
World Heritage should not be an "encrusted fossil into a living organism", like we were developing above about the artificiality of the concept of musealization as applied to a whole region. The whole territory consisting of the classified humanized cultural landscape must evolve, without losing its characteristic values that were the reasons to establish this specific status, elevating it to an environment that should be preserved and find a way to maintain its character allowing, at the same time, people to live and profit of the immaterial, aesthetical, benefits it may offer, embedded in a bridge that is built throughout the ages.
In the notion of Cultural Landscape, is implicit in some sort the concept of "intangibility" as well, even if the measures and the management of a territory that is its concrete manifestation have to deal with many opportunities, concrete measures and decisions on the field.

Notes:

i These utopian socialist thinkers tried many different models of society that showed to be impossible to put to practice, being so different from the models based on tradition.
ii G. Murray, *Les Grecs et l' Irrationnel*, 1977, p. 179, *apud*, J. C. Ribeiro, "A Paisagem Cultural de Sintra, sua dimensão política, estratégica e ordenadora".
iii Both these two royal residences, the *Palácio da Villa* (sec XVI) and the *Palácio da Pena* (an ancient hieronymite monastery that fell into decay due to the earthquake and ulterior neglect, transformed into a summer royal residence by the decade of 1840) were decisive for the historical evolution of the region and the qualification of the delimited zone of the Cultural Landscape classification.
iv Currency of that historical period.
v The building did not even have any doors or windows, by the time it was purchased.
vi Raczynski, *apud* J. Teixeira, "D. Fernando, Rei-Artista, Artista-Rei", p. 307. Raczynski was a Polish Count who stayed in Lisbon from 1843-1846 on a diplomatic mission for the King of Prussia.
vii This Order succeeded in Portugal to the Templars Order with the extinction of the latter.
viii Prince Felix de Lichnowsky, Portugal, Recordações do ano de 1842", Ática Editora, p. 141.
ix In the Pena Park there is an area that is known by the *Feteira,* near to the Countess of Edla Chalet, built for the morganatic spouse to D. Fernando that had been a widower for long, after the death of D. Maria II.
x A stageset designer as well as architect who was very prolific in the 19th century in Portugal and is related to one of the architectural references in Sintra, the Quinta da Regaleira.

Bibliographical references:

Al QUINTAS, A., *Do Passeio Público à Pena, um Percurso do Jardim Romântico*. Texto policopiado, Dissertação de Mestrado em Reabilitação de Arquitectura e Núcleos Urbanos, Faculdade de Arquitectura da Universidade Técnica de Lisboa, Lisboa, 2001.
LICHNOWSKY,F. *Portugal, Recordações do ano de 1842*. Lisboa, Ática Editora.
RIBEIRO, J. C., "A Paisagem Cultural de Sintra, sua dimensão política, estratégica e ordenadora". R. S. CUNHA, coord., Colóquio Nacional Raul Lino em Sintra, III Ciclo de Conferências, 2014,s.l. Colares Editora, pp. 107-229.

Webgraphy:

http://whc.unesco.org/en/culturallandscape

HERITAGE and TECHNOLOGY
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DIAGNOSIS OF THE CRITICAL STATE OF CONCRETE

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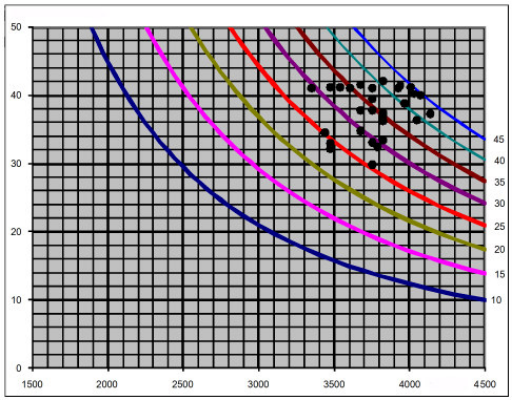
Abstract
Reinforced concrete is the material with which it is built much of the architectural heritage, ordinary, but also monumental the last 100 years.
Recently, there has, however, found that it is not the eternal material that you dreamed when you started to use it massively and with time degrades by various phenomena that are often attributed to the degradation that attacks the plates, but is not this the only cause which can lead to damage of the same, also the load cycles to the limits of rupture may determine, mechanically, a loss of capacity. And this, for example, the case of a building subject to an earthquake that while not causing collapse or breakage evident engages the concrete severely.
The concrete thus "reduced" is still able to withstand the same loads?
Is there a way to figure out when it is exceeded a threshold of attention?
In this paper we want to present the results of a campaign of investigations in the laboratory with ultrasound helps to create a first answer to these questions.
The technique, suitably calibrated, may be used in all those cases in which it must operate on elements that have been subject to exceptional loads to evaluate properly the areas in which it is essential to the intervention.

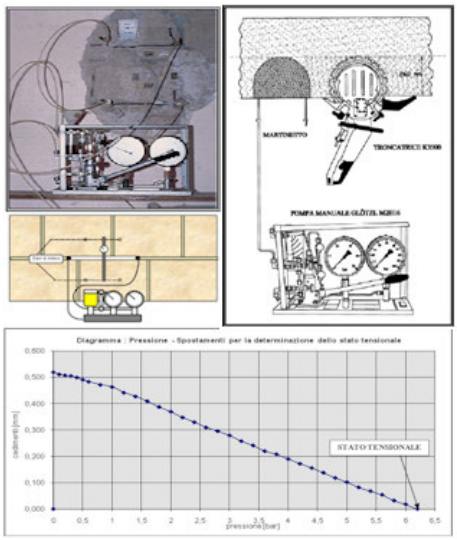
Keywords: Concrete, Experimental Test, No distructive Test, Damge

1. Introduction
By Murphy's Law - Norms Finagle:
1. Before you need plotted curves, then find the corresponding points.
2. Each experiment must be reproducible, and fail in the same way.
3. Do not believe the miracles: rely upon it blindly.

"Mistakes are not, as some might think, a negative aspect of scientific research, on the contrary, very often, the failures constitute the incenntives to the progress of science." (Prof. Antonio Vecchia).
After many years spend to certify the outcomes of tests about value of tensile strength of the concrete we have inquired if it is possible to determine experimentally and with non-destructive test stress state inside a concrete element.



2. The idea -
The idea came from analogy with the proof in flat jacks on the walls, through which you get (among the various results) stress state agent in the element walls investigated.
The comparison between the state of stress agent and the value of local breakdown makes it possible to determine a useful safety coefficient instant for an immediate assessment of the state of the art.
Unfortunately, this method is inapplicable on reinforced concrete elements, therefore it is necessary to find an alternative method.



It formulated the hypothesis that there was a relationship between the ultrasonic velocity and the state of stress in the concrete, in particular that the speed changed in accordance with the state of stress. The method would have worked for comparison between element loading and unloading, and integrated to the well known method SonReb, would have produced a safety coefficient similar to that of the test in flat jacks.

It is then ordered a campaign of breaking tests on a number of concrete cubes with a well-planned program: record the ultrasonic velocity with increasing stress in order to establish a correlation between σ (stress on the cube) and V (ultrasonic velocity)
The initial assumption is:

$$\sigma_c = f(V) \text{ or } V_c = f(\sigma)$$

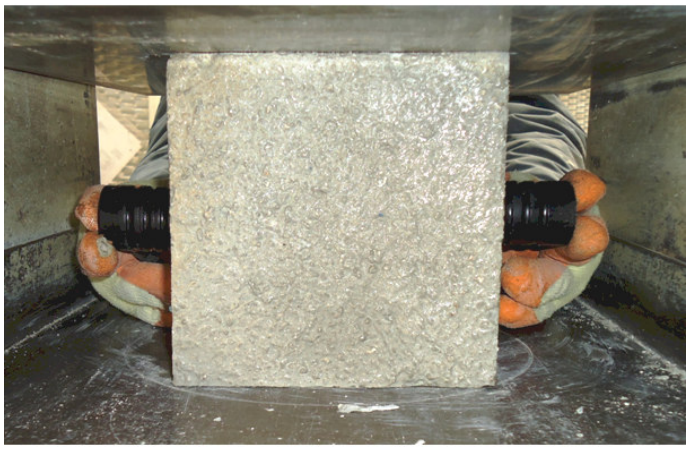
The ultrasonic speed is given by the ratio of D (distance between the probes) and T (the time takes an ultrasonic pulse to reach the probe from the issuer to the recipient):

$$V = \frac{D}{T}$$

The stress on the cube is the ratio between F (compression force) and A (sectional area of the cube):

$$\sigma = \frac{F}{A}$$

With these simple starting reports, it proposed a processing method with low probability of error in the measurement.
Of course, not being able to predict the exact value at the start of concrete failure was decided to perform the readings of the speed in increasing steps of the force F like approximately 50KN, except to thicken at the value of rupture.



3. Tests



Fig. 1 Test equipment

The results of the campaign of tests are summarized in the following diagram and table.



700															
1	**24,78**	3606	3606	3606	3606	3409	3202	2840	1250						V
		2,21	6,62	13,25	15,45	17,66	19,87	22,08	24,28						□
2	**20,22**	3906	3826	3750	3605	2257									V
		2,25	6,76	13,51	15,77	18,02									□
3	**23,99**	3676	3676	3409	3409	3409	3240	2013							V
		2,31	6,94	13,88	16,20	18,51	20,83	23,14							□
4	**27,01**	3676	3676	3676	3676	3537	3409	3125	2690						V
		2,28	6,85	13,70	15,98	18,26	20,55	22,83	25,11						□
5	**32,14**	3826	3826	3826	3826	3676	3676	3676	3409	3232	3132	3050	2580	1650	V
		2,25	6,76	13,51	15,77	18,02	20,27	22,52	24,77	27,03	28,38	29,28	30,18	31,53	□
6	**29,45**	3750	3750	3676	3676	3676	3676	3676	3537	2929					V
		2,33	6,99	13,98	16,31	18,64	20,97	23,30	25,63	27,96					□
7	**27,71**	3177	3177	3177	3177	3177	3177	3050	2757	1650					V
		2,25	6,76	13,51	15,77	18,02	20,27	22,52	24,77	27,03					□
8	**31,30**	3750	3750	3750	3750	3750	3348	3348	3348	3348	3348	3125	1853	V	V
		2,28	6,85	13,70	15,98	18,26	20,55	22,83	25,11	27,40	28,77	29,68	30,59	s	□
9	**24,78**	3125	3125	3125	3125	3125	3125	2343							V
		2,25	6,76	13,51	15,77	18,02	20,27	22,52							□
10	**19,02**	3537	3537	3537	3537	2976	1720								V
		2,22	6,67	13,33	15,56	17,78	18,89								□
11	**21,38**	3472	3472	3409	2976	2717	2259								V
		2,21	6,62	13,25	15,45	17,66	19,43								□
12	**28,62**	3826	3826	3826	3826	3826	3826	3605	3289	1953					V
		2,30	6,90	13,79	16,09	18,39	20,69	22,99	25,29	27,59					□
13	**32,61**	3826	3826	3826	3537	3537	3537	3537	3537	3537	3537	3348	3348	2205	V
		2,24	6,71	13,42	15,66	17,90	20,13	22,37	24,61	26,85	28,19	29,08	29,98	31,32	□
14	**30,71**	3787	3787	3787	3605	3605	3605	3605	3289	3073	2604				V
		2,30	6,90	13,79	16,09	18,39	20,69	22,98	25,28	27,58	29,42				□
15	**28,51**	3472	3472	3472	3232	3232	3232	3177	2884	2640					V
		2,24	6,71	13,42	15,66	17,90	20,13	22,37	24,61	26,85					□
16	**23,70**	3605	3605	3605	3472	3472	2884	1870							V
		2,41	7,24	14,49	16,90	19,31	21,73	23,18							□
17	**27,34**	3826	3826	3826	3826	3826	3605	3605	3024	2083					V
		2,21	6,62	13,25	15,45	17,66	19,87	22,08	24,28	26,49					□
18	**21,81**	3472	3472	3472	3289	2929	1150								V
		2,24	6,71	13,42	15,66	17,90	21,48								□
19	**29,51**	3750	3750	3750	3750	3750	3750	3750	3605	2976	2356	1650			V
		2,24	6,71	13,42	15,66	17,90	20,13	22,37	24,61	26,85	28,19	29,08			□
20	**26,37**	3906	3906	3906	3906	3750	3750	3472	2155	1464					V
		2,24	6,71	13,42	15,66	17,90	20,13	22,37	24,61	25,95					□

The observation more interesting is that the speed remains almost constant except to decrease exponentially when the stress value is close to that of rupture.
And comparing the data also in percentage terms (for example, for the specimen 1)

	F= Force on the spicement KN								
σ_0	**24,78 N/mm^2**	50	150	300	350	400	450	500	550
		3606	3606	3606	3606	3409	3202	2840	1250
		2,21	6,62	13,25	15,45	17,66	19,87	22,08	24,28
		100%	100%	100%	100%	95%	89%	79%	35%
		8,9%	26,7%	53,4%	62,4%	71,3%	80,2%	89,1%	98,0%
		ELASTIC							

It is apparent that the speed remains almost unchanged compared to the initial one (V = 100% Vi) until it reaches a voltage value equal to about **σ = 70-80 % σ_{rott}**
The trend in results is even more evident with the aid of the following graph.

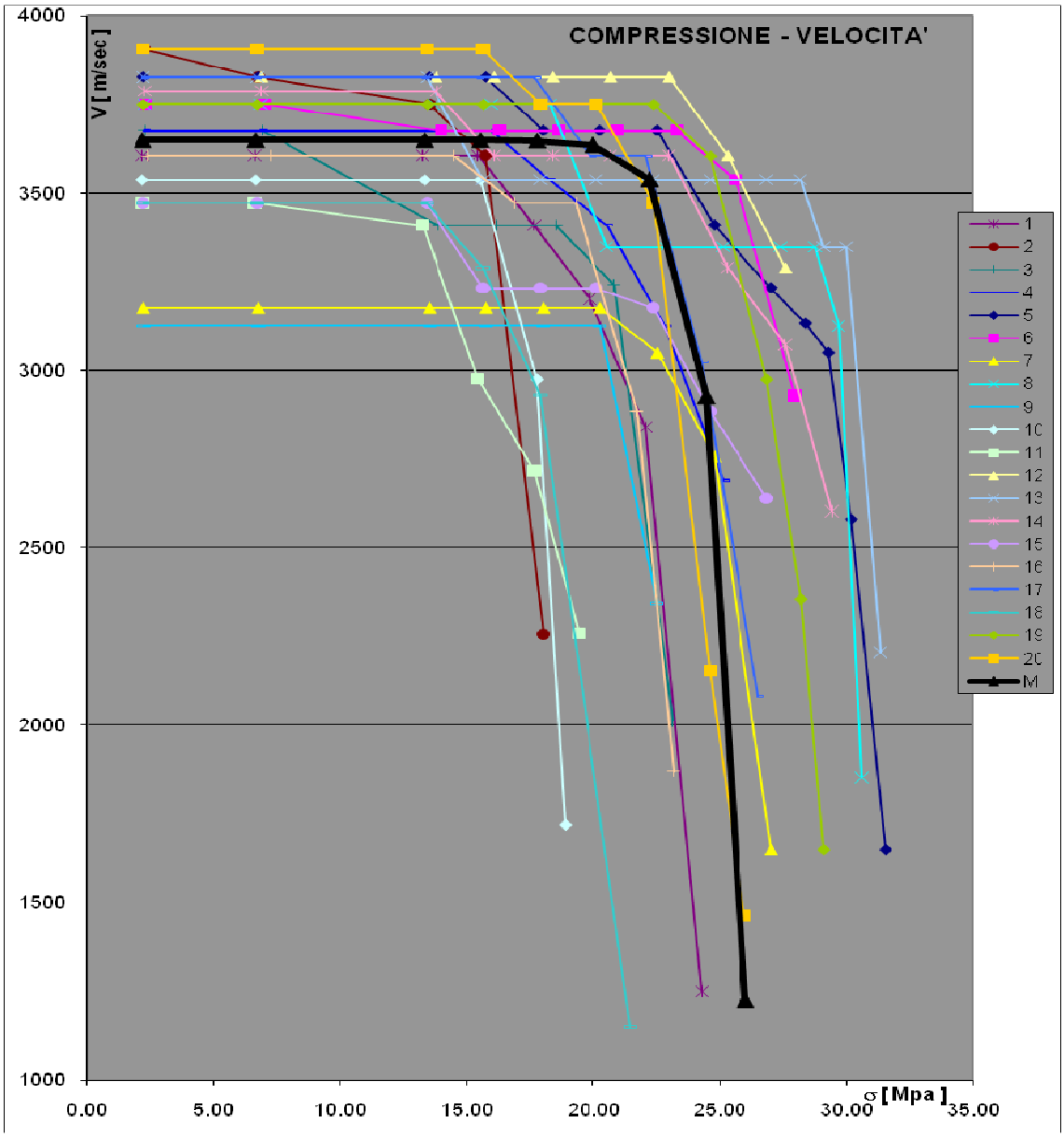


Fig 2 - Chart of functions between the operating voltages and speed Ultrasound of 20 specimens.

The black curve is the average function

The experiment was then ruled that the starting hypothesis was basically wrong. Remaining constant the ultrasonic velocity was not possible to correlate the change with the state of stress.
This statement was supported by relating the measured ultrasonic speed and stress operating in CLS:

α the parameter of setting calibration procedure is recalculated for each specimen.

$$V_{calc} = V_{iniz.}\left[1-\left(\frac{\sigma}{\sigma_{rottura}}\right)^{\alpha\cdot\sigma_{rottura}}\right]$$

Reversing the formula is obtained

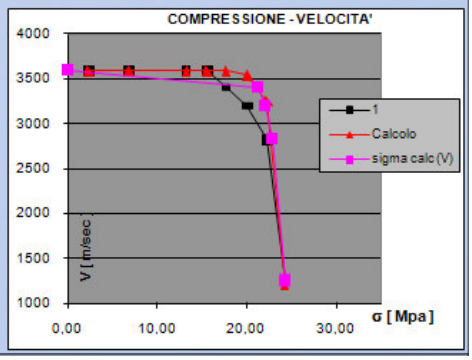
$$\sigma = \left[\sigma_r^{\alpha_{medio}\cdot\sigma_r}\cdot\left(1-\frac{V}{V_i}\right)\right]^{\frac{1}{\alpha_{medio}\cdot\sigma_r}} = f(V)$$

So recalculating the parameter α as the average has been possible to define a% error between the calculated σ and the effective σ (for example, for the specimen 1):

1	24.78	3606	3606	3606	3606	3409	3202	2840	1250	V [m/sec]
		2.21	6.62	13.25	15.45	17.66	19.87	22.08	24.28	σ [Mpa]
		0.00	0.00	0.00	0.00	21.15	21.99	22.78	24.22	σcalc [Mpa]
		- 100%	- 100%	-100%	-100%	20%	11%	3%	0%	err %

Viniz. =3606
σrott. =24.78
α =0.8

$$\sigma_{calc} = \left[\sigma_r^{\alpha_{medio}\cdot\sigma_r}\cdot\left(1-\frac{V}{V_i}\right)\right]^{\frac{1}{\alpha_{medio}\cdot\sigma_r}} = f(V)$$



As one can easily notice the formula has a good reliability (error <5%) only when the effective σ is close to that of breakage.

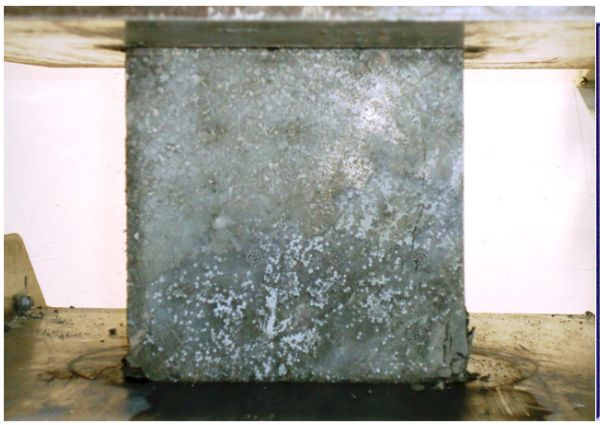
4. Result

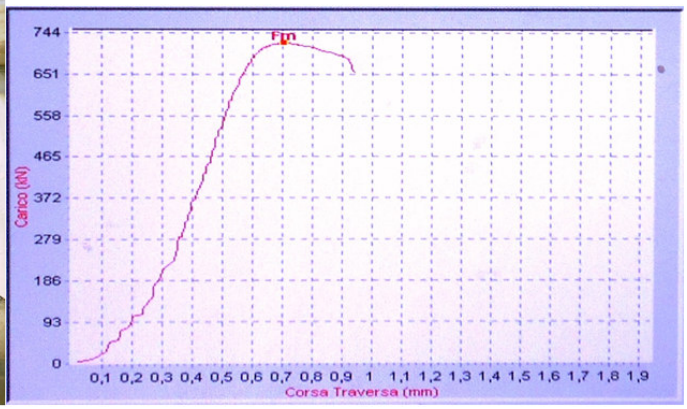
We summarize the considerations:

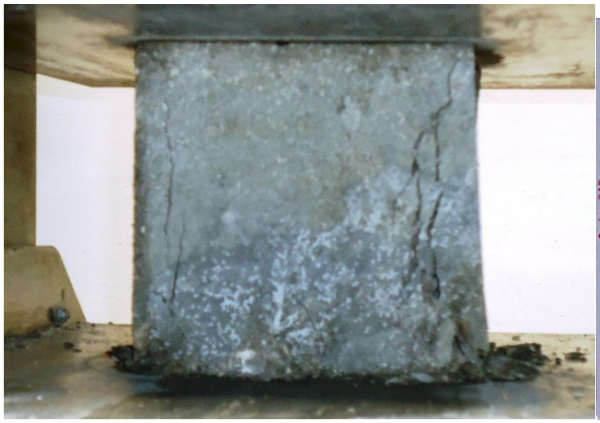
- When the material is in the elastic phase the ultrasonic speed does not change.
- In the elastic phase is not possible correlate Stress at ultrasonic speed.
- Near the break stress could be deduced with a good reliability (err. <5%) a relationship between σ and V.
- With the decrease of speed ultrasonic you have the start of decay of the resistance.
-

The last consideration is the most interesting one!
Indirectly it had given no direct proof that the ultrasonic test is a valid and expeditious method for determining the presence of micro-cracks in the concrete.
During the tests it was observed a phenomenon that basically explained the trend of the results: the concrete begins to show cracks visible to the human eye only during the break, no during inelastic.
One element of concrete, that, has achieved in his life an inelastic state does not propose visible phenomena, therefore the diagnosis can be only instrumental.

Going to investigate the phenomenon is observed given even more interesting if it leads to crushing an audition without pushing in the classic break bipyramidal you can repeat the test to obtain decreasing limit values and increasing the crack, for example:



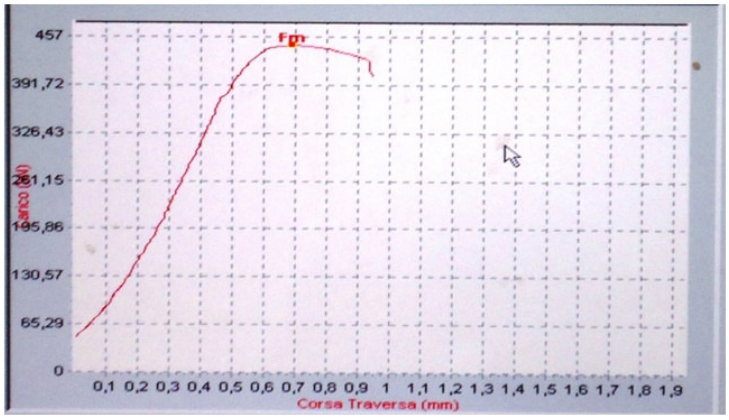












1th Time F max = 719.87 KN - σ max = 31.78 Mpa
2th Time F max = 592.48 KN - σ max = 26.16 Mpa = -16%
3th Time F max = 445.02 KN - σ max = 19.65 Mpa = -35%

The form of the diagram is the same and remains a distinct elastic phase.
Obviously, the value of Fmax is lowers.

Citing this observation to what happens during a seismic event, it is deduced that a phase of inspection can not be observed without instrument whether a particular structural element has reached or not a state of stress inelastic.
I could have a situation like in the picture and not observe no visible phenomenon of formation of plastic hinges in the head or foot of the columns.
The state of stress even if has reached critical levels, it has not produced visible effect, but the material has a resistance which is lower by at least 15-20% compared to the initial one.





During the visits after seism in L'Aquila or Ferrara it was possible to document the various phenomena of rupture, but these were presented in their drama as perfectly visible and often cause of the collapse.
The experiment carried out shows that often the concrete decay of the concrete occurs in a hidden manner and that the ultrasonic test method can offer itself as instrumental to effective diagnosis.

5. Conclusion and future

Possible uses of the proposed method
1 - Assessment of damage to a structure in CA immediately after a seismic event through a simple non-invasive test with ultrasounds.
We consider, for example, a column inside a building subject to a seismic shock. To this effect, the center line of the column will have certainly suffered less stress (we assume close to zero) than the node beam – column
Identified as Vi (initial ultrasonic velocity) that at the centerline is able to compare the values of the speed in the other sections of CLS, there where it reads a value of the speed V less than one reported in the centerline (Vi) is possible to assume a state of crisis of the material.
2 - Periodic monitoring of strategic buildings.
We suppose can perform on the buildings in CLS of strategic interest (schools, hospitals etc ..), periodically, the ultrasonic measurements in points of the building, particularly critical ones, with temporal deadlines established following exceptional events.
The possible changes of speed that we collect in the course of time, in a simple and fast way, can be an "alert" very significant compared to what is happening at the structural level in the same building. This method would be useful also, for example, for the monitoring of buildings that are exposed to continuous vibration such as buildings near of roads subject to heavy traffic and to bridges, railways etc ..
3 - Control methods identified in the plan of building maintenance.
The survey method proposed can be included in the maintenance plan of the building. (Art. 38 of Presidential Decree 207/2010)
With this, I think it was executed the warning of Finagle expressed in the laws of Murphy.

Bibliographical References

[1] ACI 214.4R-03. *Guide for obtaining cores and interpreting compressive strength results*. 2003

[2] ATTOLICO A., BIONDI S., NUTI C. e PETRANGELI M., Influence of buckling of longitudinal rebars in finite element modelling of reinforced concrete structures subjected to cyclic loading, *Proceedings of 12° World Conference on Earthquake Engineering* WCEE, Auckland, New Zealand 30 Gennaio - 4 Febbraio 2000, EQC-NZSEE, Silverstream, Paper No. 0896, 2000.

[3] AUGENTI N., La resistenza dei Calcestruzzi negli Edifici Esistenti Crolli ed Affidabilità delle strutture – Structural Diseases and Realibility - *Atti del II Convegno Internazionale su Crolli e Affidabilità delle Strutture*, Napoli, CUEN, pp.29-39, 2003.

[4] BRAGA F., LATERZA M., Un nuovo legame costitutivo per il calcestruzzo confinato, *Atti VIII Convegno Anidis,* Taormina, 21-24 Sett. 1997: 1095-1102, 1997.

[5] BRAGA F., LATERZA M., GIGLIOTTI R., DRAGONETTI G., NIGRO D., Prove di compressione ciclica su pilastri in c.a. confinati con staffe e/o con tessuti in fibra di carbonio, *Atti 11° Convegno Nazionale "L'Ingegneria Sismica in Italia"*,Genova 2004.

[6] BS 1881-120 – 1983, *Method for determination of the compressive strength of concrete cores*, 1983.

[7] COLLEPARDI M., *Il nuovo calcestruzzo*, Edizioni Tintoretto, 2006.

[8] COSENZA E., DE STEFANO M., PECCE M.. Duttilità di sezioni pressoinflesse in calcestruzzo ad alta resistenza, *Atti IV Convegno nazionale L'ingegneria sismica in Italia*, Milano 4-6 ottobre, 1989

[9] DEL MONTE E., LAVACCHINI G., VIGNOLI A., Modelli per la previsione della resistenza a compressione del calcestruzzo in opera, *Ingegneria Sismica, N. 3*, settembre-dicembre 2004, 2004.

[10] DI LEO A., PASCALE G., Prove non distruttive nelle costruzioni in c.a, *Il giornale delle prove non distruttive*, n. 4, 1994.

[11] EN 13791. *Assessment of in-situ compressive strength in structures and precast concrete components*, European Standard, January 2007, Brussels. 2007

[12] FAELLA G., GUADAGNUOLO M., DONADIO A., FERRI L.,. Calibrazione sperimentale del metodo sonreb per le costruzioni degli anni '60÷'80 della regione campania, *Atti ANIDIS 2011 -XIV convegno nazionale- L'Ingegneria Sismica in Italia,* Bari, Italy 18-22/ 09 /2011.

[13] FRUNZIO G, MONACO M, VISCONTE G (2008). Vulnerabilità sismica di edifici in c.a. non standard. *Atti del Convegno "RELUIS- Vulnerabilità sismica di edifici esistenti in c.a."*. Roma, 28-30 maggio 2008, p. 323-330, MONZA:Polimetrica International Scientific Publisher, ISBN: 978-88-7699-129-5

[14] GAMBARDELLA C. La rappresentazione e la rappresentazione della conoscenza, in M. Dell'Aquila e A. De Rosa (a cura di), *Realtà virtuale o visione reale?*, Arte Tipografica, Napoli 2002

[15] GASPARIK J., *Prove non distruttive in edilizia*. Quaderno didattico AIPND, Brescia, 1992.

[16] GRECO G., MANFREDI G.,PECCE M., Le strutture in cemento armato, da E.Giangreco *Ingegneria delle strutture, Progettazione strutturale*, Vol. 3, UTET, Torino, 2002.

[17] GIANGRECO E., *Teoria e tecnica delle costruzioni*,Liguori editore, 2003.

[18] Kuang, J.S. and Wong, H.F., Improving Ductility of Non-Seismically Designed RC Columns, *Proceedings of the Institution of Civil Engineers Structures and Building*. 158 , pp.13-20, 2005.

[19] MASI A., VONA M. Prove Distruttive e non Distruttive su Materiali ed elementi Strutturali di Edifici Esistenti in Cemento Armato. *Atti Conferenza Nazionale sulle Prove non Distruttive Monitoraggio Diagnostica*, Milano11-12-13 Ottobre 2007, Atti su CD-Rom.

[20] MASI A., La stima della resistenza del calcestruzzo in situ mediante prove distruttive e non distruttive, *Il Giornale delle Prove Non Distruttive Monitoraggio Diagnostica*, N.1/2005, Milano, Italia.

[21] MENDITTO G., NARDONE N., Considerazioni sulla Valutazione sperimentale della Resistenza Meccanica del Calcestruzzo. *Atti Conferenza Nazionale sulle Prove non Distruttive Monitoraggio Diagnostica*, Milano11-12-13 Ottobre 2007, Atti su CD-Rom

[22] MELEK M. & WALLACE J. W., Behavior and modeling of columns with compression lap splices, Proceedings of 7th National Conference on Earthquake Engineering, Boston, Massachusetts, July 21-25, 2002.

[23] PENELIS G.G., KAPPOS A.J.. *Earthquake-resistant Concrete Structures*, E & FN SPON, Londra,1998.

[24] PUCINOTTI R., Stima della Resistenza Caratteristica del Calcestruzzo nelle Strutture Esistenti. *L'Edilizia*, Ingegneria Mater. Tecnologia, N.150, anno XVI, pp.54-63, 2007.

[25] PUCINOTTI R., *Patologia e Diagnostica del Cemento Armato (Indagini non Distruttive e Carotaggi nelle Opere da Consolidare)* Dario Flaccovio Editore, 2006.

[26] VERDERAME G.M., MANFREDI G., FRUNZIO G Le proprietà meccaniche dei calcestruzzi impiegati nelle strutture in cemento armato negli anni 60. *Atti X Congresso Nazionale "L'ingegneria sismica in Italia*. 9-13 settembre 2001

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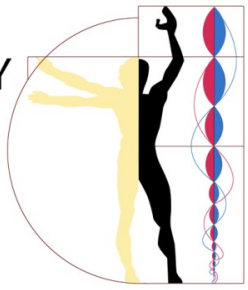

Build on natural tendencies to strengthen resilience of cultural and environmental heritage

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Abstract
"Global Risks Report 2013" examines the increasingly important issue of building national resilience to global risks: one of the most useful characteristics of resilience is its ability to help frame the issues under consideration within a systemic approach, which is particularly relevant in specific context of historic and monumental areas, landscape and environment. Resilience, in this perspective, is understood not as a fixed asset, but as a continually changing process. So "evolutionary resilience" changes whole idea of equilibrium and advocates that nature of systems may change over time with or without an external disturbance. Evolutionary resilience offers a useful framework which allows us to think in new ways about planning of interventions.
Systemic approach, through which operate in variability, multidimensional and multiform state to increase resiliency, is particularly relevant in the actions aimed at cultural and landscape heritage, characterized by "diversity" as a condition in which the process of adapting constantly changing in an evolutionary approach that results in a modification of the strategies and techniques (flexibility/diversity, redundancy /modularity, response/recovery, reliability/adaptive governance). Aim is to enable decision-makers to track progress in building resilience and possibly identify where further investments are needed.

Keywords: Resilience, Heritage, Protection, Technologies, Measures

1. Protection promotes resilience
"Global Risks Report 2013" examines the increasingly important issue of building national resilience to global risks: one of the most useful characteristics of resilience is its ability to help frame the issues under consideration within a systemic approach, which is particularly relevant in specific context of historic and monumental areas, landscape and environment. Building resilience means finding ways to change behaviours across sectors and systems, identifying the barriers that must be addressed and the enablers that should be leveraged [1].
Cultural heritage is increasingly recognized as a driver of resilience, because it is the result of centuries of adaptation to the hazards that affect local environments, and thus, it contains crucial information for communities of the place to further reduce the risk.
Resilience, in this perspective, is understood not as a fixed asset, but as a continually changing process. So "evolutionary resilience" changes whole idea of equilibrium and advocates that nature of systems may change over time with or without an external disturbance [2] without a proportional or linear relationship between cause and effect.
Resilience is not fixed but is a continuous iterative process that promotes understanding of places not as a unit of analysis or neutral containers, but as socio-spatial complex and interconnected with unpredictable feedback processes operating at different times and scales [3]. Evolutionary resilience promotes the understanding of places not as units of analysis or neutral containers, but as complex, interconnected socio-spatial systems with extensive and unpredictable feedback processes, which operate at multiple scales and timeframes. Resilience has become an operational definition, a

transformation and construction project and docking at a new way of thinking. In a transformation project of built environment, resilience implies recognition of interactions between behaviours, systems and strategies that are intentionally structured or organized, and those that emerge as a result of autonomous behaviour in response to specific disturbances agents [4].
There is not only one source of resilience or vulnerability, since both represent the effect of several factors interaction: not only predispositions and response capabilities that characterize the heritage, which may manifest itself in different possible exposure to stressful environmental events, but also the quality and potentialities, which are interwoven with a number of local environmental factors closely dependent from historical-cultural, economic and social variables. This means that interventions in processes can indeed diminish, sustain, or enhance resilience. So, resilience is a continuous process, rather than a final result.
By focusing on built heritage this approach also highlights the importance of developing certain tendencies to risk, as a key to innovation and opportunity for growth, looking for "opportunities" that always occur during a crisis to emerge stronger and better than before. Evolutionary resilience provides long-term prospects, systemic approach and immediate action.
In conclusion, resilience is an interactive concept that derives a dynamic interaction between risk factors and protective factors from different levels.
The primary objective of a good design of interventions for protection and promotion of cultural and natural heritage must be to improve the quality of historical monuments and environmental landscapes. This need arises from the important degradation process and increase of vulnerability, where the ability to self-healing and resilience of environmental systems are minimized. Cultural and natural properties are increasingly affected by events, which are less and less 'natural' in their dynamics, if not in their cause. The progressive loss of these properties as a result of floods, mudslides, fire, earthquakes, civil unrest and other hazards has become a major concern, partly because of the significant role that heritage plays in contributing to social cohesion and sustainable development, particularly at times of stress. It is therefore possible to prevent them, or at least considerably reduce their effects, by strengthening the resilience of the assets to be safeguarded. Strengthening the resilience of cultural heritage is a prerequisite for the growth and development of the system.
Systemic approach, through which operate in variability, multidimensional and multiform state to increase resiliency, is particularly relevant in the actions aimed at cultural and landscape heritage, characterized by "diversity" as a condition in which the process of adapting constantly changing in an evolutionary approach that results in a modification of the strategies and techniques (*response and recovery, diversity, redundancy, robustness and resourcefulness*).

2. Acting on resilience characteristics for protection and enhancement of Cultural and Environmental Heritage

The following components of resilience are used to build on natural tendencies to strengthen resilience of Cultural and Environmental Heritage. These components should be designed into a system and, as such, will enable assessments of cultural and natural heritage inherent resilience capabilities. The literature review has suggested what some of these traits of a resilient response might be.
Aim is to enable decision-makers to track progress in building resilience and possibly identify where further investments are needed integrating security and resilience, defining new adaptive potentialities and new stabilities in the system of cultural and landscape heritage maintaining resilience characters that constitute its identity.

2.1 Technologies and tools for identification, analysis and management of natural and human risks

Resilience Performance (response and recovery)
These two components of resilience describe how a system performs in the event of crises. Response and recovery are dependent on risk, event and time. These components will provide us with the ability to compare systems and feed the measurements and results to calibrate the resilience characteristics [1].
Recovery is defined as the process of rebuilding, restoring and rehabilitating the Cultural and Environmental Heritage following an emergency. Although distinct from the response phase, recovery should be an integral part of the response from the very beginning, as actions taken during the response phase can influence the longer-term outcomes for a community [5].

Response increases resilience
- Emergency response: build capacities for reducing disaster risks to heritage

Response encompasses the decisions and actions taken to deal with the immediate effects of an emergency. It is the decisions and actions taken in accordance with the strategic, tactical and operational objectives defined by emergency responders. At a high level these will be to protect life, contain and mitigate the impacts of the emergency and create the conditions for a return to normality [5]. Capacity-building programs aimed at reducing disaster risks to heritage should be organized for various stakeholders. These would include hands-on training courses for the managers of heritage properties and museums for developing, implementing and monitoring appropriate mitigation, preparedness, response and recovery plans for heritage, as well as those aimed at introducing policies and programs for decision makers such as city mayors and museum directors [6].

- *Strengthen disaster preparedness to Cultural and Environmental Heritage properties for effective response at all levels*

The worst consequences of natural or human-made disasters can often be avoided or mitigated if all those concerned are prepared to act according to well conceived risk reduction plans, and the necessary human and financial resources, and equipment, are available [6].

- *Development and implementation of innovative techniques and methods for monitoring the risk assessment*

Reduction of fragility of structures through design of a specific system, with related software for acquisition, processing and transmission of synthetic data on the state of damaged in the cycle of Emergencies. Systems of Early Warning (EW) and alarm response for protection of cultural heritage offer a substantial improvement in terms of efficiency and effectiveness of both the component. The early warning allows to anticipate activation times of the phases of attention / warning / alert and to allow the activation of plant procedures for safety.

- *Development and innovative methodologies for evaluation of systemic vulnerability at territorial scale*: Systemic coordinated analysis on heritage / support / context to assess the relationship between intensity of extreme events and direct and indirect consequences of such events on local system
- *Development of tools and techniques for non-invasive investigation*: survey of constructive materials completely identifies resistant elements, keeping in mind the quality and state of conservation of materials and components. This recognition requires the collection of information often hidden (concealed behind ceilings, etc.), which can be performed due to indirect non-destructive investigation technics (thermography, ground penetrating radar, sonic tomography, etc.), non-invasive, o those that are performed on samples taken from works, now defined microdestructive (endoscopies, peeling plaster, essays, small burglary, etc.). In order to minimize the impact of these investigations, in addition to knowledge of the events of the building construction, it is essential to have a thorough knowledge of construction characteristics of the artifacts in the area and in different historical periods [7].

Recovery increases resilience

- *Maintenance oh heritage*: inspections, monitoring and maintenance of cultural heritage compared to restoration
- *5R Strategies_Redevelopment, reuse, recycling, recovery, restoration of the existing environment*: sustainable development must integrate disaster risk reduction and resilience heritage at all levels through planning across sectors to increase resilience to disaster; evaluation of functional compatibility and use; optimization performance of building in relation to its material consistency and state of preservation; active conservation
- *3D digitization of Cultural Heritage*: Use of digital models for study, restoration and presentation; interactive visualization as resource for education; Tools to support research/study by Support ubiquitous availability of digital models, easy to download and consult visually at full resolution; Design tools for an increased understanding and better insight into artifacts; tools to document and support restoration; Virtual Museums.

2.2 Technologies and materials for adaptation, protection and conservation

Resilience Characteristics (diversity, redundancy, robustness and resourcefulness)

With greater diversity comes an increased ability to thrive, survive and bounce back from external shocks and stresses [8]. Diversity of systems reduces the potential negative. Diversity relates to flexibility and keeping your options open. A lack of diversity limits options and reduces your capacity to respond to disturbances. Increasing efficiency (optimization) inevitably leads to a reduction in diversity. In the same way that biological diversity increases the resilience of natural systems, cultural diversity has the capacity to increase the resilience of social systems. Cultural heritage, as a key component of cultural diversity, is a critical consideration for any strategy to build the resilience of communities [9]. Also be aware that simplifying the system for increased efficiency reduces the system's diversity of possible responses to disturbance, and the system becomes more vulnerable to stresses and shocks. Diversity is a major source of future options and a system's capacity to respond to change and disturbance in different ways (recall response diversity, in particular) [10].

Redundancy involves having excess capacity and back-up systems, which enable the maintenance of core functionality in the event of disturbances [11].

Robustness incorporates the concept of reliability and refers to the ability to absorb and withstand disturbances and crises [1].

Resourcefulness means the ability to adapt to the crisis, respond flexibly and - when possible - to turn a negative into a positive [11]. The hypothesis underlying this component of resilience is that if the cultural and environmental heritage can build trust within their networks and are able to self-organize, and are more likely to react spontaneously and find solutions to solve the challenges unforeseen when large institutions at national and governance systems are subject to risk.

Diversity increases resilience

- *Promotes and sustains the diversity of cultural heritage*: for example in Italy, distinguishing factor and a source of competitive advantage is the widespread dissemination of cultural heritage in the area and close historical and cultural heritage link in museums with reference context. Understanding the diversity of environmental, economic and social heritage is a general action to raise awareness about impacts, vulnerability and adaptation measures in the field of cultural heritage [12].
- *Build diversity and redundancy into governance systems*: promoting the balance of the diversity of mechanisms for a given need or fulfill a particular function. Within a governance local system, a variety of organizational forms can overlap in function and provide a diversity of responses, because organizations with different sizes, cultures, funding mechanisms and internal structures are likely to respond differently to the effects of the risks.
- *Strategies for maintaining or enhancing ecological diversity* include maintaining structural complexity in landscapes, establishing buffers around sensitive areas, creating corridors for connectivity and controlling overabundant invasive species. In an urban context, 'green infrastructure' in the form of vegetated open space networks can be a more resilient way of providing ecosystem services such as storm water management, compared to 'grey infrastructure' such as concrete pipes [13].

Redundancy increases resilience

Redundancy of critical infrastructure: designing replication of modules which are not strictly necessary to maintaining core function day to day, but are necessary to maintaining core function in the event of crises [14].

Robustness increases resilience

- *Innovative solutions for mitigating risks*: consolidation, monitoring and remote and multi-sensor control of effects, high performance and low impact materials (seismic isolators, reversible reinforcement techniques, low-impact materials and traditional techniques, recycled materials, highly innovative or nanometric materials)
- *Integration of advanced spread systems (buildings and outdoor spaces)*: plant systems for accessibility, energy control and quality indoor / outdoor (sensors and monitoring systems...), integrated automation, active systems and integrated systems for energy recovery by thermal cycles of external infrastructure (nearby systems), adaptive reuse of spaces
- *New approaches to adaptive transformation*: verification of design choices and intervention strategies based on the Protocols of sustainability certification (LEED, ITHACA), development of models and strategies for the evaluation of interventions on built heritage (Identity card of artifact) and for scheduled maintenance, Reuse Plans of historic buildings and areas of historical interest (e.g. Mice Project - city Hotel)

3. Methods and models for design, management, enhancement

Resourcefulness increases resilience
- *Capacity for self-organization* [15]*:* this includes factors such as sharing of experiences and exchange of good practice through the European Union, the relationship between social networks and state, and the existence of institutions that enable face-to-face networking. These factors are critical in circumstances such as failures of government institutions when communities need to self-organize and continue to deliver essential public services.
- *Creativity and innovation:* the ability to innovate is finalised to create synergies between cultural heritage, on one hand, and field of contemporary creation and creativity, on the other; promote intercultural dialogue, especially among young people, through in artistic, cultural and historical education
- *Participation in networking activities*, *with the aim to exchange experiences and start joint projects*: increased visibility and attractiveness of site on a European scale, including using the possibilities offered by modern technology of digital, interactive and seeking synergies with other European initiatives
- *New technologies for fruition of cultural heritage and enhancement of spaces of cultural and historical interest*: multiplying information relating to heritage, exploiting advantages offered by digital technologies (three-dimensional models, robotic technologies).
- *Enhancement of cultural identity*: European Heritage Label [16]. The general objectives of the European Heritage Label are to strengthen European citizens' sense of belonging to the European Union, in particular that of young people, based on shared values and elements of European history and cultural heritage, as well as an appreciation of national and regional diversity, and to strengthen intercultural dialogue. The Label seeks to stress the symbolic value and raise the profile of sites that have played a significant role in the history and culture of Europe and the building of the European Union.

Protect and manage the heritage, compared to the challenges of global change, requires not only knowledge of the state of the system, but a continuous work that is based on the deepening of its evolutionary process, identifying in resilience characteristics the new paradigm to govern future scenarios of transformation.

Bibliographical References

[1] WEF-World Economic Forum (2013). *Global Risks 2013*. Geneva. http://www.weforum.org

[2] CARPENTER, S.R., FOLKE, C., SCHEFFER, M. & WESTLEY, F.R. (2009). Resilience: accounting for the noncomputable. *Ecology and Society*, 14 (1): 13. www.ecologyandsociety.org/vol14/iss1/art13.

[3] DAVOUDI, S., SHAW, K., JAMILA HAIDER, L., & al. (2012). Resilience: A Bridging Concept or a Dead End? "Reframing" Resilience: Challenges for Planning Theory and Practice Interacting Traps: Resilience Assessment of a Pasture Management System in Northern Afghanistan Urban Resilience: What Does it Mean in Planning Practice? Resilience as a Useful Concept for Climate Change Adaptation? The Politics of Resilience for Planning: A Cautionary Note. *Planning Theory & Practice*, 13: 2, pp. 299-333.

[4] MOENCH, M., S. TYLER, et al. (2011). *Catalyzing Urban Climate Resilience: Applying Resilience Concepts to Planning Practice in the ACCCRN Program (2009–2011).* ISET-Boulder: Bangkok.

[5] Her Majesty's (HM) Government (2010). Emergency Response and Recovery: Non Statutory Guidance Accompanying The Civil Contingencies Act 2004. www.gov.uk/government/uploads/system/uploads/attachment_data/file/253488/Emergency_Response_and_Recovery_5th_edition_October_2013.pdf

[6] UNESCO (2010). *Managing Disaster Risks for World Heritage*. http://whc.unesco.org

[7] MBACT-Ministero dei Beni, delle Attività Culturali e del Turismo (2010). Linee guida per la valutazione e la riduzione del rischio sismico del patrimonio culturale con riferimento alle Norme tecniche per le costruzioni di cui al decreto del Ministero delle Infrastrutture e dei trasporti del 14 gennaio 2008. See also MBAC (2006). *Linee Guida per la valutazione e riduzione del rischio sismico del patrimonio culturale*. Gangemi. Roma

[8] *Resilience*. www.resilientcity.org

[9] JIGYASU, R., MURTHY, M., BOCCARDI, & al. (2013). *Heritage and Resilience: Issues and Opportunities for Reducing Disaster Risks*. This paper has been prepared by the International Scientific Committee of ICOMOS for Risk Preparedness in collaboration with the United Nations Office for Disaster Reduction (UNISDR), UNESCO and ICCROM on the occasion of the Fourth Session of the Global Platform on Disaster Risk Reduction (Geneva, 18-23 May 2013). It includes contributions from a wide range of committed leaders and organizations including MARSH International, a global re-insurance company, and a group of European Mayors who have committed to work together to protect heritage and build resilience in their cities.

[10] WALKER, B. & D. (2006). *Resilience thinking: sustaining ecosystems and people in a changing world*. Washington: Island Press.

[11] BRUNEAU, M., CHANG, S.E., EGUCHI, R. T., & al. (2003). A Framework to Quantitatively Assess and Enhance the Seismic Resilience of Communities. *Earthquake Spectra*, 19:733.

[12] MATTM-Ministero dell'Ambiente e della Tutela della Terra e del Mare (2013). *Elementi per una Strategia Nazionale di Adattamento ai Cambiamenti Climatici*. Roma

[13] STOCKHOLM RESILIENCE CENTRE (2014). *Applying resilience thinking. Seven principles for building resilience in social-ecological systems*. www.stockholmresilience.su.se See also Cambridge University (2014). *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems*. www.cambridge.org/9781107082656.

[14] WEF-World Economic Forum (2015). Global Risks 2015. Geneva. www.weforum.org/risks

[15] BERKES, F. (2007). Understanding Uncertainty and Reducing Vulnerability: Lessons from Resilience Thinking. *Natural Hazards*, 2007, 41: 283-295.

[16] The European Heritage Label (EHL) is a new European Union initiative. It builds on an earlier intergovernmental initiative launched in 2006. It was established by Decision No 1194/2011/EU of the European Parliament and of the Council of 16 November 2011.

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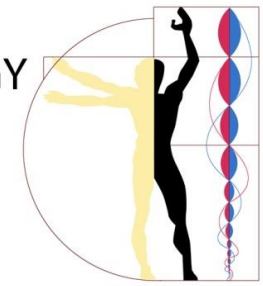

"Additional services" in the management of Cultural Heritage: the paradox of archeological site of Pompei[1]

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Abstract
In Italy "Additional Services", introduced by the Ronchey Law (n.4/1993) as a first attempt to involve the private subject in the enhancement of Cultural Heritage, are comprised in the Code of the Cultural and Landscape Heritage (L.D. n. 42/2004) among the different forms of *management*. Including a wide range of services (bookshops, gadget sales, guides, cafeterias, etc.), they are becoming relevant in the cultural *supply*, as in many worldwide experiences, representing a sector with a high capacity to generate income, employment, and more generally, development. In particular, *merchandising* maybe an exceptional generator of stimulus for those creative industries (industrial design and craft, fashion design, publishing, etc.) localized in territories with an extraordinary cultural heritage. In this perspective the article, starting from an analysis and interpretation of the official Italian data on additional services in comparison with the performances of some international institutions and places of culture, wants to highlight the strengths and weaknesses of a strategic sector that is, however, still underdeveloped.
The article is organized as follows: Section 1 will offer a concise overview of the "additional services" as introduced by the Italian Code; the Section 2, analysing the revenues from additional services of Italian cultural sites and of some international institutions, highlights strengths and weakness. Then, in Section 3 the article extends the question to a paradoxical case: the archaeological site of Pompeii. The paper ends with some concluding remarks.

Keywords: Cultural Heritage, management, additional services, merchandising

1. Introduction
According to the "Compendium of Cultural Policies and Trends in Europe", the Italian Cultural Policy model, considered from an economic point of view, «is closely connected to a mixed economy system, with the public sector historically being the primary funding source for heritage, museums, archives and libraries, and, to a certain extent, for the performing arts. However, due to heavy constraints on the national budget, in the past years governments have been strenuously promoting a more direct involvement of the private sector» [1], with it becoming an unavoidable condition.
Some of the main reasons include: the progressive evolution, also normative, in the public-private relationship; the awareness for the enterprises of the value of culture in their marketing strategies and, above all, the contraction of the public resources. With specific reference to this last consideration, the data are clear: the public resources destined to the culture represent today only 0,20% of the Public Administration budget (in 2002, with it being 0,35%); with the economic-financial crisis the assignment of the MiBACT

[1] The article take the cue from the degree thesis in Fashion Design by Roberta Formisano (a.y. 203/2014); Fabiana Forte wrote Paragraphs 1 and 2; Roberta Formisano, Paragraph 3. The Conclusions were prepared by both Authors

(*Ministero per i Beni e le Attività Culturali* e del *Turismo*) being progressively reduced from €2.037 billions 2008 to €1.595 billions 2014 [2].
In this perspective should be interpreted the different forms of *management* of cultural property undertaken by private initiative introduced by the Italian Code of the Cultural and Landscape Heritage (Legislative Decree no. 42/2004, art. 115) and aimed at the *enhancement* of Cultural Heritage. As in article 6 of the Code, enhancement consists in the exercise of the functions and regulation of the activities aimed at promoting *knowledge* of the cultural heritage and at ensuring the best conditions for the utilization and public *enjoyment* of the same heritage; private subjects may concur, co-operate or participate in such activities.
Enhancement of cultural property undertaken by private initiatives are managed directly or indirectly; direct management is carried out by direct assignment of such management to institutions, foundations, associations or other entities, which to a prevalent extent are incorporated by the public administration to which the property pertains; indirect management is carried out by concession to a third party. The choice between the two forms of management is made by following a comparative assessment in terms of efficiency and efficacy of the aims to be pursued; when the assignment is made by concession, the same is provided for through open competition procedures.
Among the different forms of *management,* there are "Additional Services", already introduced by the enlightened Ronchey Law (n.4/1993) as the first attempt to involve the private subject in the enhancement of Cultural Heritage, through the outsourcing of the management of the services, assigned - for the first time in Italy - in concession to private subjects in the face of an annual fixed fee and royalties on the single services.
Successively, "additional services" have been amplified and better specified by several laws, but until now, the issue is widely debated and under revision.
Including a wide range of services (bookshops, gadget sales, guides, cafeterias, etc.), "additional services" are becoming relevant in the cultural *demand* - ever more demanding and informed - , contributing to the improvement of the quality in the enjoyment of the cultural goods. Nowadays, this set of services plays a crucial role in orienting the preferences of cultural consumers that have become increasingly accustomed to enhancing their experience of accessing a cultural institution, through the material available in *advance*, such as useful information before the visit, *on-site*, such as tutorial podcasts and multimedia, or for assimilation *over time*, such as catalogues, books and gadgets [3].
Regarding the several typologies of services (gathered by MiBACT as: audio-guides, bookshop and gadgets, cafeterias, booking and pre-sales tickets, restaurants, guided tours), the most consistent are those of booking and pre-sales tickets; among the more strictly commercial services, the books and gadgets shops prevail over cafeterias and restaurants (as showed in Table 1).
Relating to the cultural *supply*, additional services represent a sector with a high capacity to generate income, employment, and more generally, development. In particular merchandising, the new system of commercialization and promotion not only of the products, but also of the image of the cultural institution, can offer several business opportunities for the private sector with spill-over effects on employment and the local economy, as in many worldwide experiences.
It maybe an exceptional generator of stimulus for the Creative Industries (industrial design and craft, fashion design, publishing, taste industry, etc.), localized in territories with an extraordinary Cultural Heritage, as in the Campania Region [4], however, it is still underestimated.

2. Additional services and revenues: an international overview

According to the Italian Code of the Cultural and Landscape Heritage (L.D. n. 42/2004, art.106), the Ministry- MiBACT - may grant the use of cultural properties to individual applicants against payment of a *concession fee*; concession fees and payments connected to the reproduction of cultural proprieties are established by the authority (art.108); the article 110 (Cash receipts and division of proceeds) contains the general regulation of the management of *revenues* deriving from the sale of tickets as well as concession fees and payments for reproduction of cultural property.
The revenues shall be paid to the provincial section of the State treasury and the Ministry for Economy and Finance shall re-assign the sums received to the competent base budget units for the Ministry's expense budget, according to the criteria established by the same Ministry. This kind of revenue plays an important role in financing the expenditures for preserving and enhancing the cultural heritage, having the nature of an *"entrata di scopo"* or an earmarked revenue (the proceeds are designated for the increasing and enhancing of the cultural patrimony, as in article 110). Analyzing the official data, it emerges that the potential of the additional services is still underestimated, above all if compared with the official data of other international cultural institutions.
Table 1 shows the growth of additional services in Italian cultural sites through the typological composition in the last fifteen years; the years considered are 1998 (the first available year in the statistical database of MiBACT), 2005, as an intermediate year and until 2013 (the last available data).
The data confirm the progressive expansion of the additional service, especially regarding the tickets sales and merchandising (books and gadgets shops), both showing a reduction from 2007, in coincidence with the financial crisis, with a substantial alignment in the last five years.

Furthermore, Table 1 shows the number of customers/tickets, the gross receipts and share due to the Superintendence for each typology of additional services sites; overall, with specific reference to the year 2013, the gross receipts from additional services amount to €45.793 million, of which €6.676 million is the amount designated for the increasing and enhancing of the cultural patrimony, competence of the Superintendence (the decentralized ministerial agency).
In percentage terms, this means that only 15% goes to the State, while 85 % goes to the private subjects. Analyzing the single typologies of services, for the year 2005, the main gross receipts derive from merchandising (books and gadgets shops); in 2013, about €19.105 million (42% of the total amount of gross receipt) of which 4€.060 million to the State and €15.045 million to private subjects (21% of 79%).

Year	Data	Audioguide	Books/gadgets Shops	Cafeteria	Booking/pre-sales tickets	Restaurants Self-service	Guided Tours	Total
1998	*N. Services actived*	**7**	**33**	**6**	**34**	**1**	**23**	**104**
	Customers/tickets	171.748	977.557	522.313	781.851	45.105	222.271	2.720.845
	Gross Receipts	639.517	9.040.923	2.127.819	722.668	784.389	725.234	14.040.550
2005	*N. Services actived*	**39**	**101**	**31**	**143**	**6**	**89**	**409**
	Customers/tickets	654.993	2.154.406	1.139.882	3.191.582	80.318	984.702	8.205.883
	Gross Receipts	2.342.448	20.745.719	6.001.817	5.443.534	1.571.604	2.952.027	39.057.149
	Superintendence	474.666	4.110.332	595.430	169.517	123.248	266.931	5.740.123
2013	*N. Services actived*	**40**	**82**	**16**	**115**	**4**	**78**	**335**
	Customers/tickets	950.940	1.555.221	800.950	5.208.981	48.426	576.105	9.140.623
	Gross Receipts	5.219.512	19.104.896	6.061.969	10.975.577	1.731.728	2.698.943	45.792.624
	Superintendence	705.723	4.060.374	611.365	884.108	85.405	329.521	6.676.495

Tab.1: Growth of additional services in the Italian cultural institutions (source: MiBACT data processing)

It results that there is a very imbalanced percentage, averagely stable over the last fifteen years; but it is already gained the awareness of the Italian system's weakness in the management of additional services and, in this perspective, the new rules under revision by MIBACT should guarantee more efficacy, efficiency and transparency in the management of additional services.
As highlighted in several studies, the comparison of the additional services performances of the Italian cultural institutions with the official data of other international institutions demonstrates a management capability significantly higher than the Italian one, which still results substantially backward.
This consideration appears evident especially if considering the performances of some well-known and world famous cultural institutions, the so-called "Superstar Museums" [5], those which are a "*must*" for tourists, with a large number of visitors, a significant part of their income derives from the revenue of the bookshops and restaurants and have a major impact on the local economy. It is not a case that the cities where some of the Superstar Museums are localized, have become the "global cities" for a long time, in accordance with the concept developed by Saskia Sassen [6].
Table 2 shows the performances of some these museums, resulting first in the *top ten* of the best attended art museums in 2013 [7]; the performances are in terms of number of visitors, admission income and additional services income. The same table contains the performances of the overall Italian institutions; the most disconcerting data is the total income from additional services: €46 million, the sum of income of the Louvre and the British Museum.

City	Institutions	N.of Visitors	Income (in M€)	
			Admissions	Additional services
Paris	Louvre	9,3	60	15
London	British Museum	6,8	8	26
New York	Metropolitan Museum	6,2	62	86
London	National Gallery	5,9	2	5
Vatican City	Vatican Museums	5,4	80	20
London	Tate Gallery Group	7,03	10	36
Italian Institutions	**n. 433**	**38,4**	**126**	**46**

Tab.2: Performances of some international institutions and comparison with the overall Italian institutions[2]

At a national level, with specific reference to the Campania Region, in 2014 it is second in terms of total number of visitors (6.595 after Lazio with 18.515 visitors), and among the south Italy regions, it is the one which attracts the biggest number. Among the top 30 most visited site in the country, with reference to the

[2] The data were collected from the official reports of the institutions; only for the Vatican Museums the data on income were reported in an interview with the Museum Director [8].

same year, the archeological site of Pompei continues to remain at second place, with 2.621.803 visitors after the Colosseum in Rome (with 6.181.702 visitors); in the same ranking, there are another 3 UNESCO sites of the Campania Region. However, in terms of additional services, there are several inefficiencies and, until now, their potentiality has remained misunderstood.
First of all, it is worth highlighting that, regarding the whole of museums, monuments and archeological areas, there are still few equipped with all kinds of additional services and some of them offer just guided tours. Only the Bourbon Royal Palace in Caserta, the biggest royal residence in the world and one of the five UNESCO sites in the Campania Region (in 2013 recording just over 400 thousand visitors, while in France, the Palace of Versailles has recorded more than 7 million), provides the overall range, but referring to merchandising (books and gadget shops), the receipts for visitors in 2010 (the last available data) is only 0,11 euro.
Among the ranking of the 30 most visited institutional museums, monuments and archeological areas, in the year 2013, the archeological site of Pompei continues to remain at second place, after the Coliseum in Rome and the archeological site of Ercolano is positioned at 14 place. In accordance to the data in Table 3, which shows the performances of these three important archeological sites, if differentiated in terms of visitors, it is possible to make some final considerations.

City	Institution	Visitors	Books/gadgets shops receipts	N. customers/ tickets	Conversion rate	Average purchase value	Receipts for visitor
ROME	Anfiteatro Flavio (Colosseum)	5.625.219	4.261.554	287.621	5,11	14,8	0,76
POMPEII	Scavi Vecchi e Nuovi di Pompei	2.413.515	412.673	41.376	1,71	10,0	0,17
ERCOLANO	Scavi e Teatro Antico di Ercolano	329.669	228.069	23.121	7,01	9,9	0,7

Tab.3: Performances of merchandising in some archaeological sites among the most visited (year 2013)

According to several studies, the attractiveness of the Italian additional services is very low; the *conversion rate* (the number of visitors who made a purchase, expressed as a percentage of the total number of visitors) is approximately 7 % and only a quarter of Italian museums offer additional services [9].
This performance is far from that of other international institutions (for example, 16 % for the Louvre or 31 % for the British Museum), both for the average expenditure per-capita and number of customers in the commercial activities inferior to the international standards [10].
Analyzing Table 3, the conversion rate of Pompeii is the lowest, while the average purchase value is in line with the other Italian institutions, against the performances of some international museums (in the Louvre the average expenditure per capita is € 16); in all three cases, the conversion rate is aligned with the national media. Regarding the receipts for visitors (the ratio between the receipts from merchandising and the total number of visitors), the performance of the Pompeii site is very modest (0,17 cents), as the receipts for visitors deriving from all additional services (0,98 cents).
In the next paragraph, the case of Pompeii will be illustrated. The archeological site is under the care of a Special Superintendence, a decentralized agency of the Ministry of Cultural Heritage and Activities, vested with special independent status, whose sphere of competence is the preservation, conservation and public utilization of archaeological resources (it was instituted with Presidential Decree no. 233/2007 and brings together the Archaeological Superintendence of Pompeii, which had previously been granted independent scientific, organizational and financial autonomy in 1997 and the Archaeological Superintendence of Naples and Caserta).

3. The paradox of archeological site of Pompeii

Pompeii is a sensational case of the lack of profitability from merchandising activities. A singular example in world tourism, the excavations are a unique and inimitable attractor, with an absolute reputation, but they fail to generate adequate social and economic impact on the area. This is mainly the consequence of the lack of initiatives over the last thirty years, in the planning of new touristic interventions and the lack of attention to the emerging needs in the global segment of cultural tourism as well as the enhancement of the archaeological area. The effects of this behaviour have produced some negative consequences, such as the limited involvement of the economic benefits generated by the flow of visitors who travel to the ruins [11]. The scarcity of complementary services, accessories and support to the excavation visit has decreased the value for a tourist more and more careful to the overall meaning of the whole touristic experience and increasingly able to compare a wide and varied cultural worldwide attractions.
In comparison with the objects of merchandising of museums such as the British Museum, the National Gallery and the MoMA, where the objects have a very strong relationship between design and fashion, the objects in Pompeii's bookshop are trivial and of a poor quality (see Figure 1).

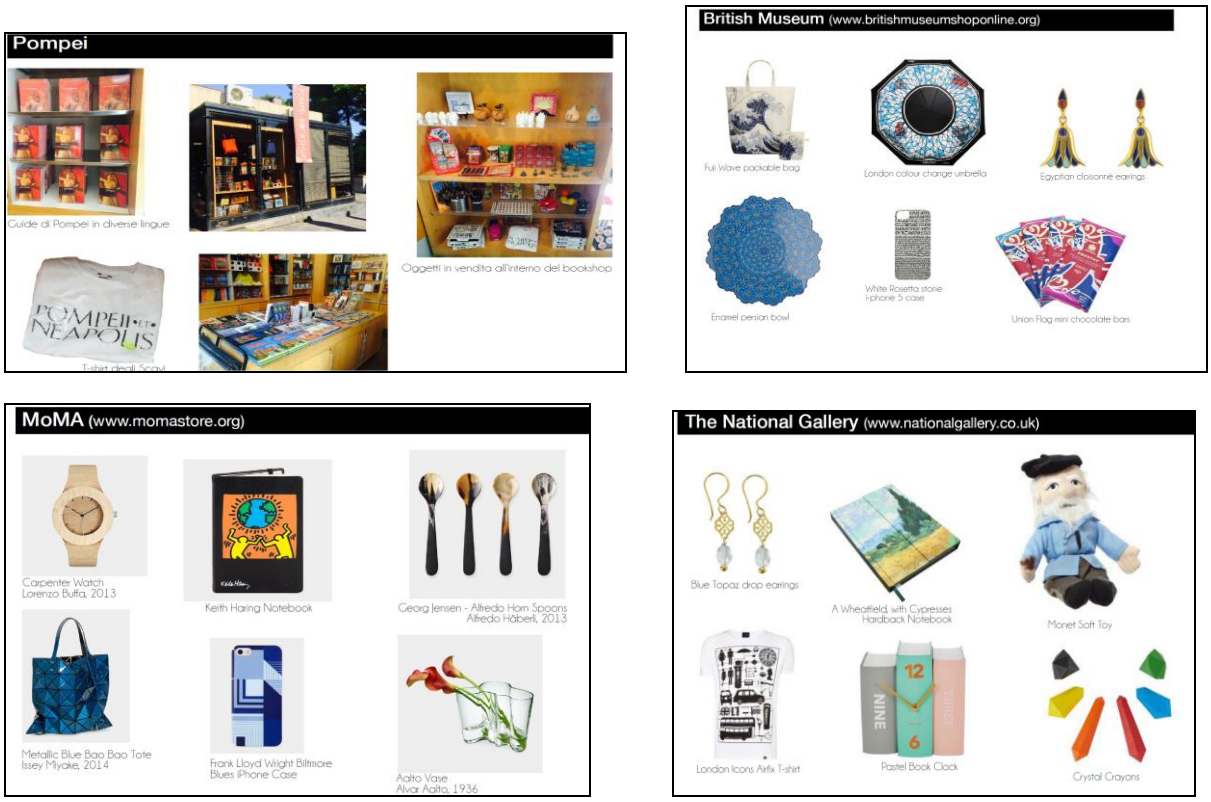

Fig. 1: Merchandising in Pompeii's Bookshops and in other famous cultural institutions

Notwithstanding, the brand "Pompeii" continues to be an element of attraction on an international level. In the last four years the flow of visitors has remained constant, around 2,2 million people, in second position in the ranking of the 30 most visited museums in Italy [12].
To this result have contributed, on one hand, the distinctiveness of the characteristics of the archaeological area; on the other hand, in 1997 UNESCO made it the excavations a World Heritage, which allowed to keep high visibility about the specific characteristics of the area [13].
The greatest paradox is that Pompeii makes more abroad than in Italy. In London, the British Museum, realized an event-exhibition, sponsored by the US investment house Goldman Sachs and edited by Paul Roberts in collaboration with the Superintendence for Archaeological Heritage of Naples and Pompeii, which put together over 250 objects, recent discoveries and famous artefacts resulting from previous excavations. Many of these objects have never been exhibited outside Italy.
The revenue was over £10 million, with most of the profit coming from merchandising activities, there is also an increase of 20% among visitors. The exhibition, "Life and death in Pompeii and Herculaneum," aimed to attract 250,000 spectators. This aim was reached in less than three months, arriving to 471,000 visitors. Open from March 28 until 29 on September 2013, the show was the third most visited exhibition from opening of the museum in 1753. The price of the entrance tickets ranged from £15 to 12.5, depending on the age of the visitor. After the introductory video that glorified the least known (by foreigners) but best preserved Ercolano, it exhibited the best of everyday objects, paintings, statues, mosaics, and casts of some of the victims of the buried cities in 79. C.
It is different for the bookshop set up at the end of the exposition. A huge space, which contained all kinds of merchandising signed *Pompei*: from mugs to T-shirts, from pencils to scarves, from bags to posters, to the Roman inspired jewellery. They were also present in the bookshop books and DVDs on the buried city, CDs with the music of classical Rome and original Gragnano pasta accompanied by bottles of oil directly from Vesuvius. The merchandising is still for sale in shops in London and on the web site of the British institution. London was therefore enriched with resources that in Italy and Campania are not always exploited to the fullest [14].
The questions that arise are spontaneous: is it not a good idea to start from the marketing cultural and territorial in Pompeii? It would benefit, employment and development if people began to weave a network of commercial level inspired wonders "export" that the whole world envies, with a satisfactory merchandising activities in collaboration with the creative industries of the Campania. If others do it, why they do not begin to do it ourselves?
From the exhibition, a film- event screening into 51 countries was later made. In Italy, it remained in cinemas for two days. "Pompeii" is the first film event to be entirely produced by a museum, the British Museum. The

film, the only event of its kind has completed the success of the exhibition "Life and Death in Pompeii and Herculaneum." The multimedia reconstruction of Pompeii and Herculaneum, two thousand years ago has cost a little more than one hundred thousand Euros. «The British Museum is excited to produce and broadcast on the big screen the story of Pompeii and Ercolano», said Neil MacGregor, director of the London museum.
The buried city continues to be a source of income for foreigners. Abroad Pompeii and Herculaneum archaeology is an archaeological and economic treasure, here in Italy it is only a cultural treasure.
After the great satisfaction for the British to tell the wonders of Pompeii to Italians, even Monaco, Hamburg and Madrid have followed this example exposing our Pompeii. Philadelphia, in the United States, has made a deal with 150 artefacts on display and a ticket of $27.50, giving the opportunity for visitors to experience "One day in Pompeii." The findings were then moved to California, where they were put on display at the Science Center in Los Angeles.
All exposure of Pompeii in the world has returned to the Italian Superintendent in 2013 about 700,000 Euro of royalties, from the rights on the loan [15].
A great opportunity for economic development failure. It is worth spending just a few days outside the excavations to realize this. Buses arrive and unload tourists, and after about two hours, the time used for the visit, continue their tour, without stopping over. When in the afternoon the excavations close, Pompeii remains empty. Only 11% of visitors stop for longer. There is a stay of 0.8 days which corresponds to a half day wanting to exaggerate. The 20 million Euros of entrance tickets are nothing compared to what could be earned if the area around the excavations around the area was invested in.
Creating a link between the archaeological site of Pompeii and the Creative Industry could be the solution to an obvious problem. The activity of museum merchandising, in the wake of the international examples that are constantly being proposed, resulting in the opening of a bookshop, could be a source of positive effects for the region and, above all, for the enhancement of the UNESCO archaeological site of the excavations of Pompeii. The aims of museum merchandising is to promote museums and works of art.
The main goal is to reproduce and sell cultural objects. Promote the culture and the image of the excavations through the objects, with the purpose of transforming them from simple consumer goods into communication elements, introducing the concept of "cultural memory"; an object, that express culture, a piece of history of places visited, which attracts several tourists united by a general interest in Pompeii, each of them is also looking for a unique and special experience and is interested by different aspects of culture of this place.
Walter Santagata, in White Paper on Creativity [16], considered how cultural tourism is profoundly changing into the "creative tourism": tourism consuming experience, which has its temporal focus not only on the past but also on the present and on the future, it affects not only the "high culture" but also to the popular and mass fashion, design and architecture. The products and services that provide creative industry, in support of the tourism experience culture, are very important from an economic point of view if we consider the traditionally high spending power of cultural tourists compared to other categories of tourists.
In line with the thought of Santagata, some designers are dedicating this year to transform the traditional and obsolete style that characterizes the classic souvenirs into a creative and irreverent object-of-memory, a new way of thinking about the merchandising of the museums. In view of EXPO 2015, 9 designers have created a collection of objects for the exhibition "Local Icons, Greetings from Rome" to be held in Rome. The objects designed, inspired by Roman icons, such as the St. Peter's dome and the Pantheon, are both a symbol of the culture of our country and a symbol of the high quality Italian manufacturing; but also represent a tool to communicate to all the Italian design.
On the theme of Expo 2015,Beylerian George, founder of Design Memorabilia and promoter of Made in Italy and Italian design in the United States, has made the collection "De Gustibus": 32 Italian editions of historical pieces that tell our country in the world, will be on sale at the museum shop of the Triennale Design Museum in Milan [17] .
These two examples show how Italian design is able to transform kitsch objects [18] into useful and high quality products. It’s possible to do this process of review of the items of merchandise also in the Campania region, where there are a lot of fairly consistent companies from the point of view of the creative industries, which include crafts, industrial design, fashion and creative activities; both for the field of cultural heritage.
By granting to private parties to start merchandising activities, it is possible to create bookshops capable of attract the attention of tourists as well as arousing emotions and memories across an experiential and emotional design of objects, so as to meet the consumer expectations, making its participation active. The relationship between culture and creativity can represents a binomial efficacy for the economic development both at local and national levels.

4. Conclusions

The scarcity of public resources for the cultural institutions, further aggravated by recent cuts, calls for greater attention to *additional services*. A more effective and efficient management could produce revenues not only for the private subject but, above all, for the administrations, considering that from an increment of the revenues, greater opportunities for the conservation of the cultural heritage derive, while also providing a

more balanced allocation of the resources. The next calls for bids for additional services in the museums should be orientated in this direction, as part of an overall ongoing reform aimed to reinforce the attractiveness of Italian cultural institutions.
Independently from the emerged criticality, the potentiality of Italian cultural heritage must be enhanced, especially in a perspective of a new productive model where private subjects and institutions are able, synergistically, to valorise the context in which they operate. In particular, *merchandising* may became an exceptional generator of stimulus for the *Creative Industries*, localized in territories with an extraordinary Cultural Heritage, as in the Campania Region, where the case of the archeological site of Pompeii constitutes, with its paradoxes, a meaningful metaphor of the Italian cultural policy.

Bibliographical References

[1] Council of Europe/ERICarts, "Compendium of Cultural Policies and Trends in Europe", 15th edition" 2014, http://www.culturalpolicies.net

[2] MiBACT, *Culture in Italy basic Figures*, Gangemi Editore, 2014

[3] Aspen Institute Italia, *Italian Museums*, 2012

[4] Forte Fabiana, *Heritage in Campania Region: a lever for cultural and creative economy*, in: Le Vie dei Mercanti S.A.V.E. Heritage, Atti del 9° forum internazionale di studi. Aversa-Capri, 9-10-11 giugno, Napoli:La Scuola di Pitagora, 2011

[5] FREY Bruno S. and MEIER Stephan, *The Economics of Museums*, in Handbook of the Economics of Art and Culture, vol.1, edited by Ginsburgh V.A. and Trosby D., Elsevier, 2006

[6] SASSEN Saskia, *The Global City, New York, London, Tokyo*, A Princeton University Press, Princeton, New Jersey, 1991

[7] The Art NewsPaper, Special Report, spring/summer 2014, http://www.theartnewspaper.com

[8] The Economist, *Vatican Museums. Full to bursting*, Mar 14th 2015, http://www.economist.com

[9] BAIA CURIONI Stefano, FORTI Laura, *Note sull'esperienza delle concessioni per la gestione del patrimonio culturale in Italia*, Aedon, Rivista di Arti e diritto on line, Il Mulino, n. 3, 2009, http://www.aedon.mulino.it

[10] Intesa San Paolo, *La gestione del patrimonio artistico e culturale in Italia: la relazione fra tutela e valorizzazione*, 2011

[11] Unione Industriali- Camera di Commercio di Napoli, *Ridare vita a Pompei: un progetto di sviluppo sostenibile per l'area vesuviana*, 2012

[12] www.statistica.beniculturali.it

[13] www.unesco.beniculturali.it

[14] http://www.britishmuseum.org/whats_on/past_exhibitions/2013/pompeii_and_herculaneum.aspx

[15] Rai1, *Petrolio, Caccia al tesoro - Operazione Grande Bellezza*, 25 agosto 2014

[16] SANTAGATA Walter, *Il libro bianco sulla creatività. Per un modello italiano di sviluppo*, Milano, Università Bocconi Editore, 2007

[17] NANI Silvia, *Pop, irriverenti, soprattutto creativi. I nuovi souvenir raccontano l'Italia* in Corriere della Sera, 14 maggio 2015, pp. 32-33

[18] DORFLES Gillo, *Il Kitsch. Antologia del cattivo gusto*, Mazzotta, 1968

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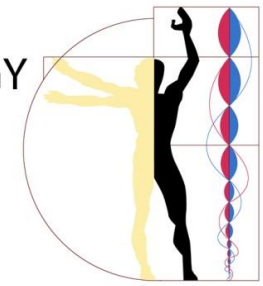

Sponsorship in the enhancement of Cultural Heritage and the role of Creative Industry: some evaluative aspects[1]

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Abstract
Enhancement of the Cultural Heritage, as set out in the Italian Code of the Cultural and Landscape Heritage (Legislative Decree no. 42/2004), consists in the exercise of the functions and regulation of the activities aimed at promoting *knowledge* of the cultural heritage as well as ensuring the best conditions for the use and public *enjoyment* of the heritage; a private subject may concur, co-operate or participate in such activities (art. 6). In this framework, *sponsorship* of cultural property concerns any forms of contribution in goods or services on the part of private subjects in the field of protection and enhancement of the cultural heritage, with the aim of promoting the name, brand, image, activity or product of the aforesaid subjects (article 120). Considering recent experiences in which important Italian brands of the Creative Industry – specifically the Fashion Industry – have sponsored the restoration of several worldwide-known monuments, this article wants to analyze some aspects in the *evaluation* of reciprocal advantages: for the public administration and communities -the "social surplus value"- and for the economic operator - promotional advantages in approaching the company image to the cultural heritage.
The article is organized as follows: Section 1 will offer a concise overview of the sponsorship contract as introduced by the Italian Code among the different form of management of the Cultural Heritage in the perspective of its enhancement; Section 2 will address the reasons why the Creative Industries choose to invest in culture through the sponsorship mechanism. Then, Section 2.1, analysing the evaluative aspects in the reciprocal advantages of sponsorship, highlights some critical aspects, exploring, in Section 3, a case study. The paper ends with some concluding remarks.

Keywords: Cultural Heritage, enhancement, sponsorship, Creative Industry, evaluation

1. Introduction
In Italy, the *enhancement* of Cultural Heritage is a very topical and vexed issue for the widespread awareness that this concept (related with that of *valorization*: "increase in value") nowadays refers not only to the cultural dimension and promotion of knowledge, but also to the economic dimension, in terms of impacts on employment, increasing of entrepreneurial activities, territorial regeneration and development [1].
Intending Heritage in economic terms – as an asset that can produce richness – it is possible to understand Cultural Heritage as the set of assets which for particular historic, cultural and aesthetic relevance are of public interest and constitute the richness of a territory and its community.
As several studies and reports in the field of Cultural Economics have highlighted, the traditional approach that considered heritage as "immutable" (not renewable and not replaceable because inherited from the past), has been overcome by an approach that recognizes its *vitality*, or productivity [2]. In this perspective, it should be interpreted the different forms of *management* of cultural property undertaken by private

[1] The article take the cue from the degree thesis in Fashion Design by Manuela Rupe (a.y. 203/2014); Fabiana Forte wrote Paragraphs 1, 2 and 2.1; Manuela Rupe, Paragraph 3. The Conclusions were prepared by both Authors.

initiatives introduced by the Italian Code of the Cultural and Landscape Heritage (Legislative Decree no. 42/2004, art. 115) and aimed at the *enhancement* of Cultural Heritage.
One of these forms is the *Sponsorship* of Cultural Property. From a general point of view, *Sponsorship* is a mutually acceptable commercial relationship between two or more parties in which one party - the *sponsor* - acting in the course of a business, trade, profession, or calling, seeks to promote an image, product or service, in association with an individual, event, happening, property or object - the *sponsee* - [3].
Specifically, in the field of enhancement of Cultural Heritage, "Sponsorship of Cultural Property" (as in art.120 of the Code), concerns any form of contribution in goods or services on the part of private subjects to the planning or carrying out of initiatives of the Ministry, the Regions and other territorial government bodies, or of *private subjects*, in the field of protection and enhancement of the cultural heritage, with the aim of promoting the name, brand, image, activity or the product of the aforesaid subjects.
The involvement of *private subjects* in the enhancement of cultural heritage has become a relevant question, that depends on several factors: the progressive evolution - also normative - in the public-private relationship, the awareness of the enterprises of the *value* of the culture in reinforcing their brands and, above all, the scarcity of public resources in preserving the Cultural Heritage. With specific reference to this last consideration, the data are clear: the public resources destined to the culture now represent only 0,20% of the Public Administration budget (with it being 0,35% in 2002).
As reported in Table 1, the budget of the MiBACT (*Ministero per i beni e le attività culturali e il Turismo*), with the economic-financial crisis, has progressively decreased from 2.037 billion of Euros in 2008 to 1.595 billion of Euros in 2014. It represents only 0,19% of the state budget and 0,10% of the GDP, with it not being a case that Italy, among the European Union state members, is one of the states which spends less on culture [4], despite its extraordinary heritage.

Year	MIBACT Budget	% State Budget	%GDP
2008	2,037,446,020	0,28%	0,13%
2009	1,718,595,000	0,23%	0,11%
2010	1,710,407,803	0,21%	0,11%
2011	1,425,036,650	0,19%	0,11%
2012	1,687,429,482	0,22%	0,11%
2013	1,546,779,172	0,20%	0,10%
2014	1,595,345,278	0,19%	-

Tab. 1: MiBACT budget [5]

Generally, sponsorship involves a relationship exchange between two entities, which often have different agendas and purposes [6]. In cultural sponsorship, the public sector - the *sponsee* – at central or local level (in all its representations), owner of a consistent part of the Italian Cultural Heritage and responsible of its conservation and fruition, is the subject with whom the company interacts through a *contract*.
Decree n. 5 of December 2012 by Minister of Cultural Heritage, specifying all technical and procedural aspects of the sponsorship contract, identify its main characteristics: it is an atypical, onerous and reciprocal agreement. Its *atypicalness* depends on its characteristics that make it not peaceable in any typical contractual typologies also if, with the normative evolution, the public administration has acquired full contractual autonomy; the agreement is *onerous* because it attributes the sponsor an economically remarkable utility, consisting of the advantages deriving from the promotion of its image that indirectly is designed to produce revenues, also purely monetary [7].
The agreement is *reciprocal* because, on one side, the sponsee is obliged to consent the promotion of the name and image of the sponsor and, while on the other, the sponsor has an obligation, either in monetary terms or in the realization of interventions or in the furniture of goods or services.
Furthermore, the Ministerial Decree, providing the ways of sponsorship contracting, includes three forms: "technical", when the sponsor provides not only to finance but also to design and realize the intervention; "pure" when the commitment of the sponsor is only in the financing the intervention, without any operative role and "mixed" form, when the sponsor finances all the interventions but executes only a part.
The procedure for selecting the sponsor is more complex than a traditional public tender of works or services because the *value* of the tender notice has to take into account the advantage for the image deriving from the operation. This represents a problematic aspect from an evaluative point of view, which still today has attracted little academic interest.
It is clear that the determination of the value of the tender notice should not be exclusively driven by the value of the works or services necessary to the public administration but it should be determined also and, above all, on the basis of the effective value of the advertising income that the same administration is able to offer to the sponsor. This is not an easy operation, because the assessment of the value of the rights and the

benefits of visibility for the sponsor, is, to some extent, disengaged from objective and measurable elements, being based on elements not always clear and definite, such as the so called “intangibles”.
Considering some recent experiences in which important Italian brands of the Creative Industry - specifically the fashion industry – have sponsored the restoration of several worldwide-known monuments, this article wants analyze some aspects in the evaluation of the reciprocal advantages: for the public administration and communities - the “social surplus value”- and for the economic operator - promotional advantages in approaching the company image to the cultural heritage.

2. Cultural sponsorship and Creative Industries

It is known that one of the strategic levers in the marketing mix, known as the 5Ps [8] is *Promotion*, that makes use of several communication activities that allow for the presentation of the product or the brand to the market; one of this is the *sponsorship* which has grown remarkably in recent years also in Italy. There, as in other developed societies, an increase in the demand of cultural products and services from society, corresponding to an evolution in the business culture, where the need of the company is to improve its relationship with society.
In other words, in the business world, culture is viewed as an important asset of the communication strategy because with culture, companies can concretely affirm their presence and social role on the territory. More than a financing, culture is perceived as an *investment,* with a return on the internal and external environment integrated with the social and cultural development for a more aware and responsible economy; inside the relationship culture-enterprise-territory is possible identify a multiplicity of values: economic, ethic, aesthetic and educational value [9].
According to the research of Civita Association “The value of Culture” [10], about 48% of Italian companies, collected as a sample, have invested in the cultural sector in the last three years and the measure of the investment increases with the company dimension (in terms of employees). Some of the main reasons that encourage the company to intervene in the sector are connected to: a) the need of brand awareness; b) to increase the public relations; c) to improve reputation.
The sponsorship mechanism is adopted prevalently by many companies and the most active are those operating in the sectors related to “material culture”, known as the Creative Industries, that together with the Cultural Industries [11], represent “the most advanced frontier of contemporary economic development” [12].
In this perspective, following the methodological approach adopted by Italian Ministry of Cultural Heritage, a first comparative evaluation of the performances of the Cultural and Creative Industries (CCI) in the Campania Region has been presented at the IX International Forum Le Vie dei Mercanti [13].
Specifically in the sector of Fashion Industry, that, notwithstanding the recession, remains one of the most driving in the Italian productive system, several luxury companies have decided to invest in culture through the sponsorship mechanism for several reasons. Fist of all because fashion industries contain all those productive activities in which culture becomes a “creative” input in the production of goods or services with a high surplus value; their competitive advantage is played on the capacity in associating to the product, symbolic and evocative universes able to communicate a value system.
Culture acquires a central role in the strategic research of new languages and not conventional communication channels; furthermore, in the Fashion Industry, the brand assumes more relevance in the consumer perception. Some well-known cases in which important Italian brands of the Creative Industry have sponsored the restoration of several worldwide-known monuments, will be illustrated in paragraph 3.

2.1 Evaluation of the reciprocal advantages: a critical area

There is no doubt that the sponsorship mechanism in the field of Cultural Heritage could entail several reciprocal advantages, but the complexity of the *evaluation* in terms of communication effectiveness and economic efficiency still represent a critical area, as in many studies. The work of Cornwell and Maignan [14], also if dated, constitutes one of the most extensive on an international level, presenting a critical review of international research conducted on sponsorship with a useful theoretical frameworks. The study identifies five research streams: nature of sponsorship, managerial aspects, measurement of sponsorship effects, strategic use of sponsorship and legal and ethical considerations.
Regarding the measurement of sponsorship effects, the main methods are analyzed, as the *exposure-based methods* (monitoring the quantity and nature of the media coverage and estimating direct and indirect audiences) and the *tracking measures* (based on consumer surveys to evaluate the awareness, familiarity and preferences engendered by sponsorships). However, the authors, highlighting the inconsistent findings yielded by the studies of sponsorship effectiveness suggest that «a central objective of future research on sponsorship will certainly be to measure its effects.»
In Italy, this field of research is still poorly investigated and not systematized by practitioners as well as by academics. While the motivations for the public sector in stipulating the sponsorship contract seem to be easy to identify, as well as the advantages or benefits, it seems to be more complex to understand the motivations of private subjects, above all in terms of evaluation of effectiveness [15].

On the side of public sector – the *sponsee* - the benefits in the sponsorship equation are clear; costs of restoration and maintenance of the monuments are ever increasing and sponsorship represents an efficient tool in collecting new and more consistent resources aimed at the *conservation* of Cultural Heritage.
As well developed by the Neapolitan School of Monument [16], the restoration is a "productive" activity carried out for social use, that can provide the patrimony of cultural goods with a "*social plus value*". It represents, obviously, the economic gain and social benefit yielded by conservation, which – as it gets a greater value - may be also said "enhancement" (as in the Italian Code). The approach to Economic Conservation by the Neapolitan School has identified several values for the historical and cultural heritage, thus, further refining the study of components and different categories of users. On the basis of the different values (use and non use value), several evaluation methods have been put forward: some of them refer to the *'willingness to pay*' concept (under both the conditions of existence or not of a market); others refer to the single attributes of the asset [17]. Whatever the case, in the field of evaluation of cultural heritage, several methodologies able to consider the qualitative characteristics, the externalities and intangibles have been developed.
On the side of private subjects - the sponsor - what are the reasons in embarking upon a sponsorship agreement? What do they gain in return of their disbursements? [18] .
As emerges in several international studies, the research undertaken in order to evaluate sponsorship effectiveness is insufficient; the intangible nature of sponsorship makes extremely difficult to prove its contribution to the firms' development and, especially in Italy, the economic analysis of sponsorships has not accompanied their effective growth. In accordance with Bucci *et al*. [19], current literature has still not connected the different aspects which characterize this kind of expense and financing: in the field of Marketing, the attention is on the managerial aspects, on the overall communication strategy of the sponsor and the evaluation of the effects; in the field of Cultural Economics, the interest is towards the sponsorship as source of financing for cultural heritage.
In order to evaluate an investment in cultural sponsorship, it is necessary to analyze its efficacy, first of all, in terms of achievement of the initial goals, clearly identified, ranked and weighted, also through the support of Multiple Criteria Analysis. Considering that cultural sponsors tend to seek *image* rather than market objectives, with an emphasis on relationship-enhancing with the wider community, to evaluate an investment in cultural sponsorship it is necessary to analyze its efficacy not as much as in terms of sales/market share, rarely appropriate [20], but in terms of enhancing the corporate image of the company to society, increasing awareness in specific target markets. In this case the evaluation is based on the assessment of the amount of exposure generated by a sponsorship activities (exposure methods) but several limitations have been recognized in current literature.
For the analysis of efficacy of the cultural sponsorship regarding the economic dimension of the investment – the economic efficiency – it is necessary to consider the classical financial performance measure, the ROI (return on investment), estimated in a precise period (as in the case analyzed in section 3); new parameters able to also identify territorial, social and cultural impacts have been suggested by several authors [21].
Finally, from a purely fiscal point of view, it is important to highlight that the legislator, with the aim of intercepting private resources, has identified in the tax benefits for the sponsor an efficacy tool, which can constitute a "tangible" advantage in the sponsorship activity. In fact, since the expenditures sustained for the sponsorship are part of that for publicity and promotion, they are fully deducible in the exercise in which the cost has been sustained (20% of expenditures for each considered exercise); regarding VAT (Value Added Tax) the sponsorship expenditures serve the ordinary rate of 21% and it is fully deductible.

3. Case study

The well-known case of the Tod's group has been characterized by using, in addition to traditional ones, other tools in promoting its own brand identity. The sponsorship agreement signed between the Ministry of Cultural Heritage, the City of Rome and the Tod's group dates back to 21 January 2011, so as to finance the restoration works of the Flavio amphitheatre. This initiative aroused no little clamour and divisions between those who interpreted the gesture as a thank you to Italy and those who still believe in the constitutional function of the cultural heritage, that is in its otherness than the market [22].
As reported by the newsweekly "Panorama" [23] when the contract was signed, «…Della Valle has effectively put under contract the Coliseum, as a testimonial to his companies». Not only benevolent patronage then, but marketing in its purest form. Associating the name of his company, which bases its identity on the main principles of *Made in Italy* and becomes its ambassador, to that of the Italian monument par excellence, visited by six million people a year, allowing the company to have an important advantage in terms of image. In the mind of a hypothetical visitor to the Coliseum, Tod's is the guarantor of preservation of one of the most important Italian monuments in the world. The logical consequence, moving from mental associations at the time of purchase of an Italian product, it is undoubtedly the choice of a Tod's product.
It's interesting analyse the terms of the sponsorship agreement. The registration of the sponsorship contract concluded between the commissioner, the Superintendence for Archaeological Heritage of Rome and the

Tod's group, dates back to 20 June 2011. The comprehensive contribution made available by the group, Tod's SpA, for the restoration of the area of the Flavio amphitheatre, was € 25 million (inclusive of VAT and any other tax provisions), allocated as in Figure 1.

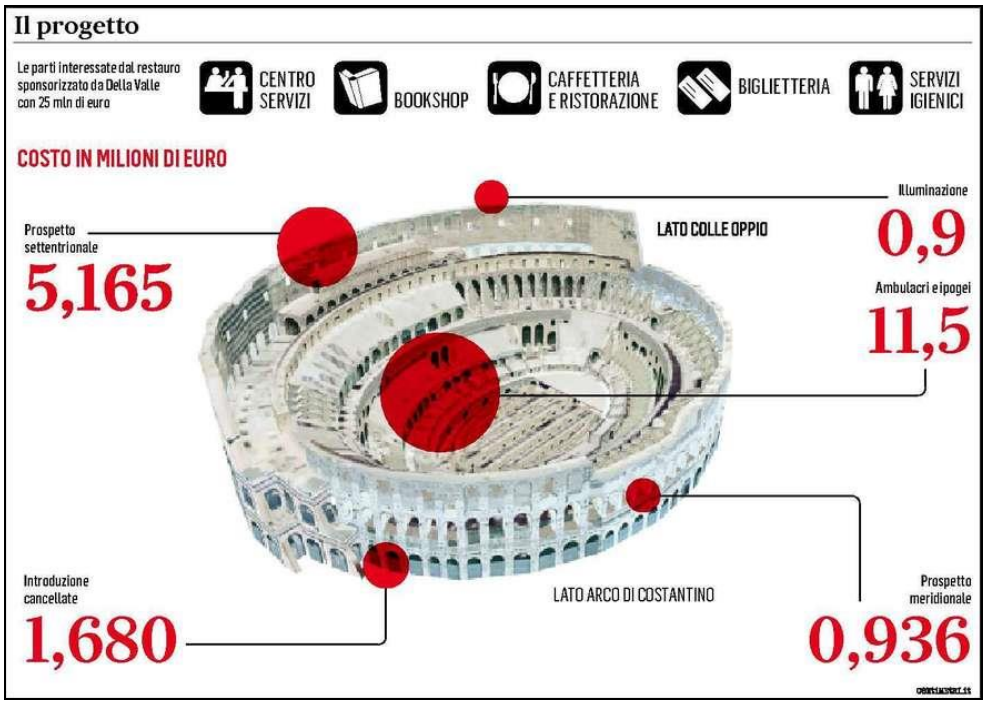

Fig. 1: Coliseum, the project and the allocation of resources (source: Il Messaggero.it)

Against the financing, the sponsor will be entitled:
- free access to the Coliseum for some groups of people;
- to use the diction "Exclusive Sponsor for the restoration of the Coliseum according to the Plan of Interventions", as well as the brand and other distinctive of the Association combined with those of Tod's to present in Italy and abroad the project, the role of the Sponsor and its institutional activity;
- to use the brand and other distinctive signs of the Association on its letterhead and institutional materials, including the website ;
- to include its brand on the back of the Coliseum tickets;
- to include its brand on the fence of the yard (in forms compatible with the feature and the decorum of the Coliseum);
- to publicize the disbursement of its contribution for the restoration of the Coliseum;
- to use the material and documentation realized by the Association also through the projection of images within its own spaces or website [24].

Regarding the communication plan, the activities concerning this area can be made by the sponsor directly or through the establishment of a non -profit organization. The Tod's group constituted an association, *Amici del Colosseo*, which is open to all those who wish to support the work of restoration of the Coliseum or other major initiatives related to national and international archaeological and historical-artistic heritage.
To the association is granted:
- the right, exclusively, to use a logo representing the Coliseum (adjustable both in Italy and abroad);
- to manage exclusively the communication activities related to the interventions, events, conventions, meetings, press conferences, information campaign;
- to organize a plan of visits in favour of the elderly, the disabled, with reduced economic capabilities, students, workers, etc .;
- to create a temporary or fixed structure, directly or through the sponsor, for the reception of association supporters, which is located near the Coliseum. It has been set up for the duration of the restoration and the subsequent two years, and can benefit of the hallmarks of the sponsor;
- to conclude agreements and conventions with associations, foundations, research institutes, universities, or other institutions or public and private entities that pursue and/or share for its own institutional purposes, similar objectives to those of the association;
- to organize photo shoot and filming campaigns out and inside the Coliseum [25].

The rights mentioned, are granted, both for the sponsor (Tod's) as well as the association (*Amici del Colosseo*) without territorial restrictions. Regarding their durability, while the rights granted to the association

have a term of fifteen years which may be extended by special agreement, those granted to the Tod's group continue for the duration of the interventions and the subsequent two years [26].
The Tod's group has invested in the sponsorship operation for the restoration of the monument symbol of Italy € 25 million, but on a purely economic level, what does the brand obtains?
As mentioned above, the economic gain of the sponsor goes through the return of image, that certainly was the case, since the Coliseum is one of the most visited monument in the world, and that the newspapers and media have spoken (for better or worse) of the "marriage" between public and private. To check the possible economic advantage obtained from Tod's group, the return of image, the corporate balances and income statements before and after the sponsorship contract should be evaluated.
A first and summary evaluation concerns the performances of financial indicators (see Table 2); analyzing the balance of Tod's it is possible to state that from 2011, the year in which it was entered into the contract, to date, the company balance sheets have grown for all the financial indicators, with only a slight decrease in 2013, presumably due to the economic crisis that hit Italy.
Despite obvious subsequent increases due to the publicity of the sponsorship agreement, it is not possible to estimate an amount or precise percentage to be attributed to the advantage of the return of image data from the sponsorship, although this has occurred.

Euro	2014	2013	2012	2011	2010	2009
Total Revenue	976.008	983.120	985.192	909.632	806.358	728.589
EBITDA	193.547	236.317	250.167	232.417	193.059	158.653
EBIT	148.179	193.155	208.837	194.630	159.944	126.448
Net Income	97.114	133.780	146.461	134.997	109.076	85.668
Intangible assets	-	196.340	198.440	202.005	189.083	191.460
ROE	-	16,82%	19,18%	19,76%	17,30%	13,20%
ROI	-	31,15%	31,63%	33,67%	30,02%	26,40%

Table 2: Income Statement (source: data Tod's processing)

The Tod's group is not the only one which have started a sponsorship contract for the enhancement of Cultural Heritage; other famous brands of Fashion Industry have followed.
On 21 March 2014, the Mayor of Roma Capitale, has presented at the Campidoglio, the project "Bulgari's jewels for Rome" with which the Bulgari brand, for the anniversary of 130 years of business, donated € 1.5 million to the Local Authority to finance the restoration of another symbol of Rome: the "Scalinata Trinità dei Monti" in Piazza di Spagna. The intervention also coincides with the reopening, in Via Condotti, of the headquarters of Bulgari.
In 2013 Fendi wrote a new chapter of its extraordinary story, further cementing its relationship with Rome. *Fendi for Fountains* is an ambitious project to revive the former glory of the most important fountains of Rome: the famous Trevi Fountain (Figure 2) and the complex of the Quattro Fontane. A tribute by Fendi to Italian beauty, art, history and culture (€ 2.180 donated, as part of a larger project on the city of Rome, that has seen a further € 320,000 for the Quattro Fontane).
Finally in May 2013 Renzo Rosso, President of the OTB Group (the holding company that controls the brands: Diesel, Maison Martin Margiela, Marni, Viktor&Rolf and Staff International) signed a sponsorship contract, investing € 5 million for the project of restauration of the Rialto Bridge (Figure 3), one of the symbol of the city of Venice.



Fig. 2: Trevi Fountain in Rome



Fig. 3: Rialto Bridge in Venice (source: Pattaro/Vision)

4. Conclusions

Sponsorship in the enhancement of Cultural Heritage can play a strategic role in creating synergies and sharing of actions between public and private subjects, especially in this economic conjuncture, where the public resources are inadequate to guarantee sufficient levels of interventions in the cultural sector.
In this perspective, sponsorship could represent the way forward in the maintenance and restoration of the Archeological Site of Pompeii, considering that the sector of Creative Industry in the Campania Region is consistent, especially in the provinces of Naples, where there is sartorial excellence (such as the Kiton brand among others).
Whatever the case, the research undertaken in order to *evaluate* sponsorship effectiveness is still insufficient; the intangible nature of sponsorship makes extremely difficult to prove its contribution to the firms' development and, especially in Italy, the economic analysis of sponsorship mechanism has not accompanied its effective growth. The recent experiences in which important Italian brands of the Creative Industry have sponsored the restoration of several worldwide-known monuments could represent a useful occasion for testing more efficacy and rigorous evaluation methodologies and techniques.

Bibliographical References

[1] Ragni, Maddalena*, La valorizzazione del patrimonio culturale nel Codice dei Beni Culturali e del Paesaggio. Gestione dei servizi per il pubblico: sostenibilità, integrazione nel territorio, prospettive*, www.beniculturali.it, 2011.

[2] GREFFE, Xavier*. The economic Value of Heritage.* Colloquio di Ahmedabad, National Trust of India. 1998.

[3] ROSSOTTO, Riccardo, *Contratti di sponsorizzazione: opportunità giuridiche*, in Aedon, n.1, il Mulino, 2010.

[4] ISTAT-CNEL, *Il benessere equo e sostenibile in Italia*, ISTAT, 2014.

[5] MiBACT, *Culture in Italy basic Figures*, Gangemi Editore, 2014

[6] THOMPSON Beverley J., *Sponsorship as a Form of Fundraising in the Arts: A Bilateral Perspective Involving Relationship Marketing*, Lecturer, School of Marketing and International Business, University of Western Sydney, Sydney, Australia. 2002.

[7] Edilizia e Territorio, *Cantieri con sponsor*, Dossier on line, n.5 aprile 2013, Il sole 24 ore, Milano.

[8] KOTLER Neil G., KOTLER Philip, KOTLER Wendy I., *Museum Marketing and strategy*, Jossey Bass, California, 2008.

[9] CANTONI Valeria, *Impresa e Cultura: insieme conviene*, L'IMPRESA n.1/2009.

[10] Associazione Civita, Astarea, The round Table, Unicab, *Impresa, Cultura, Comunicazione, Il valore della Cultura, ricerca sugli investimenti delle imprese italiane in cultura*, relazione di sintesi, febbraio 2010, http://www.beniculturali.it.

[11] SANTAGATA Walter, *Il libro bianco sulla creatività. Per un modello italiano di sviluppo*, Milano, Università Bocconi Editore, 2007.

[12] AA.VV., *Il sistema delle industrie culturali e creative in Lombardia: elementi per un nuovo modello di competitività territoriale*, Regione Lombardia, IULM, maggio 2011, http://www.cultura.regione.lombardia.it.

[13] FORTE Fabiana, *Heritage in Campania Region: a lever for cultural and creative economy*, in: Le Vie dei Mercanti S.A.V.E. Heritage, Atti del 9° forum internazionale di studi. Aversa-Capri, 9-10-11 giugno, Napoli:La Scuola di Pitagora, 2011.

[14] CORNWELL T.Bettina and MAIGNAN Isabelle, *An International Review of Sponsorship Research*, in Journal of Advertising, 27:1, 1-21, 1998.

[15] PHAM Michel Tuan, *The evaluation of sponsorship effectiveness: a model and some methodological considerations*, Gestion 2000- 4- 1991, http://www.columbia.edu.

[16] AA.VV., *Economic and Financial Aspects of the Conservation of Monuments and Historic City Centres*, Icomos-Fondazione Carlo Forte, in RESTASURO 65-66-67/1983, ESI, Napoli, 1983.

[17] FORTE Fabiana, FUSCO GIRARD Luigi, *Creativity and new architectural assets: the complex value of beauty*, in International Journal on Sustainable Development, Vol. 12, Nos. 2/3/4. pp.160-191, 2009.

[18] QUESTER, Pascale G. and THOMPSON Beverley J. *Advertising and Promotion Leverage on Arts Sponsorship Effectiveness* in Journal of Advertising Research, Vol. 41, 2001.

[19] BUCCI Alberto., CASTELLANI Massimiliano, FIGINI Paolo, *L'investimento in sponsorizzazione delle imprese: un'analisi economica in termini statici e dinamici*, in Rivista di Politica Economica, maggio-giugno 2003, http://www2.dse.unibo.it.

[20] PHAM M.T., op.cit. p.47.

[21] DOMENICHINI Ginevra, *Le potenzialità della valutazione nel rapporto impresa-cultura: riflessioni sullo stato dell'arte in Italia*, Tafterjournal n. 43 - gennaio 2012.

[22] http://www.minimaetmoralia.it/wp/diego-della-valle-colosseo/.

[23] ROSSi Giampaolo, *Una scarpa Tod's sul Colosseo*, Panorama, 27 Gennaio 2011.

[24] Contratto *Sponsorizzazione per il finanziamento di lavori da realizzare nell'Anfiteatro Flavio - Colosseo, Roma*, 4.2 Diritti concessi allo sponsor.

[25] Contratto *Sponsorizzazione per il finanziamento di lavori da realizzare nell'Anfiteatro Flavio - Colosseo, Roma*, punto 4.1.

[26] Ivi., punto 4.3 Estensione e durata dei diritti concessi all'Associazione e allo Sponsor.

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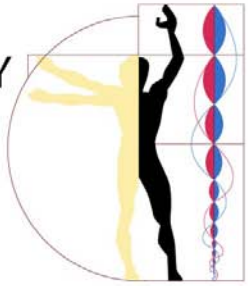

SIGNS OF POPULAR RELIGIOUSNESS IN THE SOUTHERN PIEDMONT TERRITOTY. THE DRAWING OF VOTIVE PILLARS

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Abstract
The cultural, architectural, landscape and environmental Italian Heritage is among the most varied in the World, it includes every tangible and intangible assets protectable according to the UNESCO's guidelines. Regardless of the type of asset, it is necessary a proper enhancement that increases the cultural offer, promoting the heritage knowledge through its communication and transmission.
This methodological approach guided this research dedicated to the critical analysis of votive pillars, which are present which are present in large numbers through the Piedmont. The votive pillars are small buildings erected along the roadside to mark the paths of access to Catholic sanctuaries or to commemorate religious events related to local religiosity. They are small buildings of various architectural type, size and constructive chronology. Their cultural backgrounds is confirmed already in the classical age: the Greeks venerated the stone herms located at the crossroads; the Romans built funeral shrines very similar to these along the main roads.
The research, which has reached the first stephas identified the existing pillars on the territory of the municipality of Carrù and analyzed them from the standpoint of historical and architectural. The cataloging made them cataloged through a critical inventory which highlighted some aspects - the shape, size, construction features, materials used - then comparing the most significant data and summarizing them in graphics.
Through the study of these architectures considered minor I wanted to focus on a cultural heritage that is part of our territory and the urban and rural environment, and that has always been an expression of art and popular culture.

Keywords: votive pillars, design and critical analysis, rural landscape.

The cultural, architectural, landscape and environmental Italian Heritage is among the most varied in the World, it includes every tangible and intangible assets protectable according to the UNESCO's guidelines. Regardless of the type of asset, it is necessary a proper enhancement that increases the cultural offer, promoting the heritage knowledge through its communication and transmission.
This methodological approach guided this research dedicated to the critical analysis of votive pillars, which are present which are present in large numbers through the Piedmont. Besides the "official" religious buildings, which arose on the initiative or under the auspices of the Church – m as oratories belonging to the brotherhoods – is present in a widespread manner, on the whole territory object of study, a considerable number of small building. These are chapels, pylons and votive niches, rural crosses, wall paintings of religious subjects, made by individual households or small communities (residents of a township, owners of adjoining land ...).
In these notes I want to illustrate some preliminary considerations of research, still in progress, conducted in the municipality of Carrù, during which I'm cataloging the votive pillars identified in the territory. The votive pillars are small buildings erected along the roadside to mark the paths of access to Catholic sanctuaries or to commemorate religious events related to local religiosity. Their cultural backgrounds is confirmed already

in the classical age: the Greeks venerated the stone herms located at the crossroads; the Romans built funeral shrines very similar to these along the main roads.
Without a codified terminology I used the term normally used in Piedmont, also reported from the vocabulary Treccani: *"**pillar**: small building in brick or stone, erected along the roadside, to commemorate special events, or devotion, frequently provided with niches in which are placed statues or votive offerings."*
In the search area - a hilly area of southern Piedmont in the south-west of the province of Cuneo - I found about thirty pillars and in this paper I refer in particular to their location, the construction feature and devotional aspects.



Fig. 1: Pillar-chapel at the intersection of Via Langhe and Strada Orià (left) and pillar attached to boundary wall (right).

1. Localization

The votive pillars, erected in many cases on the initiative farming families, are mainly located along the edges of country roads or intersections of roads or near crossroads. They are continuing at a irregular distance between them and they are placed along the country roads that lead to sanctuaries or small churches erected in the township of the municipal territory. Almost all the pillars, even if located at crossroads, have only one niche facing towards the main road, except one with a square plan that has a painted niche on each face.
The devotion to the cult of St. Anna led to the construction, in the north-west of the township, before a small church (late fourteenth century) and then of a sanctuary (early twentieth century). The different roads to this place of devotion are bordered by votive pillars, simply made with images linked to Santa and to the Virgin Mary. The same thing happens for Ronchi's Sanctuary erected on the site where the Virgin appeared; along the roads leading to the building there are votive pillars that refer to the Marian cult.

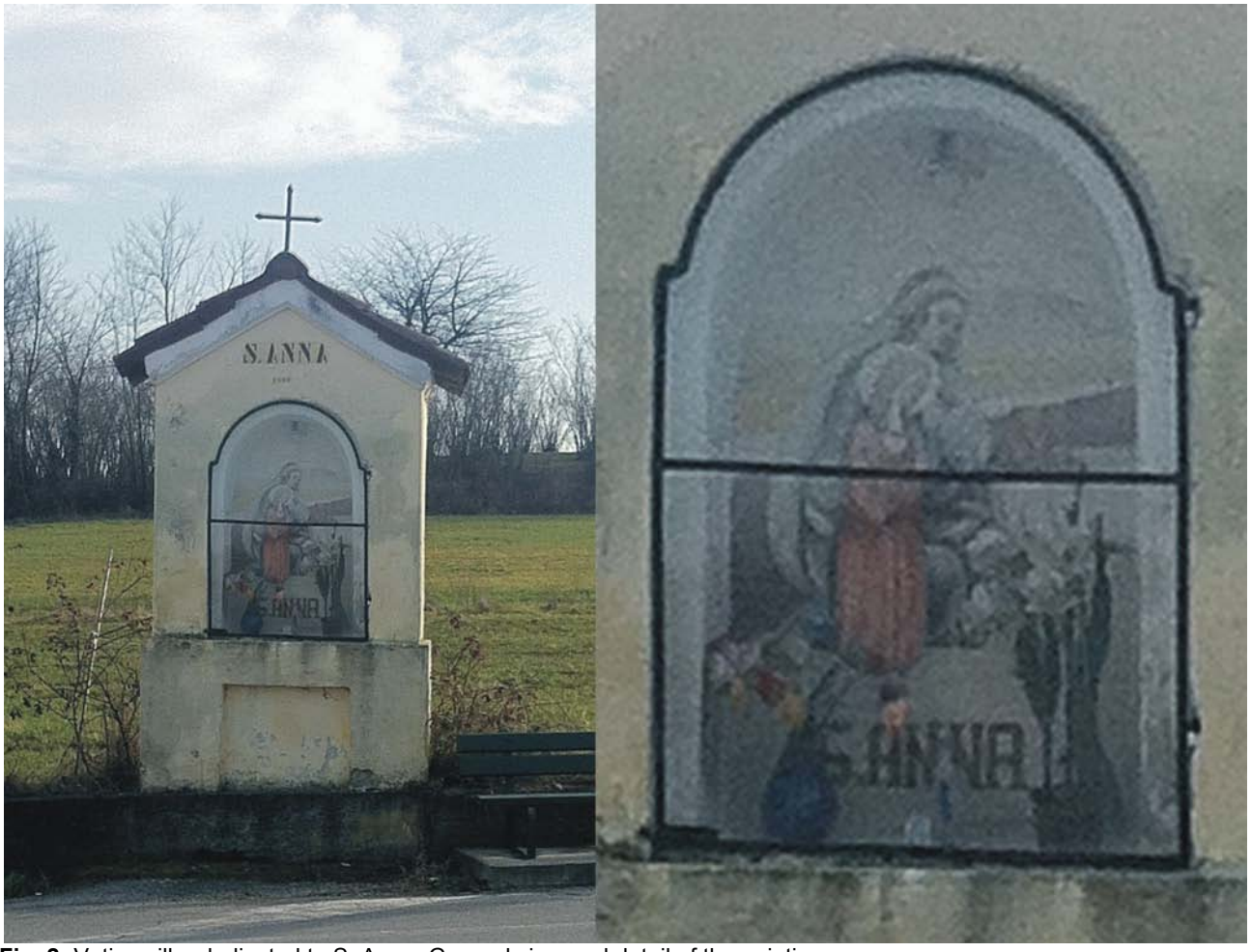

Fig. 2: Votive pillar dedicated to S. Anna. General view and detail of the painting.

2. Features architectural-constructive

In the area under consideration most of the pillars was built between the second half of the nineteenth century and the early fifties of the twentieth century.

The pillars have been realized, in the majority of cases, by masons of place or by local farmers, almost always without specific projects. The survey carried in the Historical Archive of the town of Carrù did not find drawings or requests for the realization of votive pillars.

As regards the architectural aspect, really because built without using specialized workers, the pillars are simply made and without special decorative elements. Their small size and the essential form are typical characteristics of these architectures, while the building largest and much decorated are very rare and do not represent the architectural style of the period and place (as the pillar located at the intersection of Strada Orià and Via Langhe).

Generally the pillars are to the form of elongated parallelepiped, with square or rectangular plan; the roof is gabled or, more rarely, hipped or flat or curved surfaces, and almost always has a cross made of iron, stone or concrete. The pediment frequently exceeds the volume of the pylon, to give greater height to the construction taking up constructive ways already present in the ancient ecclesiastical buildings. Between the pillars made with special shapes I remember a pillar with long rectangular base on Strada Trinità and the aforementioned pillar at the intersection between Strada Orià and Via Langhe. There are also examples of pillars with pilaster strips, friezes and pinnacles not made with quality materials, but with simple bricks, or concrete, then plastered and decorated.

In some cases, votive pillars are attacked or collected, in whole or in part, in boundary walls or facades of houses; they seem to be existed before the construction of the building and that have been maintained. In most of the cases the size of the pillars vary, in plan, between 1 and 2 meters in length and 50 cm to 1 m in depth; the height is between 2 and 3 meters. There are also examples of pillars with smaller size or much larger, like that already mentioned between Strada Orià and Via Langhe.

The pillars most ancient are built of brick masonry left exposed or simply plastered, plastered and painted the more recent ones. In none of the pillars analyzed has been used stone, not available on site. The roofing is almost always in brick tiles - tiles Piedmont - and in some cases concrete slabs.



Fig. 3: Votive pillars covered with plaster and painting

In the front of the pillar is made the niche at the height of about a meter from the road surface and with the top of barrel or semi-dome or, more rarely, flat; in some cases the opening is protected with a grating or a wooden window frame. Inside, directly on the wall of the niche, are depicted images of saints, made mostly with water colors, without glue. These paintings are today, with some exceptions, illegible or otherwise in very poor condition; some pillars have been renovated, repainted and in the niches were included paintings and statues of the Madonna. In the pillar located at the intersection of Via Langhe and road Oria the niche reaches the ground and there is a small altar with a closed access by a small iron gate.
In summary, in the area subject of the research, the pylons identified can be classified according to the following categories:

1. classic pillar rectangular in plan, with a niche on a front;
2. pillar of prismatic shape a square or triangular plan, with niches and paintings on all sides of the building;
3. pillar-chapel (sacellum), larger, a rectangular plan with small altar inside;
4. pillars attached or collected, in whole or in part, in the masonry of a building or a boundary wall.

In the research area the greatest number of pillars belongs to the classic type (65%), 25% to the type attached or collected, while the remaining 10% is divided between the remaining types (types 2 and 3).



Fig. 4: Votive pillars of classic type made of brick.



Fig. 5: Votive pillar with fence, dedicated to S. Anna.

3. Devotional aspects

The construction of the votive pillars was linked to the demand for protection for the family or harvest, or had function of votive offering for thanksgiving for a healing, or for the narrow escape from epidemics. In some cases the pillars were erected in place of disappeared churches, in other cases, churches were built in place of pilon where were important religious events occurred, as the Santuario dei Ronchi which retains the sacred image of the pillar next to which the Virgin appeared.



Fig. 6: Votive pillar elongated rectangular plan (left) and pillar square plan with niches and paintings on all four sides.

As regards the aspects devotional, Madonna in its various representations - Immaculate of Lourdes, the Graces, with the Child - is represented in most of the pillars; pillars dedicated to the Saints in most representations regarding St. Anne and St. John the Baptist.
On the pillars there is never an indication of who has built or painted, not even the date of construction; generally the sacred images are made by anonymous authors with simple stretches and soft colors. The subject of the paintings inspired by classical hagiography; technique is essential, without inventive liveliness or variety of shades. They are simple religious signs of ancient workmanship, too often categorized as cases of "minor art", but who can transmit an intense spirit expressive simply through color, images and posture.

4. Final considerations

The research presented here is still in progress; must complete the identification of the pillars in the municipal area, the cataloging, the architectural survey and graphic rendering of every building. I can, however, make some preliminary considerations which can be verified later in the study.
First I found the widespread dissemination of sacred buildings which create a grating sacred that binds most important religious buildings in the municipal area – the Sanctuary of Madonna dei Ronchi and Sanctuary of S. Anna del Bosco - churches and country chapels, a grating that winds through the different streets that lead to these sacred buildings.
The second element that emerges is the abandonment of many pillars; the few restoration works carried out have been conducted so unsuitable, not taking account of the original character of the building. Unfortunately, today there is no form of protection for this sacred heritage that is tangible evidence of popular religiosity.
Only through these studies it is possible to focus on a cultural heritage become part of the daily history of the people living these territories. These architectures, considered minor, have become reference marks, places where eye and brain have stored a meeting point that is valid personal and intimate. Learn and discover lets not forget, awaken interest on their origin and about deeper meaning of ancient devotions, try to save them before time and indifference to do quietly disappear.



Fig. 7: Votive pillar dedicated to S. Giovanni Battista. General view and detail of the painting.

Bibliographical References

[1] LAVAGNOLO, Giovanni, *Chiesette moderne: santuari, cappelle, altari, piloni votivi, oratori: Progetti originali, piante e prospetti,* Torino, 1960.

[2] ZAMPICININI, Franco, *Note sui piloni votivi nel basso Monferrato,* sta in *Studi Piemontesi*, Vol. 20, 1991, Fasc. 2, pagg. 423-428.

[3] CANAVESE, Rino, *Cappelle campestri e piloni votivi nel comune di Chiusa Pesio: segni di religiosità popolare tra cultura e tradizione,* Mondovì, 1993.

[4] AIMAR, Gianni, *Un segno lassù: piloni votivi e dipinti murali in alta valle Po,* Saluzzo, 2005.

[5] ASSOCIAZIONE IMPEGNO E PARTECIPAZIONE, (a cura di), *Piloni votivi: religiosità popolare del territorio bovesano,* 2007.

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Geldo's Castle Palace, at Castellón Province, Spain.

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Abstract

This castle palace, located in the small town of Geldo, in the province of Castellón, Spain, was built between the fourteenth and the fifteenth century and was declared as Cultural Heritage on 1985.
The palace belonged to different families: Valterra, Sorell, Folch de Cardona until the seventeenth century, when it was taken over by “Casa de Medinaceli”.
Since the nineteenth century the building has begun its decline, and was used as a bar, store, city hall, houses or clubs. In recent years have made some archaeological and restoration work
The building is squared-plant with three floors. It is distributed as typical Valencian gothic palaces, around a courtyard; it has also Gothic Portals, windows, vaults and polychrome wood coffered ceilings.
The aim of this work is to collaborate with the artistic projection of an architectural heritage which, in spite of being in a rural environment, has not just of a great artistic value, but also of historical, cultural and social one.

Keywords: Geldo, Gothic, Palace, Valencian Architecture.



Gothic window. Geldo's Castle Palace

1. Introduction

Jaume I, of Aragon, a Christian king, reconquered the kingdom of Valencia to Arabs. The Muslims were forced to leave the occupied territory, or to convert to Christianity. After the reconquest, the King donated villas, castles or places to knights and military religious orders who had helped him during the reconquest and remained other properties for himself. Thus, the owners and masters of the sites were knights, military religious orders or the king himself. In this territory were a lot of Moorish castles that had been built by Muslims to defend against Christian attacks. Some of these castles were preserved, others were reconstructed and adapted, and others were built new, to give shelter to the lords.

In the beginning, the architecture in Valencian Kingdom was a necessity architecture. Arab buildings were razed and mosques purified or re-Christianized; other civic buildings such as houses or Arab baths continued being used. But soon, Christians started to construct buildings of its own style. The first need was to build new Christian churches. The first temples were built with a diaphragms arch based structure supporting the sloping wooden roof. This model had been a valid solution during more than fifty years in the lands of Tarragona, Lleida and Huesca. It was simply the application of the construction system that religious and civil communities had been used and whose operation had proved to be optimal.

This construction system was basically economical, since minimized structural elements; and also allowed reuse and repurpose the model in the future and incorporate vaults. This type of necessity and needed architecture was spread quickly throughout Valencian Kingdom, not only in religious buildings, but also in other public buildings such as warehouses, hospitals, castles, exchange markets or ovens.

From the austere architecture based diaphragm arches and wooden ceilings, has been evolving for the strictly Gothic architecture, based on arches, vaults or mullioned windows. Gothic models would be developed in the Kingdom of Valencia along the fourteenth and fifteenth centuries, reaching its end in the mid-sixteenth century with the completion of the works of the Exchange Market of Valencia [1]. From this architectural milestone of the Exchange Market of Valencia Renaissance trends imported from Italy were to break the Valencian Gothic tradition to gradually impose the Roman models, but with strong Gothic inertia.

2. The castle-palaces

Muslims normally built castles on top of the mountains, in order to defend the vast territories that formed the "Hisn": simple constructions, usually with a Watchtower and an outer wall, built with materials from the ground and without decorative sense. In the 13th century, Christians were taking possession of these castles. Later, when villages had been conquered, some of these old castles were improved, high and thick walls, barbicans and moats were constructed, and the buildings became into authentic fortresses. The first Christian castles were built over old Arab castles. A large number of cities, villages and towns were formed next to these castles.

After a quiet period, King Pedro el Ceremonioso ordered the renovation of fortifications against a possible invasion of the moors of Granada in the 14th century. From the 15th century military buildings became feudal castles, House of Lords, with the Tower of homage, battlements and walls. But gradually the castles lost their defensive sense and became castle-palaces. The 15th century was the time of splendor of these noble mansions. Society related as much the binomial Lord-castle, which until the palaces built on the plain, retained the name of "Castle", although on occasions were Palaces for the residence of the Lord without any defensive claim. However, the continuous wars and uprisings of the Moors (Arabs who not finished converting to Christianity), made some of these castle-palaces had to fortify, until in the year 1609 Felipe II ordered the expulsion of the Moorish [2].

3. Characteristics of Valencian Gothic palaces

The typology of the stately houses, palaces or castles, palaces, during the Gothic period in the old Valencian Kingdom, are not very different from others that are found in the Western Christian Mediterranean. These are organized around a central courtyard. These houses had four floors, the ground floor, mezzanine, main floor or noble floor and attic (belowdecks). The noble floor staircase stood at an angle of the courtyard. These palaces were usually built isolated from other buildings. The main facade was more careful and had the best quality ashlar masonry or rammed earth works. On the ground floor opened only a great cover, which was the main access; the mezzanine had rectangular windows; and the noble floor used to have mullioned windows, with two to three small arches of half point or trilobed that rested on columns. In the attic a succession of small arches was opened with the function of aerate.The building was completed with large eaves with carved beams. The composition of these facades did not follow any type of symmetry. In the courtyard there used to be a well. The ground floor was intended for spaces for service, stables, storage and woodshed. From the lobby, another staircase climbs to the mezzanine. The noble floor opens to the courtyard through windows or an arch gallery. On the ground floor were located the rooms of the Lords, with very high ceilings. These ceilings were formed by polychrome mudejars carved ceilings. The access to attics or belowdecks was by indoor stairs. There lived the servants, some foods were kept or were warehouses. Behind the House was an orchard-garden [3].

A large number of these Valencian Gothic Palaces have been preserved, others are in a recovery period and some have totally disappeared. Some of them, besides the above mentioned features, had defensive towers and other ones had square shaped protected by towers (round or square) on its corners. Some examples of these so-called castle-palaces are located on Geldo Todolella, Sot de Ferrer and Betxi in Castellón Province and Sorrell Albalat, Alaquas, Benisanó, Oliva[4] and Lluxent in Valencian Province.

4. Geldo's Castle-palace.

Geldo's Castle Palace, is also called Dukes of Medinaceli Castle-palace. It is located in the small town of Geldo, in the province of Castellón, Spain. I was built between the fourteenth and the fifteenth century and was declared as Cultural Heritage on 1985. Geldo village was developed at the foot of a small mountain, on the right of Palancia River.

4.1. History.

Before the reconquest, Geldo depended on the Moorish King Çeyt Abuzeyt. On 12th of July, 1248, King Jaume I, after the reconquest, yield to García Péreç d'Osa the Tower called Xeldo, with ten *yugadas* adjacent to it [5]. In the XVth century, it was owned by Valterra family, settle in Segorbe[6]. Later in 1416 Bernat Tomás Sorell bought the population of Geldo, his son Tomás Sorell Sagarriga was second lord of Geldo (he built " Mossen Sorrell " palace, in the city of Valencia, which was one of the most important Valencian civil Gothic buildings. Also, he acquired the lordship of Sot de Ferrer in 1474 and the lordship of Albalat de Codinats in 1480). The third Lord of Geldo was his nephew Bernat Sorell II, and he also was second lord de Sot and Albalat[7]. being this family which ruled this manor, until in 1495 it was acquired by the Duke of Segorbe D. Enrique de Aragón y Pimentel (Fortune Infante). Enrique Folch de Cardona gave him the settlement charter in 1611. The Duchy of Segorbe, would depend on the House of Medinaceli from the marriage of D. Juan Francisco de la Cerda y Enríquez de Rivera with Dª Catalina Antonio Folch Cardona y Aragón firstborn, and heiress respectively, of the families Denia-Lerma, Segorbe-Cardona and Comares, after the sentence of the Valencian Audience in 1675.

The Castle-Palace was the most important residence of the town. An example of its importance, is the custom of the Bishops of Segorbe, which, when they were about to take possession of its seat, they slept the night before in this Palace, to enter the town of Segorbe next morning riding a donkey. At the end of the 19th century the Bishop Massanet was the last one which complies with this tradition [8].

Since the nineteenth century the building has begun its decline, and was used as a bar, store, city hall, houses or clubs. In recent years, some archaeological and restoration works have been conducted.



Fig. 1: Geldo's Castle-palace.

4.2. Description.

The building is located in the historic center of Geldo's village, presenting facades to Horno's square and Molino street. The building seems have been raised from an initial defensive square shape tower; and around it, in the 15th century, there was raised the Palace equipped with defensive elements. Between these defensive elements can be highlighted the rubblework slope running across its base, in its walls there are small holes opened for rifleman fire, as well as a circular tower that would carry out the mission of checkpoint. The building has rectangular L-shape plan with dimensions of 29.40 x 28.65 m. occupying an area of 676 m²; it has a back orchard-garden with an area of 225 m². The materials used in the construction are mostly rubblework and ashlar.

It is composed of three levels: levels 0 and 1 are covered by tube vaults form by segmental arches supported on load-bearing walls. The top floor is covered gable roof with wood structure. On this floor, some original load-bearing walls have been replaced by metal columns and beams.
The ground floor does not have windows, the first floor has small windows, and on the second floor, the noble plant, has two Gothic mullioned windows, three balconies in the main facade. On the main facade it has three entrances, the main in the center. The interior is distributed around a central courtyard with segmental arches and an upper gallery form by half point arches cover with coffered ceiling. The capitals of the courtyard represent in relief the coat of arms of the Dukes. The courtyard articulates the access to upper floor through a wide rectangular stair. It has rests of polychromatic wooden coffered.



Fig. 2: Central courtyard.

4.3. Researching objective

The research aims are to enhance this building, relate it to other buildings constructed in the Kingdom of Valencia in that era and to collaborate with the artistic projection of this architectural heritage piece which, in spite of being in a rural environment, not only has a great artistic value, but also a great historical, cultural and social interest.

4.4. Methodology

In order to cover with integrity this work we have opted for a mixed system of capturing information, ranging from the initial search tasks most basic information about the building, such as historical or documentary record, its location, in order to place the building in the corresponding urban, territorial, social, historical and artistic context, all those which a complete bibliographic record, graphics and archival data documenting building element is obtained.
Moreover, we have visited many castles-palaces of the ancient kingdom of Valencia, collecting data, allowing us to make a comparison between them. Then we have made a visit to the palace and we proceed to analyze the most unique, original architectural elements preserved in this Castle-palace from the typological and constructive point of view. So we analyze: Honor staircase, mullioned windows, inside portals, cross vaults, tube vaults and coffered ceilings. We also have conducted 3D scanner and Photogrammetry surveying works.
This information covers as far as possible from the recognition of the subsoil where the building sits, the study of the influence of architectural treatises of that age, the materials which composed it, building techniques, crafts and characters associated with its construction. Finally, we have approached data collection in situ with last generation resources based on 3D active imaging systems and for subsequent graphical representation and to get a graphic survey or digital model of some architectonic elements, as inside Portals.
To implement the results have done several fieldwork, with the aim of capturing dimensional metric, geometric and graphic construction characteristics performing freehand drawings dimensioned and the subsequent scaling of elements starting from field data. Finally, it has carried out a comparison of the different results and conclusions.



Fig. 3: Surveys into the castle palace.

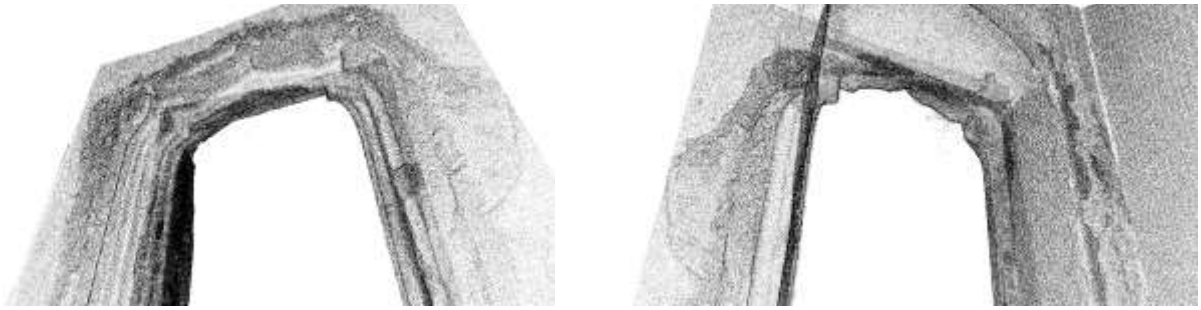

Fig. 4: Surveys with 3d scanner.



Fig. 5: Mullioned window with mozarabes elements.



Fig. 6: Mullioned windows



Fig. 7: Mullioned window with mozarabes elements



Fig. 8: Cross vaults and tube cofered vaults.

5. Conclusions

The Castle Palace Geldo can include within the typology of castles Valencian Gothic palaces. We have found many similarities with other Castle-palaces of the ancient Valencian Kingdom. Thus, Geldo building can be named as Castle-palace because the defensive elements it has and in addition it was the residence of Geldo's Lord. We also can define it as a Gothic-Style building, according with the elements of this style we can founded on it, such as inside portals and mullioned windows, and for the time in which was built, 14th-15th century. In this Palace the courtyard is not in the center of the building, but we can find it on one side, and it has the honor staircase to access to the main floor and a well. Unlike other buildings, Geldo's Palace only has three floors, without the attic with the typical lodge and characteristic windows. As all the castles and palaces it has the noble floor with stays of the Lords, where finishes were careful in more detail, which have reached us elements such as mullioned windows or interior Portals. The vaults, probably from the 16th century, are located in the space of the Palace, where the chapel of the Palace was located [9].

From the historical point of view, we find links and similarities between the palaces of Mossén Sorell, in the city of Valencia (now disappeared), the Castle-palace of Sot de Ferrer, in the province of Castellón, and the Palace of Albalat of Sorell, with four colorful towers, near to the city of Valencia. All of them belonged to Sorell family and were constructed at the same time and all of them are considered Gothic Castle-palaces.



Fig. 9: Sot de Ferrer's Castle-palace.



Fig. 10: Albalat dels Sorells's Castle-palace.

Bibliographical References

[1]JOSÉ I PITARCH, Antoni. Sobre l'art valencià dels segles XIII-XV. *Lluís de Santàngel uno nou home un nou món.* Valencia: Presidència de la Generalitat Valenciana. Comissió Valenciana de l'Expo-92, 1992, pp.73-101.

[2]BEÜT BELENGUER, Emilio. *Castillos Valencianos*. Valencia: José Huguet, 1984. 127 p. *Biblioteca Gráfica Valenciana-2*.ISBN 84-86341-01-9.

[3]ZARAGOZÁ CATALÁN, Arturo. *Arquitectura Gótica Valenciana*. Valencia: Generalitat Valenciana, 2000. 245 p. ISBN 84-482-1070-0.

[4]MARTÍNEZ MOYA, Joaquín. Classification of the graphic legacy of Disappeared Earl of Oliva's Palace. In: AA.VV. *Proceedings of XII International Forum. Le Vie dei Mercanti*. Napoli. La scuola di Pitagora editrice.2014. p. 604-613.

[5]SARTHOU CARRERES, Carlos. *Geografía General del Reino de Valencia*. Provincia de Castellón. Barcelona: Alberto Martín, 1913.
Arxiu de la Corona d'Aragó. Barcelona. Cancelleria Reial. Registre 6, f. 39r. Original. Universitat Jaume I. Castelló. Arxiu Virtual Jaume I. http://www.jaumeprimer.uji.es. Document nº 000739.

[6]BALBÁS, Juan A. *El libro de la provincia de Castellón*. Madrid: Confederación Española de Cajas de Ahorro, 1987. 873 p. ISBN: 847580411X. [Edición facsímil de BALBÁS, Juan A. *El libro de la provincia de Castellón*. Castellón: Imprenta y librería de J. Armengot, 1892].

[7]HINOJOSA MONTALVO, José. *Diccionario de historia medieval del Reino de Valencia*. Tomo IV. Valencia, Biblioteca Valenciana, 2002. ISBN: 84-482-2960-6.
ESQUERRO, Onofre; MARTINEZ ORTIZ, José, CHORRO SOLBES, Juan. *Nobiliario Valenciano*. Tomo I. 2ª ed. Valencia, Biblioteca Valenciana, 2001. ISBN: 84-482-2881-2.

[8]Web: http://www.cult.gva.es/dgpa/bics/detalles_bics.asp?IdInmueble=1393

[9]MARÍN SÁNCHEZ, Rafael. "Uso estructural de prefabricados de yeso en la arquitectura levantina de los siglos XV y XVI". Tesis doctoral. Directores: Javier Benlloch Marco. Arturo Zaragozá Catalán. Universitat Politècnica de València, Valencia, 2014.

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The instructions of s. Carlo Borromeo in the Vistabella church. Castellón. España.

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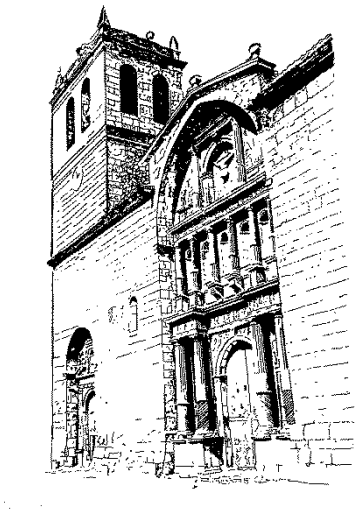
Abstract
The church of “Nuestra Señora de la Asunción”, located in the small town of Vistabella, in the province of Castellón, was built in the early seventeenth century (1604-1624). This is one of the finest Renaissance churches in the Valencian architecture, and was declared as Cultural Heritage with the category of a monument, on September 28th of 2007.
In the late sixteenth century, the conditions imposed by the Council of Trent promoted the construction of new churches.
In this context s. St. Carlo Borromeo, Archbishop of Milan, wrote *Instructionum fabricae et suppellectitis ecclesiasticae* (1577), which explained how churches should be built to follow the precepts of Trent.
The Borromeo´s book was written to apply only at to the archbishopric of Milan, but it has been very important in the development sacral architecture and has never stopped publishing.
No wonder that the Borromeo´s text come to Spain, because Milan was Spanish. Further, St. Carlo Borromeo was a friend of Juan de Ribera, Archbishop of Valencia.
Comparing conditions Borromeo´s book with the church of Vistabella, we find many coincidences. The conclusion is that the architect knew the book and followed it. The aim of this article is to explain the coincidences we have found.

Keywords: Vistabella, Borromeo, Trent, Renaissance, Valencian Architecture.



Drawing. Vistabella church facade. Castellón. Spain.
Author: Maria Jesus Mañez Pitarch

1. Introduction

The emergence of the Protestant Reformation started in the early sixteenth century. Martin Luther-German- and Jean Calvin-French- provoked it. Therefore, there were, on one hand the religious wars in France, and on the other hand the completion of the Ecumenical Council of Trent (1545-1563). This council reformed the Catholic Church deeply. The reaction of the Catholic Church before the Protestant Reformation was the Counter-Reformation.

After the Council of Trent, Pope Pius V sent to the kings of Christian countries faithful to Rome conciliar decrees. In France were not admitted until 1615. The Italian states admitted them immediately and Philip II, Spain King, admitted the decrees of Trent as a State law [1].

The decrees of Trent prompted the development of new religious architectures, including building seminars to train priests and the construction of new churches that provide the Tridentine Mass.

After the 3rd Provincial Council of Milan, St. Carlo Borromeo, Archbishop of this city, wrote *Instructionum fabricae et suppellectitis ecclesiasticae* (1577), where he wrote the conditions that had to meet the new churches.

The Borromeo´s book was written to apply only at the Archbishopric of Milan; four years after his death (1584), Cardinal Orsini, Archbishop of Benevento (later known as Benedict XIII), considered of great importance their application outside of Milan, making it to translate into Italian. Then, several Latin editions were published (Venice, 1595; Milan, Brescia 1599 or 1603). The text of Borromeo has been very important while unique in its kind, as the editions of his work, lengthened over time, reaching published translations in English and French in the mid-nineteenth century. Also in Spain, almost three centuries after its first publication, D. José Caixal and Estrada, bishop of Urgel, still decides to make a new edition of it in 1859, in Latin, to realize the necessary reforms in the churches of his diocese and writes the foreword:

"... You find clear rules, precise and accompanied by profound reasons for the construction of churches, in their entirety and on the sides of buildings consecrated to God" [2].

In the twentieth century, Bulmaro Reyes Coria made a translation into Castilian. The work was completed with instructions performed by Palladio, Serlio or Cataneo [3].


INSTRVCTIONVM
FABRICAE,
CAROLI
MEDIOLANI,

Fig. 1: St. Carlo Borromeo's book cover. 1577.

1.2 The province of Castellón in the kingdom of Valencia. Late sixteenth century.

In the late sixteenth century in the province of Castellón the following conditions occurred:

•Philip II, Spain King, with strong Catholic ideas, was the Duke of Milan.

•St. Carlo Borromeo was friend of Juan de Ribera, Archbishop of Valencia. The friendship between them allows that the second one not just had this text in his library, but also took into consideration their thoughts [4].

•There was a strong demographic and economic growth.

These conditions caused between the XVI and XVII century many churches in the province of Castellón were reformed, expanded or built, including the parish church of Vistabella.

2. The church of "Nuestra Señora de la Asunción" in Vistabella at Castellón, Spain.

The church of "Nuestra Señora de la Asunción", located in the small town of Vistabella, in the province of Castellón, was built in the early seventeenth century (1604-1624), outside the medieval enclosure. This is one of the finest Renaissance churches in the Valencian architecture, and was declared as Cultural Heritage with the category of a monument, on September 28th, 2007 [5].

The exterior is a free building, rectangular, with another small rectangle attached to the headboard. Emphasize in their main facade facing south, two covers and the bell tower. Special mention deserves the greatest cover, framed in a stunning facade altarpiece, sheltered by a pointed arch. The statues of the facade altarpiece disappeared during the Spanish civil war. Constructed of masonry and stonework, the main body is covered with tile roof gable cover the apse with five water and the header with a single slope cover, which is lower than previous constructions.

Its interior consists of a single nave and chapels between buttresses of five sections, octagonal presbytery and ambulatory chapel and sacristy in the header. Both the nave and the chancel are covered with star-ribbed vaults and side chapels with simple ribbed vaults.

The church was drawn by architect Joan Tell, of French descent. At this time in the province of Castellón worked a large number of masons and masters of French descent, perhaps because they had fled from France by the Wars of Religion.



Fig. 2: Location Vistabella church in medieval village.

3. The instructions of St. Carlo Borromeo in Vistabella church.

The Borromeo´s book, where the doctrine emanating from Trent is present [4], appears of great importance for the study of the Church of Vistabella, hence the proximity of dates between publication and the construction of the parish of Vistabella, and because is the best reference for understanding the rules and trends of sacred architecture from the time of its construction. Therefore, in this paper, we have reviewed the conditions contained in the text of Borromeo, since it is no less important than the architectural treatises of Vitruvius, Alberti, Serlio, Palladio and Vignola.

3.2 Site of the church

The first job before building is the choice of the site. St. Carlo Borromeo says to choose the most appropriate place, according to the judgment of the bishop and the advice of the architect. This was usual at the time [6]. In addition Borromeo recommended that the churches must be far away from the noise of downtown and built as an island, separated from other houses.

This criteria were followed in Vistabella church. The parish church was built outside the village center, although it was necessary to demolish part of the city walls [7], and isolated from other buildings.

3.3 Building surface

St. Carlo Borromeo said that the surface must be allowed to contain the multitude people who attend the feasts. He says that for each person must be a cubit and eight inches. So for each person is needed: 418 mm + (418/12) .8 mm = 696.66 mm. He inner surface of the temple of Vistabella is 890 m2. The number of villagers was 1400 people. Therefore 0.63 m2 / person are obtained. This is close to Borromeo ratio.

3.4 Church form

St. Carlo Borromeo was inclined longitudinal temples plant, and Latin cross form. In turn, Cattaneo and Palladio justified the plant in the form of a Latin cross for being the cross of Christ. Palladio continues this trend in the church of "Santissimo Redentore" (Venice, 1577). Years before Francesco di Giorgio Martini [8],

one of the first writers of the Renaissance, had exposed the analogy between the measurements of the human body and the floor of a temple in Latin cross form.

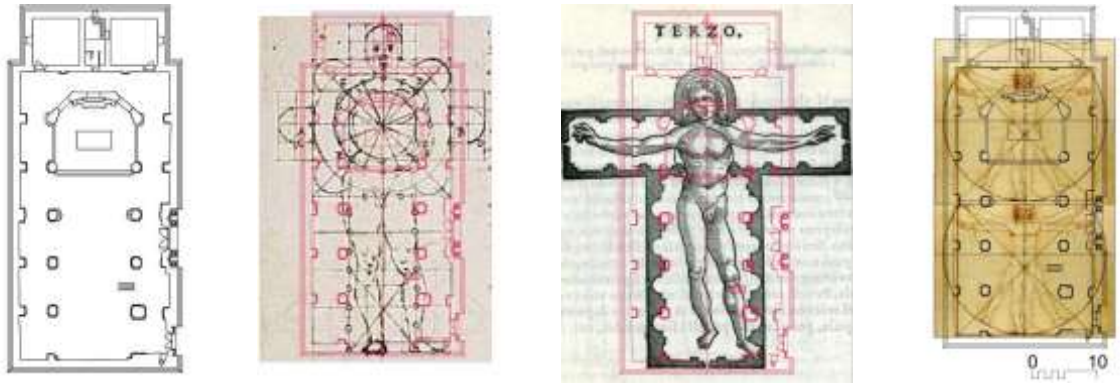


Fig. 3: Plant building on drawings of Giorgio Martini, Pietro Cattaneo and Leonardo Da Vinci

3.5 Facades

Borromeo says you should not represent any picture on the side and rear walls, and the main facade should be adorned with sculptures or paintings describing the sacred history. He also says that on the main facade, especially in parish churches should be painted or sculpted the image of the Virgin Mary (Annunciation, Assumption and Nativity of St. Mary, if this is the title of the church), and on her left must be an image of the saint venerated by the village people. The architect must locate these sculptures to be defended from the rain and bad weather. It also says that the temple should have multiple entries, for the separation of women and men, and for other reasons, like the Roman basilicas.

The east, west and north facade of Vistabella church have not ornamentation, however the south facade has two portals, with the Virgin of the Assumption, in the big portal, and San Miguel, in the little portal. In addition, following the approach of Borromeo, on the left of the Virgin sculpture they placed the image of Saint John the Baptist, of great veneration in the village. The iconography of the main facade of Vistabella church was transmitting the dogmas that Catholic Church promulgated by the Council of Trent against the Protestant heresies. The biggest portal is sheltered by a pointed arch and the little portal by a semicircular arch. These arches were built, as indicated Borromeo, so that the sculptures were defended from the rain and bad weather perpetually.

The temple has two doors. In order to separate the entry of women and men in the church, being a custom to sit in different parts of the church: he men occupied the benches next to the altar and women sat in the back. This practice will extend until the beginning of the twentieth century [9].

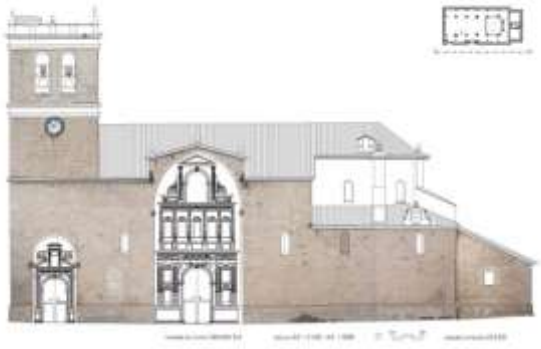


Fig. 4: Main facade.

3.6 Ceiling

St. Carlo Borromeo warns that the ceiling is very important since this protects the building. He is in favor of wooden ceilings, however, after the manner of places, says to do vaulted, so that the buildings are safer from fire.

The Vistabella temple roof is covered with ribbed vaults.

3.7 The pavement

St. Carlo Borromeo says the pavement does not have herringbone pattern or cross, nor any image or sacred history should be represented, both inside and outside the church. In terms of materials gives preference marble pavements or other solid materials. If this cannot be, it would be manufactured with burnished silicas or brick.

The Vistabella church was paving with stone and wood, without any form [10].

3.8 Entries

Borromeo recommended quadrangular doors, firmness door shutters, even proposes cypress wood, cedar or walnut; proposes coating the doors with sheets of bronze carved sacred images; also he recommended protecting the inside with latches, bolts and large keys, and construction of small doors on the main door.

The outer doors of the church of Vistabella are two sheets of solid wood, protected externally with zinc. On each sheet opens a little door. The circular door knockers preserved, and protected inside with latches, bolts and large keys. All of this is as St. Carlo Borromeo proposed.

3.9 Windows and lighting of the temple

St. Carlo Borromeo lays the foundation for building windows. He says windows should be rounded at the top part, oblong form, and wider outside than inside. He advises that the windows should be at the top of the walls, have transparent crystals and these must be opened to ventilate the building. Also says they must build a circular window at the front, where the church and the main chapel receive light, and build windows in the dome. Moreover, putting bars on the windows, if possible.

The Vistabella building windows are oblong, round on top and wider outside than inside. It has a round window at the foot of the building, illuminating the main altar, especially on August 15, the feast day of the Virgin of the Assumption. It also has windows on the vault located at the main altar. Some windows have bars.

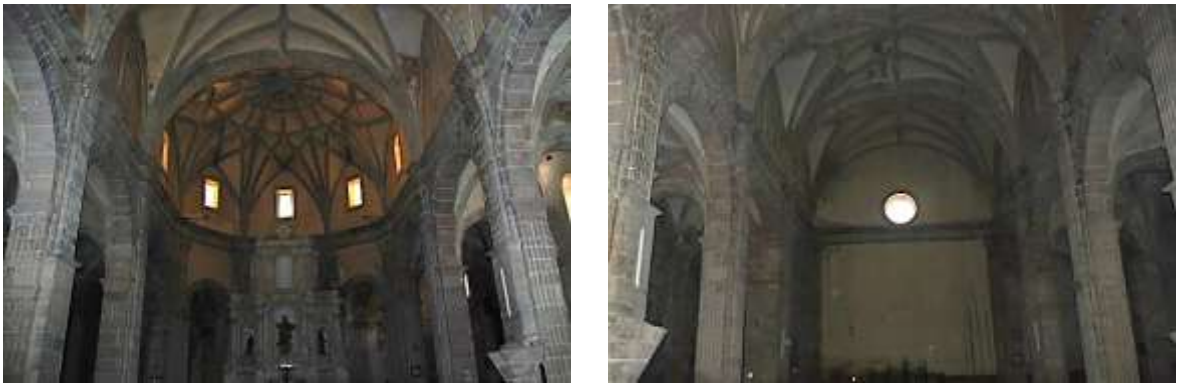


Fig. 5: Temple windows

3.10 Sacristy

St. Carlo Borromeo dictated rules in his text about the sacristy: "It should be separate from the main altar, this way the priest can march in an orderly procession from the sacristy to the altar, beside those that will serve him, as it is an ancient custom, with the announcement of the mystery"

Site and windows of the sacristy:

Sacristies must completely look eastward and southward. Its construction should not remove the light to the main chapel. It must have two or more windows, they may remain opposed one to each other, and especially one on the right side and the other on the left side, this way this place will not be humid. These windows should be protected on bars. The sacristy should be covered with vault or at least with coffered ceiling.

The entrance to the sacristy:

The entrance to the sacristy is open to a public place of the church, not the main chapel. It must be closed with solid latch, lock and key.

Oratory or altar in the sacristy:

There should be an oratorio in the sacristy, like an small cubicle in which the priest, who will say the Mass, retires to pray and meditate.

Aquamanile:
In the sacristy, they must make an aquamanile with solid stone, where the priest can wash his hands. At the bottom, they must place a concave container to collect the water, also in solid stone. The aquamanile is built with elegance and placed in a wall recess, it must have semicircular form.
The temple of Vistabella has a sacristy. It is located in the back of the altar, facing to the east and south. The access is through an ambulatory. Its door has a lock. It also has a window with bars. From the sacristy you access to a space that looks like a small chapel, which was possibly the oratorio. There is also an old aquamanile placed in a wall recess, with semicircular form.



Fig. 6: Door, vault and aquamanile of the sacristy

3.11 Bell tower

Carlo Borromeo also speaks of the need to build a bell tower: The bell tower should be square or otherwise, as the architect finds in accordance with the type of church or place. Upward, it must be built according to the amplitude of the church.
Floorboards:
The tower will have many floorboards as deemed necessary. Beneath the floorboards it must have vaults, as well as the top of the tower.
Windows:
This will have windows on each floorboard. In the high floorboard will have columns or pilasters.
Stairs:
The tower must have stairs of stone or wood, with comfortable and not dangerous ascent, snail-shaped or otherwise.
Entrance:
Entrance must be protected with firm swing, latches and key, with the objective that can be closed.
Number of bells:
This tower should have three bells, in parish churches. Large, medium and small, with different sound.
Watch:
It is desirable to place a watch in the tower. Each hour is marked with the sound of a bell. The clock should be placed in a conspicuous place.
Other bell tower form:
But when the place or the lack of resources may not support such a costly bell, it can be erected in a corner of the church, not far away from the door. There must be an entrance into the church, protected with hinged and lock. You can also build a bell gable, while the bell tower has not been built.

The bell tower in Vistabella is rectangular, of 6 by 8.82 meters and its appearance is solid. It is built in a corner of the building.
The clock chamber floor is made of wooden boards and it is covered by simple ribbed vault. Bells chamber has double arched openings in its south and east sides, and a single opening blinded in the rest of its faces; and is also covered by simple ribbed vault. Access to the bell tower is inside the building, along to the little door, it has lock and a key. The interior has a stone spiral staircase. There is also a bell gable, today without bell. Surely, this bell gable was built to call the faithful while the bell tower was being built.





Fig. 7: Bell tower and bell gable









Fig. 8: Bells, door, snail-shaped and vault of the bell tower

4. Conclusions

The church of “Nuestra Señora de la Asunción” in Vistabella at Castellón, Spain, was built in the early seventeenth century. It is a Renaissance style church. It followed the trends of the Counter-Reformation churches. To do this, the architect should have followed the instructions of St. Carlo Borromeo, Archbishop of Milan, *Instructionum fabricae et suppellectitis ecclesiasticae* (1577), which explained how churches should be built to follow the precepts of Trent. This article has noted the large number of coincidences of the Vistabella church with the Borromeo's text. No wonder that the Borromeo´s text come to Spain. First, Philip II and Philip III, Spain kings, were the Milan Dukes and they had strong religious convictions. Moreover, St. Juan de Ribera, Archbishop of Valencia, was a friend of St. Carlo Borromeo and his thoughts must be followed in the old Valencia Kingdom.

Bibliographical References

[1] *La recepción de Trento en España (1565).* TINEO, Primitivo. Universidad de Navarra. Anuario de historia de la Iglesia, nº 5, 1996, pp. 241-296. ISSN: 1133-0104.

[2] BORROMAEI, S. Caroli. *Instructionum fabricae ecclesiasticae et supellectilis ecclesiasticae.* Libri duo. Editio revisa novisque acaucta. Tarragona: Ex tipographia Francisci Arís, 1859. 351 p.

[3] BORROMEO, Carlos. *Instrucciones de la fábrica y del ajuar eclesiástico.* Bulmaro Reyes Coria (introducción, traducción y notas). México: Universidad Nacional Autónoma de México, 1985. 226 p. ISBN: 968-837-051-7.

[4] *Tipología de la arquitectura religiosa: Un tratado valenciano del Barroco (1631).* BENLLOCH POVEDA, Antonio. Universitat de Valencia, Estudis: Revista de historia moderna. 1989, nº15, pp. 93-108. ISSN: 0210-9093.

[5] *España. Comunitat Valenciana. Decreto 169/2007, de 28 de septiembre, del Consell.* BOE, jueves 24 de enero de 2008, suplemento del número 21. pp. 109-111.

[6] OLUCHA MONTÍNS, F. ALLEPUZ MARZÁ, X. *Quatre-cents anys de l'església parroquial de Vilafámes.* Castellón: Servei de publicacions Diputació de Castelló, 2012. 223 p. ISBN: 978-84-15301-11-0.

[7] MAÑEZ PITARCH, María Jesús. "La arquitectura religiosa renacentista en tierras del Maestre". Tesis doctoral. Directores: María Concepción Lòpez Gónzalez. Fernando Fargueta Cerdá. Universitat Politècnica de València, Valencia, 2014.

[8] DI GIORGIO MARTINI, Francesco (1439-1502). *Trattato d'architettura.* Manuscrito. Disponible en biblioteca de Florencia. http://www.bncf.firenze.sbn.it/oldWeb/Bib_digitale/Manoscritti/II.141/main.htm.

[9] *Dades sobre la nova construcción de l'església parroquial de la vila de Càlig*. QUEROL I ANGLÉS, Aureli. Centre d´estudis del Maestrat. *Boletín del Centre d´estudis del Maestrat.* 1985, nº 11, pp. 33-42.

[10] MUNDINA MILALLAVE, Bernando. *Historia, Geografía y Estadística de la Provincia de Castellón.* Madrid: Editorial Confederación Española de Cajas de Ahorro, 1988. 693 p. ISBN: 8475805272. [Edición facsímil de MUNDINA MILALLAVE, Bernando. Historia, Geografía y Estadística de la Provincia de Castellón. Castellón: Imprenta y librería de Rovira hermanos, 1873].

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Evolution of techniques in osteoarchaeology: a proposal for a new on-field schedule for preliminary study of ancient population.

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Abstract

There is a branch of archaeology, named physical anthropology, that concerns the study of bones: this kind of studies regards the analysis of human remains for the reconstruction of the biological profile of single individuals, and consequently life conditions and - in large scale – ancient landscapes. In this perspective, human remains could be considered as part of Material Culture and Heritage.
However, in times of economic recession, there is less and less possibility to carry on complete anthropological analysis lead by osteoarchaeologists: a lot of skeletal remains are dug, but not studied.
This work proposes a new kind of on-field datasheet, that could record the main information related to a preliminary osteological analysis of individuals (obviously in the cases in which this could be possible).
There are a lot of on-field datasheets, but all concern the material inventory and the taphonomic changes occurred to the body.
We will here introduce a simple datasheet that could be used on mobile support, as iPad, tablet, or smartphone. The utility of this kind of immediate support is clear: but we believe as well important and useful to discuss the train of thought that lies beneath this work. This new datasheet aims at recording all the principal features of osteological remains before they are stored, in order to understand the main traits of ancient populations. This datasheet was tested in San Cerbone in Baratti (LI) excavation, carried on by L'Aquila University, Chair of Medieval Archaeology.

Keywords: Osteoarchaeology, Physical Anthropology, Ancient Popolations, Datasheet, Preliminary Studies, Open Data.

1. Context and Needs (VA).

Physical Anthropology involves a considerable part of Archeaology. This tendency arose in '60 and '70 in Anglo-saxon countries, and arrived in Italy only in the '80, with the creations of a kind of professional archaeo-anthropologist, that were formed in Humanities Departments by professional biologists [1] [2].

Physical Anthropology – the study of ancient bones coming from archaeological excavation – was before considered just as an Hard Science. With the introduction of anthropological techniques on archaeological field, and the resulting need of a new kind of professionals that could understand not just the biology of bones, but also the implication regarding archaeological context, its range increased, involving also Humanities in an on-going process that includes both competences.

In Italy the two professions coexist: the archaeologists formed by biologists in Humanites Departments, and biologists that choose to dedicate themselves to archaeology.

Whatever is the formation of the anthropologist on the archaeological field, s/he has the assignment to excavate ancient burials and than handle osteological materials until their arrival in the Superintendence warehouses. It is extremely important that the on-field osteologist records all the taphonomic features of burial. Taphonomy is a quite new branch of archaeology, and it consists in taking notes of all the characteristics in the disposition of bones, with the intent to reconstruct the ancient funerary actions, as well as later interferences in the burial structure [3].

A great numbers of Archaeology Departments have their own anthropologist involved in excavations. However,, independently of the good work of thisprofessional figure, the future of osteological material is still a crucial issue.

In times of financial crisis there are less economic resources to dedicate to culture, and consequently to archaeology and anthropology [4] [5]. Therefore more and more osteological remains unstudied, and stays for decades in Superintendence warehouses. This issue concerns in particular the necropolises which involve a great number of individuals. Consequently, the most disadvantaged branches of funerary archaeology are those involving extended cemetery areas: medieval and classical ones.

At present, the equipe of LAMIA (Laboratorio di Archeologia Medievale, Informatica ed Archeologia) pertaining to The L'Aquila University and directed by Prof. Fabio Redi, is working to minimize all the inconveniences deriving from the excavation of great cemeteries; this need rises from the problems observed during the long experience of archaeological work on medieval cemeteries that the equipe of L'Aquila have dealt with for 10 years. In particular, the testing ground for the intersection of archaeological, anthropological and computer competences was the excavation of the site of Populonia San Cerbone, that was lead every year from 2005 to 2014, and brought to the complete excavation of more than 500 burials and a more high number of individuals [6].

In consideration of his enormous amount of osteological material (we have to realize that a human skeleton counts 206 bones on average: 100 individuals consist in an average number of 20.600 bones that need cleaning, restoration, inventory before analysis) it was necessary to create step-by-step the essential tools to face this massive work, and therefore to abandon paper and switch to digital documentation (see Nazionale, *below*).

In this perspective, a taphonomic datasheet, specifically designed for anthropological documentation, has ben created, and then tested in the last three years in addition to more specific features [7]; this kind of datasheet has the great beneft of producing a preliminary inventory of osteological material, consequently giving a direct and constantly updated record on the exact amount of findings.

In Italy there are official anthropological datasheets concerning the laboratory work on bones from archaeological context – developed by ICCD (Istituto Centrale per il Catalogo e la Documentazione), the official Italian administrative institution designated for cataloguing Cultural Heritage [8].However, their use is extremely limited, due to the fact that those datasheets are complicated and hard to use, and focus more on some characteristics in spite on others: in particular metric features, when there is a poor consideration regarding MOS (Markers of Osteological Stress) [9] [10], that are really essential in the comprehension of working activity and consequently the social status of examined individuals.

In the last years, a considerable number of new datasheets has been proposed by different Universities, but in the spite of the great value and quality of many, none of them have reached the status of standard, thus producing a fragmentation in this field of study [11] [12] [13].

In those times there is a great interest in open data, but it is still a work in progress, that maybe could increase the knowledge of the anthropology in Italian and Mediterranean area, building up a system of shared co-references that might give to physical anthropologists the chance to improve their tools [14].

However, as already mentioned, in some cases there is another issue regarding anthropology related to archaeology, that goes beyond the laboratory analysis of this kind of material: in fact, there is no guarantee that the human remains from excavation would be studied.

2. Proposals (VA).

Aim of this paper is to propose a better solution which can be used directly on field. The first thing we would like to underline is the fact that there is, in some cases, the real necessity to have almost two professional anthropologists in archaeological excavation. This is due to the fact that there is the real necessity to divide the work related to taphonomy to the one concerning a pre-inventory of material. Summarizing, we want to introduce two different – but complementary – competences: the “taphonomy anthropologist” and the “pre-cataloguing anthropologist”. The real advantage of this kind of work partition is the fact that the first anthropologist could supervise the recovery of burials and their deposition feature, and the other could put into practice a better cataloguing of materials that could be interpreted as preliminary analysis, and could have the function to extrapolate the main data concerning the excavated human group.

Clearly, this kind of recording requires a choice on which the features could be considered in a complete study: this selection might be difficult, but it represents a good compromise to assure the collection of the data necessary to carry on laboratory analysis.”

A possible objection is that pre-catalouge might be seen as a duplicate of laboratory catalogue work, with a remarkable waste of energy. On the contrary, the aim of this pre-inventory is to extract just the main characteristics of the human groups in study; there is also the possibility to create a link between the pre-inventory and the laboratory inventory datasheets, and there would be the possibility to compare the results of both datasheets, with the purpose to evaluate statistically the amount of the inevitable errors in the pre-inventory one, and to his reliability [15],and guide the revision process.

This kind of work has the peculiarity to be carried on osteological material directly from excavation, which means unwashed and fragmented material. The main advantage is that the mold of the ground on bones is still malleable, and may be easily and quickly removed from the more diagnostic areas, as pubic symphysis or teeth. This kind of spot-cleaning may also be achieved in fragments of bones that seems to have peculiarities, anomalies or pathologies.

As a consequence, it is clear that the anthropologist involved in this kind of work must be a senior anthropologist, with precise knowledge of human osteology, that could recognize as much as possible every distinctive feature.

The inventory of material is delegated to the taphonomies datasheets, which records not only which parts parts of the skeleton are present, but also the conditions of the material (good fragmentary, absent), while the first part of the pre-catalouge datasheet concerns the conditions of legibility of material. This part is important not only to determine the status of the material, but also for the fact that the visibility conditions, when the osteological material is studied immediately on field, strongly influence the data survey.

In the creation of the datasheet there was a first selection concerning the metrical data: in particular, for the cranium the measurements that origins from metrical point that have not visibility when the district is not clean were excluded. Also some points of facial cranium were excluded considering that they need a great precision in determining the exact points of measurements. We kept the greater part of cranial index,

because we give for taking the fact that would be possible to measure just the skulls that would be intact – it would be impossible to restore soil material.

Regarding upper and lower limb bones, we just maintained principal measures, as total length and medial diameter/circumference, to obtain the main index that could produce knowledge regarding the main features of the excavated human group.

Vertebrae, ribs, scapular girdle (except clavicula) and pelvic girdle has no measurement in those datasheets to accelerate the inventory: there is one field to record pathologies and observations; the same for hand and feet bones, that needs a complete cleaning to be determined and lateralized. Morphological traits are limited to a close number of entries, the most significant ones and the ones that are visible to the naked eye, as metopic suture, some wormian bones on cranium, or supratrochlear foramen in humerus. All those traits are infrequent, but not so uncommon, and could be indicators of genetic affinity between individuals, in lack of a DNA analysis [16].

Determination of sex and age is extremely simplified: in fact, in both cases there is a field for the determination, followed by basic multiple-choice fields; we have to keep in mind that all the discriminant elements (as teeth, pubic symphysis etc.) must be cleaned, and that the anthropologist who will evaluate all those discriminating factors should have great experience on osteological material. A classical evaluation of sex by a trainee anthropologist, with the use of Acśadi and Nemeskéry method [17], would determine a waste of time, unaffordable on field.

The employment of a senior anthropologist would be useful also for the evaluation of MOS, or Markers of Osteological Stress [18], which are fundamental features to understand the kind of physical activities in which individuals are involved, with the consequent economic and social implications. In this field we necessarily made a choice, selecting the most indicative features, but also the ones that have the best visibility: for example, we chosen to record pectoralis major not on humerus but on clavicle, since it is more evident there.

We applied the same consideration for pathologies or signs of nutritional deficiencies: we opted for recording enamel hypoplasia in consideration of the fact that teeth need to be cleaned for age determination, and *cribra cranii* and *cribra orbitalia*, that are situated in really specific areas and could be easily identified.

We purposedly decided to split the datasheet in different sections not according to subject (with the exception of the determination of gender and age at death), but ased on the skeletal district concerned. The clear advantage of this order in the data registration is the fact that there is an obvious advantage in evaluating a skeletal area one at a time, opening a plastic bags one-by-one and immediately archive after the study.

In summary, the datasheet we are now introducing are far away to be a perfect tool, and were conceived for work on-field, as it was created to solve the problems that were noticed during years of excavations and analysis of human remains.

This tool is currently under experimentation in Populonia site, and the first results appear to be encouraging.

It is clear that this is just a tassel inside a greater project, that must concern a system of datasheets able to communicate each other (for the technical part see Nazionale, *below*).

3. Computer aspects (VN).

The medieval Chair of L'Aquila University, conscioUos of the necessity of an interdisciplinary approach to archaeological themes, has been developing for many years an experimental project for a suitable solution to the problem of filing and browsing the enormous amount of data deriving from archaeological excavations. Since 2008 we have gradually switched from paper to digital documentation, organized as much as possible

as a relational database (RDBMS), with the integration of GIS for all the graphic and topographic apparatus. This operation included systems for the management of excavation data (2008-2010), building archaeology (2011), datasheets of findings (2010-2013), and finally taphonomy datasheets (2013).

All those contributions come from degree and PhD dissertations, that required a strict co-operation among experts in different sectors, that were mediated by the computer archaeologist [19]; this kind of competence was more suitable than a simple computer specialist because of the fact of his full comprehension of the variability of archaeological data.

The most recent testing ground, that we will discuss in this paper, is the proposal of a digitalized datasheet of anthropological pre-inventory. This is the last datasheet to be converted into digital format, mainly because it represented the more complex work and required specific solutions on a technical point of view.

The pre-inventory datasheet is not dissimilar from previous works, as the digital platform created for the Necropoli Collatina in Rome [11], or the complex system created from the Divisione di Paleopatologia dell'Università di Pisa [12]; but the idea of the pre-inventory datasheet raises from the need to improve the processes of management, inventory and analysis of anthropological material from archaeological excavations, with the intent of define a sharing method for the comparison of results (for what concerns methodological decisions see Amoretti, *above*).

The main innovation in this application consists in its full integration in an ongoing project, thus inheriting its best practices and improving them with new solutions. In the LAMIA (Laboratorio di Archeologia Medievale, Informatica e Antropologia), since 2008 we are testing the use of computer tecniques. The first attempts concerned linear databases without any specific advantage connected to the use of a relational database. Then, we switched to a relational structure for the data and the evaluation of different software solution, always taking into consideration two main factors:

1) the degree of complexity in the construction and in the evolution of the system, 2) The level of computer knowledge to require in the use of the program. The most complex relational databases, that need high-level competence were rejected, while various more user-friendly software has been evaluated, considering both commercial and open-source solutions, and excluding all of those that put limitations of any kind. The final the choice was Filemaker pro, which mixes ease of use to a strong relational structure.

Furthermore, there are two peculiarities compared to the other programs in the same category that had a great influence on the final choice. The first is the possibility to create the database without being necessarily familiar with computer programming and to proceed directly to the creation of a user interface, while the software attends to creation and relationship between the fields. Meanwhile, it provides to advanced users all the essential tools to create complex and customized structures.

The second difference is the possibility to further develop the structure of the database, even when it is in use, and to implement it with data, without the risk to lose earlier archived work.

According to the theory of databases, before the actual development of the system an accurate conceptual design is necessary to establich which types of data will be recorded and through which criteria they will be organized. When the data storage starts, if there would be errors concerning the structure there would be not to possibility to correct them, and would be necessary to plan a new system or the not working part, and reinsert all the data [20].

This is an essential factor for the archaeological and anthropological data storage, also because a universally approved methodology still does not exist. The possibility of modifying archives in use without losing data or their relationship allows the user to proceed to revision and spellcheck, to improve the system and also adapt it to particular situations, and above all, it allows the team to produce the most appropriate solution to the context, and in the same time to improve research.

There are also other important properties, connected with the functional aspect, that conferred to the program the operational simplicity that we were looking for.

One of those is the chance of creating complex queries in a user-friendly way, e.g. without writing code in SQL language and using the user interface instead.

This provides final user a great ease, that does not need to know notions regarding the theory of data bases or query writing. It is really useful, for a pre-inventory datasheet, a specific selection for the calculated fields: some boxes do not need to be filled by the compiler but accomplish preset operation and show their results. The last noteworthy advantage is the operation platform: the program properly functions both on Windows and Mac OSX and there is the clear advantage thate the more recent versions this database could be used also on mobile devices. We tested these functionalities with the aim of updating our vision of on-field documentation. As we were ever reluctant or latecomer in the use of new technologies, we recognized in this fact a possibility that cannot be ignored.

The use of tablet meets the requirements of extreme portability, the ease of use and the discontinuation of every kind of paper. Between all the products on the market, the choice fell on Apple iPad, because it is the only device that allows the use of Filemaker through a specific app for tablet and smartphone: FileMaker GO. This app allows the access to the same database on the pc, without actions of conversion or modification in the structure. We took into consideration also different kinds of tablet, but there was no support for the platform and/or there were recorded problems of compatibility due to the operating system.

File Maker Pro on iPad allows to operate directly on field, and bypass paper documentation and above all to reduce aorktime, avoiding the data entry phase (e.g. the conversion of all paper documentation into digitalized format), that is often the main source of errors in transcription. We also observed that there is a conspicuous advantage in the use of a mobile device in the data collection, and we verified as the compilation process is really easier and faster, for example, through the possibility to take picture directly on Filemaker using the integrated digital camera leads to a timing reduction in the flow of the work in putting the images in the inventory system.

4. The Pre-inventory anthropological datasheet (VN).

Long time before the creation of the database there were long meetings and discussions regarding its structure, the organization of fields, their relationships and the features that we needed to implement/improve.

First of all, without lingering on technical details, we just reflected on the logical structure, trying to understand what would be the best solution in accordance to the upcoming steps.

There were various proposals, but the adopted solution has been a compact organization of the data according to bone districts, assembled in typologies and similarities.

The boxes for every skeletal district are not many, and to simplify we unified bones from the same district, giving to structure velocity and practice in execution; a reasonable number of boxes prevent the defect to create enormous archives full of empty spaces, and consequently slowed down by superfluous links and controls.

Taking into consideration the complexity of the pre-inventory datasheet, our choices aimed at preventing redundance in the data. For instance, we decided to exclude materials inventory, since this set of informations is already accessible through the taphonomic datasheet.

The relational structure was developed in 7 main tables, and 3 summary tables. The AT datasheet has the assignment to be a connection for all the other charts, and contains information regarding archaeological main data, the ultimate synthesis of the valuation of gender and age at death and the final considerations, that consists in a brief final report regarding the biological profile of the individual.

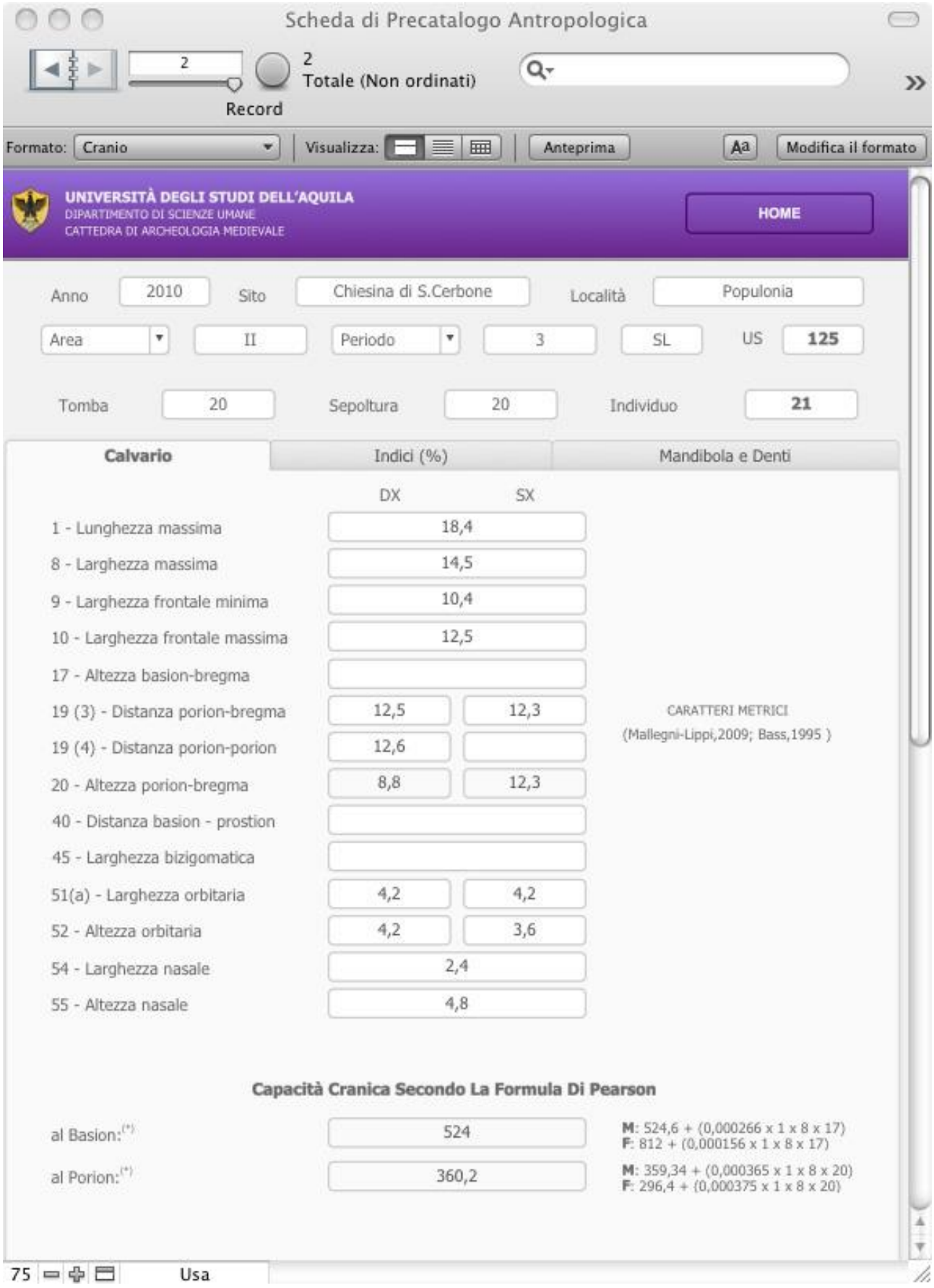

Fig. 1: Chart of metrical traits of cranial district_1.

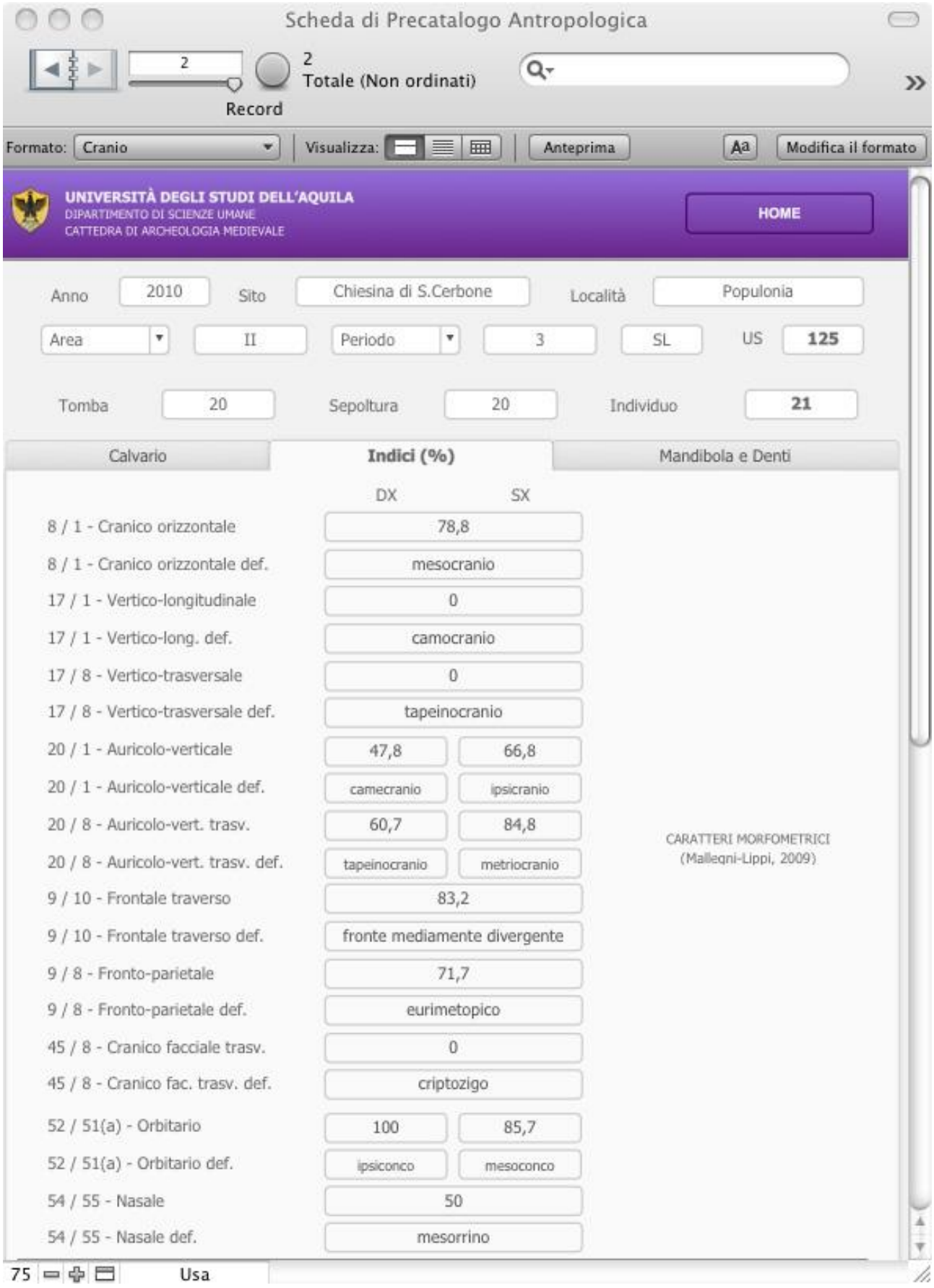

Fig. 1: Chart of metrical traits of cranial district_2.

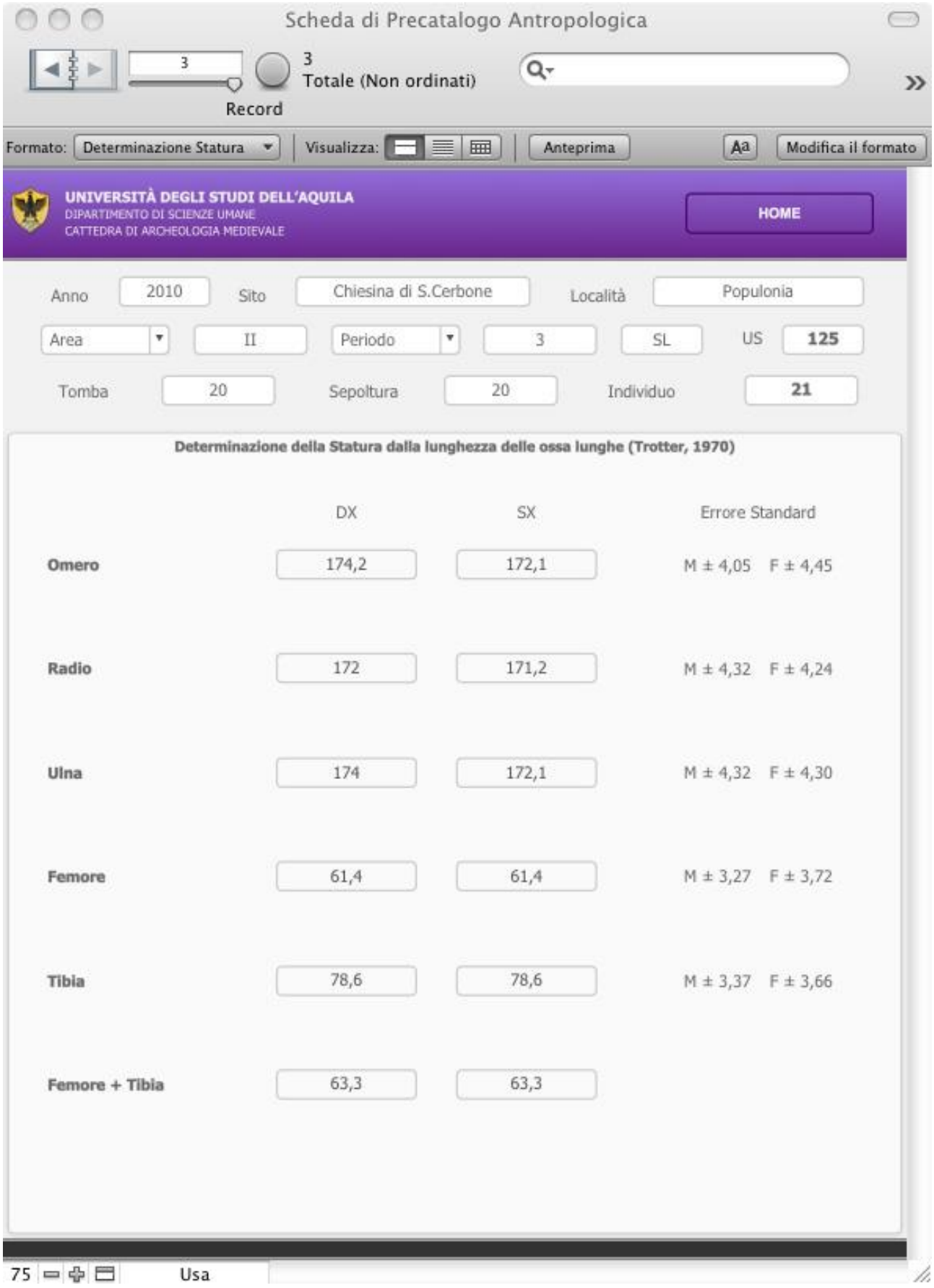

Fig. 3: Chart of estimation of stature.

The other six charts gather the fields on the basis of the organization in bone districts: Skull and Mandible (skull, mandible, teeth); Scapular Girdle (clavicle, scapula), Ribcage (verterbrae, ribs, and sternum), Upper Limbs (humerus, radius, ulna), Pelvic Girdle (hip bone and coccyx), Lower Limbs (femur, tibia, rotule and feet). For every chart it was created a graphic interface to facilitate the compiling.

To further ease the arthropologist's work, the reference tables and all the mathematical formulas were inserted inside the database in the form of boxes with automatic calculation.

Filemaker allows the use of formulas and create other personalized ones, that carry out specific operations on one or more values contained in the database, giving back only one result. The modality of writing these functions is really intuitive: by the combined use of mathematical, logical and comparison operators and text, the formulas can analyze both mumerical and textual values. For example, the formula for the extimation of stature from humerus length

(if Male = (3,08 x [1 –Maximum Lenght]) + 70,45; if Female = (3,36 x [1 – Maximun Length + 57,97; Trotter, 1970), differentiate for the gender, that is defined as "male" and "female", and carry on the expression - first a multiplication between a variable value and a costant that change in relation to gender, then an addition – and we obtain as result a numerical value.

Another simplification consists in avoiding to operator to insert again the estimated gender, indicating to the computer the exact field in which it is possible to find the reference value (The field Humerus- gender in the box Determination of Gender). We can translate this formula as:

Determination of Gender::Humerus_gender = "Male"; (3,08 * Upper Limbs::max _lenght_1_right) + 70,45;

Determination of Gender::Humerus_gender = "Female"; (3,36 * Upper Limbs::max_lenght_1_right) + 57,97;

Determination of Gender::Humerus_gender = "not defined"; 0

)

In the same manner it is possible to write a great number of functions, lightening and accelerating the workload. These expressions were used for the index computation (the percentage of two measures, that expresses a shape [21]), and other features that needs calculations (cranial capacity, markers of muscular stress etc.)

The three summary tables, linked to the one related to skeletal districts, do a measured use of calculated fields, that are useful for the following palaedemographic analysis.

The table of gender determination collects the data that are useful for the sex determination of individuals, which is not defined only by anthropometrical measurements and reference charts, but also to the judgement of the specialist, that evaluates the situation and explains the reasons of his choice. In the datasheet are displayed the results obtained through computation on specific measures for clavicle, humerus and femur, with related sources.

The table for the Age at Death Determination shows the results of analysis on ectocranial suture closure, and dental wear according to Lovejoy (1985), morphological changes in the sternal part of ribs, examination of the morphology of pubic symphysis and auricular surface, according with Brooks and Suchey method (1990), all those methods are employed to determine biological age of individuals. Also in this case we use reference tables to support the evaluation, but the final determination is at discretion of the experience of the anthropologist.

For the Determination of Stature we adopt the mathematical method of Trotter and Gleser with regression formulas applied to long bones as humerus, radius, ulna, femur, tibia and femur + tibia.

Possible errors in the data have been prevented through data normalization and standardization, as well as the removal of redundant data, the selection of univocal terms and the abolition of transcription errors. This

process was considered a primary necessity because of the context in which this datasheet would be used, as University, were it would be used also for the formation of young archaeo-anthropologists, initially inexperienced, that without clear guidelines could frustrate data relationality.

At the present time queries, exports and print formats are still missing: we deemed necessary to test the system on a larger number of individuals before its completion, in order to efficiently evaluate the potentiality of the tool and to fix possible errors in its development.

During the upcoming phase of development, we will be able to integrate new queries according to incoming requests in a timely fashion. The same workflow will be applied for exports and print formats. We made this choice to allow the final user to learn how to create queries on his own and carry on the research without the help of the computer specialist.

The datasheet that we presented here has been tested on a small number of individuals, already showing the potentiality in the combination of a consistent database and the ease of use of a highly portable device: this is the demonstration that it is possible to take advantage of new commercial technological tools for scientific research.

Bibliographical References

[1] MARINATO Maurizio *Gli studi di bioarcheologia dei cimiteri medievali in Italia*, in «PCA. European Journal of Postclassical archaeology »,III, SAP Società Archeologica s.r.l.,Mantova, 2013.

[2] SIRUGO Simona, *Storia dell'antropologia delle popolazioni antiche*, in Mallegni F., Lippi B. (edts.), *Non Omnis Moriar*, Roma, 2009, pp. 20-29.

[3] DUDAY Henry, *Lezioni di Archeotanatologia*, Roma, 2005.

[4] VOLPE Giuliano, *Le proposte per la professione dell'archeologo*, in proceedings of *L'Italia dei beni Culturali. La formazione senza lavoro, il lavoro senza formazione* (Rome, 27 September 2012), Annali dell'Associazione Bianchi Bandineli, 23, Iacobelli Editore, Roma, 2014.

[5] FRANCOVICH R., *Introduction to the IV Congresso Nazionale di Archeologia medievale* (Scriptorium dell'Abbazia, Abbazia di San Galgano, Chiusdino - Siena, 26-30 settembre 2006), All'Insegna del Giglio, Firenze, 2006.

[6] In this occasion we would thank Prof. Fabio Redi, the director of the entire project; Alfonso Forgione, the main responsible; Francesca Savini, Alessio Cordisco, Luisana Ferretti, that are the cornerstones of LAMIA.

[7] SAVINI Francesca, *L'analisi dei cimiteri dell'Abruzzo aquilano dall'XI al XVI secolo*, PhD Thesis in medieval Archaeology, Università degli Studi dell'Aquila, 2015..

[8] http://www.iccd.beniculturali.it/index.php?it/251/beni-archeologici

[9] DONATELLI Anna, *Proposta di un metodo per il rilievo delle entesopatie e sue applicazioni su resti scheletrici umani antichi e moderni*, PhD Thesis in Antropological Sciences, Firenze, 2004.

[10] HENDERSON Charlotte, *When hard work is disease: the interpretation of enthesopathies*, in BRICKLEY Megan, SMITH Martin (edts): *Proceedings of the eighth annual conference of the British Association for Biological Anthropology and Osteoarchaeology*. Oxford, British Archaeological Reports. Int. Series 1743, pp. 17- 25, 2008.

[11] MINOZZI Simona, ZABOTTI Federica, *Elaborazione di metodiche comuni. Una banca dati archeologica ed antropologica per la gestione dei dati di scavo*; Collection de l'Ecole française de Rome, 2008.

[12] COSCHINO Francesco, FORNACIARI Gino, MINOZZI Simona; *Computer models and application for the management of anthropological data*; in «JASs», n. 88, 2010 , pp. 195-199.

[13] CINTI, Alessandra, *Archiviazione informatica dei dati antropologici rilevabili sullo scheletro: proposta di una schedatura individuale*, in MICHELETTI CREMASCO Margherita., SCALFARI Francesco (edts): 1961-2011: *Cinquant'anni di Congressi. Passato, presente e futuro dell'Antropologia* - XIX Congresso AAI, Torino, 21-24 Settembre 2011; Asti, 23 Settembre 2011. Quaderni di Asti Studi Superiori, Diffusione Immagine Ed.

[14] As for Biologist Anthropologist: DESTRO BISOL Giovann., ANAGNOSTOU Paolo, CAPOCASA Marco., BENCIVELLI Silvia., CERRONI Andrea, CONTRERAS Jorge., ENKE Neela., FANTINI Bernardino, GRECO Pietro, HEENEY Catherine, LUZI Daniela, MANGHI Paolo, MASCALZONI Daniela, MOLLOY Jennifer C., PARENTI Fabio, WICHERTS Jelte M., BOULTON Geoffrey, *Perspectives on open science and scientific data sharing: an interdisciplinary workshop*, in «JASs », 92, 2014, pp. 1-22.

[15] AMORETTI Valeria *Adapt or die: strategie di sopravvivenza dell'archeologia funeraria in tempi di crisi*, in *proceedings of the VII congress of Medieval Italian Archeologists* (Lecce, 9-12 September 2015), *in press,.*

[16] LIPPI Barbara, *Caratteri non metrici dello scheletro*, in MALLEGNI Francesco, LIPPI Barbara (edts.), *Non Omnis Moriar*, Roma, 2009, pp. 139-148.

[17] ACŚADI George., NEMESKÉRY Jànos., *History of human life span and mortality*, Budapest, Akadèmiai Kiadó, 1970.

[18] LORA Sebastiano, BERTOLDI Francesca, *Indicatori ergonomici*, in Mallegni F., Lippi B. (edts.), *Non Omnis Moria*r, Roma, 2009,pp. 149-167.

[19] FRANCOVICH, Riccardo, *Per un sistema informatico applicato alla "risorsa" beni culturali: l'esperienza degli archeologi medievali senesi*, in DI GANGI Giorgio., LEBOLE Chiara Maria (edts.), La gestione del territorio. Memoria, partecipazione, sviluppo della ricerca. Proceedings of National Congress (Saluzzo 11-12 novembre 2000), Dronero (CN), Edizioni L'Arciere (Artea – Cultura e Territorio), 2001, pp. 1-11.

[20] NAZIONALE, Vittorio. Informatica applicata all'archeologia: prototipo di un sistema GIS dello scavo del Castello di Ocre (AQ). Unpublished Thesis at the University of L'Aquila, 2009.

[21] MALLEGNI, Francesco. LIPPI, Barbara 2009, *Non omnis moriar. Manuale di antropologia*. Rome.

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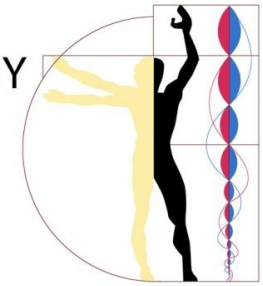

Naples, the modern living sense
A comparison between residence and society after World War II

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Abstract
There are two distinct Naples, wrote the Italian journalist Guido Piovene[1] in 1957: one that is «touristic-bourgeois, and a poor and dark one, whose inhabitants, ignore even the sea.[…] The expansion of residential buildings occurred , like everything in Naples, both with the law and with the authority of the fait accompli. A genuine vitality saved Naples from ugliness». Since the 1950s, the focus of historiographical attention has always been placed on the building production in a quantitative sense. Years later, we can notice the absence of a multidimensional approach, no large-scale effort evaluation on the conditions of the frame and on the number of parties that have helped to change the Neapolitan's residential landscape during those years.
This paper focuses the attention on the relationship between the inhabitants of Naples and the residence after World War II. In this social and cultural climate, legitimized by the shortage of housing, with a take-off in the housing market and a rising middle class, arose the opportunity for many entrepreneurs to build exclusive residences located in central or scenic areas. A key aspect reconstructed by the consultation of the Neapolitan newspaper "Il Mattino", unpublished source, from which for the period 1950-1960, were extracted all the estate advertising published. They represent a real paradox, because the newspaper was famous for complaints against the abuses of the territory.

Keywords: Naples, Modern living, Heritage, Landscape, Estate advertising

Section
All wars involve death and destruction. Naples, has been characterized by both. Naples was the hardest city hit. After World War II, the situation of the lower classes was so tragic, that it is even difficult to realize it.
In the early 1950s, around fourteen people were living in each room and, every slum could fit eighteen people. If the scope of survey was enlarged to the entire region, the demand for habitable rooms reaches 813,776. Thus, Campania took the first place and was followed by: Puglia 717,240, Sicily 498,171, Lazio 476,401, Calabria 339,391, Basilicata 197,253, Sardinia 47,920, Emilia 35,061, Umbria 6,180 and finally Abruzzo and Molise that reached 5,394.
The first national survey highlighted that, in 1931, the average index of crowding was 1.79 for each room, against 1.36 for Rome, 1.22 for Milan, 1.13 for Turin, and 0.89 for Genoa. Actually, 50% of the population, composed by the less privileged, far exceeded 2.65. No less than 396,185 Neapolitan lived in pitiful conditions (more than a third of the population): 35,000 homes were without drinking water, 75,000 without toilets, 38,000 without kitchen. In all Naples, there were only 12,000 bathrooms.
The notorious "bassi", generally ground floor apartment of one or two rooms, with direct access from the street, were 25,000 and gathered 102,000 people. Basically, to match the crowding index of Milan, they needed up to 104,000 rooms. To align it with Genoa they required 447,000. After the statistics of 1931, in 1939 there was a significant increase in population, but at the same time, the building development was at 20,000 rooms. Immediately after the war, the crowding index became 2.11 with annual population growth of 15,000 units. The buildings completed or to be completed at the dawn of 1950s were about 47,000 rooms against the 300,000 needed to bring the overcrowding indices in adequate numbers[2].

Despite the government intervention, the deplorable condition in which, “bassi” inhabitants and even worse, those who lodged in the caves, were forced to live, was unchanged until the beginning of the second half of the XX century. A survey in the first half of the fifties, of the *City of Naples Statistics Office*, stated that the death rate for infectious diseases and tuberculosis in the city, was among the highest ever occurred. A mortality, resulting from the overcrowding of the population, reduced to living in desperate conditions after the huge gaps caused by the war within the building heritage[3].
During the war, the repairs to damages caused by the bombs had to be carried out on site by local entrepreneurs, because all the others were engaged in the military effort. So that, a series of small entrepreneurs and speculators, enrolled in the lists of the Ministry of Public Works, for the award of contract.
Public works that begin to appear, were a huge financial sacrifice for the state. In the early 1940s, all the measures were designed to make the building the core of the economy, in order to provide a way out to a mass of unemployed, with low costs wages. For example, the law of the Minister Aldisio, which aimed to create a permanent fund for granting loans for increased construction activity, was appealing to those who intend to rebuild buildings damaged or destroyed by war. The builder obtained the 75% of eligible expenditure. The law stated that the loan had to be granted and paid according to the progress of the work and, especially after it had been shown the occurred expenditure of 25% by the builder constructor. The houses had to have the features provided by the Consolidated Building Exhibition of 1938, while the supply of funds was to be placed in a prior opinion of the Superior Board of Public Works.
The delivery system was cyclical, funds were granted with interest rate at 4% redeemable in 35 years, and the sums repaid including interest, had to be used for the provision of new funds. This situation, amplified by the public offices, unable to carry out checks, attracted many businessmen who had no idea about the organization and fulfillment of a building intervention [4].
«Venne un periodo nel quale, invece di essere i proprietari ad interpellare le imprese, erano queste che andavano a visitare i proprietari, per convincerli a permettere loro di svolgere la pratica necessaria per l’esecuzione dei lavori»[5].
This is actually how the postwar boom started. In the following years, given that it wasn’t arranged a National Registry of Contractors, tenders for public projects were gained with discounts up to 40% by improvised entrepreneurs who didn’t have the capacity for taking on the task. By underestimating repairs and restorations, the main concern was to spend a little as quickly as possible, saving on materials, on dosages of mixtures, on the amount of iron and on the salaries of the workers too.
From a technical-planning point of view, the realizations were at low cost through the limitation of all onerous elements and the unification and uniformity of construction, with the possibility of adaptation of the plant with four apartments on each landing.
The exterior of the buildings could be different with inexpensive devices. With only ten buildings of four stairs, we could have 96 minimum apartments, able to accommodate 6,000 people. The same plan with a simple moving of partitions could originate apartments with different number of rooms[6].
The idea was the best to simplify the problem[7].
After a while, these earning opportunities were already outdated, so entrepreneurs searched for new sources of income. They ran to the construction of residential blocks for a new middle class, eager to abandon unhealthy city center. Often these new homes, notwithstanding any planning instrument stood in agricultural area, the same areas previously used for the construction of products for public building. Paradoxically, the public wards precisely for their morphology and architectural quality produced serious repercussions on ancient units and their environmental contexts.
A sort of opening words to de-regulation[8] .
In agricultural area were built Ina-Casa neighborhoods of Secondigliano (6,630 rooms); Barra (9,200 rooms); Ponti Rossi (2,218 rooms), Via Stadera (1,132 rooms) and the neighborhoods "La Loggetta" (3,833 rooms), Via Campegna (2,300 rooms) and Via Arlotta (540 rooms); in Fuorigrotta, Ina - Casa and IACP institutes realized together the settlements of Soccavo - Canzanella (7,900 rooms), Capodichino (3,177 rooms) and Capodimonte (780 rooms). Civil Engineers built in Capodichino 3,272 rooms of “Rione S. Francesco”. Other public interventions of those years were Ponticelli, Agnano, Bagnoli, and Miano – Piscinola [9].
Private initiative, in and of itself enterprising, didn’t drop this opportunity, and in a few years, residential construction, invaded green areas and gardens, transforming Neapolitan landscape.
Above all that, we can add that while the neighborhoods of affordable and popular housing, no matter how deficient, had an orderly and regulated joint; private interventions, aimed only at the maximum exploitation of the individual funds, regardless of neither architectural banality nor urban and landscapes mortifications.



Fig. 1: A view of "Parco Comola-Ricci" in 1880 from "Gradini Tasso".



Fig. 2: A view of "Parco Comola-Ricci" at the beginning of the XX century from "Gradini Tasso". Alinari's picture



Fig. 3: A view of “Parco Comola-Ricci” in the 40s from “Gradini Tasso”.



Fig. 4: A view of “Parco Comola-Ricci” in 2013 from “Gradini Tasso”.

In this early Naples, there were various newspapers interested in the problems of the city, one of the most famous ones “Il Mattino” denounces the urban problems in several articles.
By consulting the articles from 1950 to 1960, it can be understand how much the newspaper, every day, through precise documentation, interventions of citizens and reports of administrative affairs, tried to raise public awareness, sometimes managing to arise scandals and investigations.
The paper gives a very detailed social framework of Naples, hard to find in the pages of history books. However, over the years, we realize a genuine paradox: if the first few pages are continuously dedicated to the landscape slashes and its preservation, the latest leave ample space, perhaps for economic interests, to a new media trend: the estate advertising.



Fig. 5: Estate advertising in “Il Mattino” 1957



Fig. 6: Estate advertising in “Il Mattino” 1957

The listings of dream panoramic real estate, with luxurious finishes, reached the peak of publications in the mid- fifties, just during the absence of valid urban regulations by the side of administration.
In Naples two souls of the bourgeois city are distinguishable, the big bourgeoisie represented by families traditionally rich and a "new bourgeoisie". The first identifies the house as a means to "remind" the achievements of the family, perhaps with an impressing but at the same time sober building, as befitted a family whose rank was already known. For the "new bourgeoisie" the house becomes middle-class dream achievement, for whom the house became affirmation of a social position, a sign of recognition of an economic solidity aimed. This bourgeois push, leads to the emergence of new residential neighborhoods, that strengthen and consolidate their status and their social success.
The homes became the modern realization of modern requirements, and the lack of respect for urban deeds agreed to such exclusivity, privatizing all the most valuable landscape funds. Naples would lose some of its most beautiful views. A part of landscape that had belonged to everybody’s history, soon would become just for a few privileged.
Properly the exclusivity of the scene is the basis of the projects of each building in value areas, often from the second floor to the last, taking advantage of the difference in orographic level, no building volume prevents another vision.



Fig. 7: Estate advertising in "Il Mattino" 1956



Fig. 8: Estate advertising in "Il Mattino" 1950

It was 1 April 1950, and the municipality tried to intervene in this way to regulate new construction:

«Si ricorda che per le opere edilizie occorre munirsi, a norma delle vigenti disposizioni legislative e regolamentari, delle relative licenze, prima dell'inizio delle opere stesse. Gli interessati sono diffidati ad attenersi strettamente a quanto sopra, per non incorrere, oltre che nel procedimento contravvenzione, nel danno della demolizione delle opere abusivamente costruite»[10]

As pointed out, the administration highlights how normal it was, in those years, to produce works in contravention of planning instruments. It can not overlook, however, that among so many bad building, stand out interesting examples that epitomize modern living. The buildings architecturally more interesting and mostly unknown to the historiographical panorama are many, all signed by the most important postwar Neapolitan architects. While they were working in known neighborhoods, they didn't disdain to design buildings for local entrepreneurs.
An example is definitely the agglomerate Comola Ricci, between Corso Vittorio Emanuele and Via Tasso. It was one of the most extended real estate project of those years, thanks to licenses notwithstanding the scenic route.
Many the buildings in the signature of renowned architects, from Michele Capobianco that with Arrigo Marsiglia designed three buildings, to Giulio De Luca who designed a villa .
The area today is quite neglected and in decay, due to the presence and conflict among several property administrators, with a consequent lack of maintenance works to prevent typical landslides of an area poorly suited to building.
These buildings now crumbling and to renovate, are a great heritage that must be urgently subject of building restoration. A social, political and at the same time planning problem, that's why it is important to study without stray from moralism.

Bibliographical References

[1] PIOVENE, Guido, *Viaggio in Italia*. 10ª ed. Verona: Arnoldo Mondadori Editore, 1960. 332 p.
[2] *Diciotto persone in un basso*, in: "Il Mattino", May 09th, 1950, Cronache di Napoli
[3] *I puntigli della burocrazia ostacolano la ricostruzione*, in: "Il Mattino", April 14th, 1950, Cronache di Napoli.
[4] ALLUM, Percy, *Potere e società a Napoli nel dopoguerra*, Torino: Einaudi, 1975.
[5] DI STEFANO, Organizzazione e tradizione dell'edilizia napoletana, in AA.VV. *Napoli dopo un secolo*, Napoli: Edizioni Scientifiche Italiane, 1961.
«There was a period in which, instead of being the owners to consult businesses, the latter came to visit the owners, trying to obtain the permission for work execution»
[6] *Per i senzatetto e i senzatutto*, in: "Il Mattino", September 06th, 1950, Cronache di Napoli.
[7] GAMBARDELLA, Carmine, L'architettura della normalizzazione nel dopoguerra a Napoli, in MOLINARI, Luca, *La Napoli degli americani. Dalla liberazione alle basi Nato,* Napoli: Meridione Sud e Nord nel Mondo, 2011
[8] DONOLO, Carlo, *Disordine,* Roma: Donzelli Editore, 2001.
[9] *L'urbanistica a Napoli dal dopoguerra ad oggi: note e documenti*, DE LUCIA, IANNELLO, in: "Urbanistica", n. 65, 1976.
[10] *L'intervento del Comune*, in: "Il Mattino", September 02th, 1950, Cronache di Napoli.
«Reminded that, for the building works, it should equip themselves on the application of regulatory and legislative orders, of the necessary licenses, before the beginning of the works. Interested parties are warned to adhere strictly to the above, in order to avoid penalty and damage of illegally constructed works demolition».
[11] MANZO, Elena, *La città che si rinnova. Architettura e scienze umane tra storia e attualità: prospettive di analisi a confronto,* Milano: Franco Angeli, 2012.
[12] GAMBARDELLA, Cherubino, *Centomila Balconi. Per una nuova bellezza dei quartieri italiani*, Firenze: Alinea Editrice, 2005.
[13] GAMBARDELLA, Cherubino, *Posillipo Moderna*, Napoli: Clean, 1999.
[14] DE SETA, Cesare, *L'architettura a Napoli tra le due guerre*, Napoli: Electa, 1999.
[15] ALISIO, Giancarlo, *Napoli millenovecento*, Napoli: Electa, 1999.
[16] CASTAGNARO, Alessandro, *Architettura del Novecento*, Napoli: Edizioni Scientifiche Italiane, 1998.
[17] DE FUSCO, Renato, *Napoli nel Novecento*, Napoli: Electa, 1994.
[18] BELFIORE, Pasquale, GRAVAGNUOLO, Benedetto, *Napoli Architettura ed urbanistica del Novecento*, Bari: Laterza, 1994.
[19] PETRELLA, Bianca, *Napoli. Le fonti per un secolo di urbanistica. Esposizione cronologica dei provvedimenti urbanistici realizzati e non realizzati a Napoli dal 1986*, Napoli: DI.PI.S.T., 1990.
[20] ALISIO, Giancarlo, *Il Vomero*, Napoli: Electa, 1987.
[21] COCCHIA, Carlo, *Due Regolamenti edilizi per la città di Napoli, 1886 e 1935*, Napoli: Edizioni Arti Grafiche, 1958.
[22] CASTELLI, Michele, *Napoli, le opere del Regime dal settembre 1925 al giugno 1930*, Napoli: Francesco Giannini & Figli, 1930.
[23] CHIERICI, Gino, *Per la tutela delle bellezze naturali della Campania,* Roma: Bestetti & Tumminelli, 1925.
[24] DE SIMONE, Francesco, *Piano regolatore della città di Napoli*, Milano: Dante Alighieri, 1922.

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Figura praesentis urbis Nolae: geometric theorems and classical sources in Renaissance's urbanism and in *De Nola* by Ambrogio Leone.

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Abstract
In 1514, Ambrogio Leone (1458/59-1525) published in Venice *De Nola*, a work destined to great success during the Renaissance.
Four tables are attached to the text, one of which, representing the city of Nola and another with the *ager nolanus*, already subject to a series of studies.
One of these, totally neglected by critics, contains the geometric proof of the size relationship between Nola city in Leone's time and the ancient city. The table's analysis allows to reconstruct the training of the author, his sources and the issues of his work.
It is a series of drawings, according to which Leone draws the "Figura praesentis urbis Nolae" starting from a rectangle, within which are traced further quadrangular figures.
An examination of these sketches permit the assertion that they and city's plan are drawn on the basis of the well-known theorem of Plato's *Menon*; on the other hand, they derive from the drawings of *gromatici veteres*, from which Leone also picks up the decorations in the lower part.
The table thus proves to be a valuable source for reconstructing the *milieu* of reference of Leone and also noting in plan well-known of Nola the prototype of an unprecedented application of the golden section to urban planning and topography.
Through the interpretation of Leone and on the basis of Platonic dialogue, the image of the sixteenth century city is no longer just an accurate architectonic survey, but a manner of representing the *virtus* embodied in civic monuments.

Keywords: *antanairesis*, golden section, Renaissance's cartography, architectonic representation, Platonic geometry.



Fig. 1: Ambrogio Leone, *De Nola*, II, 2. Geometric demonstration of the size relationship between the Renaissance's city and the old one. Detail.

1. *De Nola* by Leone and its cultural context

In 1514, the publication of *De Nola* by Ambrogio Leone (1458/9-1525) marked a milestone, still vital, not only for the history of the *ager Nolanus*, but for the European cultural context[1]. The work, published by the typographer Giovanni Rosso Vercelliano, consists of four topo-geographical tables attached into the text, engraved by Girolamo Moceto (1458-1531) who was painter, engraver and collaborator of Giovanni Bellini[2]. Three of those tables - about the territory, the city and its monuments - were extensively analysed by critics[3]. The fourth table, instead, has not yet been analysed, because it was probably considered marginal compared to the other. It contains the geometric demonstration of the size relationship between the city of Nola in the time of Leone and the ancient one, according to a construction that goes articulating progressively through a succession of four different figures obtained from a square based and arranged in two lines, one central, below the profile of the city, and a lower.

The geometric construction performed by the author, physician and philosopher, friend of Pontano and Erasmus of Rotterdam[4], is very important for a proper examination of scientific knowledge of the Renaissance, and assessment of the classicism impact on the emerging of cartographical science.

The image is actually a corollary to the Chapter II of the Book II of *De Nola*, entitled *De Figura et ambitu praesentis Urbis*, in which the author compares the shape of the sixteenth-century city with the ancient one.

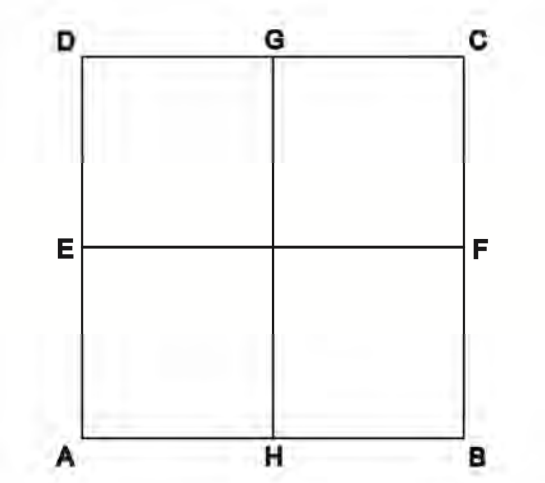

Fig. 2: Plato, *Meno*, 80d. Graphic reconstruction (by S. Carillo 2015)

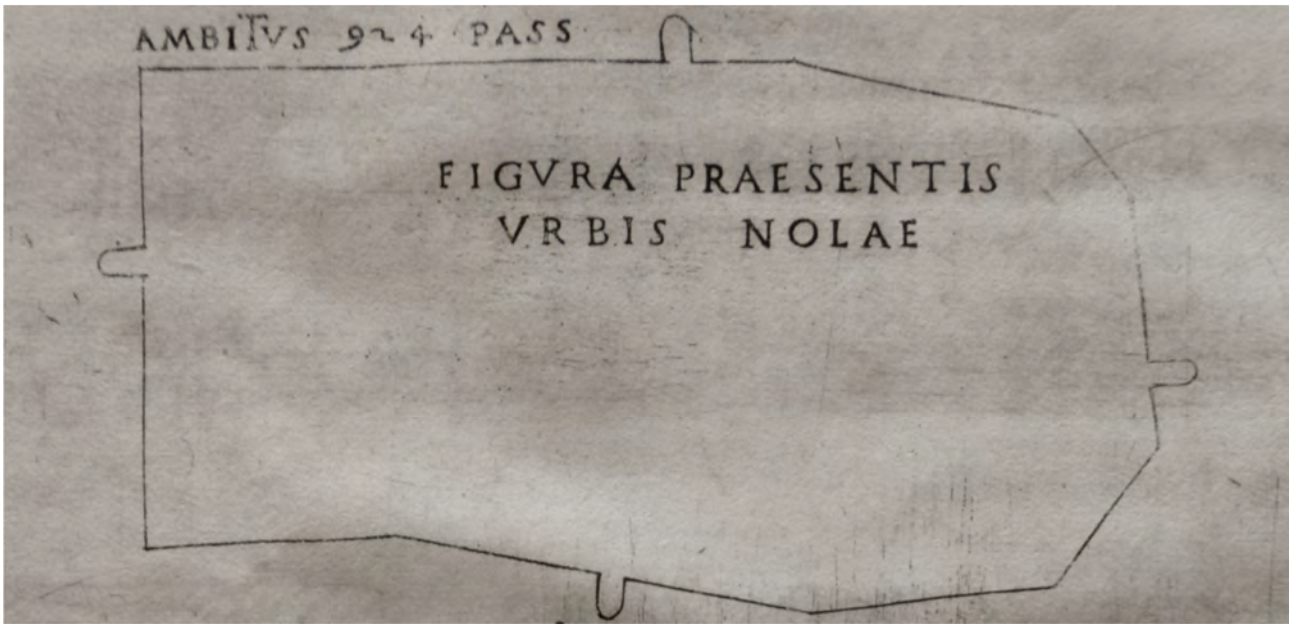

Fig. 3: Ambrogio Leone, *De Nola*, II, 2. Geometric demonstration of the size relationship between the Renaissance's city and the old one. Detail of *urbis Nolae*

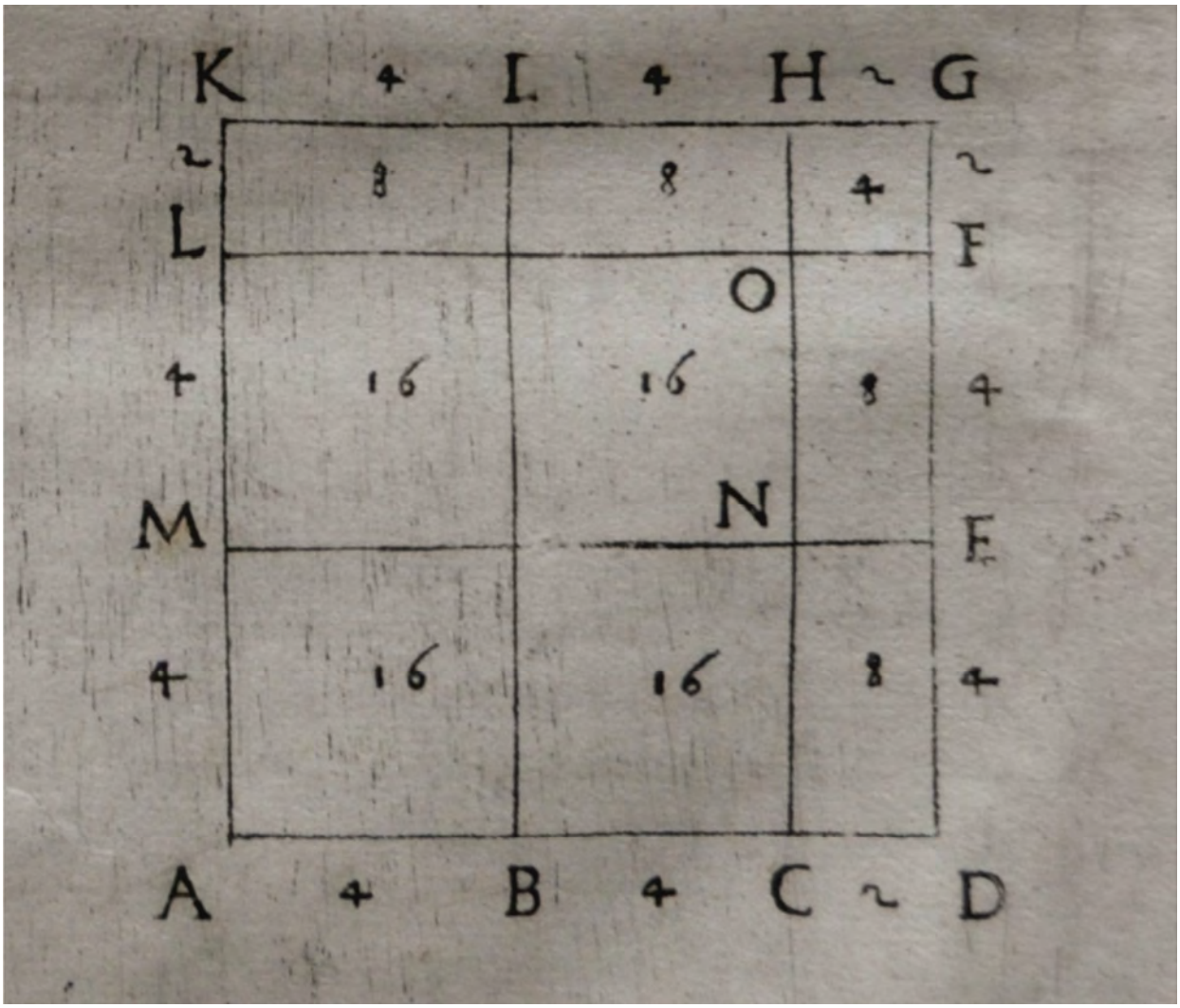

Fig. 4: Ambrogio Leone, *De Nola*, II, 2. Geometric demonstration of the size relationship between the Renaissance's city and the old one. Detail

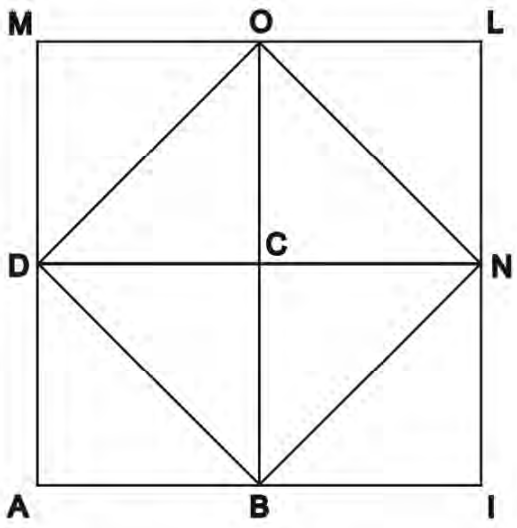

Fig. 5: Plato, *Meno*, 84d-e. Graphic reconstruction (by S. Carillo 2015)

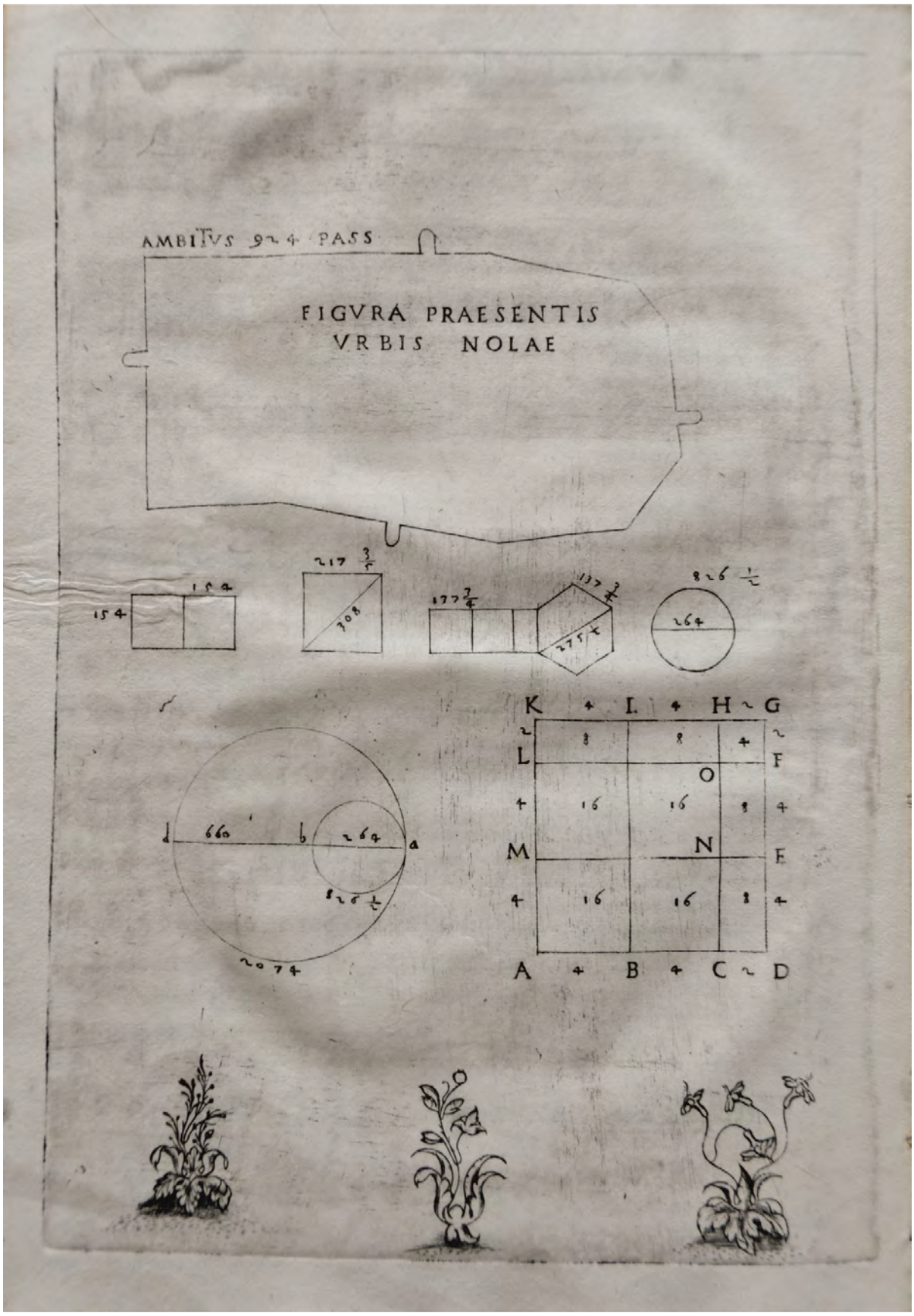

Fig. 6: Ambrogio Leone, *De Nola*, II, 2. Geometric demonstration of the size relationship between the Renaissance's city and the old one.

2. The *antanairesis* in *De Nola*

In the upper part of the table, in fact, the town outline has signed by "Ambitus 924 pass" and, in the cited chapter, we read «mensus vero ambitus noningentorum ac XX quattuor passuum inventus est».

The table translates graphically what Leone writes in the text to explain, from a geometrical point of view, the shape that the city has taken on: the middle part of the table shows the town centre area contains two squares, whose sides are a hundred and fifty *passus* each, and these squares, joined, form a large square that is two hundred and eighteen paces and three-fifths paces on each side and its diagonal measures three hundred and eight steps. The two squares, joined together with half part of one of them, are equal to a hexagon, whose sides are equal to each one of the two squares. Thus, the humanist concludes «Areae itaque Nolanae, quod ad quadrilateram speciem redacta fuerit, ambitus orae erit octingentorum ac septuaginta passuum fere, diametrus vero trecentorum et octo fere, redactae vero in speciem sexangulam erit ambitus octingentorum XXVI cum semisse, diametrus vero ducentorum septuaginta quinque cum semisse»[5].

The procedure is applied to the city area of the sixteenth century to demonstrate that the surface of the ancient settlement was six and a quarter times that one of the town in Leone's age, as shows the quadrangular drawing on the bottom right of the sheet.

Just because this sketch has never been considered, it was not recognised as it is raising a fundamental concept of Greek philosophy, the *antanairesis*, which inspires one of the most famous Platonic dialogues, the *Meno*. In the final chapters of his work, Plato shows in fact the so-called "quadrature", the construction of a square twice to a given one[6].

To illustrate *anamnesis*'s theory, Socrates leads the slave Meno from a wrong answer to the correct solution of the problem: the square whose area is twice to a given one is drawn on its diagonal (84d-85b).

Leone resumes from the Plato's text not only the procedure, but also the measures as four, and sixteen, its multiple, are the basis of the Socratic theorem, wherein the first square has a side of 4 *passus* (84d).

In the *Meno*, the first act of the geometric explanation, concerns the problem (82B-82E): the question posed by Socrates to the slave regards the side length of a square has the area twice that of the given square, explaining the construction of the double square by the diagonal of the same square. Socrates draws a square with a two *passus* side, and shows that it has an area of 4 square *passus*; therefore, proposes to double the square itself by drawing another square that has an area that is double the first one, of eight square feet. In

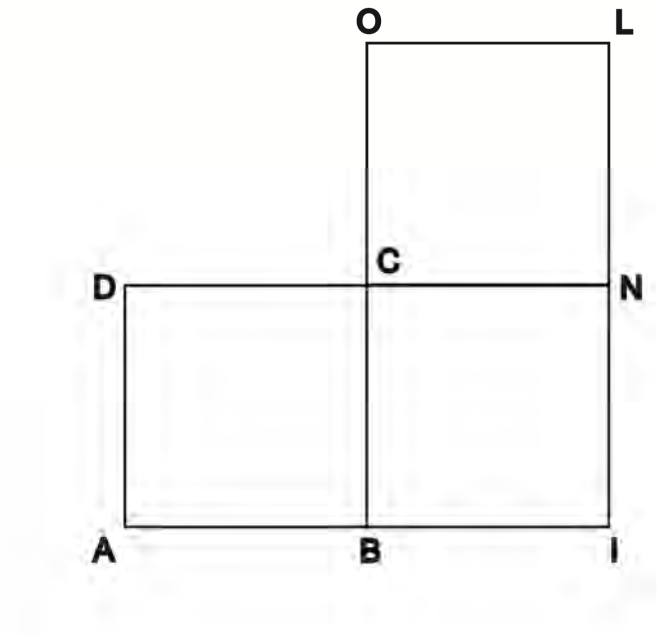

Fig. 7:Plato, *Meno*, 84d. Graphic reconstruction (by S. Carillo 2015)

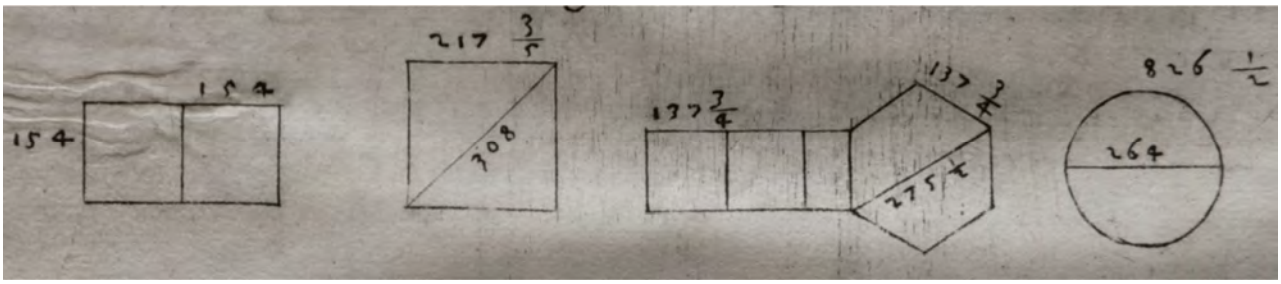

Fig. 8: Ambrogio Leone, *De Nola*, II, 2. Geometric demonstration of the size relationship between the Renaissance's city and the old one. Detail (cfr Plato, *Meno*, 84e-85b)

two failed attempts to specify the side of the double square, the slave chooses 4 as double side of the given square, at the first time.The area of the new square would then be 16 (4 x 4), while the squadre's area twice the first one should be 8. The edge is too large, and therefore Socrates proposes to try with the side measuring 3, but because 3 by 3 is 9 so not even get the area 8. At this point it is evident the fallibility of each arithmetical solution to the problem, consisting in finding a square number that is double of another square number. Socrates then suggests to the slave to indicate square's double side without any numerical calculation, but by the geometry, thus hinting incommensurability of the diagonal and of the square side.

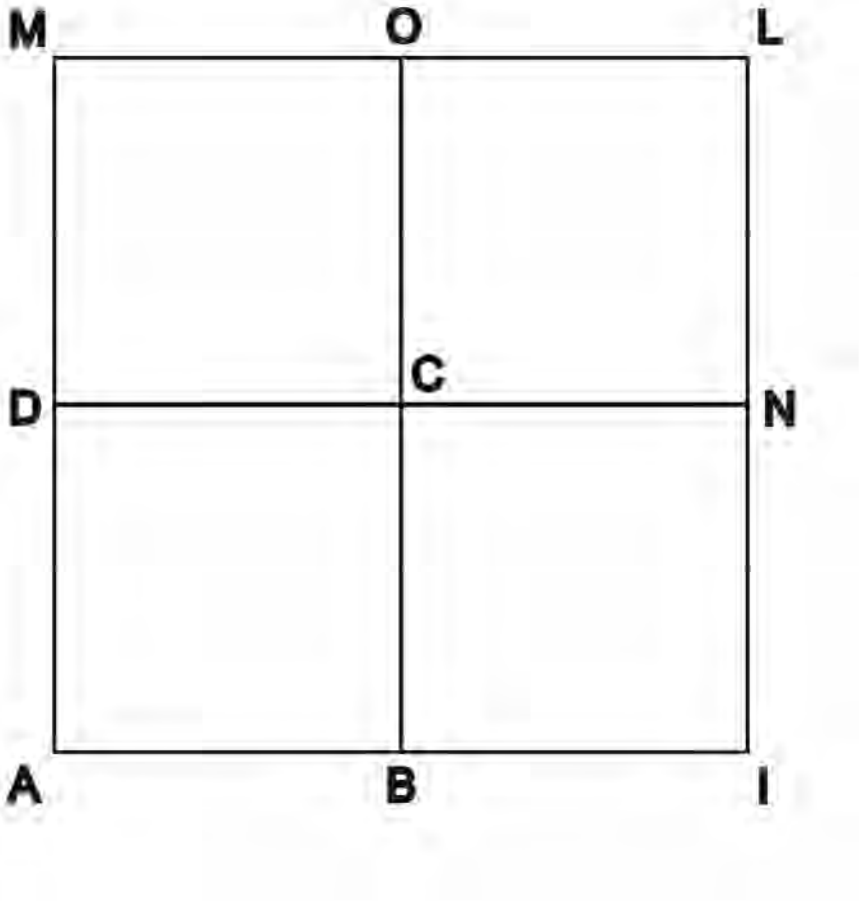

Fig. 9: Plato, *Meno*, 84d. Graphic reconstruction (by S. Carillo 2015)

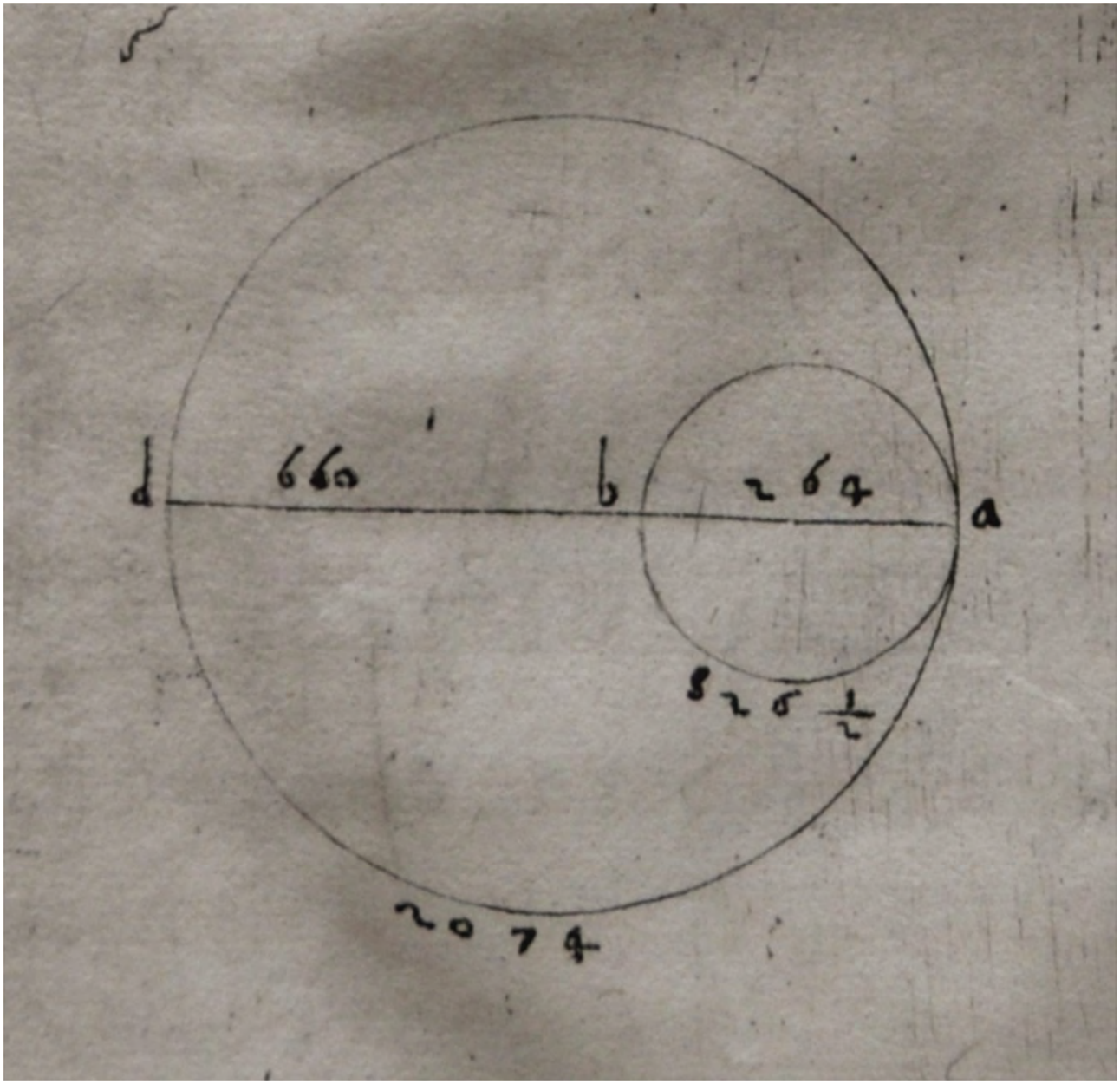

Fig. 10: Ambrogio Leone, *De Nola*, II, 6. Plan of Nola in Leone's time.
Detail: the construction of the circle from a given square

3. Platonic *antanairesis*

The procedure is therefore the same of the Platonic *antanairesis*, which is not surprising, considering that Leone knew deeply classical philosophy of Aristotle and Plato, as his philosophical works shows[7].

However, Leone does not refer purely and simply to the platonic reasoning, but fits it into a larger framework, making it functional to the celebration of the city: the reference to the classical sources, in fact, is not an end in itself, but in *De Nola* it is a condition of the perfection of city shape as in the Platonic text, as the political and civil perfection celebrated in the Essay.

The same size used in the last square (4 with its multiples and submultiples) is the explicit reference to the original, thus implying the feature of innate virtue that is the basis of the *forma urbis* of humanist's birthplace.

The platonic theorem is, for the Philosophy and the Science of the Renaissance, a reference point, especially for its deeper meaning, linked to the incommensurability idea, introduced from the *Meno*, always in the mathematical and geometric context, of the square and its side.

In a famous paragraph of *Nomoi* (819d), the Athenian reproaches to the Greeks with the ignorance of a discovery as big as that of incommensurability, he would expand for the first time exactly in the *Meno* and then, in more detail, in the *Theaetetus*[8].

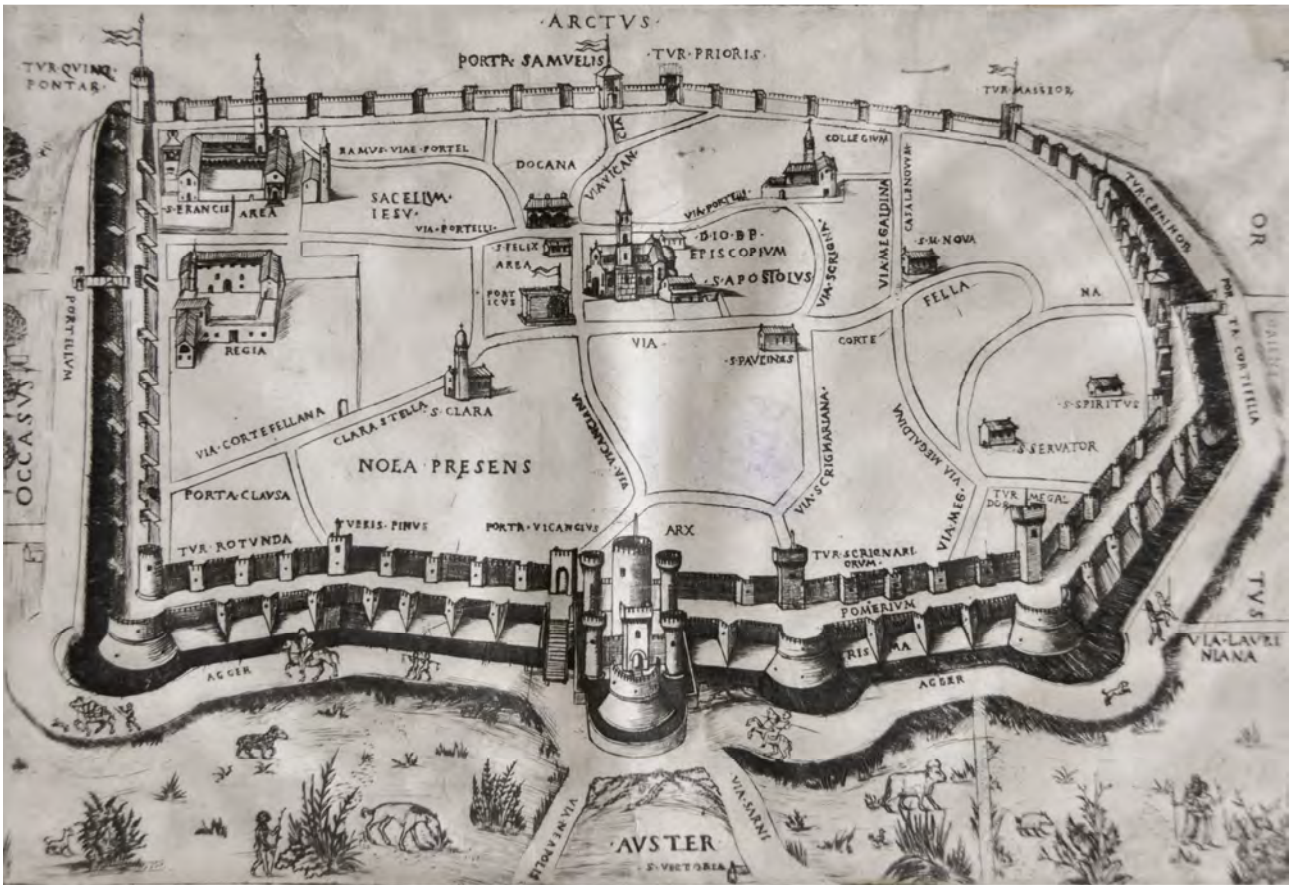

Fig. 11: Ambrogio Leone, *De Nola*, II, 6. Plan of Nola in Leone's time

4. The *antanairesis*: the irrational mathematician as a great event of the spirit

The fact that the philosopher returns on a purely mathematical topic in a political text as the *Nomoi*, is the most obvious indication of the role played by *antanairesis*, in the greek cultural system, within which it guarantees the existence of innate ideas and then of platonic 'iperuranio'.
Previously in the paragraph 82B, the topic is announced in all its metaphysical scope: up to this moment Socrates and the boy discussed about the sides' length and the square's areas, in terms of arithmetic quantity, numerically calculable. Suddenly, though, from the this moment the Athenian introduces the term πηλίκη – instead of the previous ποσόν- term which occurs in the definition of *logos* (*ratio*) of Eudoxus, preserved in Euclid's *Elements*[9] and which deeply affects the reflection of the classical age and of Renaissance, not only in the field of mathematical sciences.
Later in the Platonic dialogues, the side of the double square becomes the ineffable diagonal of the *Politeia* (546C), while in the Sophist the use of terms such as 'irrational' or 'ineffable' in the context of "Parmenides patricide" reveals the discovery of the irrational mathematician as a major event of the spirit.
Ambrogio Leone - one of the first popularizers of Platonic thought in the West[10] and so remembered by Erasmus of Rotterdam[11] in his own lifetime - applies Plato's procedure to the Nolan *imago urbis*, and crystallises conceptual operation about the city shape's drawing among the virtuous activities that are proper of the human mind, and then, as Plato, he puts political activity among the great spiritual ones, crystallising through his city shape an 'spiritually' unique event.

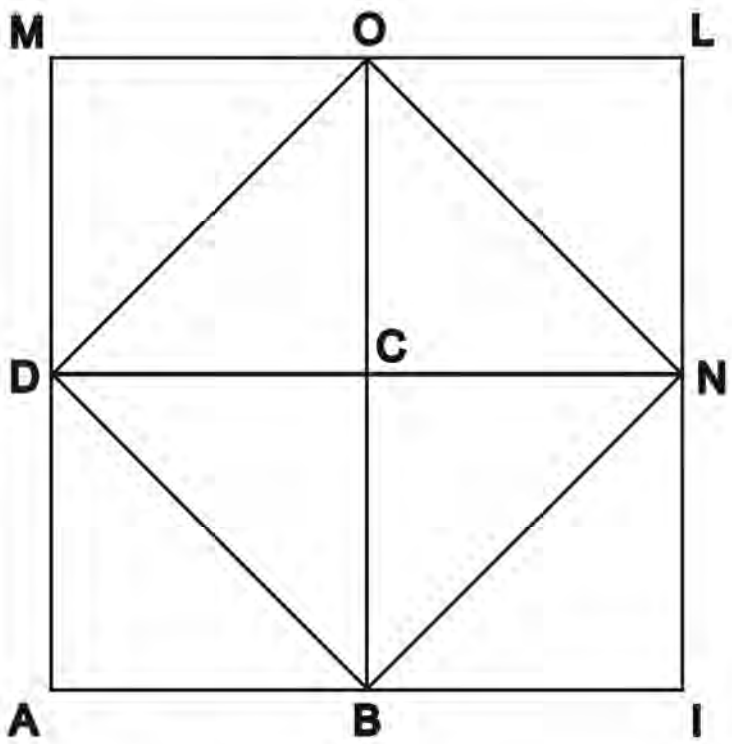

Fig. 12: Plato, *Meno*, 84e-85a. Graphic reconstruction (by S. Carillo 2015)

This cultural operation is deliberately part, as seen from the layout and the ornamentation, in the long iconographic tradition of *gromatici veteres*[12] and is inserted, for these features, as part of the cartographic representations of Renaissance. They, at least from the sixteenth century onwards, diffuse, in addition to geographical data, mostly moralizing notions and philosophical-metaphysical concepts[13]. For this reason, some critics have pointed out that, during the chronological fraction of the Renaissance, "a map is not always a map," with reference to content's polysemicity typical of city's representations of this age.
The map attached to *De Nola*, then, is not just a simple graphical representation of mathematical calculations, but it is a milestone in the cartography of the time, as a *medium* of content that go beyond the bounds of historiography and mapping. It, although falling in the vast area of the relationship between space and power, typical of the Renaissance representations, test the interest of Leo for the ideological motivations of power itself, thus contributing to throw a new light on the entire treaty of the humanist.

Bibliographical References

[1] DE SETA, Cesare; BUCCARO, Alfredo (ed. by) *Iconografia delle città in Campania: Napoli e i centri della provincia*, Napoli: Electa, 2006. ISBN 9788851003241.

[2] DEFILIPPIS, Francesco. Tra Napoli e Venezia: il De Nola di Ambrogio Leone. *Quaderni dell'Istituto Nazionale di Studi sul Rinascimento*, 7 (1991), p. 25-64

[3] SPRUIT, Leendert. sv Ambrogio Leone. *Dizionario Biografico degli Italiani*, 64 (2005). ISBN 978-88-88690-36-0.

[4] PETRELLA, Giancarlo. *L'officina del geografo. La «Descrittione di tutta Italia» di Leandro Alberti e gli studi geografico-antiquari tra Quattro e Cinquecento*. Milano: Vita e Pensiero, 2004. ISBN 9788834311202

[5] TOTH, Imre. *Aristotele e i fondamenti assiomatici della geometria. Prolegomeni alla comprensione dei frammenti non-euclidei nel «Corpus Aristotelicum»*, Milano: Vita e Pensiero, 1998. ISBN 88-343-0085-8

[6] TOTH, Imre. *I paradossi di Zenone nel Parmenide di Platone*. Napoli: Istituto Italiano per gli Studi Filosofici, 1994. ISBN 8834300858-

Notes

[1] CARILLO, Saverio. *Alcune osservazioni sulla pianta della città allegata al De Nola di Ambrogio Leone*, in TOSCANO, Tobia R. (ed. by) *Nola e il suo territorio dalla fine del Medio Evo al XVII secolo. Momenti di storia culturale e artistica*. Castellammare di Stabia: Ager Nolanus, 1996, p. 25-43.
[2] PIGLIONE, Cinzia. *Le arti minori nei secoli XV e XVI*. Milano: Jaca Book, 2000, p. 45. ISBN 88-16-43112-1.
[3] CESARANO, Mario. Il disegno dell'anfiteatro di Nola in alcune pergamene aragonesi di Napoli. *Symbolae Antiquariae,* 4 (2011), p. 49-82.
[4] MAIURI, Amedeo. *Sul De Nola di Ambrogio Leone, in Studi in onore di Riccardo Filangieri*, II, L'Arte Tipografica, Napoli 1959, pp. 261-271; SCHMITT,Charles B. sv in BIETENHOLZ, Peter G.-DEUTSCHER, Thomas B.-GUENTHER, Ise-GUNDERSON, Catherine F. (ed. by). *Contemporaries of Erasmus. A Biographical Register of the Renaissance and Reformation*, 1-3. Toronto: University of Toronto Press, 1995^2, p. 322-323. ISBN 9780802085771; PETRELLA, Giancarlo. *L'officina del geografo. La «Descrittione di tutta Italia» di Leandro Alberti e gli studi geografico-antiquari tra Quattro e Cinquecento*, Milano: Vita e Pensiero, 2004, p. 145. ISBN 9788834311202.
[5] LEONE, Ambrogio. *De Nola*, Venetiis 1514, II, 2.
[6] 82B-86C.
[10] LEONE, Ambrogio. *Castigationes adversus Averroëm*, Venetiis 1517; *De nobilitate rerum dialogus*, Venetiis 1525.
[11] FRAJESE, Attilio. La scoperta dell'incommensurabile nel dialogo Menone. *Bollettino Unione Matematica Italiana,* 9/1 (1954), p. 74-80.
[12] Euclide, *Elementi*, V def. 3
[13] LEONE, Ambrogio. *Ambrosii Leonis Nolani divini philosophorum opus quaestionum, seu problematum*, Venetiis 1523.
[14] REALE, Giovanni. Erasmo da Rotterdam, *Adagi*. Milano: Bompiani, 2013.
[15] AA.VV. (ed. by). *Die Schriften der römischen Feldmesser: Gromatici veteres*. Berolini 1848; SANTINI, Carlo. *Le praefationes dei gromatici*, in SANTINI, Carlo-SCIVOLETTO, Nino. *Prefazioni, prologhi, proemi di opere tecnico-scientifiche latine*, I, Roma: Herder, 1990, p. 137-148.
[16] SCHULZ, Jurgen. *Mappe come metafore: cicli murali cartografici nell'Italia del Rinascimento*, in *La cartografia fra scienza e arte. Carte e cartografi nel Rinascimento italiano*. Franco Cosimo Panini: Modena 1990, p. 97-113.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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The dams of Rio Grande's basin (Amelia TR)

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Abstract

The research concerns the two dams located in the basin of the Rio Grande stream at the foot of the Amelia's Acropolis. These structures, whose origins are partially attributable to the interventions of Roman Emperor Aurelian, are due to poor maintenance interventions in the seventies that led to the closure of the original bottom outlets that have changed the hydraulic infrastructure leading it to lose its original function. Central is the complex regulatory framework in which these goods fall so exceptional: because dams are higher than 15 meters, since 2004 with a "declaration of state of emergency" have been ascribed with other 12 dams in the Register Italian dams (RID) and after its abolition the dams were entrusted to the Directorate General of dams of the Ministry of Infrastructure and Transport. After 10 years this condition has brought neither intervention nor planning by the central authorities, which thereby preventing any intervention on the infrastructure, has repeatedly tried to return them to the regional administrative bodies. This complex impasse leads to reflect about the actual safeguard of these historical and the practical possibilities of promoting and protecting those "second nature" that, overcoming the mere functional value, constitutes the identity of the local landscape Italian and European.

Keywords: Cultural Heritage, Heritage Conservation, Heritage Management, historical infrastructure

1. Introduction

This study collects part of the activities developed by a research agreement between the Department of Civil and Environmental Engineering and the Municipality of Amelia (Terni) in the last three years. An accurate analysis of some architectural heritage of the Amelia are the starting point for a critical interpretation concerning problems relating to the protection of minors and cultural heritage to the more general upkeep of the landscape .



Fig. 1: Rio Grande Basin from Amelia

2. Territorial context

The basin of the Rio Grande (right tributary of the Tiber River) is the place around which structure the site of Community Importance (SCI) "Monti Amerini" (IT5220008). The abundance of water marks the territory and connotes with identifying characteristics evident.
In addition to the Black and the Tiber albeit marginally places configure the area, the Rio Grande is the structure of water that flows through the landscape and draws Amelia. Just at Amelia on this auction is also

booked the Pit of Stains, just before the dam nineteenth intervene to change the morphology of the reservoir water, which widens to form a small basin.
The Rio Grande watershed has an area of about 191 square kilometers, a length of about 43 km of main and ends in the Tiber near Orte [1]. The area upstream of the basin is mainly characterized by fluvio-lacustrine and marine [2], the sector of medium-sized river, with a width of approximately 5 brought me very low, less than 0.01 cm / sec.
The vast river basin originates from the complex orographic formed by Mount Piglio (637 m) and Mount Cimamonte (636 m). After bifurcated meets near Collicello and Sambucetole after handling and passing through a gorge, meets the dam known as the Para generating a lake basin called Lake Vecchio. Para exceeded the water system connects to the pelvis of the ditch and Stains, crossed the Ponte Alvario, flows from the bulkhead of "windows" which is placed over the bridge that supports the road SS205. The Rio Grande continues to flow to the feet of Amelia through the Roman bridge Orgamazza rebuilt in the Renaissance, by walking alongside the Annunciation and below the bridge called Hell or Infernaccio, a name probably given in relation to the noise that the river produced during floods [3], and then on to the town through distinctive and associated names "Purgatory" and, later still, "Paradise." In some areas of the Rio Grande has designed the landscape in the rock, with sheer walls like the one called "Scoglio Kite" that rises above the river, so named in reference to the mythological figure of Boreas, the cold north wind , or perhaps because of a refuge bandit who had that name for its ability to not get caught [4].
The water, through two channels, flowed downstream and was used to operate the five mills present along the rod river downstream of the dam, already rearranged in 1427 [5]: the first is the site under the Para, the second just under the Ponte Grande, the third under roughly the Scoglio Kite, adjacent to the fourth bridge Orgamazza and fifth places in Gioiosa, at the remains of the castle of Altobello of Clairvaux, while the body of the ancient dam were present, and visible until a few years ago, the sloping holes which allowed the collection of water in the case of lowering the outflow [6].

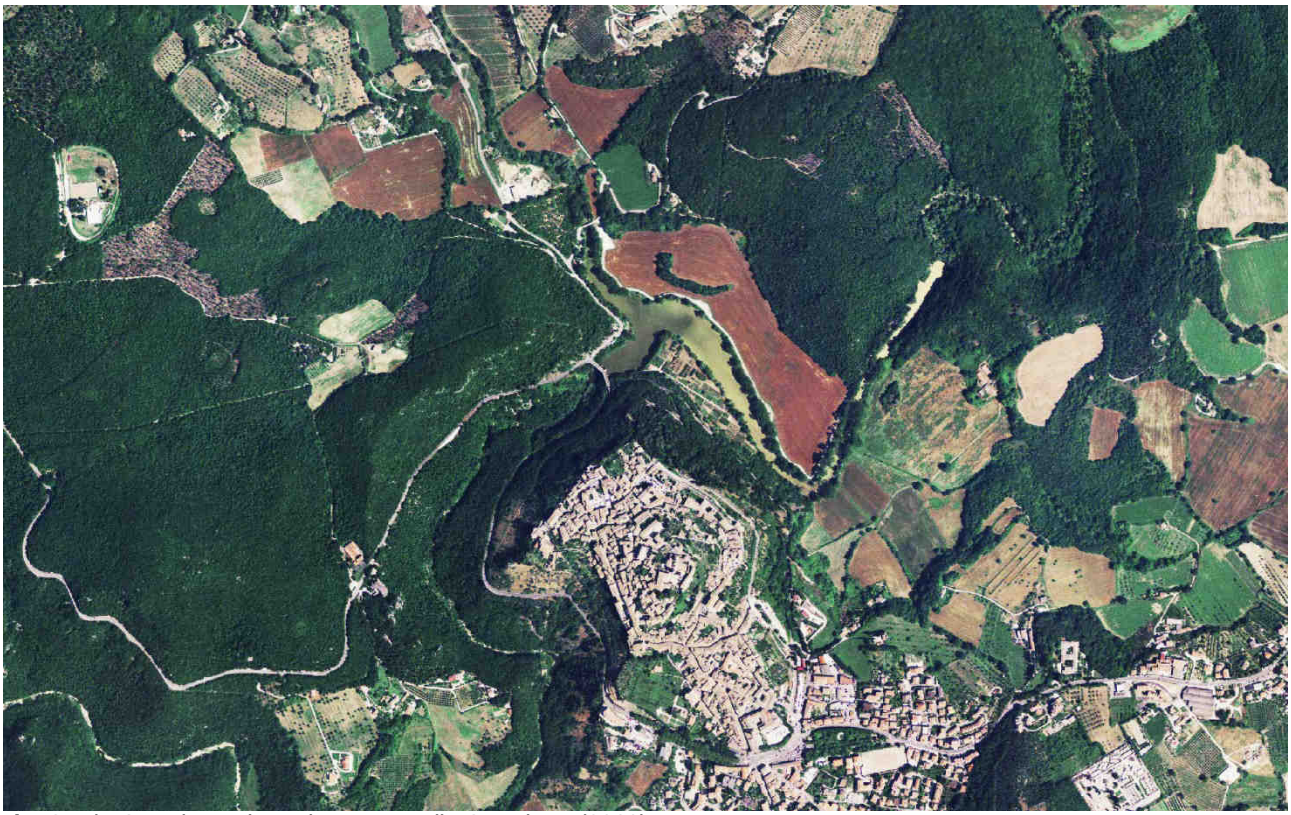

Fig. 2: Rio Grande Basin and acent Amelia Ortophoto (2000)

3. The two dams

The dam of Para, located upstream, has perhaps a plant likely matrix Roman, totally lost, since it was probably rebuilt in the thirteenth century and restored in the following centuries, in the fourteenth century [7], in the fifteenth [8] with interventions aimed at the operation of the mills also [9], as well as in the seventeenth century, through the work of the engineer Sergio Venturi [10], and over the past centuries. It is marked by an arc of about 50 meters, has a height of just over 15 meters, a width of about 1.8 meters, while the thickness of the bottom is not measurable. Built with limestone blocks typical of the Middle Ages, originally had the

right bank a discharge channel featured a mixed conformation between the excavation of limestone rock and the juxtaposition of blocks of the same material, substructure today in very poor condition because of all abandoned and replaced by a more modern system of the fifties [11]. The comparison with the images of the last century, shows a different configuration of the dam, closed to the center, with the water that flowed into the right side where in fact it was placed the mill. In 1930 he designed a slit "V" in the center of the body, cut partially buffered in the fifties by landowners who saw eroded their fields [12].
The second dam is called the "windows" or "Big Bridge" for the juxtaposition above the hydraulic structures of the bridge created in 1880 and designed by John Stalks [13] and partially rebuilt after the war for the bombings that affected a pillar but not undo it on hydraulic structure [14]. It has a height slightly greater, with the tilted walls suitably to the vertical in the upstream side and with a slope of only 3 degrees in the downstream side, respectively 37 and 47 meters long, with an opening at 150 degrees towards the valley. Has a thickness of 7.5 meters in the top and about 11.5 meters per foot, high section more than 15 meters above which are placed the pillars, between which the water flows, which support the road, [15]. Tradition attributes the dam at the age of Emperor Aurelian (270-275 AD) [16], also by virtue of the presence of the ancient Via Amerina historic byway of great importance in antiquity, which was still able to overcome the obstacle of the river [17], a hypothesis that seems appropriate with the materials still visible at the base.
If the assumptions that should be discharged were most certainly validated, the two facilities could pose as a holistic system of cultural goods of the highest value, with the Para, with its sophisticated features, assurgerebbe the role of first arch dam in the world after the end of the Roman Empire, stealing the primacy century dam on Fersina or Elche [18]; and the dam of Ponte Grande that you would also be borne by cultural among the few survivors of the Roman age.



Fig. 3: The actual state of “La Para” dum

4. Safeguards and valorisation actions

For the extraordinary quality environmental and historical value of the Rio Grande for the population of Amelia is extremely intense, so much so that if the territory is an association of the "Friends of the Rio Grande" [19] since the seventies, it is because this place has always been a sort of large urban garden, perhaps because absent in the city perched on the important slope. The lake, with its path, becomes a meeting point for walks, rides, games, sports .... Historical memory is still very strong, so it is alive the memory of its prosperity, than in the Rio Grande went fishing or swimming. The increase of the naturalness of the place transform inevitably the area of the Rio Grande to become a major tourist attraction, especially if one takes into account that the river basin is still a kind of green oasis in the important industrial center of Terni, and that now already existing path receives every day many passersby or sports. The area located immediately at the foot of Amelia was arranged over the years by a series of agreed actions by local governments: in particular the first major intervention continued by the City of Amelia with a mixed group of

design in 1998, with an amount of approximately 1.2 billion pounds, he became interested in the redevelopment of the routes, a network that extends for several kilometers [20]. Subsequently, with regional funding [21], was completed part of the route; two years after application has been made to access European structural funds [22] and was built the wooden bridge over the river and guaranteed connection to the historic center (2008). A path on archeology botany with the planting of orchards ancient traditional enriches the urban space [23].

If the contextual environment, already protected by the bond SIC, has been redesigned and enhanced, just as it can not be said for the important problems of water runoff. The criticality of the place comes from the fact that from the seventies bottom outlets of dams have been buffered, denying the practice of emptying and washing out of the basin, implemented with rhythm decades, to prevent sedimentation of sludge carried downstream by the floods [24] . Over time the absence of a hydraulic maintenance has transformed the state of the reservoir geological, currently characterized by several meters of mud of which a good part of the sedimented, under a limited surface of the water. Floods, even for sopralluvionamento continuously bring more and more sediment than in summer transform the bed into a place completely arid. Besides the interstitial pressures associated, proportional to the known principle Archimedes height, overload the facilities, which moreover presents alarming infiltration and patchy extrados wall.

In this context, the game is a time to be in the nerve in the inscription of the two goods, by inches, in the Italian Registry Dams (RID) [25], in 2004 [26]. Intervenes in the State concerned, that hereafter assumes responsibility for the well. Even after the suppression of the RID [27], the same powers pass to the General Directorate for Dams and Infrastructure Water and Electricity [28].

According to the institutional roles attributed by current legislation, the Directorate-General shall, in order to protect public safety, technical approval of projects of large dams that exceed 15 meters in height or that determine a volume greater than 1,000,000 cubic meters, taking account of environmental and hydraulic safety resulting from the management of the system from the reservoir formed by the dam and all its complementary works and ancillary [29], also providing supervision on the construction of the dams of competence and operations control and management due to the dealers. You should pay attention to the definition itself: although the two dams are completely buried, even assuming that presented paradoxically only 1 cubic meter of water, however, are the responsibility of the Ministry, because more than 15 meters high, placed in condition Alternatively, the capacity of the volume, in fact confirmed by the repeated orders that continued [30].

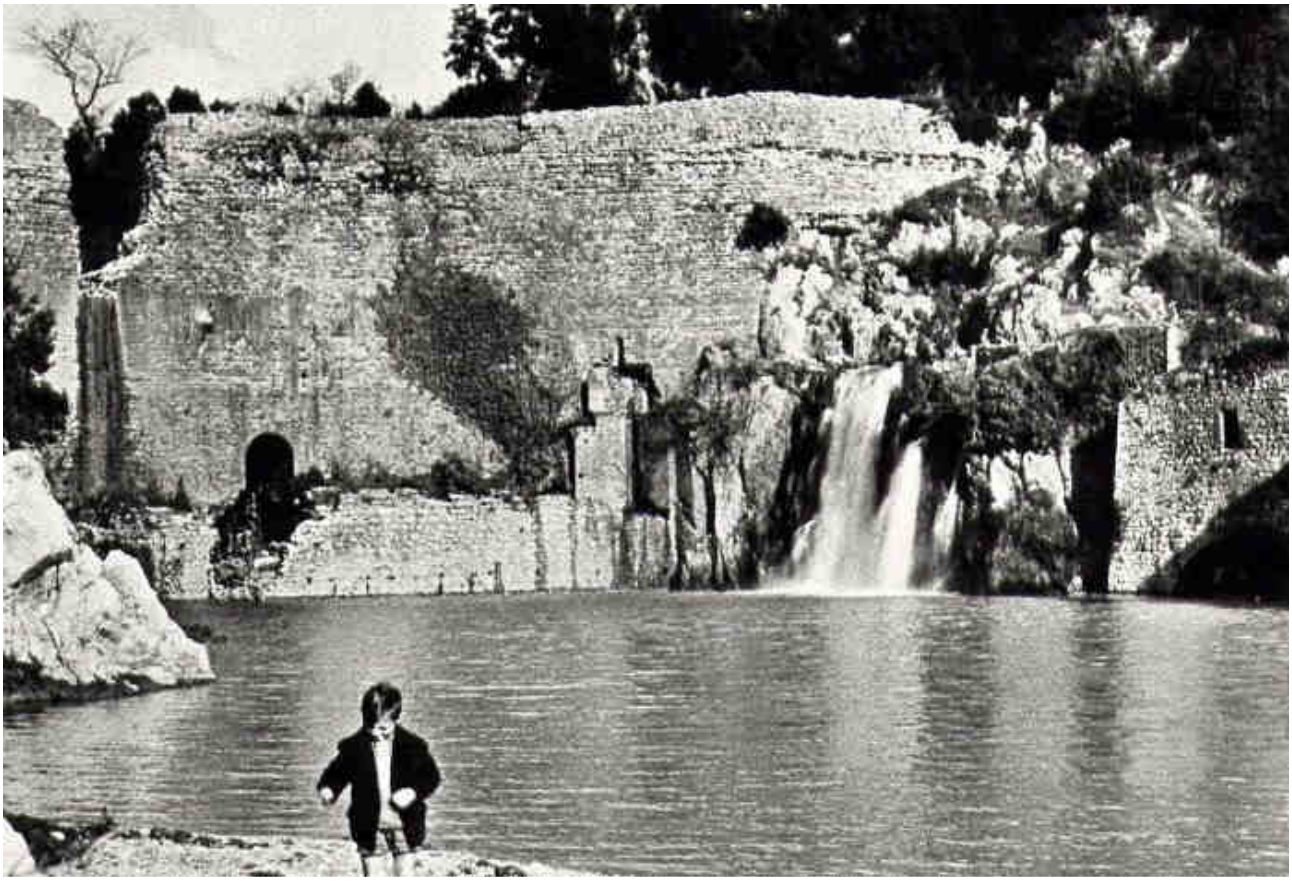

Fig. 4: "La Para" dum at the half of XX century.



Fig. 5: “Finestroni” dum at the half of XX century.

5. Recent projects

Constate the progressive problematic nature of sedimentation, over the years have developed several projects to protect the environment historicized: in particular are worth mentioning the study drawn from a thesis, University of Perugia, [31] aside for the high costs and storage problems of sludge but certainly at present the analytical investigation of more scientific for reasoning and calculations developed.

Of great interest is the next project proposal of 2007 [32], prepared by the Office of the City engineer, in this case by Ing. Stephen Ferdinandi, with the advice of the engineer Dutch Jaques Van Der Salm, the company Dravo SA [33], a member of the first order of dredging internationally with an office in Amerino, in Montecampano, which proposed a static dewatering, near the gates of the bridge, with a total expenditure in the first 10 years of EUR 35 000 for maintenance and tests, and a cost of about 300 thousand euro for scooping located in three different parts of the basin. This plan was defeated in 2009 by the Commissioner prof. Roberto Guercio, giving reasons for the refusal to proceed, despite funding started to stability problems of the good that would lead to the collapse scooping static.

He was recently funded a first intervention demonstration on dewatering from the Region, the Province and the City finalized only recently, face intake of 10,000 cubic meters of sludge, first trance of work completed in 2013 [34]. This technique aims to become a solution to the problem of sediment at the same time capable of determining an improved condition for the banks. The storage cylinders in permeable geotextile therefore occurs with minimal environmental impact, without real disruption of the ecosystem. The technique consists in moving and aspirate the sludge using an excavator equipped with a particular functional equipment to the handling of the solid parts to convey the trapped mud, thanks to the particular shape of the float, to the hopper of extraction, the top of which is accommodated a submersible pump in a special order. The pump has the function to eject the sludge trapped in the hopper, aspiring and passing the gases through the pipe, to the duct.

The scope of this action is to contextualize in relation principles of environmental sustainability (reduction of the viability of the means of work, minimizing the impacts of the yard ...) but especially for the legislative solution to the problem of disposing of the sludge reused "on site" for remodeling morphological river: through this technique fact sludge does not exceed zero hydrometric and are not made out of the border state property, with the exception of the waste legislation and earth and rock excavation [35]. In this way in practice it is not create waste which must not be disposed of, with a potential reduction of CO2 emission remarkable. Furthermore, the sludge, which as a result of the characterization are not compromised by pollutants and fertile, and remain in theecosystem. The sludge thus collected and reallocated by the special interim conducted in special sacks in geotextile material, capable of supporting the mass muddy and squeeze out the water that falls in the river. The operation is then continued in a second stage of works banned in 2015 [36].

Always starting from such intervention, in June of 2013 was presented the proposal within Notice LIFE +, with a project called AMELIFE presented by the City of Amelia as coordinating beneficiary and from an

important partnership of the Department of Environmental Biology of "Sapienza "University of Rome (prof. Francesco Spada _ scientific manager); Umbria region (Service Public Works: programming, monitoring and safety-design and implementation | Service Water resources and hydraulic risk | Service Enhancement of the territory and landscape protection); Province of Terni (Sector Regional Planning and Economic Development | Environmental Department and Soil Protection); Regional Directorate for Cultural Heritage and Landscape of Umbria; ARPA: Regional Agency for Environmental Protection of Umbria; Consortium Tiber Black; Lipu Italian Bird Protection League - NPO [37]. The proposal focuses on the protection of the landscape and the holistic system of plant and animal species of the place, working in particular to preserve the wetland habitat essential to the survival of local biodiversity. This operation is based on a reading, even innovative, environmental status, with proposals for conservation of endangered species, which are an essential first step in the continued application of the technique of dewatering face the removal of 40,000 cubic meters of sludge. At this correlates the naturalization of new banks in relation to the phytogeography detected and systematic retention of critical species native. The project then plans to intervene in the hydraulic removal of the causes that have generated problems of sedimentation of silt and clay, with small works of natural engineering hydraulics in the tributaries of the Rio Grande and the Pit of stains (cleaning of the debris, thresholds for stabilization of the riverbed), and with the construction of a channel in the rock at the side of the dam downstream of only 50 meters and a section estimated 1.5 meters in diameter, with the aim of recreating a possible periodic discharge of water and sediment residues. The timely intervention of enhancement are based on opening a local road, the possible use of the riverbed top of Para, a study on the preservation and renovation of the image of the place, and the promotion of training activities on the territory included in the dissemination of search results. The proposal was not funded by the European Commission.
Finally, we can write down the controversy that arose in relation to the hypothesis of reopening of bottom outlets, invoked, with little sense of reality, by some associations of local citizenship [39], planning evidently remained uncertain for the reasons already explained, that is, for refusal to intervene in the dam body and the lack of interest, public and private, trying to operate the dam characterized by low hydraulic flow. The possible scenario that lies behind this hypothesis is the will to transform the flooded water in simple stream, located 15 meters below the current level, with an upheaval of the environmental system may be desirable for the stability related to the ecosystem, but certainly a strong impact on the landscape, a profound transformation of a chasm which would redraw the territory and the functionality of the space.



Fig. 6: Recovery interventions in the basin: the barge and big bags for dewatering before backfilling

6. Actual questions

Research has highlighted the need to promote a profound holistic intervention that can combine the stability issues, related to civil protection and the protection of cultural heritage, as well as the preservation of the site of European interest and environmental landscape, for the value of the identity space for the population. The real problem with the state of affairs has proved to be impossible to overcome the segmentation of skills, implicitly denying that comes from a state of law incapable of decline subsidiarity knowledge.
The proposals that have taken place over the last few years have had to cope with a requirement not to intervene in any way in the dam body. Certainly remains clear and paradoxical immobility that characterizes the institutional activity, certainly inhibited by a lack of resources and the crisis in which pours, but also incapable in more than ten years, the implicit "declaration of a state of emergency" of the good [39], even to verify and certify the stability of the structure, according to the loads connected to the sludge that for interstitial pressures associated bring an increase definitely not solved by the settling of the sludge itself. On the other hand, the management of the problem by technicians of the Italian Registry Dams can not be chargeable certainly had not pleaded the order in charge of safeguarding civil protection, as at present, the eventual collapse of the structure would not result in exceptional movements of sludge, which are now in a state of deep sedimentation. All this, however, must be first put in relation also to the current functionality of the two goods, especially for what concerns the bridge juxtaposed to the dam of the valley, infrastructure

which is based on the underlying substructure of roman matrix. The diversification of skills door then the local authority responsible, currently the Province, interested civil protection, stability of the upper body, for which may provide more evidence to pressure loading, but without the possibility of intervening in the dam body where the real concerns are attributable to the tensions arising from bending stress, which decreases under the same load tests.
The recent Ordinance of Civil Protection [40] where it is asked for a verification of the interest by the local government to take charge of the goods, indicating the lack of financial support for certain burdensome securing the same, stands as the paradoxical attempt to get rid of the fourteen dams that pour into the same condition. It is not just stress that in the same text it is stated that, alternatively, the Ministry will ensure the disposal of the asset, a hypothesis that has to deal with the most important unconstitutional the failure to conservation of cultural heritage protected by Article 9, and the correct allocation of skills, since according to Article 117 the state has the task of dealing with the protection of the environment, the ecosystem and cultural heritage, the real stars of the context.
Even more worrying for the level reached is the parliamentary question in April 2014 [41] to the question that reveals a lack of understanding of the problem, but even more the response of September 2014, where even denies the very definition of large dam that has characterized the bond, arguing that the two "ancient" dams, "are now completely" full of mud", that the tank does not contain more water but only the soil, sediment deposited by the water over the decades, which is why are considered, uniquely by the Ministry, "no longer works similar to dams but to a hydraulic (bridle) or a simple retaining wall, therefore risks with more limited", with the consequence that "the competence for this type of works not the Ministry (which deals specifically with large dams), but Region and Province "[42]. In the paradox of having arbitrarily omitted that the dam more than 15 meters high, regardless of the volume of water, it is by definition in the hands of the Ministry, with this response belies the same recent order of civil protection [43] with which you Question Regions interest to take charge of the dams, request that suddenly comes in a state of fact.

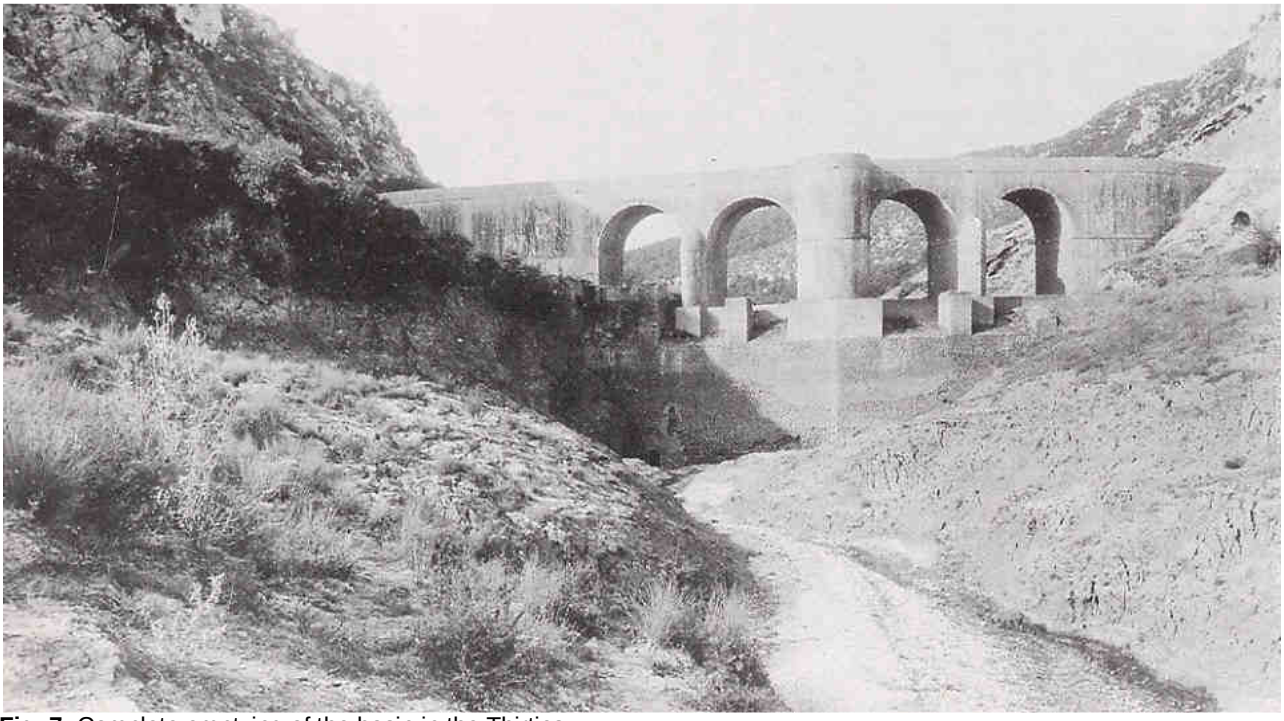

Fig. 7: Complete emptying of the basin in the Thirties.

7. Final consideration

The identity, according to Umberto Eco, is based on the construction of the enemy [44] and is revealed in an increasingly clear that the bureaucracy is the real problem of the protection and development of cultural heritage and our country, with the legislation that in trying proper attribution of responsibilities leads to the division into sectors in which each pleads his cause that they are not for what he competes in the wrong. The implied criticism is aimed not so much upon the work of technicians, but the operation of the institutional apparatus.
In the specific case it is shown that if the risk of landslides of sludge is passed to the RID is not necessary to intervene, on the other hand if others would promote actions including intervention in the dam body there would be a shared responsibility also by the Ministerial that you should take charge of a problem with the refusal to work can be avoided, logic which clearly excludes the restoration of the original function of the dam

in the first place because its reactivation should be related to a verification of stability to the infrastructure ' current legislation, unlikely without recovery interventions, and secondly for consequential management problems not opposed to direct interests and the sustainability of the initiative in economic terms, provided that substantially affects the inaction of the state and that also would deter any private participation.
In making a critical examination of the projects, the dewatering appears as one of the palliatives intended to subtract sludge and pressure to the infrastructure, the same does not have the ambition to solve problems that have created the current critical state. Changes proposed in the LIFE project stands as perhaps the only viable solution to resolve the current revival of the accumulation of mud, but consistent with the hypothesis does not warrant an intervention on the stability of the dam subject to pore pressure. The hypothesis of the proposed Van der Salm is perhaps the most attractive solution, which while it responds to the problems of sludge, however, should be accompanied by a project to upgrade the infrastructure. The real problem, however, is there inherent functionality of accumulation of water and problems related to its management, so that such a path would be the prelude to a depletion of the basin, with the creation of a canyon impactful landscaper and social.
The different hypotheses then focus on dam downstream, the oldest and largest, to the concern of the stability of the well, and partly seem to forget the dam renaissance of Para, with its accurate features that conceal a basin practically inaccessible and not perceptible but with an alarming state of degradation for natural waste never cleaned.
The issue of landscape, the value of the sense of place, can not remain on the sidelines of planning, being among the first causes of the state of the infrastructure damage the disconnect between identity and identitarity between cultural and society. The search box has collected so the goal is not so much to provide a solution to the problem, but to interpret from the context of the reasons that have generated such a state, going to intervene at the roots of the problem. The study therefore stands as the foundation for the redesign of an intervention strategy, which should be both participatory and subsidiary state. Skills, roles, proposals, can only find synergies between them because of the defense of the cultural heritage of our landscape. Of our identity.

Bibliographical References

[1] CNR-IRPI. *Relazione del piano di monitoraggio idrogeologico* (2013).

[2]

It is fine-grained deposits sublitorali (34.3%), and limestone massifs (23.5%); in the valley, near the confluence, buildup marine-brackish, fine-grained, spanning an area that covers 7.8% of the total area. The characteristics geolithological basin of the Rio Grande were acquired by the hydrogeological map of the Umbria Region (scale 1: 100,000), while those in land use are referred to the paper updated in 2000 and developed under the project-Corine Land Cover (1: 100,000). www.regione.umbria.it [2013].

[3] DEL LUNGO Stefano. *Cultura ed evoluzione nel paesaggio.* In MENESTÒ Enrico*. Amelia e i suoi Statuti Medievali,* Spoleto: Fondazione Centro italiano di studi sull'alto Medioevo, 2004, p.232. ISBN 88-7988-552-9.

[4] SANTINI, Loretta. *Guida di Amelia e dell'amerino*. Perugia: Quattroemme, 1999, p.113. [ISBN] 88-85962-43-2.

[5] CORVI, Emilio. MARTINES, Giangiacomo. *Amelia. Rilievo del centro storico.* Roma: [s.n.] ,1977, p.38.

[6] ARICE P., MILIACCA G.. *Frutti dal passato. Storia del progetto di recupero e conservazione presso il Bacino del Rio Grande ad Amelia*. Amelia: Leoni Grafiche, 2004, p.12.

[7] "*Il 31 Gennaio 1331, a consigli riuniti, si delibera "quid placet providere et deliberare super venditione molendinarum pare lacus communis" cosa si ritiene di deliberare circa la vendita (o, più probabilmente, la locazione) dei mulini comunali del lago della Para. Un consigliere propone che "molendina communis vendantur ad incantum plus offerentium" i molini comunali si vendano all'incanto a coloro che avranno fatto la migliore offerta "pacto expilandi portam dicte pare vel non expilandi prout utilius videbitur Antianis et pro eo tempore quo voluerint" alla condizione, però, che la paratoia del lago venga o non venga aperta, secondo quel che sembrerà essere maggior utile da parte degli Anziani e nel tempo da essi stabilito. "Et quod in presenti consilio fiat Syndicus ad vendendum" E che nella stessa seduta venga nominato un Sindaco incaricato delle relative operazioni. La proposta viene approvata con 58 voti favorevoli e 35 contrari. Attualmente, nel c.d. Lago Vecchio (o la Para, come ancora oggi viene da qualcuno designato), sono riconoscibili due molini, posti a valle, rispettivamente, della diga superiore e di quella inferiore". Successivamente, "il 22 Maggio 1331 si propone in consiglio di aprire le paratie ("cancella") del lago della Para ("parelacus") e che si costruisca un'idonea canalizzazione ("quod fiat quedam forma") attraverso la quale scorra l'acqua per alimentare il sottostante molino ("per quam labatur aqua ad molendinum desuptus"),*

come finora si è usato ("sicut actenus consuevit")". SPAGNOLI, Giovanni. *Effemeride*. In www.giovannispagnoli.com/Giovanni_Spagnoli/Effemeride.html [2015].

[8] "Papa Martino V, con sua lettera inviata agli Anziani il 24 Maggio 1421, desidera che il muro del Lago Vecchio venga riparato. All'uopo, per contribuire alle relative spese, è disposto a rinunziare a una parte del sussidio che il Comune deve versare annualmente alla Camera apostolica". SPAGNOLI, Giovanni. *Effemeride*. In www.giovannispagnoli.com/Giovanni_Spagnoli/Effemeride.html [2015].

[9] Between 1465 and 1467 jobs are important facts to stem and bar the lake old in order to provide the water necessary for the operation of the mills. Carlo. *Cronistoria Amerina.* In "*Rivista Araldica*", LIII (1955), Roma, p.19.

[10] CANSACCHI Carlo. *Cronistoria Amerina.* In "*Rivista Araldica*", LIII (1955), Roma, p.38.

[11] DRAGONI, Walter. GIAMMARTINI, Barbara. DRAGONI, Davide. A *contribution to the history of water management and dams: the Roman and Medieval hydraulic structures on the Rio Grande stream, Amelia (Umbria, Italy).* Procediings of "3rd IWA Specialized Conference on Water & Wastewater Technologies in Ancient Civilizations". Istanbul: 2012, pp. 823-830.

[12] ARICE P., MILIACCA G.. *Frutti dal passato. Storia del progetto di recupero e conservazione presso il Bacino del Rio Grande ad Amelia*. Amelia: Leoni Grafiche, 2004, p.12.

[13] SANTINI, Loretta. *Guida di Amelia e dell'amerino*. Perugia: Quattroemme, 1999, p.108. [ISBN] 88-85962-43-2.

[14] *Torna a scorrere il Rio Grande di Amelia*, in "Il Momento", venerdì 11 giugno 1948.

[15] DRAGONI, Walter. GIAMMARTINI, Barbara. DRAGONI, Davide. A *contribution to the history of water management and dams: the Roman and Medieval hydraulic structures on the Rio Grande stream, Amelia (Umbria, Italy).* Procediings of "3rd IWA Specialized Conference on Water & Wastewater Technologies in Ancient Civilizations". Istanbul: 2012, pp. 826.

[16] DI TOMMASO Angelo. *Guida di Amelia.(*DI TOMMASO Angelo. *Amelia nell'antichità e nel Medio Evo.* Terni : Annuari guide regionali italiane, 1931). Gruppo di ricerca fotografica: Terni 1991, pp.13-14.

[17] MARTINORI, Enrico. *La via Cassia e le sue deviazioni*. Roma Sansaini, 1930.

[18] DRAGONI, Walter. GIAMMARTINI, Barbara. DRAGONI, Davide. A *contribution to the history of water management and dams: the Roman and Medieval hydraulic structures on the Rio Grande stream, Amelia (Umbria, Italy).* Procediings of "3rd IWA Specialized Conference on Water & Wastewater Technologies in Ancient Civilizations". Istanbul: 2012, p.827.

[19] Referring Web Pages Web: Riogrande.altervista.org [2015].

[20] Esercizi Finanziari (E.F.2008) Delibera di Giunta Regionale (DGR) n. 1658 del 3 novembre 2004 dei Piani Opere Pubbliche (OO.PP.) - 210.000 euro.

[21] Documento Unico di Programmazione (DOCUP) Obiettivo 2 – 2000/2006 Bando Integrato Filiera Turismo-Ambiente-Cultura.

[22] E.F. 2011 D.G.R. n. 1615 del 28 febbraio 2011- cap.8901 - 125.000 euro, tot. 300.000 euro circa.

[23] AA.VV. *Tra antiche mura… uno scrigno di ricchezze. Il territorio di Amelia ed i suoi frutti*. Pantalla (PG): Edizioni 3A-PTA, 2013. Collana "i quaderni della biodiversità". ISBN 88-88417-08-7.

[24] DELLA ROSA Franco. *Amelia un secolo di storia allo specchio 1860-1960*. Viterbo: Gruppo Ricerca Fotografica, 1989, pp.48-50.

[25] Istituzione: Decreto Legge (DL) n. 112 del 31 marzo 1998, articolo 91; Disciplina: Decreto del Presidente della Repubblica (DPR) n. 136 del 24 marzo 2003.

[26] Ordinanze del Presidente del Consiglio dei Ministri (OPCM) n. 3382 del 18 novembre 2004.

[27] DL n. 286 del 24 novembre 2006, art.2 - comma 170 e sgg.

[28] DPR n. 254 del 19 novembre 2007.

[29] DPR n. 136 del 24 marzo 2003, art.10, comma 2.

[30] OPCM n. 3388 del 23 dicembre 2004, n. 3390 del 29 dicembre 2004, n. 3449 del 15 luglio 2005, n. 3452 del 1° agosto 2005, n. 3494 dell'11 febbraio 2006, n. 3506 del 23 marzo 2006, n. 3508 del 13 aprile 2006, n. 3559 del 27 dicembre 2006, n. 3564 del 9 febbraio 2007, n. 3738 del 5 febbraio 2009, n. 3746 del 12 marzo 2009, n. 3783 del 17 giugno 2009, n. 3792 del 24 luglio 2009, n. 3799 del 6 agosto 2009, n. 3872 32 marzo

2010; Decreto del Presidente del Consiglio dei Ministri (DPCM) del 10 marzo 2011;Ordinanza del Capo del Dipartimento della Protezione Civile della Presidenza del Consiglio dei Ministri (OCDPC) n. 53 del 22 febbraio 2013.

[31] MANCIOLA, Piergiorgio. *Studio per la riqualificazione funzionale ed ambientale dell'invaso sul Rio Grande in Comune di Amelia*. Report: Consorzio di Bonifica Tevere - Nera & Dipartimento di Ingegneria Civile dd Ambientale. Perugia: Università degli Studi di Perugia, 2000.

[32] Ufficio tecnico del Comune di Amelia, Archivio del Comune di Amelia (ACA). Progetto Van Der Salm (2007).

[33] Referring Web Pages Web: www.dragaggio.com [2015].

[34] DGR n. 748 del 23 giugno 2008.

[35] Deliberazione della Giunta Municipale (DGM) n. 15 del 10 febbraio 2015.

[36] DL n. 152 del 4 aprile 2006, art. 185.

[37] FILIPPUCCI, Marco. *AMELIFE _ mud and water in the conservation of Rio Grande basin*, LIFE13 NAT/IT/001466.

[38] ITALIA NOSTRA AMELIA, Rio Grande: una storia tutta italiana. https://www.facebook.com/groups/148765811986038/?fref=ts.

[39] OPDM n. 3382 del 18 novembre 2004.

[40] OCDPC n. 139 del 09 gennaio 2014.

[41] Senato della Repubblica – Interrogazione a risposta in Commissione 8a (Lavori pubblici, comunicazioni) n. 3-00915 presentata dal Sen. Lucidi (M5S) il 24 Aprile 2014.

[42] Risposta del sottosegretario DEL BASSO DE CARO in Commissione 8a (Lavori pubblici, comunicazioni) del 24 settembre 2014.

[43] OCDPC n. 139 del 09.01.14

[44] ECO, Umberto. *Costruire il nemico e altri scritti occasionali*. Milano: Bompiani, 2011. ISBN-13: 978-8845265853

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
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From the acquisition of cartography, the latest methods of representation.

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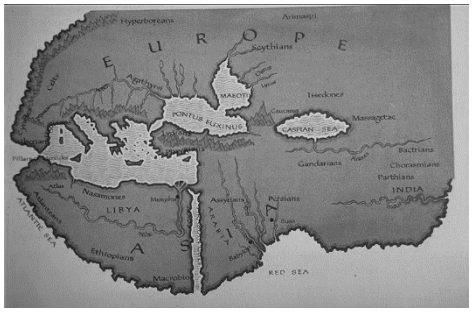
Abstract
The history of cartography is identified with the origins of the men who have always tried to meet two of their primary needs: the safety of the place of residence and the desire to move to know and look for food and resources. What you said about the geography of Strabone may also be referred to cartography, "that geography had to be a useful tool to society of his time and especially to the rulers that they administered." All these requirements "military, economic, cultural, environmental, tourism, administrative" were always behind the construction of the map. The cartographic documents oldest extant date back to ancient Egypt and Mesopotamian civilizations and concern city plans or maps of limited mining regions. With the growth of scientific interest, in parallel to the progress of mathematics and astronomy, was reached already by the Egyptians to the construction of the entire Earth cards, of which the oldest examples come down to us date from the greek of Anassimandro Mileto (sixth century BC). In Roman times it developed the so-called route maps, because destined to meet the needs of travelers, illustrating routes and distances. The term representation is derived from the Latin re-ad-praesentare, which literally makes sense to re-submit, make (again) and present in all civilizations, man has always tried to represent reality to express an emotion, a feeling, to express a message or simply to convey what his eye perceived. The real knowledge of the architecture and the environment is punishable only by analyzing geometric spaces, designed to emphasize the close relationship between the genesis configurative surfaces (and their intersections) and their translation into their images, because, Aristotle sensed as early as the fifth century. B.C. "The soul never thinks without a picture".

Keywords: history of cartography, representation, GIS, design.

Cartography and capture methods.
When asked what is cartography? You can respond with a simple definition: the representation of the Earth's surface. To be more precise, the most comprehensive definition and commonly accepted by scholars is as follows, cartography: "the complex of studies and scientific operations, techniques and artistic works that take place starting from the results of observation or by use of a documentation, in order to develop and equip cards, plants and other modes of expression (representation) to awaken the exact image of reality." Logically "exact image of reality" means a representation that is as close as possible to the actual image.
Cartographic representations present generally are classified into two broad categories. The first is that of base cards (or topography), which describe the physical surface of the Earth and make it possible to derive the relationships of existing position on the land between the details shown on the card. The second is that of thematic maps that represent, on a base map (topographic, geographical or historical) simplified

accordingly, one or more elements of thematism and that have a geometric or spatial precise relationship with the different geographical entities.
Cartography is the branch of science that represents the geographical territory and the phenomena that you develop. The cards can be of different kind depending on requirements that must meet. Cartography supposedly originated at the beginning of human history: the evolution of human civilization for its activities has felt the need to represent the Earth, in order to facilitate travel for both economic and military purposes and, therefore, can be considered cartographic sketches of primitive man attempts to fix the location of their home, or itineraries that followed transfersthrough signs, printed in different types of materials, constitute the graphic expression of the idea that our forefathers had of the surrounding world. It is believed that the earliest known cartographic representations are imprinted in Babylonian tablets containing maps dating back more than 3000 years ago. Cartographic representations made in antiquity were so numerous, but for the use of scientific methods had to wait for the Greek civilization. The Greeks, as great navigators, they need to represent overseas territories and to trace the routes; they were therefore the first to attempt to locate the shape of the Earth and calculate the size. Astronomers, geographers, Greek philosophers and mathematicians is measured in the research of scientific systems to achieve precise representations of Earth in which return data, news and information collected from travelers and mariners. According to Herodotus, you must attribute to Anaximander, a student of Thales (mid-6th century BC), the first of which is [1].
At the end of the same century is expected to go up another card of the same type carried out by Hecataeus of Miletus [2]. Nearly three centuries later, around 300 BC, dicaearchus released a paper set to a latitudinal line that ran to the middle of the Mediterranean; because, apparently, there was also a vertical line, or longitudinal, this is considered the first attempt of CROSSLINE us known. Another famous cartographer of antiquity was Eratosthenes [3] (276-196 BC) who made a map of the then known world which included, besides the Mediterranean, East India and the South Ethiopia.





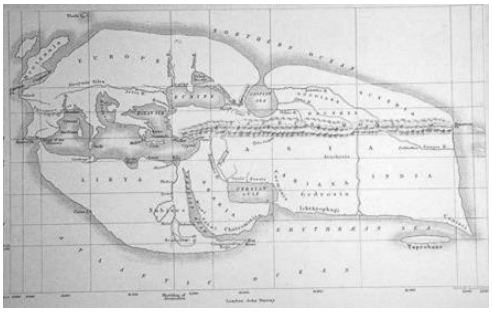


Fig. 1; 2; 3: 450 AC Herodotus; 520 AC Hecataeus di Miletus; 220 AC Eratosthenes

In the 1st century BC the Greek geographer Strabo (before 60 BC – maybe 20 ad) wrote a wide geography, operates in 17 books, in which he described the vast regions to visit him in numerous trips throughout the then known world. Based on the Ptolemy (a.d. 100-178), famous astronomer, mathematician and geographer, Myron of tyre (120 CE) made on a card, lost, a horizontal cylindrical projection of the Earth then known, with parallel vertical and horizontal lines (corresponding to longitude and latitude), measured in degrees.
In the 19th century, finally, came the great cartographic institutions that have begun to create the cards using more advanced systems. Modern technology has greatly expanded the possibilities of cartography and, especially since the second world war onwards, with the aircraft that accurately represent large parts of the territory and with the birth of photogrammetry, cartographic techniques have evolved tremendously.
In the 1st century BC the Greek geographer Strabo (before 60 BC – maybe 20 ad) wrote a wide geography, operates in 17 books, in which he described the vast regions to visit him in numerous trips throughout the then known world. Based on the Ptolemy (a.d. 100-178), famous astronomer, mathematician and geographer, Myron of tyre (120 CE) made on a card, lost, a horizontal cylindrical projection of the Earth then known, with parallel vertical and horizontal lines (corresponding to longitude and latitude), measured in degrees.
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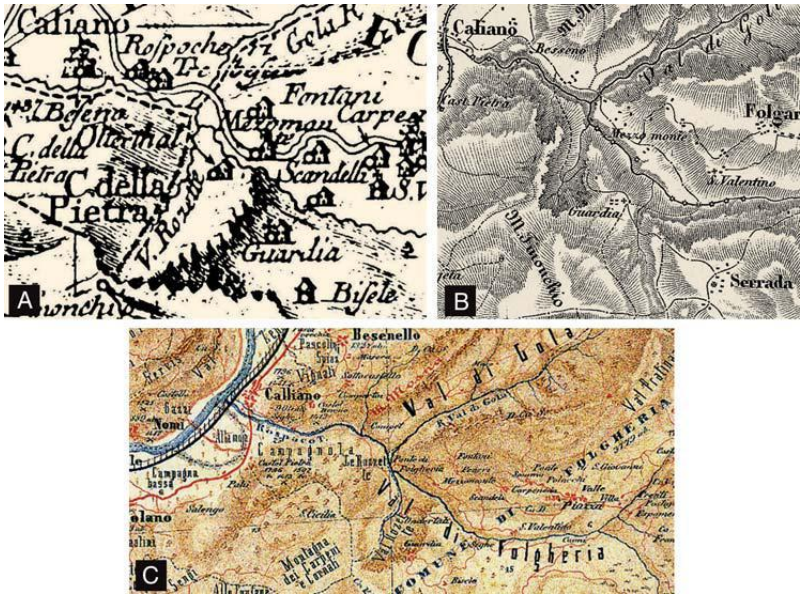
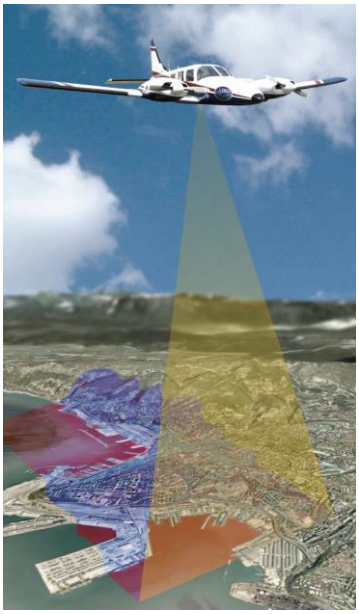


Fig. 4: Evolution of Italian topographic map. From monochromatic, with dash spelling to tri-color Edition with spelling to contours.

The first edition of the paper was made in monochrome, with a curved dash and orography, while in the years following the Great map of Italy was presented in various forms, for a total of six different editions: in black with surface relief with curves and polychrome with hatch, orography in curves and shade, in black with a curve without hatch orography, with polychrome relief with curves without shade, New topographic map of the Kingdom of Italy and in so-called "Stanag" Edition. The publication of these documents began in 1879, with the first edition in black, and was extended beginning in 1900 with the other three monochrome and polychrome subsequent editions [4].



The development of electronic calculators, electronic distance measurement by means of laser beams and light, and the use of computers in the design of the cards, along with increasingly sophisticated software, have allowed a very rapid evolution. For example, some systems based on the use of mosaics of aerial photographs have been treated in a special way you use to build the orthophoto map, able to integrate or replace conventional topographic maps. The system most used today for the production of topographic maps is the aerophotogrammetric, which uses an aircraft flying in a straight line at constant speed, and perform predefined intervals, a series of photographs on a portion of territory by capturing spatial data from different angles. This creates a strip made up of images that reproduce a portion of land together with a part of that shooting with the previous release, to allow a precise concatenation. With a series of parallel strips shows the portion of the territory concerned. If you then pass to the stage of plotted, in which through a dedicated appliance, we rework the images going to their projection after adequate correction of uneven ground. The image data are completed by cartographer with the inclusion of other useful elements for the realization of a full paper, such as contour lines, odds, place names or other data collected directly on the ground. The document thus produced is then transferred to the printers to transfer onto the paper. A real revolution was determined from satellites ERTS (Earth Resource Technology Satellites), provided with equipment for remote sensing, sensitive portions of the electromagnetic spectrum invisible to the human eye. The type, quality and image depend on the staining techniques of acquisition and by the choice of wavelength is able to bring out a certain phenomenon. The information is transmitted to ground stations in where, using highly sophisticated programs are decoded and transformed into legible images. Thus, results in documents that allow cartographic processing of high precision for almost inaccessible areas. Generally these devices operate in the infrared because doing so can capture the energy emitted by the different types of materials on the surface, such as rocks, soil, vegetation, water masses, buildings, infrastructure and translate it into photographs or images that allow the creation of thematic

maps. Above our heads spin a large number of satellites that regular orbits and every day are a portion of the territory of variable amplitude; the Landstat such as reveal a square km 185x185. The information that they transmit the satellites are not generally used for great detail but, generally, for large-scale works.

The knowledge representation and new boundaries

The real knowledge of architecture and the environment is achievable only through a geometric analysis of the spaces designed to emphasize the close relationship between the configurative genesis of surfaces (and their intersections) and their translation in its pictures, since, as Aristotle already knew in the 5th century. BC "the soul never thinks without not an image." Only the knowledge and understanding of the genesis and subsequent processes allows a correct representation and, with it, the design of spaces and also amenities of figurative high complexity. To re-establish the identity of a place like an architectural artefact becomes increasingly need a real work of knowledge representation, which can be committed only by discretization and measurement of all those tangible and intangible values of the territory which are essential for traces of the past in the present action. Discretization and measure are the only actions that allow to pass from a knowledge of "natural" type a "cultural" type and their interaction gives rise to a result that has a value added otherwise unimaginable. Historically means to detect and measure the idea of measurement takes, after Leon Battista Alberti, which marks the apex of empirical based anthropometric interest not dissimilar by scientific methods, regulatory significance whose numerous theories, just think of Palladium, Vignola, Pacioli and Lodoli, express once again the impossibility of defining a single universally valid coding, but what you say here is how can no longer suffice a geometrically defined but it is increasingly necessary a kind of relief that prospect for the n dimensions of product and territory, multi-dimensional relief, a relief that assumes a multi-criteria analysis that by integrating the multiple skills, return the right value to the heritage of cultural and environmental heritage. Multi-criteria analysis therefore puts in motion a complex process, a process of accumulation of knowledge and of knowledge, based on the relationships between technology, society, politics and economics, and it is precisely the set of these relationships to give life to that quid that becomes physically measurable and quantifiable and that returns to renderer the role and dignity of Designer [7]. The understanding of modern complexity requires a multidimensional knowledge from which it is possible to descend the geometric landscape eco drive seen as foundational tool of balanced and sustainable development of the territory, which can be implemented only through a serious and clear operating relationship between man and environment, based on the desire to recover the historical memory and conscious recovery of each sign and artifact that characterize and founded the identity of a place and retrieve its essence.

The eco-geometry can therefore be understood as the discipline that allows you to manage the representation of complex system of the territory and by relating individual know-how, redraws a new identity as integral of knowledge.

Being aware of reports that the so-called "information revolution" established with architectural thinking, what appears important to underline is how the phenomenon of interactivity, spread from digital culture, together with the expansion of our sensory faculties, constitutes a fundamental dimension to understand those processes that are profoundly changing the educational content, communicative and expressive design of the representation of contemporary architectural thinking. Today, the boundaries of representation seem to tend to a progressive enlargement and far from consolidated graphics, architectural design appears in search of new expressive values.

The idea, contaminated with new means of expression, is constantly looking for new forms. In this direction can be also revised the phenomenon of virtual reality, which is no longer just a representation of an event, or simply its reproduction, but it is perhaps the representation of a mental model of the real world, an instinctive play of ideas, that involves all the senses and is brow sable in multiple dimensions. Over the last twenty years the themes and applications involving the sectors of architecture and environment, Visual communication, graphic language, showed a radical change due to the development of the technologies of image and digitalization of the evolution of the modelers and the most recent introduction of virtual space.

It is a revolutionary scenario that triggered amendments so sensitive that they require, during these years, a continuous series of reflections which covered the scope of representation, of his subjects. Information systems have given an undeniable centrality to those searches that can develop in the areas of representation and of visual perception by giving to these sectors, their tools and their generative strategies, a dimension that has gone to expand their traditional role of expressive and communication Act of the idea already accomplished. The representation has become time and at any place for the wording before and then management of forms and images that relate to the architectural dimension. The complexity and the

articulation of issues today require careful reflection on the role and the scope, such as impersonation, appearing as the core of a constantly changing process. The issues and the roles of representation, therefore, appear today as ever, Central not only to understand and rule changes, but precisely because of these changes, you can deduce new ways to understand the nature of modernity.
It is now necessary to critically analyze and understand the potential of computer technology in the field of architecture, noting how the knowledge of the potential offered by electronic means is now instrumental in the creative process, representative, informative and cognitive architectural thinking.

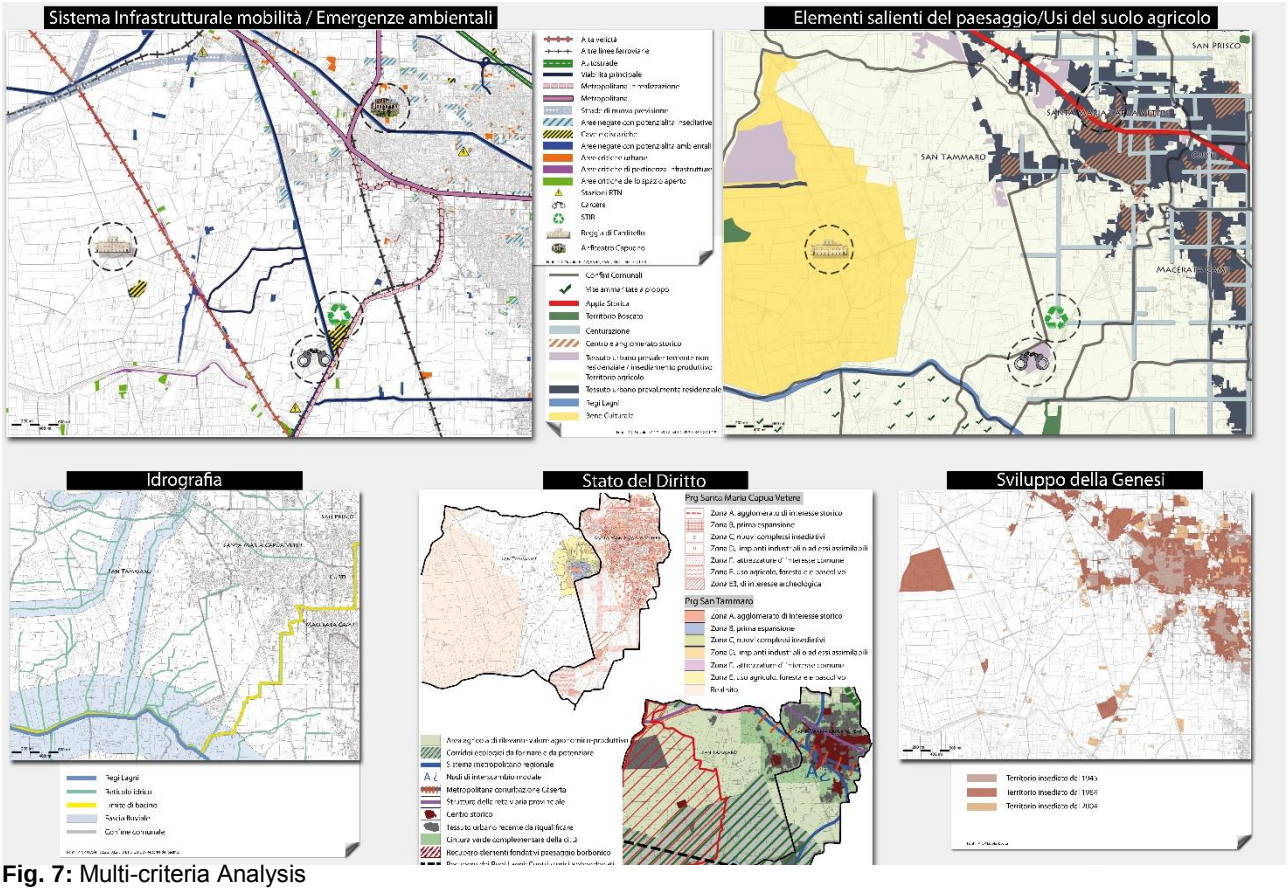


Fig. 7: Multi-criteria Analysis

The representation, therefore, is no longer just a replica of the real thing, but becomes autonomous reality itself, reaffirming its heuristic power crisis and that character subordinate who in the past was attributed. A new principle seems to be born from the overcoming of hierarchy and the ability to weave networks and cross relations. Next to the relief intended as knowledge and of investigation already done, the relief appears to concern itself with increasing strength to become and unfinished, to what to do next to "architecture and the built environment" and now ubiquitous "the architecture of communication." The communication mode of architecture runs parallel to the messages of our time, researching and developing representative increasingly metaphorical models and creative digital size related. The ubiquity of images, which characterizes the culture and spirit of our time, leads us to reflect on certain forms of expression of the architectural project.
The project elaborated with computer graphics techniques, now seems to prefer highly hybridized expressive modes, as well as contemporary architecture seems to establish a renewed relationship with the environment, through a continuous exchange of information made of continuous interconnects.
Connective architecture spoke, for example, Derrick de Kerckhove, referring to the architecture of connections, managing thresholds and infrastructures that bind the real space with that virtual, to the mental and physical interconnectivity of bodies and minds. Connective architecture — one outlined by de Kerckhove — which, in the hands of modern inventors, the cybertect, should aspire to "build social and cognitive environments are useful, reliable and attractive", paraphrasing the famous Vitruvian triad. New digital images, propose big changes in thought and action in relation to the traditional setting, helping to broaden the concept of representation and with it the architectural thinking Hypertext communication. The virtual, perhaps, should not be seen as alienating, but as the bearer of new horizons and new possibilities in the

field of the real; in the face of the binomial "architecture and its depiction", it would be very appropriate to investigate this relationship as osmosis, much to look at architecture as a form of "representation" tool, by virtue of its ability to contain all forms of art as Paul Valery. The protection of the natural and built environment is implemented with a masterly work of knowledge representation, i.e. measurement and discretization of the tangible and intangible values that define its identity through its eco technology. Today, we are equipped with formidable terrestrial tracking tools, and aereophotogrammetric for high-tech satellite, supported by sophisticated software that can return the environment in three dimensions under investigation, but there is a superficial use of the representation of the environment technology that stops your skin, so to speak, to the housing without investigating in depth and without creating added value, if not on individual themes.

Educational and scientific mission which aims is to use all the technological opportunities that allow us to enter the body of the natural and built environment in order to discretize, to measure it and evaluate it for any size multidimensional with the scientific expertise that identifies. The result expected to be given by innovative representation as integral to management and implemented scientific competencies identifying the complex system of natural and built environment. The activity measurement and representation turn natural resources into a profit and loss account as sources of sustainable development not only in relation to the knowledge of the potential within the territory but also in the promotion of competitiveness of values between territories.

GIS information system

The development of information technologies to end ' 900 have expanded the scope of digital cartography in the context of the numerical cards. The paper becomes a full-fledged database can be used independently or as part of the GIS information systems to give rise, as a final result of researches and elaborations, to flexible, three-dimensional representations, sometimes interactive, like the one shown here.

GIS systems, since this is a recent technology, there is no consolidated and unique definition, but you can observe different definitions according to the different operational contexts. An information system (because it produces information) identified by the abbreviation geographical GIS (Geographical Information System) is a computer system that allows the acquisition, storage, analysis, visualization and return information arising from geographic data (because for them it is possible to establish a precise location on the Earth's surface) and events that exist and occur on the territory.

Most notably GIS systems consist of a series of software able to process, analyze, and display data and information somehow related to the territory, associating each georeferenced geographic element (through an analytical process by which an object is placed on a card in a given coordinate system), one or more alphanumeric information. We may add, moreover, that it is a complete and efficient tool, specially designed for a precise knowledge of the area, both for the treatment and analysis of information associated with the objects (points, lines, surfaces) georeferenced, i.e. referring to elements or events in a given portion of the Earth's surface by spatial location note. In Italy, sometimes use the acronyms interchangeably geographic information system (GIS) and geographic information system (SIT). Actually the GIS systems are closely connected to the Cartographic element (etymologically geography means Earth design), while such systems SIT bond is not strictly necessary; think, for example, in a geographic information system for the management of municipal registry office (i.e. linked to the territory, but in its administrative aspect), which does not require a connection to the given map feature. A substantial feature of a GIS is the ability, as mentioned earlier, Georeferencing information, i.e. to assign to each element spatial coordinates information regarding an appropriate frame of reference (Gauss-Boaga, UTM etc.) that really is the object. The General objectives of the geographic information systems are essentially those of research and analysis, so those create, simulate, prepare scenarios and trends, at the same time, to see the results. Most frequent realizations of GIS can be classified into two main types of systems:

- for the management of assets and resources, as technological networks, land registers, financial data, etc.;
- planning and support for decisions related to land management, such as drawing up urban plans, environmental impact assessments, etc.

GIS systems can be used in different applications: in agriculture, public administrations, companies that manage the technological networks, civil protection, in the context of the design of infrastructure, in transport and telecommunications etc. A GIS system, however, is not an automatic decision-making system, but rather an effective tool to query, analyze, and display data in support of decision-making. In this sense, whether it is necessary to locate places to establish industrial activities, discover the optimal path for a vehicle or locate

the best soil for a particular culture, a GIS system allows you to achieve these goals faster, better and cheaper, by improving the organisation and management of resources. In this sense is illuminating the slogan with which you synthesize the previous concepts: «best information lead to better decisions '.
One of the most frequent errors in evaluating such systems is to confuse the GIS with one or more of its technological components before listed. In fact, it is a common tendency to identify a GIS system with one of its building blocks, first of all, the mapping platform. Actually it is not a cartography, nor traditional, numeric, but neither the Cartographic platform is uniquely and simply one of the starting points in the creation of a GIS system. GIS systems operate on the basis of two different models or techniques of spatial representation: a model rasters and vector model.

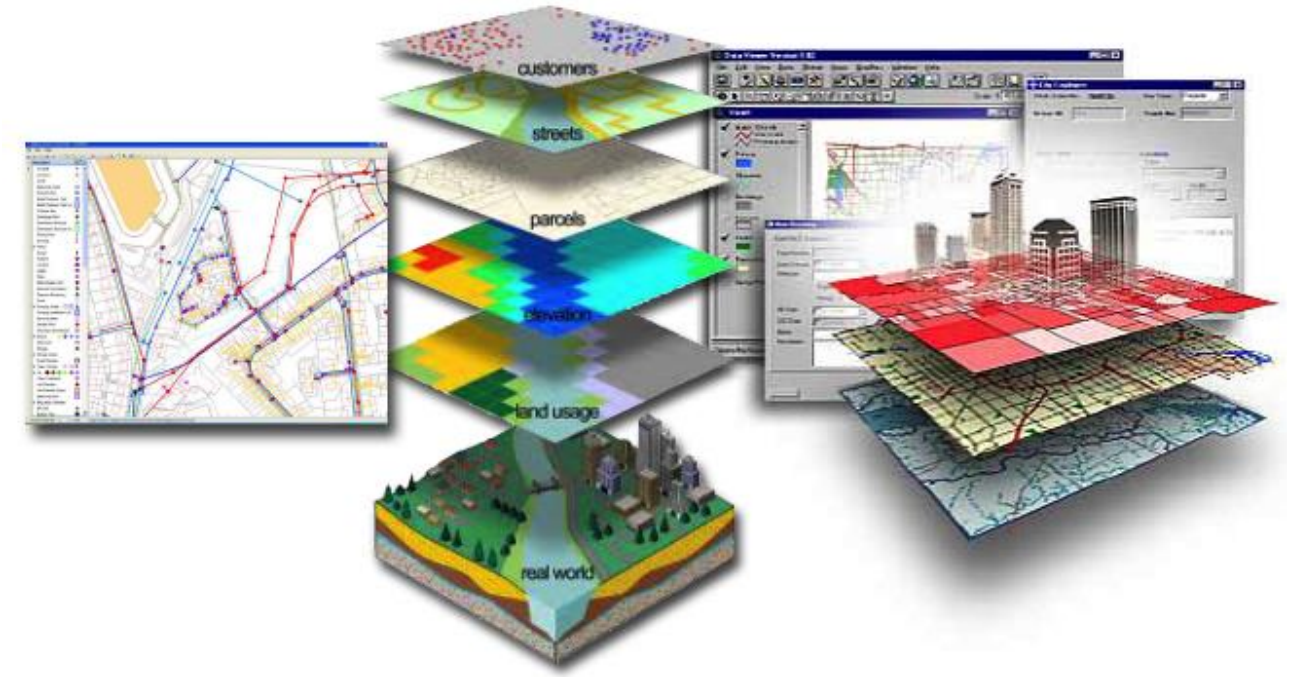


Fig. 8: Layered Structure (layer) of a GIS system; each level contains a certain thematism.

Raster technique (pictures) the territory is represented by an array of square cells, called pixels. Each pixel has information about what it represents in the territory. This impersonation model lends itself well to manage systems based on satellite images or images obtained through traditional cartography scanner.
The vector technique (art), its CAD systems, is used to describe items and events such as "discontinued". With this technique the territory is represented using elements of numerical cartography (points, lines, segments or areas). A point is located in a geographic information system through its real coordinates (E1, N1, Q1); a line or a polygon by the position of its vertices (E1, N1, Q1; E2, N2, Q2 ...).
Each element is associated with a record (set of fields containing information) information database. Vector data have three fundamental properties:

- geometry: cartographic representation of the objects as their form and their location;
- topology: relations between objects (connection, adjacency, inclusion etc.);
- Info: connected to data (numeric, text, etc.) associated with each object and generally used to represent discrete, data as:

– the location of the waste bins of a city;
– the representation of the streets;
– a Charter of land use.

The topology, mentioned earlier, is the discipline that deals with connectivity and adjacency of geometric elements such as points, lines and areas; It allows to analyze the spatial relationships between geographic data. A topological data structure determines exactly how and where they are connecting points and lines on a numerical card by means of logical links, called nodes.
GIS systems record information in a multi-tiered structure (or thematic) information known as layers, each containing a single on-screen thematism and geometrically by points, lines, or areas, as shown by [8].
Leveraging the Organization layer, GIS systems have the ability to perform an analysis of the spatial relationships between the attributes (information related to geographical data) database and connecting these with the cartographic section, to represent a model of the territory.

A GIS system, in short, provides the following basic functionality:

- storage of data from diverse sources and techniques after their transformation and homogenization;
- Organization of acquired data (previous paragraph) and storing their attributes, graphic and alphanumeric topological;
- space research and selection of objects using queries on their geometric components and/or alphanumeric code;
- availability of operators for processing and spatial analysis on the database, with the possibility of generating more new information from those stored;
- display information and production of processed leaving;
- generation of digital terrain models (DTM).

To ensure the efficiency of GIS systems require a general uniformity of data organization and referencing the same cartographic reference system.

In a landscape, we must investigate and reconstruct the reality, describing the area's childhood, places, objects, the points of view of memory, all the material and immaterial components, this represents a eco-geometric model of reality, a paradigmatic model of environment and built. The paths of knowledge of architecture must be the correct approach for the recovery and enhancement of this complex system which, with various facets, from time to time we call the environment, territory, landscape, and that includes the cultural and artistic heritage of humanity. This research study must gradually teach as the human environment needs to rebalance with nature, of reappropriate of its time, the rhythms, the sensations of the human sphere that determine real wellness and is no longer apparent.

Bibliographical References

[1] RICHARDS John A., *Remote Sensing Digital Image Analysis: An Introduction*, Springer 2013. ISBN 978-3642300615.

[2] GAMBARDELLA Carmine, *Tra antico e moderno. Il progetto di un'identità in divenire*. In: Atti del Seminario di Studi Internazionali su Architettura e Città. ROMA: Kappa, ISBN: 9788865140048

[3] GAMBARDELLA Carmine, *Ecogeometria*. Edizione Scientifiche Italiane, 2011.

[4] MARTUSCIELLO Sabina, *La rappresentazione come eco dell'architettura*. Edizione Scientifiche Italiane, 2003.

[5] TOPCU, H. *I Piani di gestione delle città storiche UNESCO e il "Paesaggio storico urbano".* INU Edizioni-Urbanistica, 2012.

[6] DE FIORE G., *La figurazione dello spazio architettonico*, Genova 1967

[7] DE RUBERTIS R., *Il disegno d'architettura*, Roma, 1994

[8] FATTA F., *La rappresentazione dell'architettura in fotografia: analisi critica e campi d'applicazione nell'ambito del rilievo dell'ambiente*, Palermo, 1990

[9] GAMBARDELLA C., *I layer della forma urbis*, Napoli 2000

[10] GAMBARDELLA C., *La leggerezza della geometria*, Napoli 2000

[11] GAMBARDELLA C., *Le Vie dei Mulini. Territorio e impresa*, Napoli 2003

[12] GAMBARDELLA C., *Atlante di Pompei*, Napoli 2012

[13] GIOVANNINI M. (a cura di), *Spazi e culture del Mediterraneo*, Roma 2006

[14] VITTA M., *Il paesaggio*, Einaudi, Torino, 2005.

[15] SIBILIO PARRI, Barbara*. Economia e Diritto del terziario, Uno Strumento Di Gestione Del Patrimonio Culturale: Il Caso Dei Siti UNESCO*. Milano: Franco Angeli Editore, 2011;

[16] Referring Web Pages Web: http://www.sitiunesco.org

[17] Referring Web Pages Web: http://www.planetek.it/

[18] Referring Web Pages Web: http://www.igmi.org/

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Italian architects and transformations of Tirana, regulatory plans of the new capital in the years 1925-1943.

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Abstract

Research on various urban plans and architectural projects conducted in the years 30-40's for Tirana trying to clarify a topic of great interest and less known in the mosaic of Italian architecture until the end of World War II.

Tirana recognizes three projection phases in these years which were basic for the configuration of the new capital, able to cope with the large demographic influx and creation of public spaces in which will be built the new state buildings, inexistent until that period.

The first plan of 1925 will be entrusted to Armando Brasini a Roman architect, who will throw the idea of a monumental boulevard surrounded by major government residencies.

The second plan for the city center, completed in 1930 by Florestano Di Fausto was the plan which was then implemented and had preserved some elements of the Brasini plan.

The third regulatory plan of Tirana, designed by Gherardo Bosio in a period slightly more than one year (1939-41) can be considered as one of the most important plans of Italians architects in Albania.

The challenge of Bosio and his collaborators was drafting an integral regulatory plan to the whole territory of Tirana and simultaneously the reconfiguration of the central monumental part and the administrative complex, linking his proposals with the central projects of the city inherited from the history and from his compatriots.

Keywords: architecture, urban planning, Tirana, Italian architecture in Albania, regulatory plans

1. Section

Introduction

In January 1920 at Lushnja congress in a compromise between the north and south of the country was decided the formation of a provisional (technical) government, which decreed Tirana as the temporary capital of Albania. After climbing to the top of the Albanian government in 1925, Ahmet Zogu decide to confirm Tirana as the new capital of Albanian state. At this point the challenges were enormous, needs to designed almost from scratch over existing tracks a typical oriental town, a capital-city with a clear urban structure and equipped with a suitable network infrastructure.

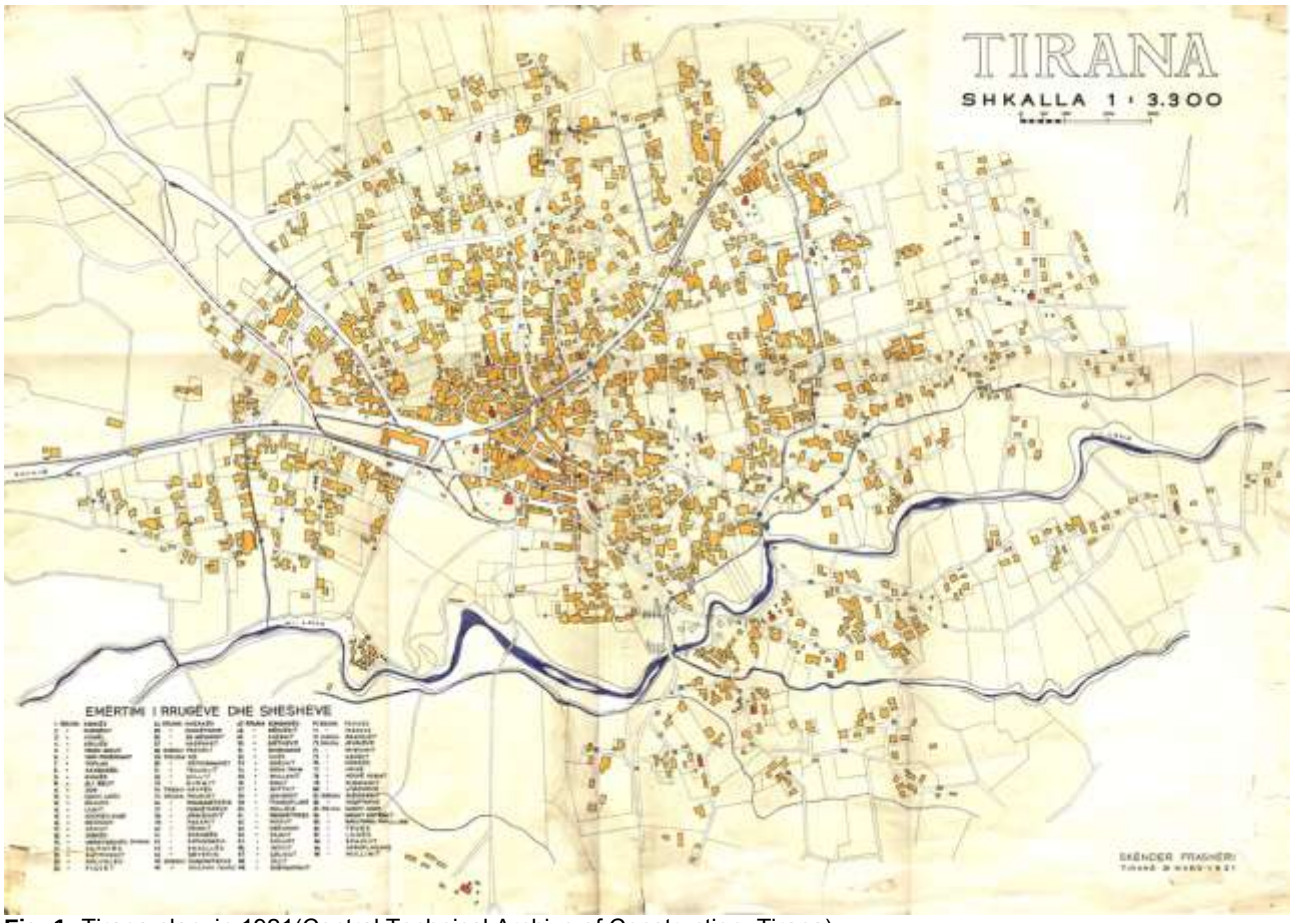

Fig. 1: Tirana plan, in 1921(Central Technical Archive of Construction, Tirana)

With a perfect geographical position, on a national road junction north-south, not far from the port of Durres in the west, the landscape of the Dajti Mount dominant east, Tirana was for the moment the most appropriate place to accommodate the governmental structures of the new state. According to various demographic data, the estimated population was of 12 000 inhabitants in 1920, after migrations towards the new capital was increased by 30 000 inhabitants in the census of 1930 and was estimated in 1945 about 60 000 inhabitants. According to historians, the city was founded in 1614 by Sulejman Bargjini who built a mosque, a *hammam* and an inn, creating the first urban nucleus of Tirana. In subsequent years, around the complex, the city began to spread spontaneously by principles of muslim Ottoman cities.

2 Paper Preparation

Observed from above, the city looked like an agglomeration of steep roofs and adobe walls painted in white. The repeating Game of these roofs change with the presence of religious public facilities like Islamic or Catholic-Orthodox. Ethem Bey Mosque and the Clock Tower as a complex was very important for the city, which in urban interventions for the development of the capital Tirana, will become part of the existing urban connectors and determining new shape.

Urban development of trade and craft part of the Old Bazaar, close to the t Ethem Bey Mosque and the Clock Tower complex, divided Tirana into two parts: in the north and east part of the housing consists of simple constructions, in most with adobe and south-west it's trade and craft production, where streets and squares system was an integral part of the city with a vernacular character.

So, the moment of naming the capital, Tirana represent a typical oriental structure, where the existing urban texture, regarded by many as the "garden city", should quickly vacate space for the structures of the state government, non-existent at that time.

At the same time, should face the inevitable growth and expansion of the city, as a result of demographic population setbacks. The new state bureaucrats, various traders and workers were directed to Tirana with the hope of a better life, for this situation were urgently required new space for residential and commercial environments.

After all those centuries under Ottoman occupation, economic and cultural projection of the future, for the Albanian leadership class was naturally oriented westward. For this reason, their demands were clear in the



Fig. 2: Tirana Bazaar in 1921

political and economic, but also in urban and architectural view of the territory. Ahmet Zog, Albania's prime minister at 1925, in a delicate political situation, while in Italy was consolidated fascist regime, was forced to practice a policy more favorable to the Italian State and the Italian capital. [1] Where would require to Mussolini parallel professional help for engineers, architects and urbanists of "high level" to develop a regulatory plan refined and competent for the new capital and with significant interference in Albanian territory.

This negotiation process allowed the creation of the Albanian National Bank, as well as creation of Svea (Albanian Economic Development Society) which would ensure that funds lent by Italy will be spent in public works and for the implementation of the regulatory plan of Tirana which will projected by the Roman architect Armando Brasini [2].

Brasini embodies a classic architect who brought from his homeland an architectural language inspired by the monumental tradition of Roman baroque, which were transplanted without any change in Tirana, in a very different context from both Italian and the European one.


Fig. 3: The montage of Brasini plan in 1925



Fig. 4: The aerial perspective of Brasini plan (Archive of Brasini, Roma)

Brasini [3] idea for the new center of the Albanian capital, where taste and oriental presence was strong enough, it was a considerable axial radical intervention on the urban texture and that would mean a strong linear cracks that would serve as monumental boulevard of the main city's. The orientation of this avenue should be according to the axis north - south, interventions characteristic of the ancient Romans in their colonies performed according to the principle "*cardo maximus*", shifted light from the west. In fact, a good part of boulevard will developed on an agrarian territory, fragmented by Lana river, part of which was proposed by Ahmet Zog as suitable area for the urban expansion to the new capital. [4]

This boulevard is a coordinator axis for urban development and a capacitor for the new centralization, with varying degrees. The prospects for the new squares were attached to the regulatory plan, it's monumental central of ministries, the Skanderbeg Square and final the Presidential Palace. Boulevard trail enters to the city through an important point that is Skanderbeg Square, which was transformed in the main axis of the new urban image. Major breakdowns required to implement the new axis should leave the space of a monumental axis defined as the "heart" of the city lacked up to that time. The idea of the monumental central square derivative of colonial roman traditions had originated as "forum". In Roman cities, users generally found the angled intersection of "cardo maximus" with "decumanus maximus", in the east - west axis, where in the specific case of Tirana, decumanus forum is missing and at the intersection of cardos with radial roads coming from other cities.

With this urban scenery, Tirana would have totally changed the image with strong architectural language consequence of ancient Roman culture, in stark contrast with the existing city. The idea of large urban transformation, according to Brasini, also clarified in the demolition project regardless of existing buildings, replaced with the new government headquarters, administrative, cultural, characterized by a clear ornaments of Roman monumentality. [5]

Major monumental axis was introduced as a way of broad and straight, almost entirely with portico and Doric columns, being updated with new items that came up or replace the existing part of the Ottoman city. These interventions organize open and collective space in the new axis and disposing on a monumental way the square near the mosque of Ethem Bey with the positioning of ministries.

With the realization of a typical French geometric park on the easy slope to be extended at the entrance of the Presidential Palace will organized a panoramic area at the entrance of the city. Not so far from the Presidential Palace, Brasini projects a square surrounded by Administrative buildings organized by the planimetric view with a strong radial system and concentric circles.

The aggravated report between Brasini and Ahmet Zogu, probably due to project delays or different requirements from our part, resulted in the cancellation of the contract by Ahmet Zog. The project for the center of Tirana was not realized and Brasinit ideas were left on one side.

After termination report with the Roman architect Armando Brasini, Ahmet Zogu, who then, in September 1928 will be elected king, to continue with the transformation work for the new Albanian capital, initially commissioned Austrian architect Hans Köhler and Albanian engineer Skender Frashëri to deal with the new regulatory plan. 1 Later on to this group will join the Italian architect Florestano Di Fausto. This delicate issue should certainly be continued where Brasini had left it.

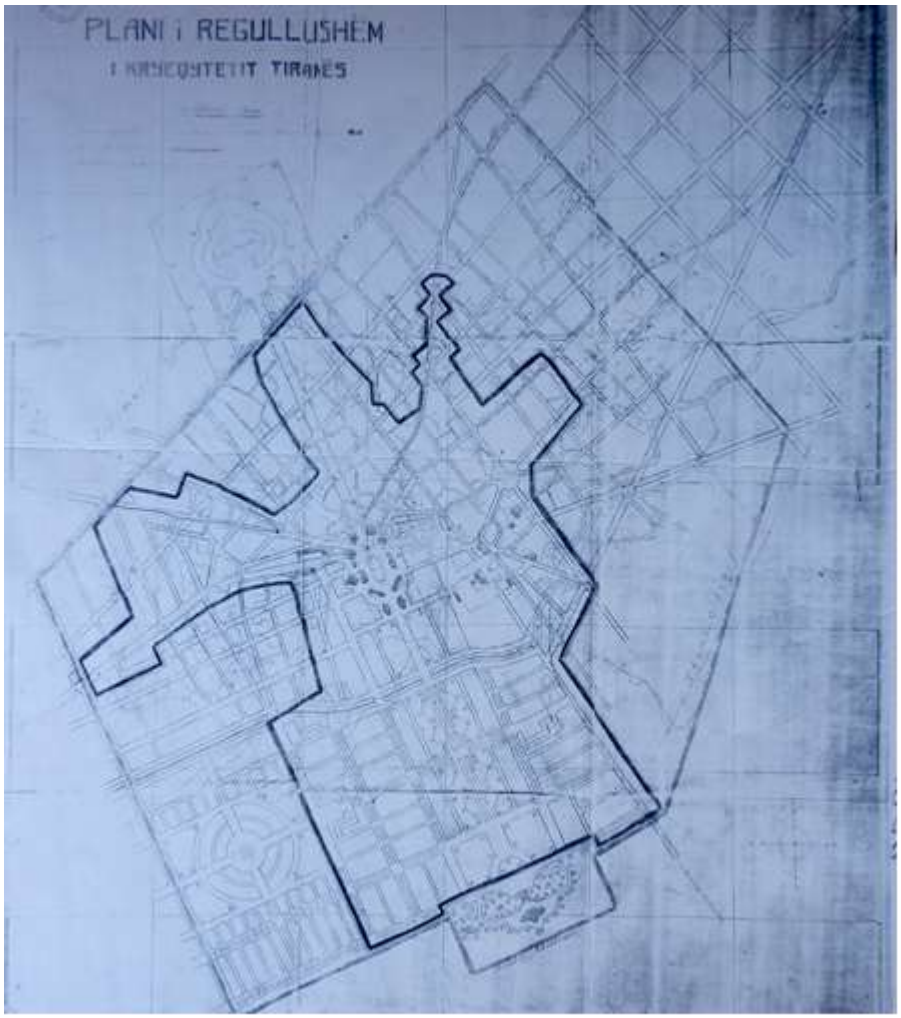

Fig. 4: Tirana plan in 1928-1930 (Central Technical Archive of Construction, Tirana)

The plan of 1928, after several options made earlier from those three, appeared as the first ever regulatory plan of Tirana. The main goal was the design and implementation of a superb infrastructural network, necessary to support expansion and construction to the south west of the city. This area will serve as a territory reserve able to cope with demographic growth that the plan is required to precede, aiming in the future the population of the new capital will be doubled or trebled. [6]



Fig. 5: The project for boulevard and Skanderbeg Square in 1928 (Central Technical Archive of Construction, Tirana)



Fig. 6: Aerial photo of the main square in 1936 (Archive of IGM, Firenze)

This plan, in its interventions, guarded and re-proposed Boulevard idea proposed by Brasini with newness the extension of the major axis to the north and also the central leveling therefore central ministries plaza already slightly redesigned. At the extremes of the boulevard were respectively large monumental squares. This intervention required major breach in the existing radical character of the city.
Strolling towards the main square was reserved for three typical French dressing parks, with 300 and 200 meters, which did configured geometrically in full symmetry by the main axis of the boulevard. On the opposite side of the royal palace, in the north of the boulevard was supposed to be established the city stadium, after the clear split that the radical axis make to the existing Ottoman city.
The plan proposed nearly a quadratic road system for the entire city and somehow respected major introductory axes derive from other cities to reaching the center, the new Skanderbeg Square.



Fig. 6: Aerial photo of the main square in 1936 (Archive of IGM, Firenze)



Fig. 6: Scheme of the ring roads on the regulatory plan in 1939 (Archive of Bosio)

Very important was the provision make by the plan for the city in the south-west with the new quarter 'Tirana e Re', whose territories were taken from the disposition thought that would be made to the Lana River and from agricultural territories. To the symmetric rectangular scheme of this new urban part was put in a large park as well symmetrical as the axis of Tellini Boulevard, parallel to the major boulevard.
Fascist military intervention in 1939 finds the city which extended more and more like an oil slick, where new buildings are occupied the place of the old ones, or very old buildings adapted rapidly, barracks and buildings looked everywhere.
With the major demographic movements, lack of housing and commercial space and insufficient road system caused a major urban crisis. To overcome this problem, it was designed a radial road network which converged in Skanderbeg Square, which the ministries houses were almost fully realized. More than any other city in Albania, Tirana needed a really Regulatory Plan.



Fig. 6: Regulatory plan in 1939 (Archive of Bosio)

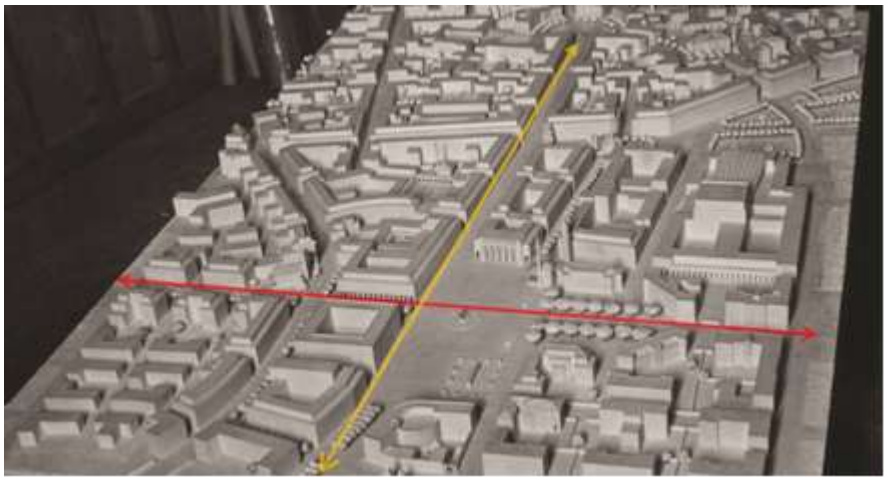

Fig. 6: The project's of the main square and old bazaar (Archive of Bosio)

Fascist government sends in Tirana a group of young architects led by Gherardo Bosio, which will deal with the Regulatory Plan of Tirana. Studies for the plan began in September 1939 with the design and later the realization of the square and the boulevard of the fascist ideology. In October of the same year, the work began for the plan idea of the regulatory plan which ended with a project plan approved by Law 71, on 7 March 1940.

In 1938 began the studies on network road and urban and above all, also began the studies for the limited plan in the area between the street "Vittorio Emmanuelle III" (today "Zogu I") and the old road to Shkodra. A specific plan with some organic unity was prepared for the area called "Tirana e Re", which were included the Lana River to the south and the hill where today is the artificial lake and on the east from Elbasani road.

In appearance all buildings were irregular and varied as the derivative of rapid urban development.

Constructive and architectural features of buildings in the center were mainly oriental, with almost most of the buildings with only one floor and build in rammed earth (qerpic) and crashed with few modern villas built up to that moment. According to Bosio private gardens gave the positive and picturesque notes, often very large, which presented through the narrow streets.

Tirana compared with other Albanians centers had no history of environmental characteristics of great importance to protect and preserve. Mosque of Ethem Bey, Old Mosque and the Bazaar was a valuable architectures that had such an interest to be considered important in determining the new plan.

In this plan Bosio interferes with caution, but with determination where compelling reasons of public interest, traffic, construction, hygiene and aesthetic element asked for. He was alert to the majority of existing buildings while maintaining a good portion of them, considering them almost entirely, without losing the idea that those objects which can then be presented discrete interest and texture to their decoration , can looked miserable when one day will be displayed in front of buildings that arise in the future, with great length and height to four, built according to the most modern and hygienic time.

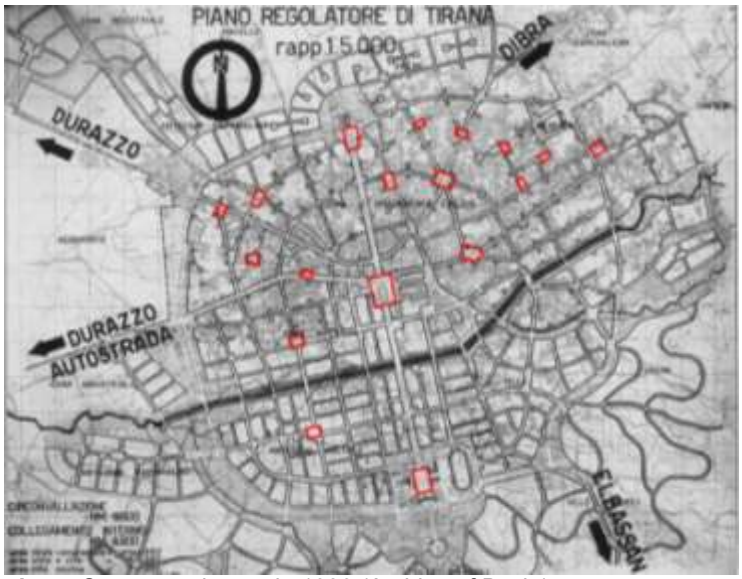

Fig. 6: Squares scheme, in 1939 (Archive of Bosio)



Fig. 6: Boulevard project, in 1939 (Archive of Bosio)

Many roads may seem sufficient for pedestrian and vehicle traffic at the time, was expanded and in some cases shifted when clearly seen that would have been totally inadequate for the heavy traffic that will created by the expansion of the city in the future, as well as introducing new ways of public and private transport.
Regulatory plan foresaw the distribution of transit traffic outside the urban core, collecting from the directions of Durres, Shkodra, Elbasan and Dibra at the entrance of the city. With a total length of 8.111 kilometers, ring-shaped trajectory, consisting of two types of road structures: the tract stretching north-west and north-east, with a total width of 33 meters, the two roads form a central garden and were joined by wide sidewalks; the tract in south and south-west, with a total width of 42 meters, with a single central road accompanied by extensive gardens and a road for side service.
In the period of communism, the following plans made from Italian like a detailed studies on the vision of the city, were not considered. Plans from 1957 to 1989 will be rerun with small parts of the Bosio plan.



Fig. 6: Aerial view of Mother Teresa Square (A.Vokshi)



Fig. 6: The aerial view of Skanderbeg Square. (A.Vokshi)

3. CONCLUSIONS

The intervention that Bosio provides for the existing old part of Tirana derive from some evidence that the architect himself will announce in it relation of the Regulatory Plan. This space considered by him as the "garden city", which had to canned in an integral way, first, as mentioned above, is the aesthetic factor and architectural forms with strong local scenic environment. According to him these forms should be canned as well as a memory of the old city of Tirana and the old Ottoman texture should be integrated with the new primary road system and the logic of mini-centers small quarters with the corresponding squares evenly distributed in the territory.

Bosio second argument in favor of their conservation is the relationship that citizens of Tirana had with their houses and a special way of life, seeing the whole problem also by the social view. It would be difficult according to him for the citizens to adapt quickly to the new conditions.

Another essential element considered by the architect is the economic factor needed to transform large parts of the city already consolidated.

Parts of the city look like that formally are consolidated; in reality they continue to follow their oriental and chaotic character, a part of to problems like marginalization and isolation of residents inside, and urban degradation of buildings. Even today seems that spatial quality worsened with the individual interventions around the objects which are performed at different times.

Two perspectives can be addressed in project operations; the money is intended that part of public interventions can play a key role in the activation of the regeneration processes on based sectors of the contemporary city. This will normally be made in relations with existing urban value, infrastructure networks and "urban porosity" necessary for recreational spaces.

Bibliographical References

[1] Antonello BIAGGINI, Storia dell,Albania contemporanea, Milano, pp 63-81

[2] F. Jocomoni Di San Savino, La politica dell'Italia in Albania nelle testimonianze del Luogotenente del Re, Cappelli Editore, p 25-37

[3] M.A. Giusti, Albania, Architettura e Città, Maschietto Editore, Firenze, p 20

[4] M.Giacomelli, A. Vokshi (a cura di), Architetti e ingegneri italiani in Albania, Edifir, Firenze, 2012

[5] G. Gresleri, Albania: una dimensione sospesa tra opere pubbliche e rifondazione della città, in Architettura italiana d'oltremare Atalante Iconografico- a c. di G. Gresleri, P.G.

Massaretti, Bologna, Bolonia University Press, 2008, pp. 433-468.

[6] M.A. Giusti, Albania, Architettura e Città, Maschietto Editore, Firenze, p 60

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New qualities for the revitalization of the ancient villages

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Abstract
The marginalization of small Italian villages is the result of complex social phenomena such as the gradual depopulation resulting in the aging of the population and the economic impoverishment deriving of the progressive depletion of productive resources. In the presence of such phenomena, we cannot imagine recovery strategies providing only the restoration of the building fabric. It is necessary to implement interventions that consider the phenomenon globally, through the identification of new compatible uses, energy self-sufficiency, respect and appreciation of the identity characters.
We propose interpretation methods of the potential of areas in order to evaluate design alternatives and consequently identify appropriate and compatible intervention strategies. The approach refers to the status of the architectural technology that considers the performance aspects of the built environment and the needs of the users according to a systemic point of view. Possible solutions are supported by the constant and essential use of the technological innovation, and control of sustainability of the interventions. In support of the argument, we analyzed case studies related to places of the foothills area of central and southern Italy.

Keywords: ancient villages, depopulation, public space, save energy, smart city strategies
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1. Multi-objective strategies for the rehabilitation of the villages.
(Antonio Bosco)

Today, in Italy, the urban centers under one thousand residents represent nearly a quarter of the existing cities, with a geographical distribution that is concentrated mainly along the Alps and the inland areas of the Apennines, with a prevalence of mountain towns on those plain. These small towns are often fragmented into small isolated villages of ancient plant with a population fewer still (in the tens or hundreds). Despite their small size and the limited number of local residents, these villages occupy overall a significant portion of the country, having a population that is around 1.7 million inhabitants. Moreover, they often fall within naturalistically significant areas, for this reason they are the center of attention of many European directives.[1]
As said, the small villages are mainly concentrated in the inland areas of the Italian territory and it is with those territories that they share most of their characteristics. As reported in a recent note, Euro IDEES informs us that the inland areas are *"the vast part of the country, not flat, strongly polycentric, with widespread decline of the cultivated area and often suffering from population decline".* They also represent

[1] Data from: *Atlante dei Piccoli Comuni 2014,* by ANCI - IFEL.

"part of the country ... distant from the centers of agglomeration and service, with unstable development trajectories, but at the same time equipped with resources that are absent in the central areas".[2]
This suggests that the plans for redevelopment of these areas have to consider the demographic and positional problems. We should also take into account the significant presence of natural resources that are scarce in the large centers instead. We will also consider, in the planning of the small villages, the opportunities for a polycentric approach aimed at creating cooperative networks, both physical and virtual, useful to emphasize the peculiarities of each node, mainly in the distribution of services.

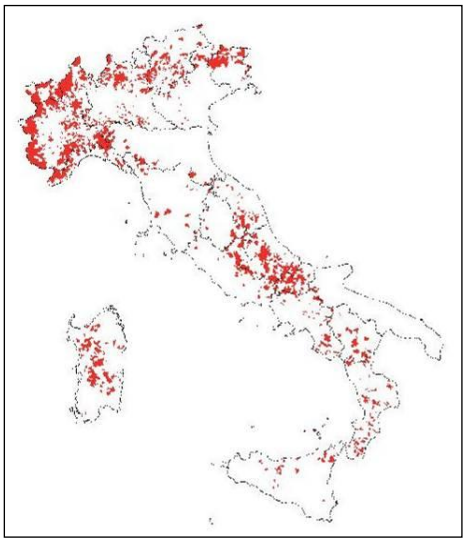

Fig. 1: Geographical distribution of small municipalities up to 1,000 inhabitants.[3]

The aging population of the historic villages determines two additional problems: the increase in social spending and the gradual reduction in the ability to produce wealth. For these reasons, the redevelopment project must stop these statistical trends and reverse their sign in the future. The red line in the level of aging of an area (that is the limit of the capacity of endogenous growth) is fixed by demographers at 30% of the elderly population of that total. Beyond this threshold, we can reverse the trend only by entering new population; to succeed we must attract young people and growing families creating new and stable employment opportunities.[4]
At present, persisting the uncertain economic conditions that afflict the nation, it is necessary to reconsider and re-evaluate the role that small territories can play within the dynamics of development. The recovery and redevelopment of the old villages, favouring the demographic balance between the different areas of the country, could contribute directly and indirectly to a profound revision of the paradigms of growth and management of the territory.

1.2 Key objectives

Observing a revival of interest in the restoration and rehabilitation of small villages, we note that the private real estate transactions do not determine, in most cases, a positive impact on the development of the surrounding territories. The speculative interests and the need for immediate gain for private investors prevail over the public interest. To contrast these real estate transactions it would be desirable to provide in agreements between public administrations and private entities, clauses on defence of the collective interests. The private sector could instead be rewarded with tax incentives and credit facilities, leaving even the possibility to manage business activities for the appropriate periods to ensure the economic return on investment.
The building rehabilitation, as mere real estate transaction, and the creation of isolated accommodation facilities are not able to adequately promote the development of the territories. To encourage an effective

[2] Euro IDEES, annex VI, *Nota metodologica: indicazioni per implementare il progetto Borghi Vivi rispetto agli orientamenti della strategia nazionale per le aree interne,* Brussels, April 2, 2013; pp. 2-3.
[3] Image from: ANCI - IFEL *op. cit.* p. 19.
[4] Cf. Euro IDEES, annex VI, *op. cit. p. 4.*

revival of the places we have to act simultaneously on several fronts converging toward structural changes able to create stable conditions of welfare for old and new residents.
To summarize in a few points the appropriate action to outline valid approaches to redevelopment, we list the following seven areas of interests to be considered in the preparation of plans and projects.

1. Recovering buildings and urban spaces, preserving the identity characters.
2. Adapting the residences and urban spaces to current standards.
3. Stimulating public mobility and improving accessibility to places.
4. Promoting economic activities, encouraging those aimed at care of the land.
5. Encouraging the formation of new social tissue by promoting hospitality and tourism.
6. Designing according to environmental sustainability criteria.
7. Implementing solutions to save energy and developing "smart city" strategies

The list of objectives, however, is likely to remain a sterile exercise if one does not consider the need to provide methodological support or guidelines that can guide operators in the design work and scheduling. These theoretical tools are crucial, for example, to evaluate the resources and the architectural, economic and territorial potential of each site, and simultaneously identify the environmental and orographic constraints of each zone, considering the extreme variability of these factors. The areas of interest listed above indicate, in a first approximation, the most appropriate strategies to be implemented for proper data collection, an objective evaluation of the conditions of the places, and an appropriate definition of the design choices.

1.3 Towards new design strategies

We cannot here address all issues of cultural and technical-operational posed by the preservation of identity characteristics of the villages. We can only emphasize the importance of carefully evaluating the historical "depth" of the territory for drawing up quality projects. We should however remember that the vast amount of information collected should not lead us to abandon the path of experimentation and innovation in favour of timid and conventional projects. Magnaghi says in this regard: *"The historical analysis of the territorial making process is not aimed at research-conservation of the "original nature" of the place (genotype or genetic memory), but the identification of its good reproductive practices providing rules (construction, settlement, environmental, relational) to continue the work of territorialisation according to criteria and innovative forms. Therefore, the analysis is not aimed at transforming the area into a museum or copy styles; but to acquire wisdom and the art of building they have created, in earlier times, virtuous relationships between human settlement and environment and use them for the transformation project"*.[5]
From the environmental point of view, we cannot imagine to elaborate the project without considering the climatic peculiarities of the site that will cover the different exposures, the feedback on shadows and sunlight. It will be also explored the possibility of using alternative energy sources including geothermal or arising from the recovery of waste materials.
Many villages and especially those located in the mountains of central-southern Italy are characterized by an orography unsuited to the current needs of use and unfavourable to the system of mass production. In these cases, the chances of success of the interventions depend mainly on the degree of residential and economic attractiveness that can be implanted in the places. These are indeed the most requested qualities by potential stakeholders including the old residents (who have a direct memory of the old village), the younger generation (who know the village through the stories of the elderly), the new inhabitants (attracted by the opportunities offered from redeveloped village), and of course private investors (interested in the economic viability of their investments).
Another condition that characterizes some abandoned villages is their proximity to new settlements built at a short distance in the most comfortable and favourable conditions in terms of topography and environment; the reasons for the reconstruction are to be charged to catastrophic events or risk conditions having recommended the relocation of the village. However, it is apparent how this choice manifestly contradicts one of the main principles of sustainable development, namely the need to save the soil to be allocated to new buildings by focusing at the restoration and enhancement of the historical heritage. It would therefore be appropriate, based on the European recommendations, to promote the upgrading of small towns through

[5] Magnaghi A. (2000), *Il progetto locale. Verso la coscienza di luogo,* Torino, Bollati Boringhieri; p. 76.

coordinated actions between central and local administrations, entrepreneurs and intellectuals, tending to a harmonious redistribution of the population in the territory organized as a network, against current trend towards concentration in few large poles. This could cause an economic and ecological benefit to the entire system through the development of specific local produce, the promotion of tourism and the sustainable maintenance of the territory.

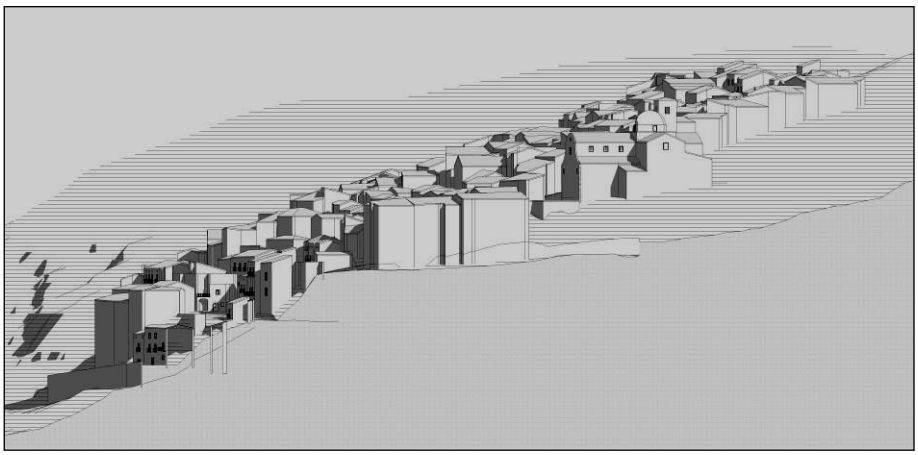

Fig. 2: Complex topography characterizes many small villages of the inland areas.[6]

The production indicator will evaluate the recovery of ancient traditions and old crafts that are still viable and profitable if framed within a more general valorisation of the territory. New and original forms of economic activities should be supported, related to the hospitality industry and to the widespread agricultural redevelopment of derelict land in order to return, as mentioned above, to the control and direct maintenance of territory and landscape.

Improving the quality of housing is a cornerstone on which to rest the redevelopment of the villages. To achieve this, it is crucial to increase the comfort inside the houses and provide for a better use of urban spaces. The thermal comfort of the interior spaces must be aligned to current standards with additions of plant and especially through the adaptation of the layering technique of roofing systems and perimeter walls, by intervening from inside to avoid any change of the image of the buildings.

The problem of accessibility and usability of places is a matter that must be addressed at multiple levels. There are villages to which is denied or seriously hampered the accessibility from the outside for lack of roads and rail links, or due to the orographic nature. In these cases the actions may be particularly costly and complex and need to be entrusted to the competence and responsibilities of the higher administrative levels (region, state). However, there are functional deficiencies affecting the viability and the internal paths that must be within the local expertise for the redevelopment of the area. In this case, we must assess the condition and the roughness of roads and steps that can pose real barriers for weaker individuals and can influence the transport and the supply of goods. In redesigning the urban space we must mediate between the "slowness", which can be considered a value to be preserved for the quality of life of the villages, and the "speed" that can instead be essential to the economic productivity and safety of the inhabitants. To allow acceptable levels of mobility and usability of urban open spaces, it is suitable to allow for assisted mobility systems such as escalators, elevators and stair lifts, considering that such systems can also facilitate the movement of commodities and manufactured goods.

Improving the quality of life in old villages also depends on how the project solves the problems of the preservation and restoration of the buildings. If action is taken on the buildings without respecting the materials and traditional building techniques, the alteration of shapes, colours and dimensional relationships between parts may result in the loss of identity characters.

[6] Picture from the master's degree thesis on redevelopment of the village of S. Pietro Infine (Caserta, Italy), supervisor: prof. arch. Antonio Bosco, student: Pasquale Di Monaco; a. a. 2013-2014.

The proper use of innovation determines the quality and sustainability of the project; for example, the equipment for the exploitation of alternative sources must be fully integrated in buildings and in the urban fabric, avoiding solutions that alter the peculiar characteristics of the places.
The intensive use of information systems to enhance and simplify the dialogue between citizens and government can make a significant contribution to the revitalization of the villages. The creation of a network between nodes distributed on the territory would be a massive boost to a cooperative management of resources and services, contributing significantly to the rationalization of territorial marketing. The smart technologies offer two key advantages over the objective of safeguarding the identity: on the one hand they require light physical media and easily integrated into the structures, and on the other hand they will allow to limit the movement of matter in favour of the transfer of information.
In conclusion, it should be stressed that whatever the nature and extent of the design solutions, they will always have to adequately deal with the local context, as they inevitably interfere with it physically and emotionally. If it is true that the places have a soul then any change must be measured, on the one hand, with the constraints of the historic site, and secondly with the emotional demands of the users that are only partially mitigated by the improvement of living conditions.

2. Notes for a methodology of approach to the rehabilitation project

(Mariarosaria Arena)

In order to overcome the issue of the revitalization of depopulated small villages, it is necessary to rough out the framework of needs for the recovery of urban space's quality as a collective living place. This quality involves the material and the intangible aspect of the context. The first consists of the configuration of public spaces, of the curtains that define them, and the substances that occupy and invade them; the latter is related to the uses, memories, ethical and economic values, external and internal networks in relationship with the physical and virtual outside of the city.
The quality of the spaces, when it is generated among the buildings, defines the image of the city. According to what Massimo Pica Ciamarra said in his "Apology of (not) built" " *The cities live on open, not built, areas; on the design of squares and places; animated by intangible relationships uniting the individual actions and making them as fragments of a whole. Enclosing and delimiting the space, distinguishing between inside and outside. At the same time contradicting the separations, limiting, establishing a continuity. The constructions as a sequence of places, with filters, mediations, passage rites. What is external to the built is internal to the city. With very few exceptions, these interiors change in time, acquiring new unforeseen meanings. The real power is in the continuity of their changes"*[7].

2.1 The public spaces

Studies on the qualification of the public open space have analysed the different aspects determining the levels of performance, taking into account social factors and relationships[8], the ways of using and safety[9], the environmental comfort[10], the innovative potential of energy generation. Starting from this framework of contributions, we aim to analyse and identify the characteristics found in the ancient abandoned villages as strengths and weaknesses. We will go on through the reinterpretation of the qualities of the public space in the specific context of the urban centers when they are characterized by the dynamics of depopulation, because of the inability of the urban structures to adapt themselves to the needs of contemporary living.

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[7] Pica Ciamarra M. (2004), *Apologia del non costruito*, Convegno internazionale “Interni urbani” – Camerino, Palazzo Ducale

[8] Gehl, J (1987) *Life Between Buildings: Using Public Space*, Van Nostrand Reinhold, New York
Knowles R.L., (1999) *Solar Envelop*e, in *Architecture City Environmen*t, the PLEA 2000 conference, Oxford Alden Press,.

[9] Martincigh L. (2012), *Strumenti di intervento per la riqualificazione urbana. La complessità dell'ambiente stradale,* Ed. Gangemi, Roma

[10] Dessìl V. (2007), *Progettare il comfort urbano. Soluzioni per un’integrazione tra società e territorio,* Sistemi Editoriali, Napoli
Nikolopoulou M. (coord.) (2004), *RUROS - Rediscovering the Urban Realm and Open Spaces,* Commissione Europea, DG Ricerca , Azione chiave n°4, quinto programma quadro
Bosco A., Rinaldi S., Valente R., (2012), S*trumenti di progetto per il microlandscape urbano,* Alinea editore, Firenze

The specificity of the suggested theme lies within the terms and conditions of use / non-use of these urban systems are closely connected to their physical features. The quality of the uses has its origin in the morphology of the places, generally structured according to the activities and the slow pace of life, and with strong configurative characterization, even when simple and free of high intrinsic values. The deficit of compatibility between the slow pace and the speed of urban contemporary lifestyles contrasts with contexts where the much-needed flexibility would lead to the loss of the peculiar characteristics and identity.
Therefore, the analysis that we intend to structure is aimed at identifying the physical, morphological and social aspects, in relation to which it is possible to identify the requirements to ensure that the urban space may find its role in the territorial structures contemporary without losing its value, seen as evidence of the past, but also as a model of living forms.
The aims of the intervention to be implemented are meant to protect the identity features of the place, to innovating and upgrading the usability of public space and rendering recognizable structure.
The focus is on open spaces and relationships. The rules for the use of public space are highly meaningful for the quality of the urban context and analysing their characteristics allows identifying factors of attractiveness or inadequacy that the place expresses.
In its configuration, the urban open space is characterized by sets of subsystems belonging both to private and collective structures. In fact, the urban scenes defining the relationship's spaces are the interface between the private space (the building) and the city, while the horizontal surfaces and equipment (street furniture) are a collective heritage.
The urban centers we are concerned with, are at risk of neglect because of the interruption of the *continuity of change*, for inherent difficulties determined by the physical and / or proprietary characteristics to the site or, more often, for the loss of interest on the investment changes given by the impoverishment of the social potentiality and the capacity of the site to produce jobs and income.
Therefore, to improve the quality of urban life it is crucial that the changes will affect both public and private assets, in order to achieve proper requirements. The requirements for buildings are classified according to established models in the scientific literature. Moreover, the requirements for the open spaces are widely described and R. Valente proposes their extension to improve their performance intensity[11].

2.2 Methodology of reading to the public space

In previous studies we proposed a methodology for determining the quality potential of the urban open space, structured on systemic reading of the tangible and intangible aspects defining the features[12]. The processing of data collected through five levels of study reflecting the physical, microclimatic, materials, psycho-perceptual, and use aspects, allows to structure a framework of knowledge of the place that is represented through diagrams interpolated for the identification of quality potential improvement through changes or additions.
The analysis identifies the following steps:
• place's data acquisition (1);
• microclimate behaviour analysis (2);
• material analysis (knowledge of the limits) (3);
• analysis of social significance (4);
• psycho-perceptive analysis (5).

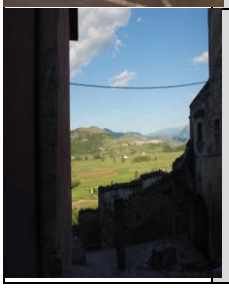
In assessing the open spaces of urban systems with particular characteristics, such as town centers at abandonment risk, for which quality improvement coincides with the ability to preserve its own integrity, it is necessary to pursue the analysis at additional levels that take into account the ability to interconnect with local structures outside, intended as physical and/or relationship structures, considering tangible and intangible aspects.
Hence, the interconnecting elements are defined, that should direct the analysis for the detection of the quality potential. For each of these elements we identify aspects to be included in the reading of analysis, using the structure of the protocol in respect to the issues listed in the tables below.

[11] Valente R., (2012), *Spazi aperti urbani ad intensità prestazionale*, in Bosco A., Rinaldi S., Valente R., cit.
[12] Arena M., (2012) *Analisi del potenziale di qualità,* in Bosco A., Rinaldi S., Valente R., cit.

Internal connections

		1) place	2) microclimate	3) material	4) sociality	5) perception
	road/road relationships	1.a. number of converging roads 1.b. width of roads 1.c. type of roads	2.a. orientation of the roads	3.a. discontinuity of the paving 3.b. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.c. road signs
	road/square relationships	1.a. number of converging roads 1.b. width of roads 1.a. type of roads	2.a. orientation of the roads	3.a. discontinuity of the paving 3.b. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.c. road signs
	walking routes/ driveway	1.a. presence/ absence of pavement 1.b. presence/ absence space for pedestrians 1.c. obstruction on the way	2.a. orientation of the roads 2.b. road's sun exposure	3.a. discontinuity of the paving 3.b. Interface between paving / building's bases and street furniture 3.c. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.c. road signs
	pedestrian resting areas	1.a. special areas 1.b. presence/ absence of security 1.c. presence of green areas 1.d. relations with paths	2.a. characteristics of the resting places with seat 2.b. sun exposure of the spaces for the stop	3.a. discontinuity of the paving 3.b. Interface between paving / building's bases and street furniture 3.c. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses 4.c. percentage spontaneous uses	5.a. perspective on the roads 5.b. visual interferences 5.c. scenic view 5.d. visual attractors
	parking spaces	1.a. special areas 1.b. presence/ absence of security 1.c. relations with paths	2.a. sun exposure of the spaces for the stop	3.a. discontinuity of the paving 3.b. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences
	altimetry	1.a. declivity 1.b. configuration of the height differences (stairs, etc.). 1.c. length of the sloped sections	2.a. road's sun exposure	3.a. discontinuity of the paving 3.b. Interface between paving / building's bases and street furniture 3.c. maintenance	4.a. interference among activities, stop and paths 4.a. percentage improper uses 4.b. transitability 4.c. opportunity to sit	5.a. perspective on the roads 5.a. visual interferences
	public / private interface	1.a. number of accesses on the road 1.b. height differences road / access 1.c. geometry of accesses	2.a. orientation of the roads 2.b. orientation of of facades	3.a. discontinuity of the paving 3.b. rises 3.c. maintenance 3.d. Interface between paving / building's bases	4.a. relations among runs pedestrian, vehicular, access with dedicated spaces 4.b. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.c. view towards the inside public/private space

External connections

		1) place	2) microclimate	3) material	4) sociality	5) perception
	internal primary roads	1.a. road width 1.b. curves and straights	2.a. orientation of the roads	3.a. discontinuity of the paving 3.b. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.a. road signs
	primary/ internal roads connections	1.a. width of converging roads 1.a. type of roads 1.b. declivity	2.a. orientation of the roads	3.a. discontinuity of the paving 3.b. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.c. road signs
	primary roads/ pedestrian path connections	1.a. pavements 1.b. number of accesses on the road 1.c. height differences road / access 1.d. geometry of accesses	2.a. orientation of the roads 2.b. orientation of the paths	3.a. discontinuity of the paving 3.b. maintenance 3.c. interface between paving / building's bases	4.a. relations among pedestrian runs, vehicular, access with dedicated spaces 4.b. interference among activities, stop and paths 4.c. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.c. view inward public/private spaces
	secondary roads outside access to workplaces	1.a. width of the roads 1.b. type of crossroads 1.c. declivity	2.a. orientation of the roads 2.b. green shield	3.a. type of the paving 3.b. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.c. formal and informal road signs
	secondary roads outside of access to places of entertainment	1.a. width of the roads 1.b. type of crossroads 1.c. declivity	2.a. orientation of the roads 2.b. green shield	3.a. type of the paving 3.b. maintenance	4.a. interference among activities, stop and paths 4.b. percentage improper uses	5.a. perspective on the roads 5.b. visual interferences 5.c. formal and informal road signs
	interchange parking	1.a. size of the area 1.b. space or building 1.c. width / type of roads and access routes 1.d. number of levels 1.e. declivity	2.a. orientation of the roads 2.b. sun exposure of the parking space	3.a. type of the paving 3.b. maintenance 3.c. appointments	4.a. interference between stop and paths 4.b. percentage improper uses 4.c. information points 4.d. public transport parking	5.a. perspective on the roads 5.b. visual interferences 5.c. formal and informal road signs
	panoramic viewpoint	1.a. size of the area 1.b. space or building 1.c. width / type of roads and access routes 1.d. number of levels 1.e. declivity	2.a. orientation of the roads 2.b. orientation of the viewpoint 2.c. wind protection	3.a. type of the paving 3.b. type of the parapets and the fences 3.c. maintenance 3.d. appointments	4.a. interference between stop and paths 4.b. percentage improper uses	5.a. landscape's type 5.b. visual interferences 5.c. formal and informal road signs

3. Sustainable innovation and constructive culture of the ancient villages

(Sergio Rinaldi)

The foothill area of Central/Southern Italy still contains natural and cultural landscapes of peculiar importance. Here, during the centuries, a broad variety of architectural and typological solutions developed, rising from a long process of adjustment to the climate and the geography of the landscape.
Despite their state of under usage and neglect, these places can become attractive again for the stable residence and the free time.
To redevelop this important heritage, is necessary to save from definitive destruction the recoverable parts, integrating new functions and upgrading the buildings to high residential standards, according to the expectations and the needs of the modern life.
Thus, a flexible approach to the intervention project is necessary, to apply creatively, the traditional architecture principles to the new possibilities offered by process innovation of the building systems.
So the traditional architecture combined with advanced technologies can satisfy the requirements of energetic efficiency and of ecological and economic sustainability.
In these places the architecture developed, during the time, through a careful management of the landscape sources, usually lacking and barely available, and in the presence of adverse climate conditions. Creative solutions, whose applicability has been verified, were tuned to solve the residential issues, often with limited sources and local materials.
All the choices and the solutions adapted, from the scale of the settlement to the more specific building details, express a particular charm, because their shape reflects a skilful adjustement to the local conditions, defined by weather and landscape.
In this context, building culture and ecological innovation are not in contradiction. Indeed, always, the knowledge of the local builders nurtured with continuous innovations and produced specific solutions to the single local issues.
Knowledge and expertise can be found out from traditional architecture, and transferred to the present days to optimize the energetic efficiency and the costs of lifecycle of buildings and settlements. This aim can be reached applying the current technologies and the specific knowledge of the local conditions according to the ecologic aspects of building.
Considering these premises, who writes directed some didactic experiences of technologic design on small villages of the foothill area of the Apennines, which were progressively abandoned.
Energetic and technologic recovery proposals were realized in the context of more general strategies of economic and productive recovery. In particular, I am referring to two examples, the first about an localizate intervention; the integration in a vacant lot of the historical pattern of a small village of the Abruzzi in the area of L'Aquila earthquake[13]. The second example is the recovery of a tiny village, almost abandoned, in the northern area of Caserta, near the line with Molise[14].
The first project suggests the realization of a small building destined to house a cultural circle and a meeting area for the residents, with a panoramic tower, which overlook the surrounding area.
The building is located in an inclined lot cleared from a small structure recently abandoned, which is going to be demolished. (fig. 3) (fig. 4)
The introduction of a tower, emerging from the building pattern around, is due to presence of some medieval sighting towers in the area, and to the tower of Caporciano castle, which dominate the village. (fig. 5)
The reasons supporting the proposal are the individuation of new functions and activities to support a sustainable tourism and the relaunch of the productive potentialities of the area. In fact the materials used for the new building are all produced in the area to favour and potentiate the usage of building products at km 0. So building is almost entirely realized with Xlam wooden panels, produced by local factories. Moreover, is

[13] Thesis in Architectural Technology from title: "Integration of structures for sustainable tourism in the municipality of Caporciano". Seconda Università di Napoli, Master of science in Architecture, tutor prof. arch. Sergio Rinaldi, year 2010/11, student Sabina Cerullo.
[14] Thesis in Architectural Technology from title: " Aorivola_0 Energy village". Seconda Università di Napoli, Master of science in Architecture, tutor prof. arch. Sergio Rinaldi, co-tutor prof. arch. Antonio Bosco, year 2010/11, student Linda Laurenza.

proposed the re usage of the inerts, products of the demolition of the pre-existent building, for the realization of closing walls, made with metallic cages, containing the ruins of the demolition.



Fig. 3: The batch of intervention

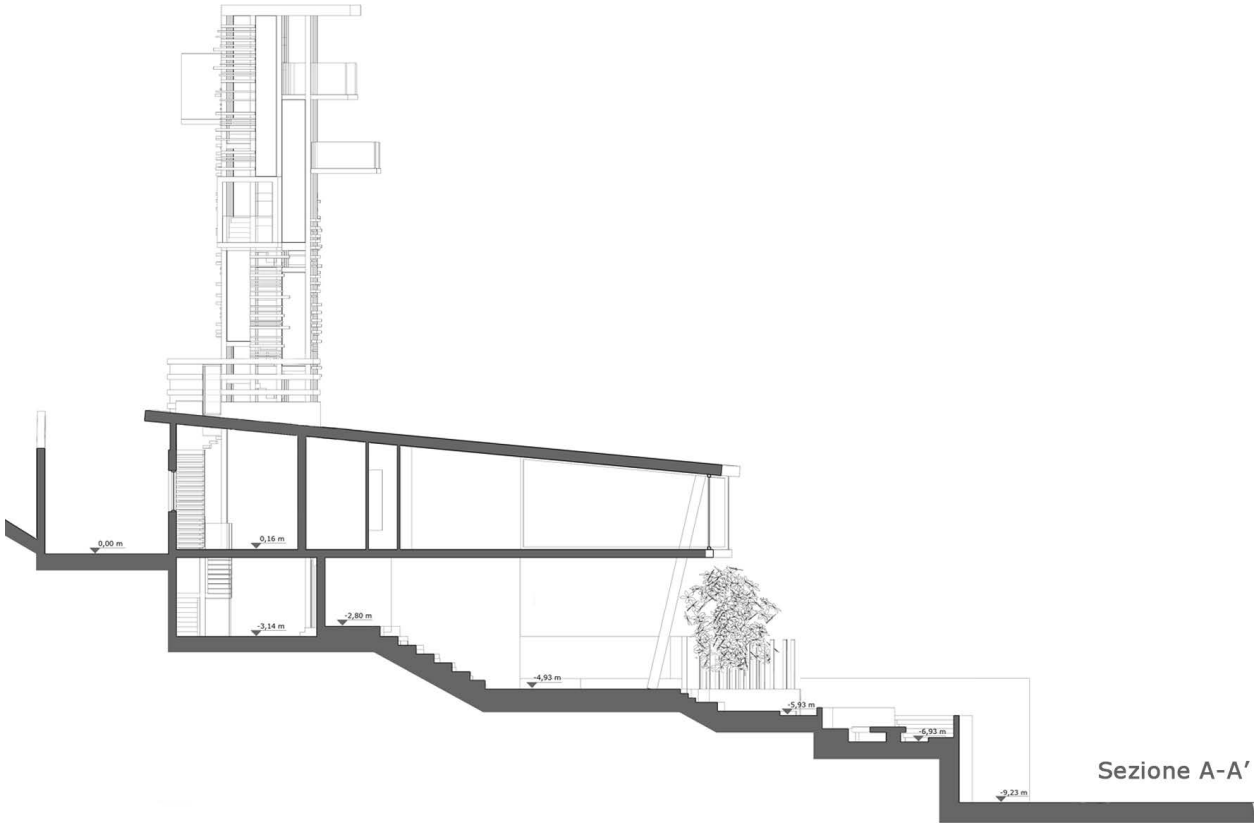


Fig. 4: Cross section



Fig. 5: Foto rendering (left the new tower to the right tower of the castle)

The second example proposes a project of requalification of a very small village, currently populated by thirty people, where is expected the total energetic self sufficiency, obtainable with various renewable sources (solar, Eolic, biomass). (Fig. 6) (Fig. 7)



Fig. 6: Map of Aorivola



Fig. 7: Profiles of the village

In particular vertical eolic generators will be added to coverage integrated with photovoltaic panels in addition to a structure of district heating connected with a reactor of cogeneration (termic and electric) alimented with the waste of the local agricultural production (nuts).
The reduced dimension of the village (less than 1 km^2) and the conformation of the settlement allowed us to consider it as a unique big building, whose project of requalification is conceived in a uniform way. The need to make the village attractive suggested the idea of realizing a diffused hotel and various rest stops connected with a wine and food itinerary of the typical products of the area. (Fig. 8)

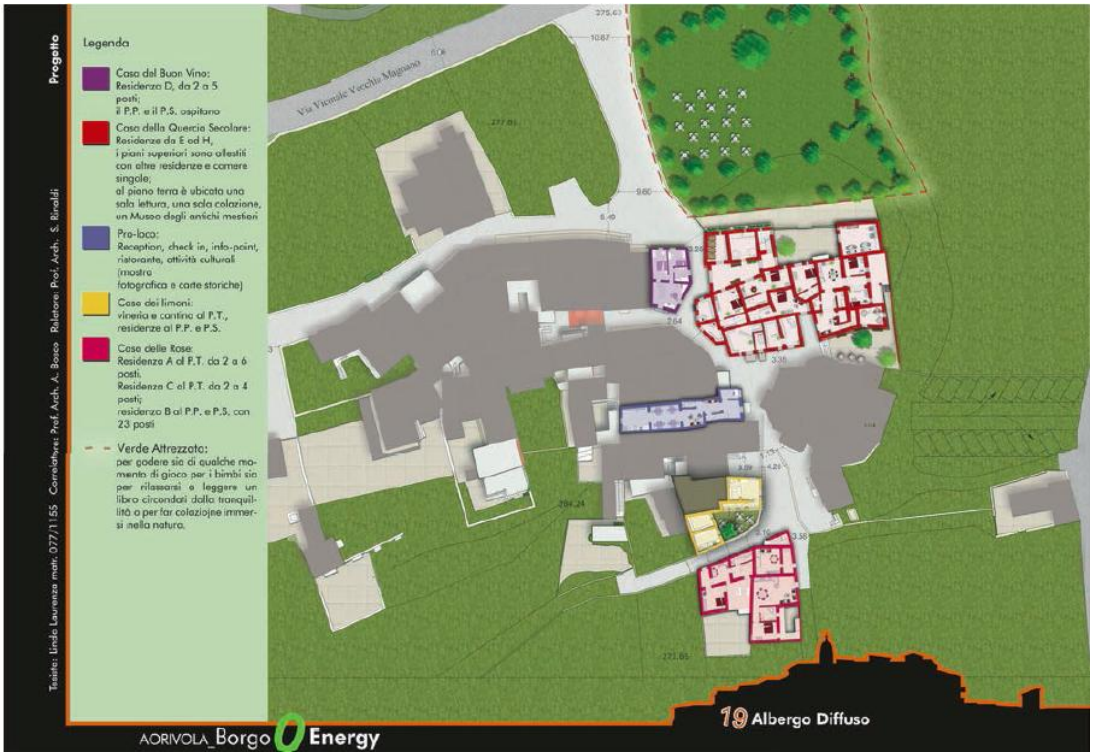


Fig. 8: Project plan

The will to repopulate a village, which has a residential capacity of about 240 people, is sustained by an idea of supporting to the new operators of the touristic activities, new possibilities of employment connected to the agricultural production of quality products.
The appeal of the recovered village will be favoured by the availability of “smart” technologies for management and the usage of tools and common services.

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MIND KNOWLEDGE EXPERIENCE
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TRIUMPH ARCH IN THE ARCHAEOLOGICAL SITE IN TYRE (LEBANON): A NEW APPROACH TO GIS ANALYSIS OF VERTICAL ELEMENTS IN 3D ENVIRONMENT

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Abstract

In recent years the GIS has been increasingly used as a fundamental survey and data management tool in multi-disciplinary fields. The GIS was originally designed for “environmental” use in territorial management while today it is more frequently used for analysis, cataloguing and modelling of sites considered to be of cultural, archaeological and architectural importance. Software which may be used to manage the territory as a whole must necessarily be applied even in the case of surveying, graphic rendering and management, through the relational databases, to all the aspects which characterize the cultural heritage, or are in any case related to the same. This innovative application is a field, which is currently being developed and has an enormous potential in the field of research. The study of the archaeological area of Tyre tends to define guidelines that produce an application methodology for the management of the spatial data of the archaeological elements, not only as views, as generally occurs, but also of elevation drawings. Perspective representations have up to now been completely ignored by the GIS, with the graphic elements processed exclusively by CAD. The aim of this research project is to produce a complete and detailed dynamic map on which the archaeological site may be represented realistically in three dimensions, by fully exploiting the interrogation potential of the vectorial data through the SQL language of the GIS.

Surveys of archaeological structures performed with advanced tools such as the laser scanner, are in this case processed with the GIS, permitting in-depth analysis of their geometry, with respect to detailed information, recorded and catalogued in the RDBMS, and georeferencing the same to allocate the correct geographic information to the data. The project was developed on the Tyre (Lebanon) site and takes into account the archaeological area as a whole, focusing in particular on the Triumphal Arch. The AutoCAD vectorial map is reprocessed in full starting from a project in ArcMap where specific shapefile are created and the database is connected and structured, allocating the elevation details that make it possible to create 3D features, which may be imported to ArcScene, which is the 3D processing software of the ESRI. The polylines are transformed to polygons to permit areal processing and analysis of the single elements of the Arch, assembling all the descriptive data of each element in the table. Correct georeferencing is allocated in a system that may be used internationally, namely the UTM_WGS84, in this case in zone 36N, to ensure correct positioning even in 3D. The real potential of this research method is that it is now possible to analyze vectorial elements in perspective and as views, taking into account their correct geographic location with all the implementations offered by GIS intelligence, rather than simply working with reconstructions, views and 3D models.

Keywords: archaeological site, GIS, 3D model, cultural heritage

1. Introduction

3D visualization is increasingly used in different fields, while the software available is more efficient than ever and renders copies which are extremely realistic. In the field of archaeology, thanks to the collaboration of archaeologists, historians, architects and IT experts, these technologies are currently undergoing amazing developments in terms of surveying and graphic rendering, but almost exclusively for the visualization of virtual environmental that undoubtedly make it easier to obtain information and valorise a site or object, but do not yet offer significant advantages in terms of conservation or restoration.

When talking of the conservation and restoration of an archaeological and/or architectural object, it is of essential importance to obtain objective and detailed information on each single part of the same, including the materials, phenomena of degradation such as causes, effects and dimensions, parts on which interventions might have been carried out in the past, and to draft complete and detailed documents of the interventions implemented and how they were carried out on the work of art. In the case of cultural assets, the GIS may be a good solution if used in synergy with other dedicated software, so as to combine the capacity to manage graphic-dimensional survey components together with extended databases, which is the real strong point, that may be used for different types of analyses and processing. The detailed documentation of different parts of an archaeological site or object must necessarily include detailed processing in 3D. In recent years many studies and research work has been carried out on the use of 3D in its different applications, as support for projects that ensure optimal rendering of all the characteristics of an object or archaeological site, on its virtualization, both scenically and with specific scientific characteristics (Köninger and Bartel, 1998; Kolbe et al., 2005, Caprioli et al., 2007; Brusaporci et al., 2012, Baratin et al., 2012).

In this paper the different components of the GIS are used for the management of the archaeological area of Tyre in the Lebanon, including the correct modelling and positioning of each archaeological-architectural; element thanks to a procedure that is defined in full, in the Roman Arch of archaeological site of Al Bass, which is a UNESCO World Heritage site.

This 20 metre monumental arch was the entrance to the Roman Tyre and in particular to the Necropolis, and opened into a majestic colonnaded road. The remains of the triple-bay triumphal arch, together with those of the colonnade street, constitute an evident proof of the importance of the Al- Bass site in Roman times. it dates to the late IInd century AD and was destroyed around the middle of the VI century, probably by an earthquake. Two round towers limited the arch from both sides, but today only the central and biggest arch remains, with a mosaic that covers the floor of the northern tower.

2. The GIS structure

The reason the Roman Arch was chosen, rather than the other structures on this vast and important archaeological site, was because different types of data were available which made it possible to develop all the main operations required to manage a 3D element with a series of specific and reproducible steps.

Over and above the aspects related to organising the data to manage information in a GIS for this application to the archaeological site of Al Bass, this particular case involved integrated management between two of the main applications of ArcGIS, ArcMap and ArcScene in order to use all the potential functions of these applications in a 3D environment. As a matter of fact the acquisition, processing, transformation and implementation of the 3D characteristics was all done in ArcMap, then passing to ArcScene, a 3D modelling and visualization environment for the final referencing and search.

A validated methodology was defined and repeated in other study cases, in the fields of archaeology and architecture, for the integrated management of plans and charts in an easy-to-search GIS used for complete restoration and conservation purposes (Baratin et al., 2014, Bertozzi and Moretti, 2013, Bertozzi et al., 2014).

This paper focuses above all on processing and analysing the elevations: the preliminary phase entails the acquisition of all the survey data of the object, associated to the onsite surveys, and reprocessing of data by means of dedicated software. In this case, these are surveys carried out with indirect integrated techniques, by means of laser scanner, which performs a sort of scan of the physical surface of the objects with a laser beam, rendering it as a set of topographic, photographic and direct survey points in the three-dimensional space, to determine the real distances, measurements and dimensions that are then reproduced.

As regards the organisation of the GIS, the data are in part 3D models, that may be used directly in ArcScene but only for visualisation purposes, as single blocks, without permitting searches and analyses, or orthophotos and DWG files, generally used as polylines, that permit defining the shape and width of each stratigraphic unit of the object. In the case of walls, a “Wall Stratigraphic Unit” (W.S.U.), while in the case of coating layers (plastering, flooring, stone etc.), a “Coating Stratigraphic Unit” (C.S.U.) is identified, Figure 1.
The interoperability and interchange of data and files between different software is quite naturally an essential prerequisite for the integrated management of sites or even single archaeological-architectural elements, as in fact it is for any physical object present. Quite obviously work must be organised by the various experts so as to facilitate interchanging and using the data, in order to avoid long and complex processing phases. The problem often occurs with the CAD and GIS. The first is undoubtedly very commonly used for drawing and the graphic rendering of objects, but in processing the data that may be used successively in the GIS, it is not only print layout that must be evaluated but also the real components of the objects, with all the advantages of a vectorial file. The most common anomalies encountered are the scaling of the drawing since if one is not working in CAD in a scale of 1:1, additional transformations are required in order to ensure correct georeferencing when allocating the real dimensions; the frequent use of open polylines which must be transformed into polygons, the only geometric primitive that provides a range evaluation of the objects and statistical analyses. Finally, particular attention should be paid to the correct use of layers, which once imported into the GIS make it possible to organise files more easily.

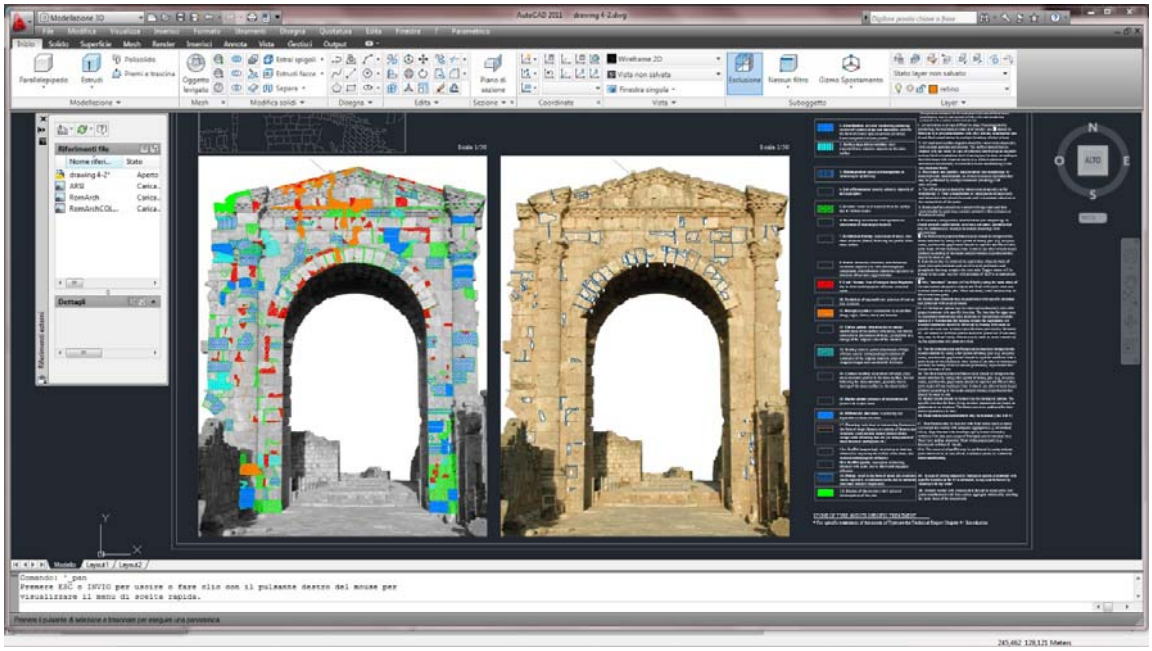

Fig. 1: Data used in the GIS project, obtained from surveys of the object using integrated techniques and processed with specific software, which in this case is the AutoCAD and rectification software

Once all the input files have been acquired and all the information have been documented on different data media, the GIS system is constructed for the charts:

ARCMAP

- Importation of input data and geometric arrangement and creation of the shapefiles (scale transformation and closing of open linear elements, if necessary)
- Creation, organisation and arrangement of the databases associated to the vectorial elements
- Creation and organisation in the Geodatabase
- Allocation of heights and creation of 3D linear features with a series of operations using the different tools of ArcGIS, in a new single tool, created with Model Builder
- Transformation of the 3D features into 3D polygons
- Geostatistical analysis
- Entry of the Metadata in accordance with international standards
- Georeferencing of the features

ARCSCENE

Dynamic visualisation and searches of the 3D elements (that may be managed together with appropriately modelled elements in plan view)

ArcMap is the user interface used for processing and visualising data in 2D, a factor which makes it necessary to transcend a basic concept: the GIS generally works in plan view, so that what is intended by 2D is an aerial view of a territory or building. In this case, the GIS is used as a blank work sheet. The idea is to analyse elevations as though they were no longer on plane XY, but on a hypothetical plane XZ, where they will in fact be once they have been imported into ArcScene. The system in ArcMap is thus not georeferenced, but only the unit of measure in metres is assigned. The Arch was analysed as a whole, including the four external facades, the two internal facades and a number of detail surveys of the state of degradation of the facade of the entrance to the Necropolis.

3. The geometries and the Database

The input phase includes the acquisition and organisation of all the vector files and rasters available, importation of DWG files into the new project, exportation of the files used in the GIS, as new shapefiles, keeping the three geometric primitives, points, lines and polygons, separate. The geometric primitives may be modelled three dimensionally if necessary, even if in the successive range analysis only the polygons are used. The geometric composition of the shapefiles undergo initial processing, arranging all the elements which define the same in order to obtain a correct structure, even from a topological point of view. The attributes are then organised, creating or organising the database, and entering all the fields and data required for each record (each line in the table of attributes corresponding to a specific geometric element). If different information is entered in the databases, it is possible to connect these by means of a key field, by creating an RDBMS, which is a relational database, with Join and Relate. All the information in the table are entered manually if they have not already been defined in the CAD, using tools for the multiple selection of elements in a feature, in order to digit the attributes in blocks at the same time with “Field Calculator”, and define the characteristics of specific fields for all the records selected. Once the features have been organised, we move on to the Geodatabase (GeoDB): a data model introduced by the ESRI that manages the RDBMS and the spatial component together, also saving the rules and relations, on the features or attributes, relevant to the objects in the real world. GeoDBs are compatible not only with the feature classes, rasters and attributes, but make it possible to implement advanced integrity and behaviour rules for GIS data, using types of data such topologies, nets, raster catalogues, terrains, specific rules for cadastral fabric, relations, subtypes and domains. A particularly interesting characteristic in this case is that in a feature class of a GeoDB it is possible to enter images for each record in the attributes table, Figure 2.

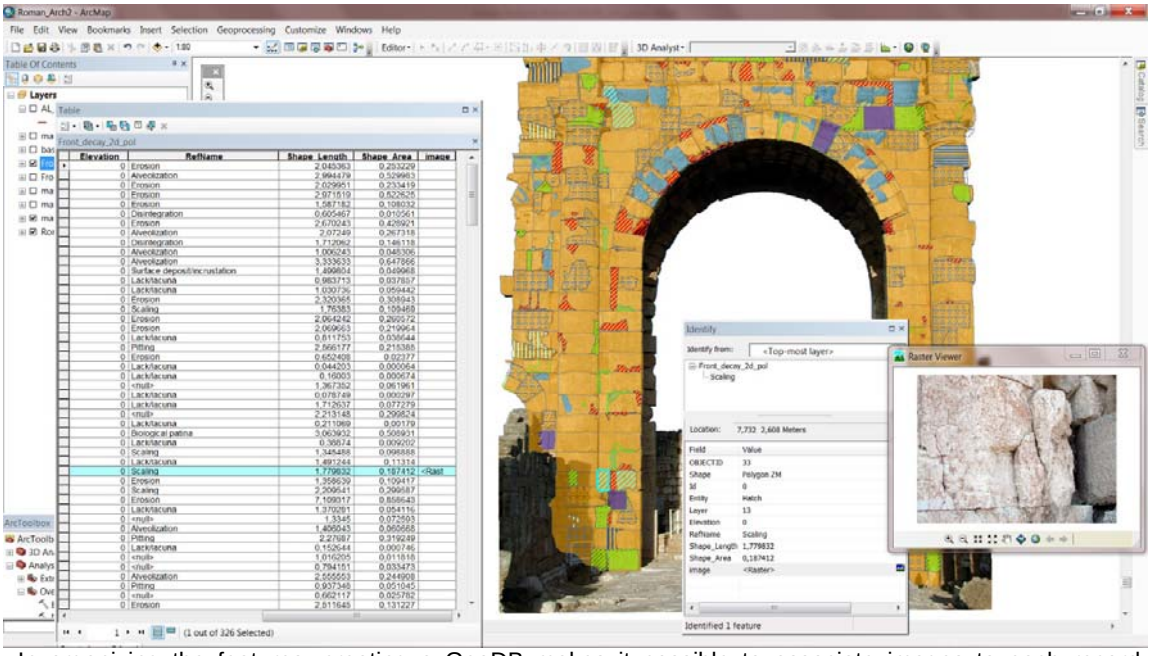

Fig. 2: In organizing the features, creating a GeoDB makes it possible to associate images to each record in the attributes table, and to implement integrity and behaviour rules

3.1 3D features

In order to create 3D features, one starts by allocating the altimetric characteristics of each element and feature class (the files used by the GeoDB), analysing a chart as though it were on a vertical plane, XZ. The files are shifted along a hypothetical axis X, where the values of Y correspond to 0, with the Spatial Adjustment extension, used to georeferenced the shapefiles and feature classes. A specific shapefile was created in order to recognise the point of arrival and facilitate positioning, and is a line which starts from the co-ordinate 0,0 and continues keeping the same co-ordinate Y=0 (this shape is only used as a support base for the features). Since the objects are already in the correct dimension and unit of measure (m), the software may now calculate the height of each point making up the feature, evaluating its distance from 0, namely axis X, along axis Y. In order to standardise and speed up the process, a special tool was created that makes it possible to automatically perform a number of repeatable steps for each feature that is transformed to 3D, using a function of ArcMap called Model Builder. All the tools used are entered in the correct order, allowing the possibility, from time to time, of modifying the input files and positioning of the new output files created. Using this new tool the following steps are performed:

- Split of the features at the vertexes. This means that each line or polygon is cut into the same number of segments (lines) as the vertexes with which it was drawn. In this way it is possible to allocate the heights accurately even to the smallest parts.

- Addition of two fields “Z start” and “Z end” in which the system automatically calculates, by means of “Calculate geometry”, the co-ordinate Y at the beginning and end of each segment, which in our case represent the co-ordinates of the relative height, Figure 3. It should be noted that these are not sea level heights, but the elevations of each element with respect to the ground, in order to position them correctly in the vertical position.

- Creation of the 3D features starting from the linear features with segments and relative heights, with the tool “feature to 3D by attribute”, using as attributes the two fields “Z start” e “Z end”.

- Transformation of these 3D features into 3D polygons, with the tool “Feature to polygon”.

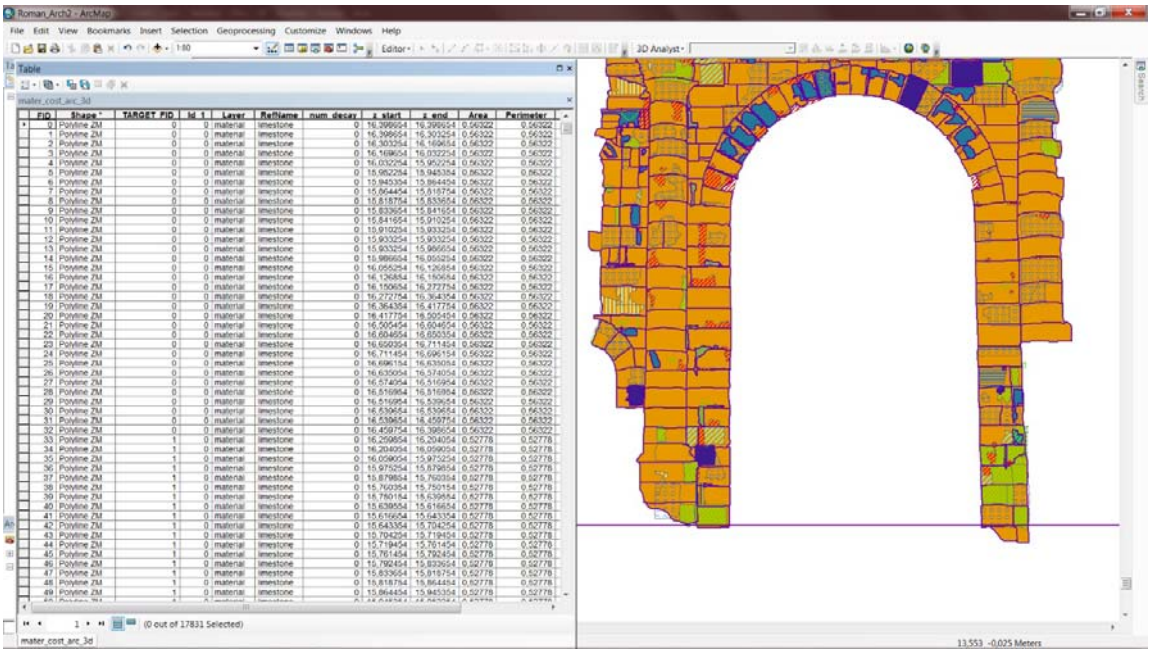

Fig. 3: The features are shifted along a hypothetical axis X identified by a shape file specifically created to calculate the altimetric co-ordinates of each element used to create the 3D features

3.2 Geostatistical Analysis

All the data relevant to each feature in the database, may be used to perform a number of statistical analyses relevant to the dimensional, compositional and range characteristics of the different elements. The

spatial analysis capacity is the potential that makes the GIS an instrument which authentically supports decisions, in that these functions make it possible to compare and summarise large quantities of data, bringing to light relations which are implicitly already present in the cartographic database, but which are difficult to find simply through visualisation. These analyses include a number of basic analyses such as querying, measuring and transformation, that make it possible to identify and select elements or groups of elements by means of specific “queries”, assess lengths, areas and distances and create new features from the union, intersection, etc … of other existing features. Statistical analysis is an additional function with respect to those described in the above work stages. The statistical parameters related to the geographic position of the data are calculated. There are indeed many statistical and geo-statistical analysis tools, starting with spatial analysis, such as interpolation and estimates for modelling, through to calculations on the attributes, defining statistical indexes as minimum, maximum, mean, median etc. … Through these calculations it is possible to analyse the values of each feature, evaluating the distribution of the different elements, their spatial relations, calculating the sizes of stone, of certain types of degradation, their frequency, patch shape … It is in this way possible to better understand the composition of an object and the level of degradation as well as the possible restoration plans, in order to plan times and costs.
A number of basic statistical analyses were applied to the Arch (minimum, maximum, mean, median, standard deviation) including frequency and polygon neighbour analyses, in order to analyse the repetitions of values and statistics on the proximity of polygons, and Summarize operations, where new tables are created with sums of values by categories from which it is possible to create different types of graphs.

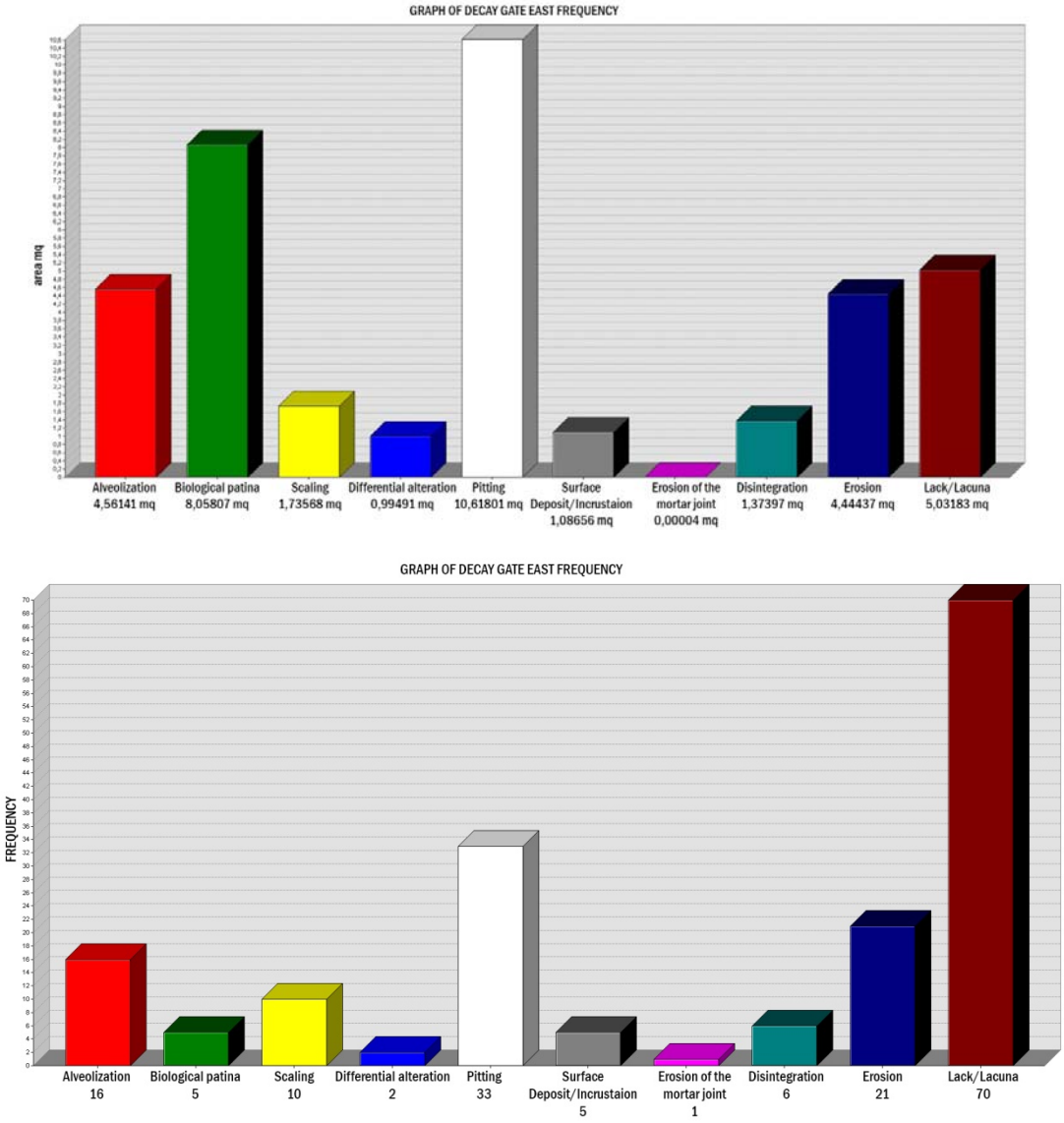

Fig. 4a and 4b: The graphs created with the statistical analysis tool of ArcMap, making it possible to compare the existing degradation, with the frequency of distribution in the elements analyzed and their dimension

4. Metadata and Georeferencing

Metadata are files with information about other data. Metadata provide information regarding the element you are working on such as its origin, who has worked on the same, the reference system, descriptions, key words etc. … Metadata are particularly important in a world which is now completely interoperable and interchangeable, in terms of tracing the chronological history of specific data and permitting constant and accurate updating. There are various standards for entering metadata, which are built into the ArcGIS, and we used one of the most common standards, namely the standard deriving from the directive INSPIRE, which was defined to overcome national levels and create European infrastructures that would be able to communicate. After defining the standard, all the information used are entered with ArcCatalog, and the data of each feature is edited, so that these may then be exported and validated in a specific website created by the European Commission.

Once the metadata have been defined, the files of the charts are now complete, and the last step may be performed, namely the georeferencing to position the same correctly on the earth. To do this each wall of the monument is considered as taken into account, the Roman Arch, as through it were an aerial view, and the co-ordinates are then assigned to the same, two by two and very close together. The choice of the georeferencing system is indeed very important, above all in the case of international projects, and in our case this was the universally known WGS84 system associated to the UTM projection system for the area considered. The co-ordinates are allocated to the edges of each facade with Spatial Adjustment, transforming the files irreversibly, which are then visualised in ArcMap as large lines in plan view, and are then passed to ArcScene in order to correctly structure the same.



Fig. 5: After georeferencing, the 3D features are displayed as fairly thick 2D lines, so that it is necessary to pass to ArcScene in order to visualize them in 3D

5. Arcscene

ArcScene completes the development of the project, making it possible to visualize and query the 3D features appropriately georeferenced in all their structural components. The facades of the Arch and degradation surveys coexist in the correct position, making it possible to use elements in plan view appropriately modelled with TIN at the same time, such as Base Height (ArcMap permits the use of 3D models of the terrain as morphological base for the features in overlay), Figure 6. The elements keep all their dimensional characteristics and attributes, permitting analyses and queries like in a 2D environment, but in their correct position and direction, Figure 7.

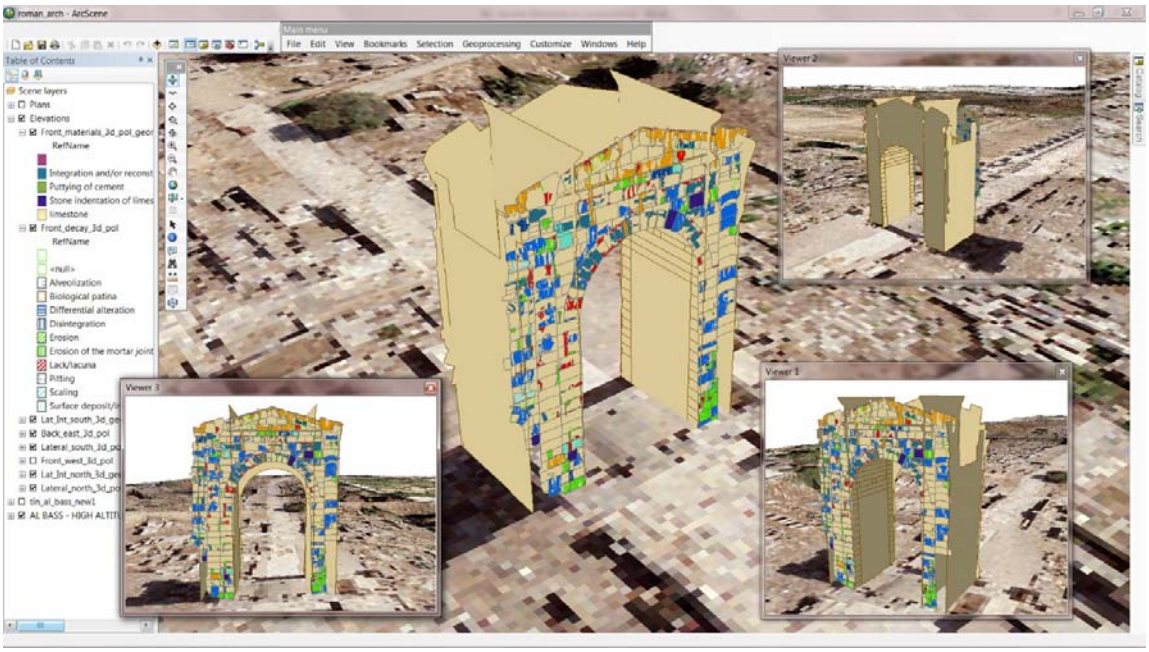

Fig. 6: Various visualization windows of the 3D features processed in ArcScene.

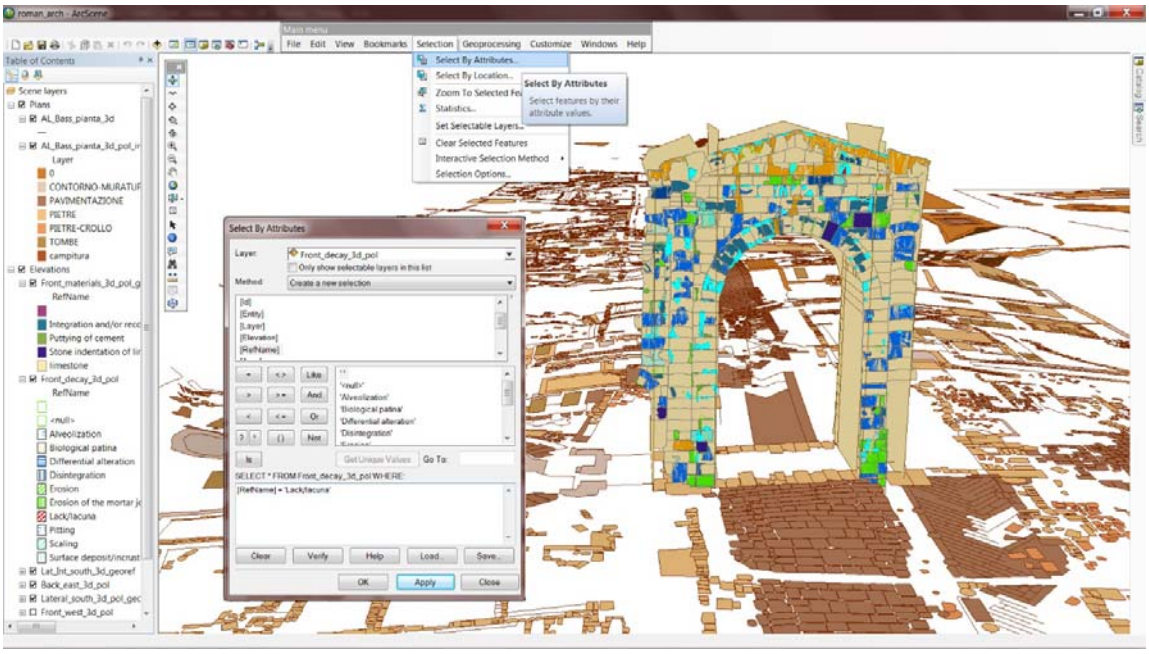

Figure 7: Elements in plan view and in perspective coexist in the same project, with the correct structure and position and it is possible to query and analyze the data directly

6. Conclusions

This new methodology was experimented for the Roman Arch, which is one of the many archaeological structures in the site of Al Bass, with a view to managing the data relevant to the documentation, protection and valorisation of the cultural heritage. Jack Dangermond, the founder of ESRI, said that the potential of a GIS is limited only by the imagination of the person who uses it; these systems have indeed proven to be extremely efficient instruments in many different fields, adapting perfectly, thanks to the many extensions and tools available, to very different situations. The GIS has been used in the world of archaeology only in recent years, but it immediately became a fundamental tool in terms of management and planning, as is now recognised in the territory. The new frontier, however, is undoubtedly 3D. The indisputably innovative characteristic of the methodology proposed in this paper is that it does not stop at modelling and virtualisation of components in 3D, but proposes a way to manage and query the same, through to the basic

stratigraphic units, in their correct structure and areal position. Problems of this kind will undoubtedly be resolved within a very few years, thanks to the exponential development of software, but as things stand, a “problem solving” approach is proposed applicable to archaeological and architectural structures which also permits integration with territorial and environmental aspects.

7. Bibliographical References

[1] Baratin L., Bertozzi S. E Moretti E., 2014. Tecnologia GIS per la manutenzione programmata dei beni culturali. In: Atti PPC Conference 2014. Monza-Mantova, 5-9 Maggio 2014.

[2] Baratin L., Bertozzi S., Moretti E., Spinella M., 2012. Gis and 3d models as support to documentation and planning of the Baku Historical Centre (Republic of Azerbaijan). International Journal of Heritage in the Digital Era, Vol.1, pp 71 - 76. EUROMED 2012, Lemessos, Cyprus, October 29 -- November 3, 2012, Proceedings.

[3] Bertozzi S., Baratin L. E Moretti E., 2014. Cultural Heritage: restituzione reale di prospetti e piante in ArcScene. Atti della 15 Conferenza Italiana Utenti ESRI. Roma, Auditorium del Massimo, 09-10 Aprile 2014. Supplemento a GEOMEDIA, vol. 2-2014, ISSN: 1128-8132

[4] Bertozzi S. E Moretti E., 2013. Gestione integrata dei rilievi del Portico di San Francesco ad Urbino. In: Baratin L, Acierno M, Muratore O. Strumenti e Metodi per la Conservazione e la Valorizzazione dei Beni Culturali. Ancona: IL GABBIANO S.r.l.

[5] Brusaporci, S., Centofanti, M., Continenza, R., Trizio, I., 2012. Sistemi Informativi Architettonici per la gestione, tutela e fruizione dell'edilizia storica. In: Atti 16a Conferenza Nazionale ASITA, Fiera di Vicenza, 6-9 novembre 2012.

[6] Caprioli, M., Figorito, B., Scognamiglio, A., Tarantino, E., 2007. Historical documentation of the rock churches in the Sassi of Matera with terrestrial laser data in a 3D GIS. In: The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, ETH Zurich, Switzerland, Vol. XXXVI-5/W47.

[7] Kolbe. T.H., Groger G., Plumer L., 2005. CityGML – Interoperable Access to 3D City Models. Oosterom, Zlatanova, Fendel (Eds.): Proceedings of the Int. Symposium on Geo-information for Disaster Management on 21.-23. March 2005 in Delft, Springer Verlag

[8] Köninger A., Bartel S., 1998. 3D-GIS for Urban Purposes, Geoinformatica, 2(1), pp. 79-103.

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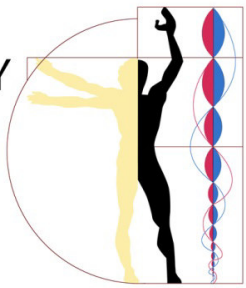

Theories and techniques to solve complex systems

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Abstract
The theories on the evolution of the species and natural in heritance of genes have been sources of inspiration for the search of new techniques of stochastic optimization for different types of applications.
"Complexity theory" focuses on the interdisciplinary study of its systems. In its evolution, the study of complex adaptive systems and emerging phenomena associated with them are of fundamental importance.
Innovation is an iterative process aimed at the creation of new products, processes, knowledge or services through the use of scientific knowledge, new or existing.
Innovation and complexity merge into one problem: optimize processes by encoding real problems, along with the search for the best solutions that evolve and are best suited to the new conditions.
The optimization problems are solved using heuristic processes, while among the techniques adopted for solving problems using iterative algorithms that gradually select the most appropriate solution among those obtained in each step, the most used are: Hill Climbing, Ant colony optimization, Tabu search, simulated annealing, Genetic algorithms.
In this work, we analyze the systems as complex adaptive systems and optimization techniques, focusing on the theory of genetic algorithms.

Keywords: Complexity theory, Complex adaptive systems

1. Innovation and Complexity
In current literature, there is no simple definition of the word "innovation".
Stokic, Campos, Sorli, & Gorostiza, (2003) suggest that innovation is a new product that is introduced into an environment. This definition is defined for products or services that have been fully used.
Alternatively, Kusiak claimed that innovation is an iterative process aimed at the creation of new products, processes, knowledge or services through the use of scientific knowledge for the new or existing. Kusiak also argued that product innovation is in agreement with the introduction of new products and services that differ from those currently on the market.
The difference between invention and innovation is the fact that the first can occur in any environment, while innovation implies the need of acceptance by the market.
Complexity is a concept that is defined in each discipline in a manner and their cognitive goals.
The linear system is the basis of the definition of complexity. It is a system in which cause and effect are linked by a relationship of proportionality. It is not always true that a complex behavior requires a complex system with many degrees of freedom. In fact, non-linear systems, although structurally simple, few elements with few interactions may show a remarkably different behavior.
The complexity of a system can be derived from:

1. the structure of the system, determined by the number and variability of its components and the local nonlinear relationships between them that then prevail;
2. by the behavior of the system over time and in relation to its reference, which together determine the ability to make transitions between different regimes or states of the system;
3. the emergent properties of the system over time. The dynamics of a complex system, its behavior, has also brought the interaction of the three previous points.

There are several forms of complexity.
The Logical depth is defined as the minimum time it takes for a computer to solve a problem.
The complexity of the grain of a system is the length of the shorter message able to describe, at a distance and at a given level of resolution (granularity), a system, provided that the two parties can speak the same language and have a comparable level of knowledge and understanding
As part of the theory of complex adaptive systems (CAS), Gell-Mann in 1995 suggested a measure of complexity that was defined "effective" and that, with reference to an adaptive system that observes and builds a schema, is the length of this scheme, i.e. the length of the shortest description of its regularity.
Complexity, in other words, appears as an emerging science, a science that deals with emerging phenomena - natural or social -:

- Associated with the operation of a complex system that evolves over time;
- Generated from the bottom up, that is exclusively due to local interactions between the system components;
- Unpredictable, whose trend is expressible i.e. by means of non-linear equations;
- Irreducible, that is independent of the existence and the properties of the individual components of the system.
- Self-organization, emergence, collective behavior.

2. Complex system

A "complex system" is intended as a "system whose model currently available, constructed by the observer of the system, is complex."
There are some features common to all complex systems:

1 Many components of varying complexity
2 Interactions between components
3 Lack of hierarchy "pyramid":
4 adaptive interaction with the environment:

Based on these characteristics, it is possible to classify the system as follows:

A) the least complex systems: natural systems are not organic, closer to the "left wall" absolute minimum complexity, and simple artifacts (those that cybernetic call "trivial machines"); crystals, clouds, rivers, elementary particles and entire galaxies (lifeless) fall into this category, as well as all the artificial devices completely describable in terms of inputs/outputs. The systems do not show the least complex adaptive interactions with the environment;

B) systems of medium complexity: they are complex artifacts (those that cybernetics call "non-trivial machines"), from the thermostat to the computer, as well as some systems prebiotics, like ribosomes and viruses; all devices that have "internal states" are of medium complexity and therefore cannot be described completely in terms of inputs/outputs, all virtual machines that can be implemented on computers and computer viruses. The systems of medium complexity can be adaptive and may exhibit new behaviors and unpredictable ("innocently emerging");

C) Complex systems (medium to high complexity) and very complex: they are all systems of the biosphere, from bacteria (close to the "left wall" of biological complexity minimum) to the human population (down the "right tail" of biological complexity) ; we can distinguish between these systems "just" organic (medium to high complexity) and those neurobiological (high complexity). Complex systems are adaptive and all of them are associated with the so-called emergent phenomena (life, mind, social organization, etc.)

Complex systems in their evolutionary path are therefore always far from equilibrium and move in a space of infinite possibilities behavioral.
Kauffman, in his study on Boolean networks, identifies three different classes of the behavior of a complex system: ordered, chaotic and one in the balance between the two, which he calls complex. The orderly behavior characterizes a system in plaster, crystallized, the chaotic, it is an absolutedisorderly conduct, and any attempt to form organized structures fails inexorably, although there are small crystallizedislands.
In both cases, the creative and evolutionary behaviors are not possible: the system does not have the necessary stability to configure organizational schemes of any kind and evolve.
The third class is that of the complex behavior, the more creative and with greater opportunity to evolve; a class of rules under which the agents of the system are never completely crystallized in a position nor entirely prey to disorder; a state of behavior for which the elements of the islands in casts begin to interconnect with other elements outside of the island and the islands start to configure the organizational schemes; behavior that takes advantage of both previous states.
Each class would constitute a system of rules and different limits a particular region of space of the infinite possibilities of the system behavior: the region of the order, that of chaos, and that in the balance between

the two, the edge of chaos (edge of chaos), where the systems are stable enough to store information, but also quite labile to transmit it.
The optimization problems are solved using heuristics and between the techniques for solving problems using iterative algorithms that select gradually the most appropriate solution among those obtained in each step the most used are: Hill Climbing, Ant colony optimization, Tabu search, simulated annealing, Genetic algorithms.

3. Tabu Search

The technique of Tabu Search has been offered by Fred Glover as a way to continue the search beyond the local minima. The fundamental concept of Tabu Search is then to make "prohibited" the latest moves made in the process of research, so as not to repeat the cycle of operations and fall into local minimum. A key characteristic of the Tabu Search is therefore the systematic use of memory: to increase the effectiveness of the search process, keeps track not only of local information (such as the current value of the objective function), but also some information relating to ' route taken. Such information is used to guide the move from the current solution to the next solution, to be chosen within a set of adjacency.
An evolution of the method-down is the Tabu search; it consists of starting from an initial solution and by means of some operations to arrive at a solution belonging to the set of adjacency of the current solution.
The purpose is to calculate a value of the objective function less than that calculated with the current solution.
Numerous computational experiments carried out show that the Tabu Search is now an optimization technique established, which can compete with almost all known methods, and that thanks to its flexibility, can beat many of classic optimization procedures. The defect of the method of descent is in the fact that, if there are no solutions in the set of adjacency "better" than the current one, the search is stopped, then the optimal solution identified by the method is associated with a local minimum of the space of solutions, which is often far, especially in terms of quality, from the global optimal solution.

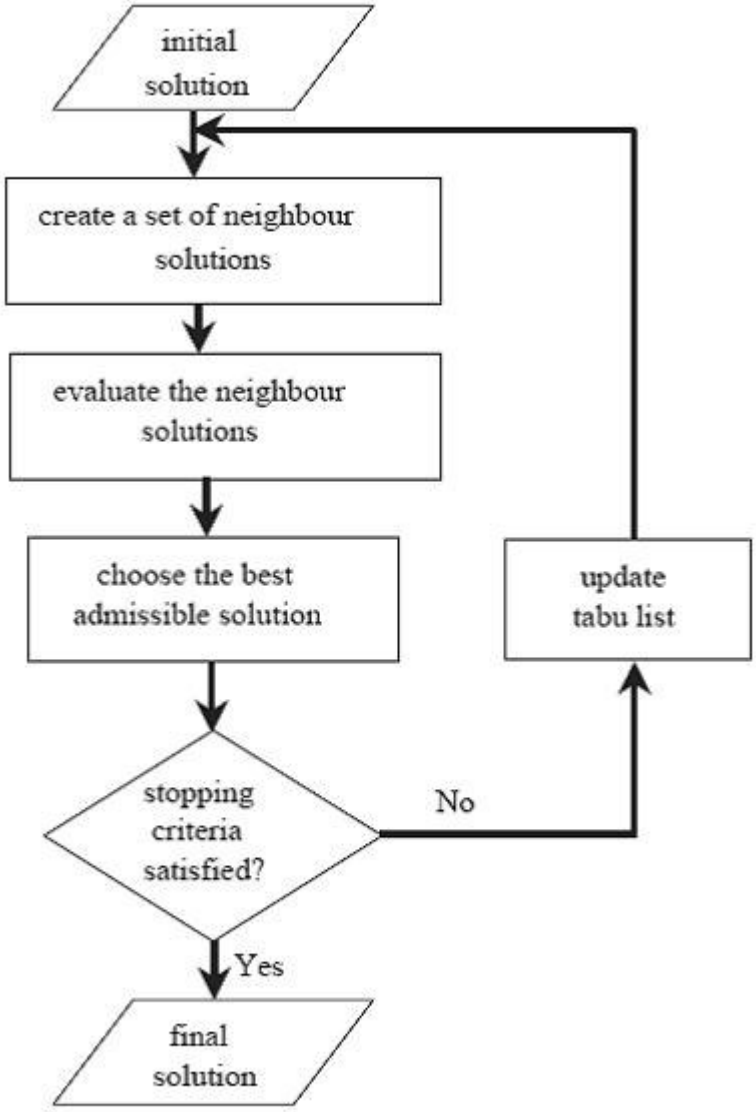

Fig. 1: Flowchart of a standard Tabu Search algorithm

4. Hill climbing

The hill climbing search is a local search based on a cycle of search nodes with the best values in the vicinity of a particular reference node. The term indicates the hill climbing algorithm's ability to "climb" the nodes to those with higher values. The search space hill climbing algorithm is restricted to nodes closest to the current one. When a node is better near the reference node (current node), it is replaced with the new node. The processing cycle hill climbing algorithm terminates when it reaches the node with the highest value ("peak") that is, when no node neighbor has a higher value than that of the reference. For example, there is the following matrix with 100 nodes and aims to reach the node with the highest value. A sequential search would involve 100 steps in the worst case and 50 steps on average to find the node with the highest value.

In the case of local search, we choose a node initial reference, based on a heuristic, and proceed with the development of local search. In five steps the algorithm achieves the goal. The example is intentionally trivial to give a better idea of the functioning of a hill climbing search. However, in a hill climbing algorithm, the probability of failure is very high.

The advantage of this method is that it uses little memory (spatial complexity). Not having to analyze all of the nodes and the possible paths, it is characterized by lower processing time (time complexity). It is therefore a very quick and fast algorithm.

The main disadvantage of the hill climbing algorithm is the risk of hitting a local maximum. When the algorithm finds a local maximum value, greater than all the neighboring nodes, it crashes. However, this does not exclude the presence of a distant global maximum with a higher value.

To reduce this risk, you can use different techniques. First you can try to improve the heuristic function of initial identification of nodes. Secondly a local search algorithm, should be run several times following the logic of the iterative hill climbing algorithm. Processing more times a hill climbing algorithm from different

initial nodes, bearing in mind the best result, it is possible to improve the effectiveness of the search without unduly penalizing the speed and processing time of the hill climbing algorithm.
Another risk of the hill climbing algorithm is to run into a local maximum plate. When all the neighboring nodes have a value equal to the current node, the algorithm stops. To reduce the risk of running into a local maximum pot is, however, it is possible to admit a percentage of lateral movement between the neighboring nodes with a valueequal to explore the space of local search when there are no other nearby nodes with values greater than the current one. It is not advisable to always allow lateral movement since it could generate an infinite loop (loop) during the algorithm.

5. Ant Colony Optimization

In recent years there has been an innovative way to invent techniques for solving design problems and optimization: the study of the engineering nature, i.e., the study of how certain data environmental constraints, the evolution has created great form of life for those constraints. Understanding these mechanisms allowed, by analogy, for the development of new algorithms and their adaptation problems are completely different from those in which they were originally observed. The algorithms have a strong natural charm, since while nature takes millions of years to evolve a form of life that has an excellent multi-processor, a computer can make this evolution last few days. One of the most fascinating phenomena of organization observable in nature is a colony of ants. Since they are small, the ants always find the shortest and easiest to return home. The algorithm that formalizes the behavior of ants is called Ant Colony Optimization (ACO) and was introduced in 1992 by Marco Dorigo.

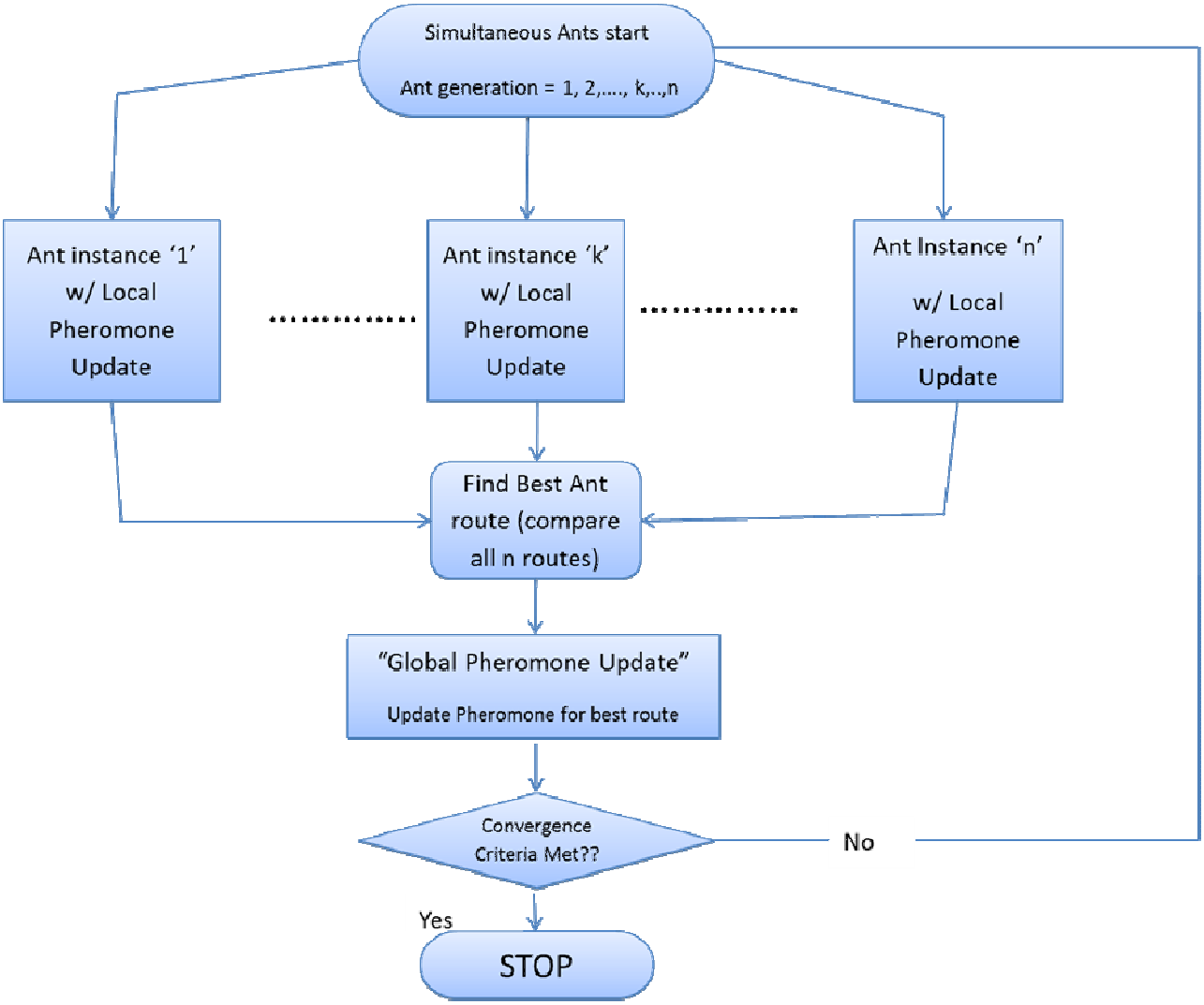

Fig. 2: Ant Colony Optimization algorithm

6. Simulated Annealing

The Simulated Annealing search the solution generating solutions close to the current. Solutions that lead to a higher value are always accepted. Solutions that lead to a lower value are accepted probabilistically.
This process aims to find a global minimum when in the presence of multiple local minima.
The concept of annealing is derived from the science of metals, where it is used to describe the process of elimination of lattice defects from the crystals through a procedure of heating followed by slow cooling. In this case, a defect lattice corresponds to a wrong combination of two objects.

7. Genetic Algorithm

Genetic Algorithm (GA) are heuristics technique of general purpose computing, relatively new, inspired by the mechanics of natural selection.
GA are applied in a wide range of issues: from control problems for pipelines, blast furnaces and the guide surface to air missiles, to problems of optimization such as the traveling salesman and those far more extensive scheduling, problems engineering as the design of turbines and aero parts of aircraft, the modeling of financial markets telematics. Many scheduling problems, such as the flow-shops, are problems of permutation that can be managed via genetic algorithms based on crossings permutation. Often these algorithms are implemented together with the simplest heuristic for solving more complex scheduling problems. These heuristics are used to achieve feasible solutions, while the genetic algorithm focuses on the search for optimality. Other approaches using genetic algorithms to govern the preference of a heuristic than another. The AG are also used for multi-objective approaches of scheduling problems or to seek Pareto optimal solutions. GA have not yet had a high incidence of problems in operations research and decision making, and yet there is a reluctance in the scientific in their use. This is due in part to historical reasons in part implementation difficulties.
Due to historical reasons, the first transmission of the GA by the University of Michigan, the researchers chose to present the results in conferences instead of specialized conferences and oriented applications journals. This is because, unlike that of the SA for its characteristics, it is similar to a random variation of the search, the nature of the GA, whichis totally different than the usual techniques of optimization, does not allow an immediate comparison of performance with other approaches. The problems stem from the close correlation implementation nature between the algorithmic method and natural phenomenon, in itself quite complex in terms of phenomenal terminology. The GA using the individual's survival in populations of decision rules or solutions to problems or function values. Creatures (codified rules as strings of logical information) that have happened in the population have the opportunity to mate and produce offspring, whose structure combines features inherited from the strings of their parents. The evolution of the population of strings is random, but its rate of improvement is higher than that of a simple random walk. The GA (such as biological evolution) use past experience to produce an efficient search with high performance. The AG working with populations of solutions (intrinsic parallelism) and try to guide the search through improvements, using the principle of survival of the best solutions.The Genetic Algorithimsquality of each solution is measured with the fitness (equivalent to the objective function or cost function in conventional optimization methods) which is the decoding of the string genetics. In this sense, the string is called genotype, while the solution decoded takes the name of phenotype. The search proceeds with a series of generations in which each individual contributes to the next generation in proportion to its fitness. This is accomplished by selecting individuals at random. Thus, a probability function weighted by the values of fitness, or the values of the scaled phenotype, or even a simple rank.
The basic structure of a genetic algorithm provides a cyclic operation that simulates the process of evolution of a population. Each cycle represents a generation and its internal operations are carried out to generate a new population consisting of the best individuals.
The structure of a genetic algorithm is:

1. Definition of the initial generation. Define (even randomly) a first set of possible solutions to the problem under consideration.
2. Evaluation of each solution and the best selection saddles. Evaluate each solution, associating each an indicator of quality (or fitness) so that you can order.
3. Definition of a new generation. Define a new group of solutions suitably changing solutions with high quality, so as to favor the development at the expense of worse.
4. Conclusion processing. If the number of iterations set has been reached or the quality of the best solution available is acceptable you can finish processing, otherwise it returns to step 2 to define a new set of solutions.

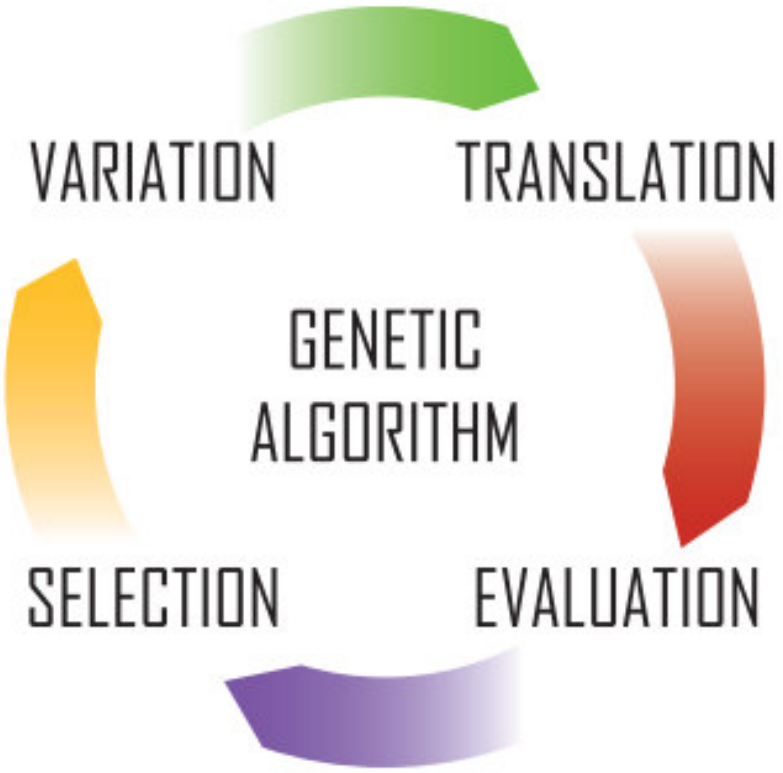

Fig. 3: Genetic Algorithm

Bibliographical References

J. HOLLAND. *Adaptation in Natural and Artificial Systems.* Cambridge, MA: The MIT Press. Published 1975

F. FAGGIONI. C. SIMONE. *Le declinazioni della complessità Ordine, caos e sistemi complessi*. Sinergie 79/2009. 2009

A. KUSIAK. *Innovation of Products and Services: Bridging World's Economics*. Proc. of the 19th Intl Conf on Production Research, (p. 1-6). Valparaiso, Chile. 2007

D. STOKIC, A. CAMPOS, M. SORLI A. GOROSTIZA. *KM Systems to Support Incremental Innovation in Manufacturing Industry*. 10th ISPE Intl Conf on Concurrent Engineering. Madeira. 2003

D. WHITLEY. *GENITOR: A Different Genetic Algorithm*. Proceedings of the Rocky Mountain Conference on Artificial Intelligence. Denver, CO. 1988

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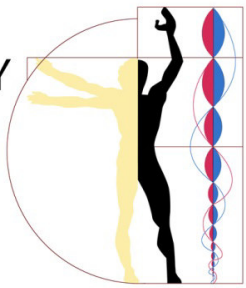

An application of optimization processes in the evaluation of a security basket

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Abstract
Optimization studies the theories and methods for the detection of maximum or minimum points in a mathematical model (without directly dealing with how this model has been built).
In order to find the minimum or maximum of a function, for the most part, non-linear, optimization algorithms are used.
In particular, genetic algorithms are used to solve optimization problems. They constitute a class of probabilistic search technologies that are inspired by the biological development and if suitably encoded, are able to provide solutions for real-world problems.
Holland, for the first time, simulated the processes in natural populations that are essential for evolution. The initial hypothesis is a population of individuals, each of which represents a possible solution to the problem, it is associated with a score of adaptation "fitness" depending on how "good" the solution is to the problem.
In this work, we analyze an optimization process of a security basket consisting of securities with a variable yield using a genetic algorithm. The initial population is identified by yielding securities between -15% and 15%, with an evaluation of the fitness score.

Keywords: Complex adaptive systems, genetic algorithm, security basket

1. Complex adaptive systems
In physics, a complex system is a system in which the individual parts are affected by local interactions, short-range, which cause changes in the overall structure
The characteristics of complex systems are:

1. Many components more or less complex: in the more complex systems, subsystems (i.e. components) are themselves high complexity; components can be "hardware" (molecules, physical processors, cells, individuals) or "software" processing units (virtual);
2. Interactions between components: components interact by passing information (in the form of energy, matter, or digital information); the amount of connections and the presence of substructures and recursive feedback loops (so-called "rings") increase the complexity of the system, but the information that the components are exchanged may not be too many (otherwise the system becomes chaotic) nor too little (the system will "crystallize");
3.Absence of a "pyramid" hierarchy: if there is a single component, which alone governs the behaviour of all, the system cannot be complex; its description, in fact, can easily be reduced to that of the subsystem - leader; the case of complex systems "hologram" is different, in which each component has information about the system as a whole (for example, each cell contains all the genetic information of the organism to which it belongs).

These are supplemented by a fourth defining characteristic of complex adaptive systems:

4.Adaptive interaction with the environment: the system is much more complex, since there are many factors that affect its adaptation to the environment (which must take into account the model): incidence of random factors, learning, interaction with the observer of the system, and so on; while

the system evolves, its subsystems co-evolve by developing strategies for co-adaptation (symbiosis, cooperation, communication, etc.).

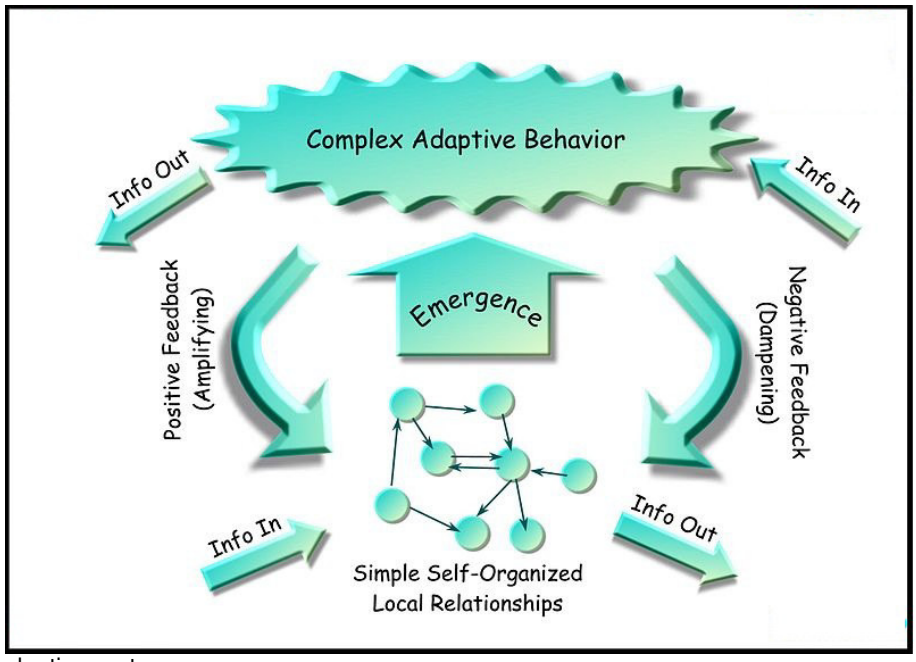

Fig. 1: Complex adaptive system

Complexity theory studies the interdisciplinary nature of complex adaptive systems and emergent phenomena associated with them.
Many natural systems (e.g., brains, immune systems, ecologies, societies) and increasingly, many artificial systems (parallel and distributed computing systems, artificial intelligence systems, artificial neural networks, evolutionary programs) are characterized by apparently complex behaviours that emerge as a result of often nonlinear spatial-temporal interactions among a large number of component systems at different levels of organization. These systems have recently become known as Complex Adaptive Systems.
The system of a security basket is characterized by the fact that it is not possible to establish the laws that govern it and is therefore unpredictable. Its behaviour is not linear and can, in certain cases, absorb large disruptions without having major effects while on the contrary, certain small perturbations can cause catastrophic effects.
Different groups of traders have different expectations about future prices and future dividends. For example, one group might be fundamentalists, believing that asset prices return to their fundamental equilibrium price, whereas another group might be chartists, extrapolating patterns in past prices. Traders choose their trading strategy according to an evolutionary 'fitness measure', such as accumulated past profits. Agents are boundly rational, in the sense that most traders choose strategies with a higher fitness.

2. Genetic algorithm

Genetic algorithms are tools to solve problems of research and optimization. They follow a heuristic approach inspired by genetics and the principle of natural selection of Charles Darwin.
The genetic algorithms use a set of solutions that evolves over time intervals called generations. Evolution is driven by the search of the optimal solution by means of comparison, in fact, to every solution of the whole or individual of the population is associated with a value called fitness that indicates the quality compared to the problem. Using this value, it is possible to compare and select the best individuals of the current generation and use them to create the population of the next.
With this procedure, based on the principle of natural selection, we try to derive a set of individuals always best, with the advance of generations, contains the optimal solution of the problem or its approximation.
It often refers to individuals with the name of chromosomes due to their structure and operations with which it is possible to edit. In fact, each solution is described by a set of features similar to the genes, which are used on the same crossover and mutation operators present in the genetics to create new solutions.
The basic structure of a genetic algorithm provides a cyclic operation that simulates the evolution process of a population. Each cycle represents a generation and its internal operations are carried out to generate a new population consisting of always the best individuals.

The first step of this algorithm is to create a random population from which to start (Figure 2 (a)). While the subsequent steps are repeated at each generation and are associated with the principle of natural selection (Figure 2 (b)) or genetic (Figure 2 (c)).

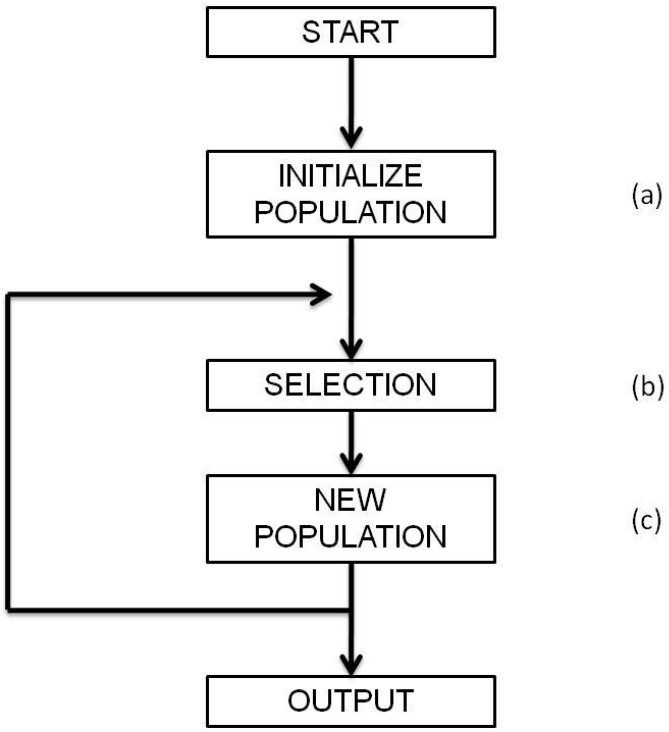

Fig. 2: General structure of a genetic algorithm.

In particular the first steps involved in selecting the best individuals of the population, while the others to generate new individuals. The latter operations are possible by combining or altering the characteristics that identify an individual.
From the point of view of genetics, new chromosomes are obtained by recombining their genetics or by altering the genes with the operators of mutation and crossover.
For each combination of genes, it is possible to calculate a value called fitness that indicates the capacity with which the chromosome or the solution is able to solve the problem. In natural selection, this value measures the individual's adaptation to the environment. Thus, a better fitness is linked to a higher chance of survival, while the interior of the genetic algorithm to a higher probability of selection.

3. Fitness function

The operator of selective breeding plays the leading role in the evolutionary process: it assigns a genetic copy number roughly proportional to its fitness to each string. The playback mechanism therefore interacts closely with the fitness function.
The general rule to build the fitness function, is that it should reflect the real value of the chromosome in some way. As stated above, for many problems the construction can be an obvious step, but the real value of a chromosome is not always a useful amount to guide us in genetic research. In combinatorial optimization problems, there are many constraints, and many points in space represent invalid chromosomes, and therefore have "real" value zero.
Sometimes the fitness function has discontinuities such that some individuals get a very high best fitness value (although not optimal), while all the other members of the evaluations obtained a very low one.
In this case, the next generation will tend to be dominated by genetic copies of the best individual, which will not have the opportunity to combine with different strings: the evolutionary process will soon end in a state of premature convergence to a local minimum.
We analyze an optimization process of a security basket consisting of securities with a variable yield using a genetic algorithm. The initial population is identified by yielding securities between -15% and 15%.
To use a genetic algorithm we must first code the decision variables of our problem as some finite-length string. For this problem, we will code the variable x (yielding securities) simply as a binary unsigned integer of length 5. We indicate with the first bit the sign of yielding securities, 0 for negative yielding and 1 for positive yielding, ad ex. an yielding securities -12% we will code 01100.

With a five-bit (binary digit) unsigned integer we can obtain numbers between 0 (0 / 0000) and 15 (1 / 1111) and between -15 (0 / 1111) and 0 (0 / 0000). With a well-defined objective function and coding, we now simulate a single generation of a genetic algorithm.
To start off, we select an initial population at random. We select a population of size 5.
Our initial population is

	code	yielding value
1	11100	12
2	00011	-3
3	01110	-14
4	11011	11
5	11000	8

As a fitness function we consider

$$f(x) = x^2 \qquad (1)$$

we obtain

	code	yielding value	fitness function
1	11100	12	144
2	00011	-3	9
3	01110	-14	196
4	11011	11	121
5	11000	8	64

we calculate the sum, average and the maximum

	code	yielding value	fitness function
1	11100	12	144
2	00011	-3	9
3	01110	-14	196
4	11011	11	121
5	11000	8	64
sum			534
average			106,8
max			196

we indicate the relative frequency with f_i and the expected count with f_i /f

$$f_i = \frac{f_{(x_i)}}{\sum_{i=1}^{5} f_{(x_i)}}$$

$$\frac{f_i}{f} = f_i * n$$

where n is the number of yielding security.
We obtain

	code	yielding value	fitness function	relative frequency	expected count
1	11100	12	144	0,27	1,35
2	00011	-3	9	0,02	0,08
3	01110	-14	196	0,37	1,84
4	11011	11	121	0,23	1,13
5	11000	8	64	0,12	0,60
sum			534	1,00	5,00
average			106,8	0,2	1
max			196	0,37	1,84

Another function is

$$f(x) = x^3 \qquad (2)$$

we obtain

	code	yielding value	fitness function
1	11100	12	1728
2	00011	-3	-27
3	01110	-14	-2744
4	11011	11	1331
5	11000	8	512

we calculate the sum, average and the maximum

	code	yielding value	fitness function
1	11100	12	1728
2	00011	-3	-27
3	01110	-14	-2744
4	11011	11	1331
5	11000	8	512
sum			800
average			160
max			1728

we calculate the relative frequency and the expected count

	code	yielding value	fitness function	relative frequency	expected count
1	11100	12	1728	2,16	10,80
2	00011	-3	-27	-0,03	-0,17
3	01110	-14	-2744	-3,43	-17,15
4	11011	11	1331	1,66	8,32
5	11000	8	512	0,64	3,20
sum			800	1,00	5,00
average			160	0,20	1,00
max			1728	2,16	10,80

The third function prolonged for continuity at the point x=0 is:

$$\begin{cases} f(x) = \dfrac{x^3 - 1}{x} & if \quad x \neq 0 \\ f(x) = 0 & if \quad x = 0 \end{cases} \tag{3}$$

we obtain

	code	yielding value	fitness function
1	11100	12	143,91667
2	00011	-3	9,33333
3	01110	-14	196,07143
4	11011	11	120,90909
5	11000	8	63,87500

we calculate the sum, average and the maximum

	code	yielding value	fitness function
1	11100	12	143,91667
2	00011	-3	9,33333
3	01110	-14	196,07143
4	11011	11	120,90909
5	11000	8	63,87500
sum			534,10552
average			106,82110
max			196,07143

we calculate the relative frequency and the expected count

	code	yielding value	fitness function	relative frequency	expected count
1	11100	12	143,91667	0,26945	1,34727
2	00011	-3	9,33333	0,01747	0,08737
3	01110	-14	196,07143	0,36710	1,83551
4	11011	11	120,90909	0,22638	1,13188
5	11000	8	63,87500	0,11959	0,59796
sum			534,10552	1,00000	5,00000
average			106,82110	0,20000	1,00000
max			196,07143	0,36710	1,83551

we apply the technique of the one-point crossover identifying the fourth bit as the crossover point for which the new population will be

11100	12
00011	-3
01110	-14
11011	11
11000	8



11101	13
00010	-2
01111	-15
11010	10
11001	9

we calculate the fitness for the three functions:
for function (1)

	code	yielding value	fitness function	relative frequency	expected count
1	11101	13	169	0,29	1,46
2	00010	-2	4	0,01	0,03
3	01111	-15	225	0,39	1,94
4	11010	10	100	0,17	0,86
5	11001	9	81	0,14	0,70
sum			579	1,00	5,00
average			115,8	0,20	1,00
max			225	0,39	1,94

for function (2)

	code	yielding value	fitness function	relative frequency	expected count
1	11101	13	2197	4,05	20,23
2	00010	-2	-8	-0,01	-0,07
3	01111	-15	-3375	-6,22	-31,08
4	11010	10	1000	1,84	9,21
5	11001	9	729	1,34	6,71
sum			543	1,00	5,00
average			108,6	0,20	1,00
max			2197	4,05	20,23

for function (3)

	code	yielding value	fitness function	relative frequency	expected count
1	11101	13	168,92308	0,29161	1,45805
2	00010	-2	4,50000	0,00777	0,03884
3	01111	-15	225,06667	0,38853	1,94265
4	11010	10	99,90000	0,17246	0,86228
5	11001	9	80,88889	0,13964	0,69819
sum			579,27863	1,00000	5,00000
average			115,85573	0,20000	1,00000
max			225,06667	0,38853	1,94265

4. Conclusion

The set of a security basket is a complex adaptive system. To solve an optimization problem we used a genetic algorithms and analyzed an optimization process of securities baskets consisting of securities and we evaluated the fitness score. The initial population is identified by yielding securities between -15% and

15% and we code the initial population simply as a binary unsigned integer of length 5. We used as fitness function the function (1), (2) and (3) and for everyone calculate the fitness score. We applied the technique of the one-point crossover identifying the fourth bit as the crossover point and we calculated the fitness score.

We noted the function $f(x) = x^3$ cannot represent the set of a security basket because the relative frequency is negative while the functions $f(x) = x^2$ and $\begin{cases} f(x) = \dfrac{x^3 - 1}{x} \\ f(x) = 0 \end{cases}$ are optimizing the set of values defined.

Bibliographical References

P. ARTZNER, F. DELBAEN, J.M. EBER, D. HEATH. *Coherent measure of risk*, Published 1999.

G. D'ANGELO. *Complexity and landscape: interactions and analogies* proceedings of XII Forum Internazionale Le Vie dei Mercanti Best practices in heritage conservation and management From the world to Pompeii a cura di Carmine Gambardella Collana Fabbrica della Conoscenza, La Scuola di Pitagora editrice, ISBN 978-88-6542-347-9, pag. 1650-1659, published 2014

J. HOLLAND. *Adaptation in Natural and Artificial Systems.* Cambridge, MA: The MIT Press. Published 1975

C.H. HOMMES. *Financial markets as nonlinear adaptive evolutionary systems.* Published 2001.

M.C. MIGLIONICO F. PARILLO, (2012) An Application in Bank Credit Risk Management System employing a BP Neural Network based on sfloat24 custom math library using a low cost FPGA device

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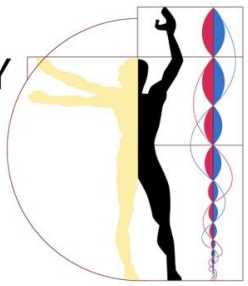

BIOMATERIALS: the synthetic biology applied to architecture

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Abstract
Currently, our planet is suffering for problems related to overpopulation, accumulation of waste, depletion of raw materials, extreme exploitation of the productive soil and reckless issuance of pollutants in air, soil and water to such an extent as to make the habitat less and less suitable for the survival of living organisms. Thus, project interventions are necessary in order to safeguard first the natural environment so that an adequate social and economic development is possible. In this context, the role of architecture can be significant.
It is believed that 'making architecture' today means to search for harmony between man, environment and built through cradle-to-cradle sustainable projects that cleverly use natural resources in order to restore the ecological cycles compromised by the destructive impact of the human species. Scientific knowledge acquired in biotechnology and engineering allow us to achieve this goal by working with natural systems and benefiting from them, without destroying the integrity and the capacity for renewal. A new branch of biological sciences, named synthetic biology, will be able to imagine and build new living systems for useful purposes, according the approach: “House like a tree”.
The paper illustrates the contribution of this new discipline to the construction sector and analyses the performances of some kind of biomaterials that offer a paradigm shift in the perception of buildings from mechanical entities to living or like-living organisms. This study discussed how transformation could be achieved with the help of the sustainable design approach and environmental philosophy. The environmentalist discourse has an ideological influence on architectural approaches, as well as shaping these. Thus, we urgently have to change our conceptions about nature, such as human-centrism and the control-over-nature approach. We have to talk about new ways of collaborating with nature.

Keywords: Biomaterial, LCA, technological design, sustainable architecture

1. From green architecture to regenerative development (by A. Violano)
The future construction procedure are increasingly characterized by designing of buildings, which will have the least impact on the environment, consume less energy than they produce, are comfortable and smart. The LCA approach applied to the evaluation of the only amount of energy needed for the construction (cradle phase), use (operational phase) and disposal (grave phase) of a residential building, demonstrates that the '"*grey energy*", relative to the no-operational phases, varies between 30 and 40%. In fact, reducing the operating energy (all regulatory instruments currently have this purpose), the embodied energy is increasingly important. Especially for buildings designed in order to be "net zero energy", the energy used during the construction phase and disposal becomes significant.

However, this, which appears to be the last frontier of sustainable building, is a design process almost obsolete. Scientific researches show us that we need to go further. The cradle-to-grave approach is now considered partial. The need is to close the loop and to reason according to the cradle-to-cradle approach.
We can start from the thought of bio-architect Rachel Armstrong, which says: "*Living systems are in constant conversation with the natural world through sets of chemical reactions called metabolism. This is the conversion of one group of substances into another, either through the production or the absorption of energy. And this is the way in which living materials make the most of their local resources in a sustainable way. So, I am interested in the use of metabolic materials for the practice of architecture. […] So I am having to make them*". [1]
In order to create these new materials, the "bottom-up approach" considers the possibility to generate them from scratch and replace inert materials with living ones. In her vision of future architecture, buildings would have the physiological capabilities to process nutrients, break down waste, self-repair and interact with surrounding environment. It is developing an innovative "ecology of space" which implies a new "ecology of behaviour". The Environmental behaviour, in fact, also involves an education in order to think the spaces as the co-evolution of a part (architecture) with the whole (Nature) and to inhabit the spaces around us in a way based on being in the presence, rediscovering the pleasure of a coexistence that is a live, adapt, grow together. New models of design concept redefine the powers of the technology industry for innovation, mainly oriented to integrate the building in the life cycle of the ecosystem, according the approach grave-to-grave. There are necessary, in some cases, creativity and courage, in other cases, awareness and sensitivity, but in both cases there cannot be technological innovation without innovation of mind: this is a renewed approach to interdisciplinary project with a range of conceptual lines on which basing methodology and practice [26].
An interesting example is the "*systemic design*" proposed by Pasquero and Poletto (BIO-Urban Design Research Cluster of Berlett School of Architecture - London) that proposes an "augmented" and multi-scale approach to design, borrowing the concept of bio-hacking, but not changing the human condition through the use of technologies as to inaugurate a superior post-human being, but transforming the building structure in a living organism.
Many other design experiments exceed the frontier of green architecture in order to push itself towards the Regenerative Development. The need is to increase to habitat quality, helping the ecosystem to raising its level of resilience, relying on the opportunities offered by globalization that has become a point of strength, the renewal's flywheel. The objective is seen in positive terms: it is not enough reducing the impacts, but it is necessary to increase the benefits. The principle is the "environmentally friendly behaviour", according to which to install a purification plant where the wastewater enters into the river is not sufficient; we should not produce polluting wastewater. However, there is more: the wastewater not only do not has to cause environmental stress to the river ecosystem, but it must increase its level of homeostasis and resilience. In the environmental balance, all the variables that have a negative sign should be transformed in factors that have positive sign, stimulating an endogenous and regenerative development.

2. Evaluating different attitudes within sustainable architecture (by A. Ciravoğlu)

The environmental ethics perspective has a broad spectrum that proliferates into political and scientific ideological areas [9]. Environmental approaches are deeply ingrained within the social and political structure of our existence. This presence has also crept into our faith about our daily life system, decision-making mechanisms, and values. Despite the fact that it has been a primarily sociological approach, the environmental perspective so far has been neither able to be accommodating nor able to produce peaceful solutions [17]. Order of priority in terms of sustainable objectives is different for each an ecologist, an architect, a politician or a sociologist. For instance, the concept of sustainability can remind an architect designing 'high performance buildings'. However, as we examine the word, it can be understood that sustainability does not only consist of brick and mortar architecturally, but social sustainability is also important at least as much as architecture technologies [13]. The literature on sustainability can be evaluated in three stages. Rees [24] defines these three stages as status quo (change can be achieved through current formations), reform (a fundamental reform is necessary, however this is not possible with the present social structure), transformation (the root of the problem lies in economic and social power structures in a way a radical transformation is required). The author maps out two axes, the *social-economic* and *environmental arguments* of sustainability. The social-economic axis covers the priority of the environment from low environmental concern through techno-centred to eco-centred [15]. Erkenez and Ciravoğlu [7] developed a map which can be followed from Figure 1, based on an evaluation of Hopwood et al. [15.], O'Riordan [20] and Rees' [24] studies in terms of their impacts on the discipline of architecture. Here, it can be seen that the authors examine environmental approaches and sustainable architecture discourses proposed by Madge [17], Guy et al. [14] and Fieldson [9] within an attempt to classify environmental arguments of Hopwood et al. [15], O'Riordan [20] and Rees [24].

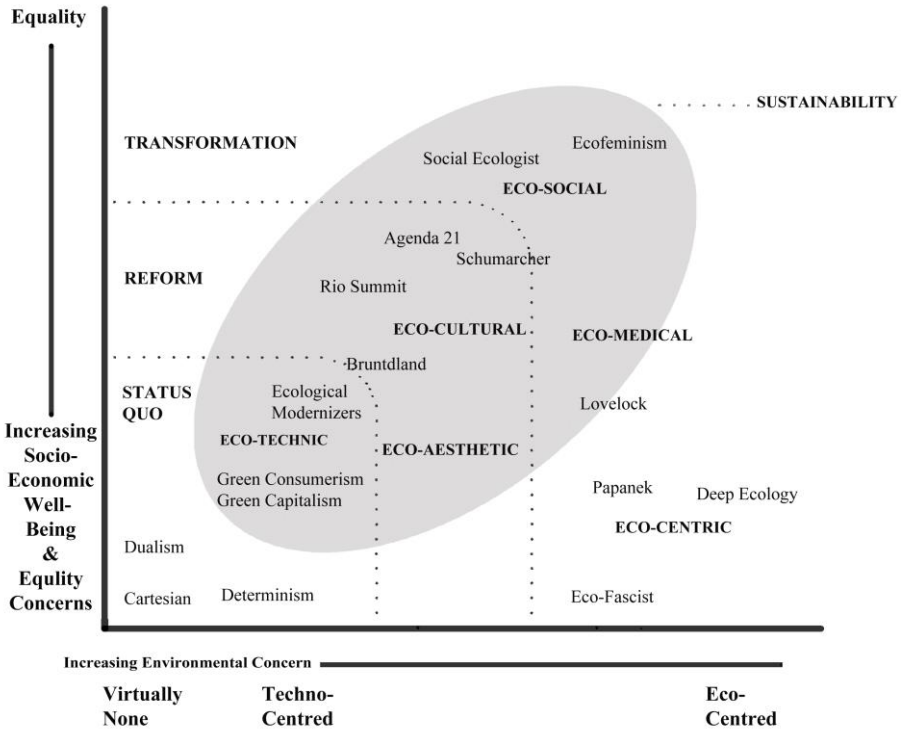

Fig. 1: An Attempt To Reposition Sustainable Architecture [7]

The purpose of the figure is to reposition current sustainability approaches. It makes it possible to observe in what kind of an area sustainable architectural approaches have manifested themselves. It also shows more clearly the intellectual shifts needed to succeed in order to reach a sustainable future.

In our day, the debates over sustainable architecture come to a deadlock when it comes to the discussion if the problem concentrates on problems related to sustainability or if they are design problems. Because, no matter how compatible with nature the building is, in terms of technology and materials used, when it is considered with regards to its environmental effects, it would not be inappropriate to call it an anti-ecologic act [5]. This definition, has been expressed by O'Riordan [20] as environment-centric and technology-centric within an environmental classification he has made. These approaches towards environment that are placed on either side of the spectrum are in fact, self-definitive. The author who states that the environment-centered approach is more nature-oriented and that it supports social equality according to this analysis, defends the opinion that the technology-centric approach gradually supports the current policy and economy. When examined from an architectural perspective, we can say that both of these approaches bring along the problems contained within themselves. For instance, the technology-centric approach in architecture appears as a source-based approach that is not completely renewable and is co-produced with engineering branches and in fact, can bring along a different kind of environmental pollution [6]. However, in environmental-centric approach, balance between natural and human disrupts to nature side and human needs come secondly. Yet, the only necessity for the actualization of a paradigm shift is not the efficiency of buildings evaluated in terms of sustainable architecture. There is a necessity of grouping the socio-economic conditions, social efforts for equality, nature and this struggle together, within the system formed by the master model. The goal here was to reflect all approaches used in architectural design as shown in Figure 1, but to adopt the approach in the Figure 1's upper right corner. The *status quo perspective* believe that sustainability can succeed with knowledge and life-style choices. They associate their approach to the concepts of green design, green capitalism and green consumption [17]. Their suggestions include profit-aimed approaches they developed for industrial and environmental fields [6].Upon evaluating the status quo approach with respect to architecture, we encountered a large number of sustainable architecture examples that fall into this category. The architectural approach that dominates this area is eco-technic. Because this approach was developed through technological logic and policy-oriented discourse, it is not surprising that it led to the construction of a large number of products. Like ecological modernizers, architects with an eco-technic approach believe that environmental problems can be solved by relying on science and technology. According to the supporters of this approach, the source of the problem is the old practices developed without thoroughly estimation of the environmental data. They strive for energy efficiency, smart buildings and high-tech designs [14]. Parameters such as the materials used for the skin, U values, site planning, comfort and daylight, solar, ventilation, material solidity, air quality and moisture are being considered important in the actualization of smart building criteria and energy efficiency. These parameters show

themselves in the design as new types of glass and solar shading, intelligent facades, double-skin walls and roofs, and photovoltaic. In addition, energy management systems that include high illumination, passive solar design, natural or mix-mode ventilation, efficient air conditioning and comfort cooling are the indispensable systems for High-Techs [9]. Some authors argue that such a strong focus on nature, ignoring inequalities among humans, in a way benefits imperialism. Besides, not all deep ecologists have a strong focus on the environmental as described above. For example, the owner of the Gaia Hypothesis James Lovelock [16] stresses that the Earth should be regarded as a whole system with a value greater than the collection of its individual parts, and that the environment cannot be divided into parts. These approaches also reject the concept of development. These expressions become meaningful within the context of *eco-centric approach*.
The eco-centric approach benefits from the scientific paradigm of systems ecology. It emphasizes the epistemological integrity implied within ecology, and ecological metaphysical reality. Nature is fragile and can get easily out of balance. The purpose of sustainable architecture is not only enhancing the environmental performance, but also to emphasize that it should avoid being the accomplice to the environmental destruction it criticizes. While examining the technologic necessity, it also thoroughly considers the question of what are the efficient technologies required, instead of only considering the development of efficient technologies. It mentions that the question of what is the necessary technology need to determine limits of efficient technology. Design objectives of this approach are autonomous, decentralized buildings in harmony with nature, which have limited ecological footprints [14]. Building design approaches strive to draw a perspective that shows parallelism with the ecologic system. Against the traditional open system dominated by the current building system, its inefficiency and its linearity, they bring forward the qualities of the ecologic system, which are its efficiency, vitality and an approach that emphasizes the cyclical system.
Another transformational approach is the *eco-social approach*. This approach claims that there is a dialectical connection between nature and humans. Supporters of this approach argue that approaches to environmental issues are only possible through social criticism and social restructuring. The eco-social approach in architecture builds on Murray Bookchin's definition of social ecology [4]: The ecological principle of unity in diversity grades into a richly mediated social principle. This approach advocates for a decentralized industrial society that constitutes small commune units that have their own productivity. This approach sets its sights on reaching people who can take responsibilities for the designing of a healthy life, achieving a community that can rely on its on productivity and for the environment. Therefore, the utilization of natural resources are going to be minimized while the utilization of human as a resource is going to be maximized. The purpose of design at this point is to develop design parameters that can provide a more organic formation of the society in terms of their relation with the environment they live in.
This approach is going to contain technologic and aesthetic factors within itself, as much as it does social factors. Thus, it will also offer an insight into the power of control mechanisms over the technology. Its building design aspects are reflected by a transparent, flexible and participatory design process that complies with local ecological data [14].
The transformational environmentalist philosophy associates its understanding of sustainability with energy efficiency and the recycling of resource use, along with a fundamental transformation of society and individuals. The sustainability paradigm can only be realized through social sustainability, which is in a social organization that lacks hierarchy, is non-competitive, and respects culture and biodiversity [3].

3. The need of a paradigm shift in architecture (by S. Erkenez)

Schools of environmental philosophy discuss the continued control and pressure on man and nature using different concepts. This difference results from the dualist approach that has existed since Plato and shaped by Descartes' Cartesian way of thinking. The idea, which defends the existence of a master model that rules slaves, animals and the nature, lies beneath Plato's approach towards the 'mind', which is the basis of the dualist discourse. Body on the other hand is described as the servant of mind that serves the mind, under the control and judgment of it. Here, 'mind' is emphasized instead of body. In the Cartesian way of thinking, the dualism of human/nature becomes a contradiction to the dualism of consciousness/mechanics. The view defending mechanism shapes the dualisms of human/nature and mind/body. It is said that by creating dualisms, the Western patriarchal structure shapes social structuring, the philosophy of science, and Western culture. By placing one element lower within a hierarchical system, thus marginalizing it, dualisms such as culture/nature, male/female, mind/body, subject/object facilitate the exploitation of the lower element. According to the author, the elite white man's culture is above and beyond everything, and everything is shaped in accordance with his needs and objectives. The group declared as the 'other' by the elite white comes up against instrumentalism and homogenization. Here, everything that has shaped as the 'other' can be controlled and is examined from an instrumentalist perspective. At this point, the role of the mind is to utilize the power and become the master and owner of the nature [22]. Underlining also the social aspects, unless this dualist system, which forms the basis of all Western science changes, an environmental transformation in the truest sense will not happen. The development concept used in the system described as the master model is itself regarded as exploitation. Exploitation happens through a relationships system

that objectifies the other, places the other somewhere within the hierarchical system, homogenizes, reduces, and ignores the other. In fact, class and gender discriminations and marginalization and seeing nature as a material source are both the results of the same approach. Therefore, solutions focusing on energy efficiency only and the approaches that exclude nature cannot develop a holistic view.
Explaining the dominant design approach derived from the master model, Birkeland [3] states that in the process of design, nature is converted into an object for the sake of man's needs and aspirations. She argues that by adopting a reductionist approach the perception that man and technology are dominant to nature is being created. Thus, removing the built environment from nature, a built environment is created with the help of mechanical tools. Man is in the center, and mankind is logical, authoritative and independent. For transformation to happen, focus should be on the development and improvement of environmental and social relations. Design approaches that are flexible, participatory, appropriate, and locally managed can be regarded as the closest parameters to achieving the targeted goal. The approach these parameters are closest to theoretically is that of social ecologists. However, as widely stated in the literature, while Bookchin opposes hierarchy and centralization trends in society, he remains inadequate in providing a solution. The reason is that by accepting the superiority of the human mind, he normalizes mankind's domination over nature [22]. Even if design approaches developed within this context propose social equality, because at a fundamental level they are conceptualized based on male-dominated thinking, unless a solution is generated at the core of the problem, generating change will be difficult.
The necessity to conduct social and ecologic efficiency together stated as the design approaches for sustainable architecture were formed, against the problems identified, has to be emphasized once more. It is significant to look truly through a holistic view and to redress the balance between the aforesaid design parameters. The options of design approaches that can be developed in this direction have to be discussed. The instrumentalist approach that mechanizes the human body should be gotten rid of. Multi-sensitive design parameters can be considered in order for the body to perceive the nature and built environment by abandoning the dualism of subject and object. According to Pallasmaa [21], body is the primary factor that perceives and experiences architecture. The things that people experience in the nature are not very different that what they experience in a building. A human perceives a building through the body; eyes, ears, nose, bones and muscles as a whole, with dimensions. In addition, it also states that architecture does not only create a physical perception, but also a mental perception.
Paradigm shift can only be possible through a flexible design approach, which does not strictly separate the relations with built and natural environment. In addition to this, in order to extinguish gender and social discriminations, design solutions that are more organic and that are not hierarchical must be produced with a participatory and manageable designing process.

4. Synthetic biology: the new tool for architects (by V. Montaniero)

The buildings are generally designed to respond in standard way to the environmental conditions. This means that they are inert objects, which cannot interact and integrate with the natural system, constantly changing. [8] A possible solution is offer by a new branch of biological sciences known as synthetic biology. According to a European high-level expert group, this discipline is "the engineering of biology: the synthesis of complex, biologically based (or inspired) systems which display functions that do not exist in nature. This engineering perspective may be applied at all levels of the hierarchy of biological structures – from individual molecules to whole cells, tissues and organisms. In essence, synthetic biology will enable the design of 'biological systems' in a rational and systematic way". [25] Although this discipline is often equated with the genetic modification of biological systems, actually the two approaches are very different. In particular, in genetically-modified organisms (GMOs) there are only one or two genes introduced in the whole genome; the rest of the cell works as before, synthesizing only some different molecules with the aim of obtaining a single new function (for example the defense against pests or herbicides). In synthetic organisms, instead, almost the entire genome is revolutionized.
Researchers essentially use two kinds of methods to engineer synthetic organisms:
- *bottom-up method* that consist in to design and assemble synthetic biological systems starting from their basic components, the so-called Bio-Bricks parts, that is genetic sequences previously standardized like electronic components. These Lego-like Bio-Bricks can have several functions and can be easily plugged into each other to create completely new biological systems in micro-organisms. These techniques can be used, for example, to transform bacteria into machines for sensing and degrading pollutants. By simplifying and standardizing biology, the MIT has developed the "*Registry of Standard Biological Parts*", which provides a library of standard parts that have been tested, characterized and organized so that users can find what they need when developing new biological systems. The Registry is continuously growing thanks to iGEM (International Genetically Engineered Machine) based at MIT, an international contest where every year several university teams compete to develop new Bio-Bricks to be added to the Registry.
- *top-down method* that is the opposite strategy is the so-called "minimal genome", which aims to remove pieces from the genome of a bacterium to obtain the smallest number of genes essential and necessary for life. Then, the BioBrick parts are gradually added to it in order to opportunely modify the organism. The result

should be an improved and optimized cell that does everything with more efficiency and speed. The first method is used to study the origin of life for the design of an artificial bacterium, while the latter has industrial applications such as the synthesis of new molecules.
Effectively, synthetic biology could contribute to different fields such as:
- *Pharmaceutical industry*: the aim is to produce smart drugs able to reach and act selectively only in the sick cells, as in the case of tumors.
- *Environment*: engineered organisms or biological structures may indeed act as sensors to detect the presence of pollutants or hazardous substances, such as explosives in areas at risk. Then, this capability could be further combined with the ability to degrade harmful substances into simpler compounds not damaging to humans and the environment. The so-called "bio-remediation", one of the most crucial objectives of synthetic biology, is based on the design and modification of bacteria and other microorganisms such as fungi to eliminate toxic substances and pollutants from soil or contaminated water.
- *Energy*: the challenge is to design a set of converging chemical pathways that allow a quantitative conversion of readily available solar energy and natural or waste materials to, for example, bio-fuels.
- *Information technology*: the goal is to build integrated circuits made up by biological parts that can act as molecular electronic circuits, in order to achieve a biological computer.

Since synthetic biology involves designing organisms to perform tasks and produce physical materials, there are possibilities also for the architectural field at many scales. “The most straightforward architectural applications may involve the design and manufacture of new building materials within laboratories or factories. Examples may include bio-plastics that do not require oil for the production, bacteria that fuse sand into bricks without any baking process and wood that is extremely strong, flexible and durable. Compared to their natural counterparts, these new synthetic building materials may offer higher performances, lower costs, lower carbon emissions and less waste.
A different kind of architectural applications may involve the design and installation of new building systems on site, outside the laboratory. These systems may be more complex than materials produced in the laboratory. Examples may include biosensors that change color when detecting toxins or structural problems, microbes that find and heal cracks in concrete, termites that eat construction waste (as well as old cars and cell phones) and organisms that act as factories to produce building materials on site.
Additional architectural applications may involve the complete design of new living buildings, which may offer some of the dynamic features of natural living systems, including growth, renewal and adaptation. A mind-blowing example is the possibility of programming a seed to grow into a building. This way, the building is transformed from a mechanical entity to a biological entity.
Furthermore, the impact of these new biological technologies on architecture might involve the process as much as the product. Once architects will add the tools of synthetic biology to their classical design means, entirely new designs and applications might emerge.” [2]
The specific term used to identify this design practice is bio-design. It “goes further than other biology-inspired approaches to design and fabrication. In particular, unlike bio-mimicry, cradle to cradle and the popular but frustratingly vague ‘green design,’ bio-design refers specifically to the incorporation of living organisms as essential components, enhancing the function of the finished work. It goes beyond mimicry for what concerns the integration, as it dissolves boundaries and synthesizes new hybrid typologies. The label is also used to highlight experiments that replace industrial or mechanical systems with biological processes.” [18] In conclusion, the synthetic biology may help us design and manufacture the built environment with higher performance and lower environmental impact than traditional methods. [10]

5. Bio-based building materials: a sustainable alternatives (by A.Violano)

Design is not only a process, but also a “place” of reciprocal relationship, which can be the engine of positive, progressive and holistic change, according the scientific paradigm that emphasizes the creative act combining it with complex and dynamic technological choices.
Innovation is not only in technical choices, but also in the way of design integrating the building system until it becomes co-evolutionary part of the natural system, increasing its "Intrinsic Value” [27], the value which characterizes the ecosystems, which is a kind of value that cannot be expressed in monetary terms. In the evaluation of a regenerative design, the intrinsic non-monetary component of the Social Complex Value [11] of the architectural heritage can be significant. Then, it is possible add to the traditionally associated categories of values (cost, market, use) also an intrinsic component that indicates the co-evolution of the part to the whole, that represents the building's faculty to be an ecosystem. In that moment, we can speak of *Regenerative Development*, able to self-sustain in a long period, but above all to revive the ancient wit of human being’s symbiotic evolution with his/her own habitat, regenerating physical places up to create symbiotic and identity links again. [23]
From the architectural point of view, the issue can be faced according to both an eco-cultural and an eco-aesthetical approach. However, in both cases, the design paradigm calls for creatively to integrate natural (eg. Bioreactor Façade, a dynamic façade system for the production of renewable energy using algal biomass and solar thermal heat) with artificial (eg. Photovoltaic system or solar thermal collector) plant

systems, in addition to bio-based (eg. bio-brick or fungi based materials) with traditional eco-compatible components.
This is the case of the coating system designed by Studio ecoLogic: the "Urban algae canopy" that uses the naturally adaptive and dynamic behaviour of micro algae in order to create a selective solar shading. When the solar radiation increases, the microalgae naturally grow and photosynthesize, reducing the transparency of the roof and ensuring a good level of shading. The integration between natural and artificial plant systems provides for the application of smart building automation systems, which, thanks to presence sensors, activate an electrovalve system that varies the flow rate of algae inside the envelope, causing the displacement of the algae themselves, according new needs. The system reacts in relation to rates of use, creating lighting or shading where it effectively needs. Thus transparency, colour, shading varies in real time, reacting to joint information between sunshine and direct users, integrating micro-algae with digital control systems. The integration of life into building materials, systems and components allows to design future buildings and household objects that could be able to respond dynamically to any external stimulus and to develop a 'sensitivity' to changing elements like climate and inhabitants, in imitation to biological systems having the ability to sense, react, regulate, grow, regenerate and heal.
Generally, biological-derived or biotic material is any material that originates from living organisms. Most of such materials contain carbon and are capable to decay. Examples of biotic materials are wood, linoleum, straw, humus, manure, bark, crude oil, cotton, spider silk, chitin, fibrin and bone.
The use of biotic materials, and processed biotic materials (bio-based materials), as alternative natural materials, is popular in relation to environmentally conscious people, because such materials are usually biodegradable and renewable and their processing is commonly understood and has a minimal environmental impact. However, not all biotic materials are environmentally friendly, such as those that require high levels of processing, those that are harvested unsustainably or those that are used to produce carbon emissions.
The common properties of bio-based materials are the following: minimal environmental impact production process, high recyclability, minimal hazardous, high productivity and high environmental purification efficiency. This section collects some of the new “grown materials” applied to the construction sector and illustrates their performances through application examples, which offer a paradigm shift in the perception of buildings from mechanical entities to living or like-living organisms.
Another interesting example of the living building component is the bioMason, which is a brick that is "grown". This new material is "born" from the sand thanks to natural elements (nitrogen, calcium and water) that are combined and crystallized through the digestion of bacteria following the procedure of the formation of coral reefs. The production time is relatively short: 5 days. When bacteria complete their life cycle and die for lack of food, the compact and resistant brick is ready to be used, without the need of high-temperature firing, which is a process resulting in large environmental impacts (the production of about 1 million bricks enter into the atmosphere about 650 thousand tons of CO2). This component integrates seamlessly with traditional natural components, such as bricks or insulating plaster of hemp and lime, which has performance of large vapour permeability, fire and frost resistance, it does not produce toxic fumes in case of fire, and it is recyclable and biodegradable. The "grown materials" commercialisation allows extending the concept of synthetic biology over the perceptual interpretation of visual arts, stimulating the increase in familiarity with these unusual natural products.

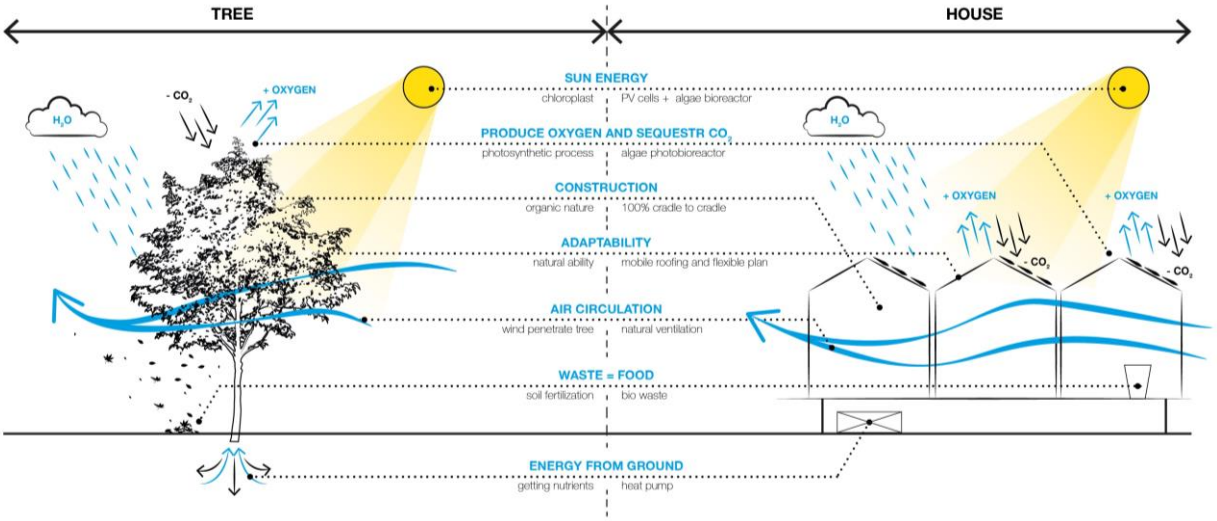

Fig. 2: The architecture natural behaviour: the concept of a house like a tree

Substantially the grown materials are characterised by the activation of biological processes during several stages of their life cycle, from cradle to grave. Generally, the real added value of the biological process application on materials is related to the increasing of their performances during the operational stage of applications. This happens because these materials can be assimilated to the natural processed ones, both in the first stage of the production/growth and in the last of disposal and decomposition.
According to this assumption, the research group of the Second University of Naples proposes a focus on the collection of building applications of grown materials, regarding to the operational stage of life cycle, which compares the microorganism actions to generate or to improve the materials proprieties. The following section illustrates the two main families (biotic-processed and biotic-processing) of grown materials.

6. The grown materials applications in Architecture best practies (by F. Verde)

The grown materials are grouped in two main families:
-the *biotic-processed* that collects the materials generated by an actively participation of living organisms in the process of creating the final product. The biological process is limited to the production of the final product or material and finishes with its use.
-the *biotic-processing* that collects the materials in which the living organisms are integrated into the final product in order to perform specific functions useful to extend the service life.
In these two families, we can focus three sub-categories related to their microorganism base. In fact is possible to derive the grown materials derived from bacteria (or bacteria based); the algae based materials, products, and the fungi-based materials.
Among the biotic-processing materials, we can focus on the *Bio cement* based on the bacteria of the *bacillus species*. Their spores can survive for decades in a kind of sleep mode, without food or oxygen and come to life if water and oxygen are 'added', so, if a crack appears in the concrete. They are then able to multiply and produce limestone, thereby closing the crack in a few weeks. Once the crack is closed up completely, moisture can no longer get into the concrete, so it will not weaken. This is the perfect solution for underground spaces for example, in which it is always damp. [http://syndebio.com/bio-concrete]
In the biotic processed materials from bacteria, we can collect the *bioMASON*. This product turns bacteria form sand into a crystalline structure that can serve as bricks or a cement-like construction material. Bacteria, which provide a defined environment to form in combination with a *nutrient*, *nitrogen* and *calcium* source allow for the formation of natural cement in ambient temperatures. The raw input materials used in bio cement production include *sporosarcina pasteurii* (bacteria anaerobically grown with NaCl, yeast extract), while cementation feed stocks include yeast extract, urea, and calcium chloride. These inputs are inexpensive, globally abundant, and manufactured in ambient temperatures. The water component used to deliver the cementation reagents is recycled in a closed-loop system and reused in the manufacturing process. Biomass ammonium byproducts are captured in a closed-loop system.[www.biomason.com]
Another significant material derived from processed bacteria is the *Bio-on*, derived from *PHA.* The generation begins with the natural bacteria selection and the agricultural waste (*molasses*) which are digested inside a fermenter in a few dozen hours. The bacteria build up PHAs, a reserve of energy. This is how the natural Bio-on polyester is created. It is completely natural and it has the same features as the main oil-based plastics. The next step is the process of recovery (recovery of PHAs) are retrieved when *Polyhydroxyalkanoate* PHAs and separated from the rest of the organic material of the cell. All waste material (in small quantity) is re-entered in the initial production cycle.
After the fermentation, the PHAs are extracted. The biopolymer is extracted without any organic solvents, fully respecting nature and without polluting. The final material is similar in proprieties to the plastics, so the applications are going to be largely experimented. [www.bio-on.it]
Among the *fungi based materials* (biotic-processed) is important to focus on the Ecovative. This material, firstly produced for packaging, has a huge potential in building applications as insulation panel or envelope component. It is produced from organic waste and mycelium. The company use *mycelium* (mushroom "roots") to bond together crop byproducts such as seed husks or stalks. The mycelium growing process happens indoors, in the dark, in less than a week. The resulting Mushroom® Material is then dried which stops the growth.
Among the algae based materials (biotic-processed) is considered the *EDIMARE* insulation material. This product is realised by mixing the pure sheep wool and sea wool, obtained through an industrial processing of the *Posidonia Oceanica* collected on the beaches of the Sardinia territory. This new material is used to build heath-insulating panels with the highest thermal inertia, if compared to other similar ones.
In the family of biotic processing, there is a collection of some algae based products. In particular the *Solar Leaf* and the *Urban Canopy*. These technologic components use the *micro-algae* trough the photosynthesis to produce biomass and energy. These two different technologies present a large experimentation range, and the *Solar Leaf* was yet implemented in a building retrofit in Hamburg. These components might to substitute entirely or partially the building envelope, adapting their proprieties to the different needs of users according to surrounding environment changes.

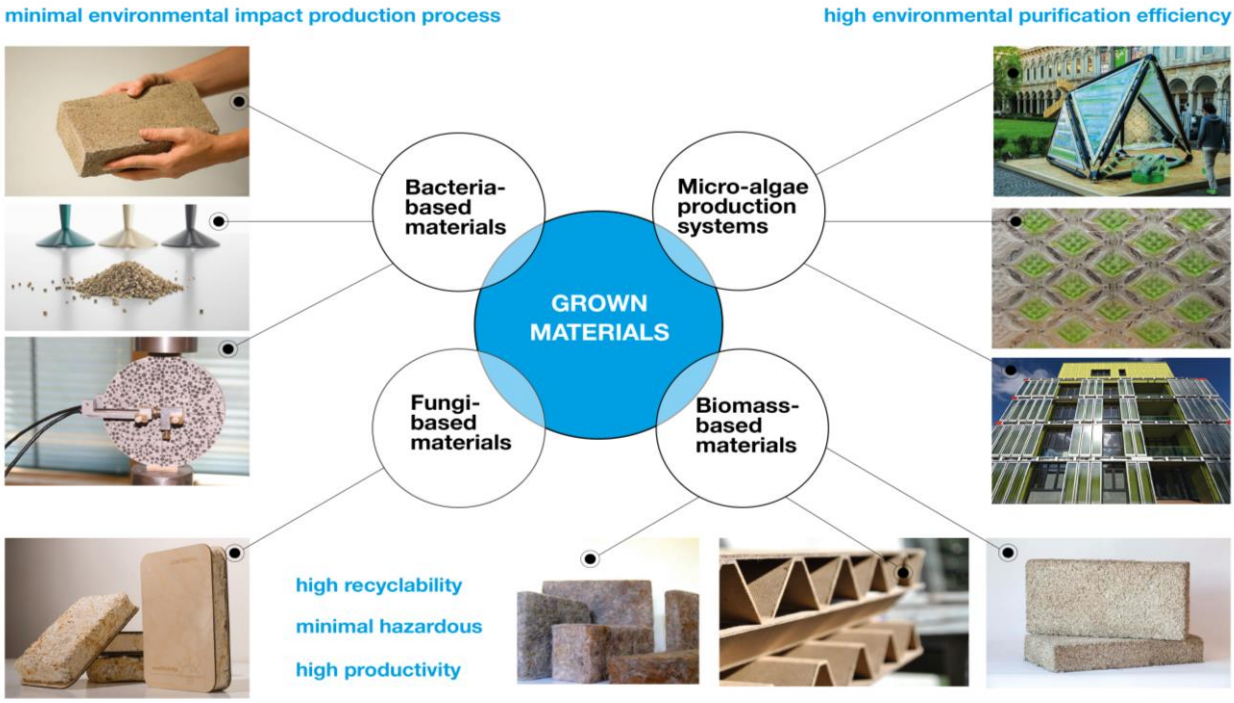

Fig. 3: New frontiers of building materials

7. Conclusion (by A.Violano)

As biological evolution, the architecture can be holistic, intelligent and co-evolutionary, but it needs to direct the construction market towards the production of materials, systems and components that not only meet the demand of pseudo needs, responsive only to commercial logic.
Technological progress, more and more conditioning and pervasive, it is certainly a wonderful expression of human creative potentiality, but must be guided by new mental approach and directed to eco-oriented use . A regenerative approach requires that the construction industry move away from techno-social decadence in order to identify and replant the roots in the natural world and cultural origin, recovering a sense of belonging socially, economically efficient and environmentally coevolution. This does not mean to go back and stop the progress; but it means moving forward and imagine future scenarios in which buildings they live in symbiosis with their inhabitants and the environment of which they are part.
"*Understanding how objects and Nature work means to recognise and to understand the many ways in which man-made systems interact with natural ones, which implies what I call ecological intelligence*". [12]
We must understand that the sustainability will never achieve its needs if we do not change our behaviour, culture and way to work. This is the new frontier of architecture; this is the mental and behaviour innovation that asks to the technicians: let us cultivate ecological intelligence and change our way to design!

Bibliographical References

[1] ARMSTRONG, R. Living Architecture. How Synthetic Biology Can Remake Our Cities and Reshape Our Lives. TED Books, 2012

[2] BENJAMIN, D. (2011). *Bio Fever – Recent developments in synthetic biology suggest new and unpredictable possibilities for creative design*. Retrieved from http://www.domusweb.it/en/op-ed/2011/03/30/bio-fever.html

[3] BIRKELAND, J. *Design For Sustainability: A Source Book of Integrate Eco-Logical Solution*. London. Earthscan Publishing, 2002

[4] BOOKCHIN, M. *The Modern Crisis*. New Society Publishers. Philadelphia, 1986

[5] CIRAVOĞLU, A. *Mimarlık ve Çevreci Yaklaşımlar Bir Arka Plan Denemesi. Mimarist*. 2009, 2:38-42.

[6] CIRAVOĞLU, A. *Sürdürülebilir Mimarlık: Eskimiş Kavrayışlarla Yeni Söylemler Arasında*, Mimarlık, 2008, 340:13-16.

[7] ERKENEZ, S., CIRAVOĞLU, A. *The Only Way Out: Introducing A Gender Perspective For Sustainability*, In World Sustainable Building Conference, Barcelona, GBCe, 2014,

[8] FERRARI, M. (2012). *For a syntetic biology*. Nemeton High Green Tech Magazine, p. 7

[9] FIELSON, R. Architecture & Environmentalism. Movements & Theory in Practice. Architecture & Environmentalism, 2004. 6(1): 20-33.

[10] FONTANA, J. (2014). *Come la biologia può dare nuova vita alle nostre abitazioni e farci vivere nelle future megalopoli. Che futuro! Lunario dell'innovazione*. Retrieved from http://www.chefuturo.it/2014/10/come-la-biologia-puo-dare-nuova-vita-alle-nostre-abitazioni-e-farci-vivere-nelle-future-megalopoli/

[11] FUSCO GIRARD, L., NIJKAMP P., *Le valutazioni per lo Sviluppo Sostenibile della città e del territorio*. Milano: Franco Angeli, 1997

[12] GOLEMAN, D., *Intelligenza Ecologica*. Milano: Rizzoli, 2009, p. 55

[13] GOULD, K., HOSEY, L. *Women in Green: Voice of Sustainable Design*, Bainbridge Island, Ecotone Publishing Company, 2007

[14] GUY, S., FARMER, G. *Reinterpreting Sustainable Architecture: Place of Technology*. Journal of Architectural Education, 54(3), 2001, p.140-148.

[15] HOPWOOD, B., MELLOR, M. O'BRIEN, G. (2005). *Sustainable Development: Mapping Different Approaches*. Sustainable Development, 13:38-52, doi: 10.1002/sd.244.

[16] LOVELOCK J. *The Ages of Gaia: a Biography of Our Living Earth*. Oxford University Press, Oxford, 1988

[17] MADGE, P. *Design, Ecology, Technology. A Historiographical Review*. Journal of Design History, 1993. 6(3): 149-166, doi:10.1093/jdh/6.3.149.

[18] MYERS, W. (2012). *Biodesign: Nature, science, creativity*. The Museum of Modern Art, New York, pp. 8-9

[19] NAESS, A. Deep Ecology and Ultimate Premises. The Ecologist, 18(4-5), 1988

[20] O'RIORDAN, T. *The Challenge for Environmentalism*. In New Models in Geography. Peet, R. and Thrift, N. (Eds.). London. Unwin Hyman, 1989, 77–102.

[21] PALLASMAA, J. *The Eyes of the Skin*, In the Academy Series Polemics, Great Britain: Academy Editions, 1996

[22] PLUMWOOD, V. *Feminizm ve Doğaya Hükmetmek (Feminism and the Mastery of Nature)*, İstanbul. Metis Yayınları, 2004

[23] REED B. The Integrative Design Guide to Green Building: Redefining the Practice of Sustainability. New Jersey: John Wiley&Sons Ed., 2009

[24] REES, W. (1995). *Achieving Sustainability: Reform or Transformation?* Journal of Planning Literature, 9: 343-361

[25] Synthetic Biology Applying Engineering to Biology, Report of a New and Emerging Science and Technology (NEST) High-Level Expert Group, European Commission, Brussels, 2005, p. 5

[26] VIOLANO, A. Eco-Smart Home: eco-design technologies for living. In VOYATZAKI, Maria. Architectural Education and the Reality of the Ideal: Environmental design for innovation in the post-crisis world. THESSALONIKI:Charis Ltd Ed., 2013. p. 365-381.

[27] ZIMMERMAN, M. J., The Nature of Intrinsic Value. Oxford: Rowman &Littlefield Pubblishers, 2001

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BUILDING WITH WOOD: the summer energy performance according the UNITS 11300:2014-I

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Abstract
The idea of wooden building is often linked to the concept of temporary (construction for the emergency), pertinence (the tool shed) or recreativity (mountain chalet); however, the new frontiers of biocompatible, energy-efficient and low-cost construction are moving the market towards the current use of wood in the building sector. Wood can be an efficient alternative to traditional building materials: bricks, cement, steel, not only in northern countries with temperate cold altitude climate, where the widespread use of this material is related to wide availability and its heat insulating physical characteristics.
In the Mediterranean area, the traditional use of wood is related primarily to the construction of roofs, floors and finishes (windows, doors), but it is rarely used for structures and cladding, because the prevalent need is the control of free solar gains.
In fact, for the buildings of the Mediterranean area, the " shadow right " has priority over the "solar right", as the warm temperate and subtropical Mediterranean climate invites us to consider prevailing the technological and design parameters related to the energy performance for summer air conditioning: the net thermal energy for cooling and dehumidification, the seasonal average efficiency and the primary energy. In particular, the new law UNITS11300: 2014 Part I modifies and expands the procedure for solar thermal contribution (for opaque and windowed components), evaluating the contribution of all passive and active gains that can contribute to energy saving.
The paper illustrates the results of a research carried out in collaboration with companies in the sector, aimed at optimizing the performance of the wooden envelope in Mediterranean climate areas, integrating technology solutions such as solar greenhouses, solar ventilated walls (Trumpets Walls), opaque components with closed or opened strongly ventilated air cavity, solar ventilated elements, opaque elements with transparent insulation, shading systems, ...

Keywords: Wooden building, Mediterranean construction, summer energy performance, low-cost building

1. Not just comfort (by A. Violano)
"*The western society is perpetrating one of the greatest mystification of all the times. It is passing off wellness as comfort. It is leading us to believe that having another piece of furniture, a mobile phone, a TV... is wellness. While it is just comfort. The western society is a fantastic and incomparable comfort-maker, but it is unable to make wellness... rather, when it finds it, it destroys it! Wellness is a very exquisite and difficult proportion among three parts: the others, the environment and me. Respecting these three identities makes the wellness*" [3]
Sharing this opinion, the starting point of this project about how optimizing wood performance where there is the Mediterranean climate are: me as a direct receiver, in an architectural users-centric vision; us as a synergistic relationship between house/individual and the surrounding environment (climate conditions and habits linked to the "Mediterranean living" concept); the environment, meaning both the natural context (biophysical and bioclimatic) and social-cultural context.

The dual relationships between needs and performances have been considered with a specific market analysis, respecting current laws and satisfying the minimum requirements, and considering on the one hand the most important building firms' offers and on the other hand the general trend, that influences how projecting. However, the wellness project goes beyond...
Encouraging the eco-efficient and auto-sustainable-oriented technological innovations is the current researching and working conditions' main feature (from net zero energy buildings to plus energy buildings). They can be the result of a mental innovation, both ecological and environmental.
For the technological choices, it is not enough integrated in the cover a photovoltaic or solar thermal system to build an energetically efficient building.
For a building scale project and for the production, organization and managing the building processes, it is important to state the preference for project solutions involving raw materials and the fulfilment with a checked environmental and energetic cost in a lifetime and over, according to the cradle-to-cradle approach.
The building is not a simple whole of building elements, but a complex system, a combination of different functions, with an own distribution in space, morphological aspect and micro-environmental features.
The need of a technological project able to control how the environmental factors interfere with the building to grant a high level of stability and of the inner environmental quality compatible and suitable with the different functions existing in it derives from the system complexity.
According to the different situations, the main ideas that give the birth to the development of innovative technologies are addressed to the global quality of the building system, or better, addressed to what I call the “possible quality”... and here the building market plays the main role.
When the meeting point between demand and supply is not in equilibrium, it is needed a work in order to improve the existing building system's performance or to add new materials, components or technological units able to reach the “Possible Quality”. [2]
In this case, the architect the duty of interpreting the relationship between the building system potential supply and the real receivers' demand, according to the rational comfort and wellness needs.
However, these goals is not an unaware deduction; they come from a complex design thought, which combines the architectural and composite background, through the available resources and the needs' manifestations, and also to the eco-compatibility of the proposed transformations.
The real efficiency of the building system cannot be evaluated only in the operational rating. In fact, researches concerning the relationship between building materials, construction processes and their environmental impacts have demonstrated that the embodied energy of construction materials in a building can sometimes equal the operational energy over the building entire lifetime. [4]
If in the constructions built before the entry into force of the legislation about energy efficiency, the energy consumed for living, in a 50-year period, was ten times greater than the energy absorbed to build them, in high-performance buildings such consumptions tend to be equated and, in some cases, to build it is required an amount of energy even double compared to that consumed in the operational phase.[1]
Therefore, it is needed to consider the construction site phase(cradle phase) and the dismission phase (grave phase), trying to carry out the *pro-sumer* idea, that introduces again the waste of the past in the building productive cycle, and that makes technological and design choices to reuse in the future unused materials, systems and components.
Of course, respecting the times of the nature doesn't imply necessarily the no-time architecture, but projects able to be flexible, recyclable and convertible; in this way the long-lasting problem (not in terms of abuse of power) is what we have to face, supporting and not preventing models that want to change more quickly today than in the past.
Beside the space distinction concept, linked to specific contexts, there is the life-style distinction in the time. This connection is necessary to create a new projecting and redeveloping houses, because as in the tradition, the house in the microcosm that reflects in the organization, in the structure, in the aspect and how livable it is, the ideal concept of the human natural and social order.
However, if the building is a microcosm, it co-evolves with its surround and the integration of life into building materials, systems and components allows to design future buildings and household objects that could be able to respond dynamically to any external stimulus and to develop a 'sensitivity' to changing elements like climate and inhabitants, in imitation to biological systems having the ability to sense, react, regulate, grow, regenerate and heal.[5]
Therefore, the inner meaning of “Mediterranean living” has a great influence on the way of building, living and choosing the best solution. The project linked to the context summarize the complexity.
The process considers the critical phases at the beginning of the project belonging to the “Mediterranean living” project: meta-planning set and the coherence. It is not possible to start from the concept, but from an analytical subject of all the factors playing the “design game” that have to be analyzed with scientific accuracy in terms of strength (opportunity) and/or weakness (restrictions).
The deriving design solutions will have in their DNA the disciplinary and extra-disciplinary contents to belong to the wellness category and not just to the comfort one.

The thought's categories, which are design targets, are:
- Qualifying/Structuring
- Controlling/Defining
- Supervising/Orienting

Tools, methods, targets and reasons also consider the streams material, energy and information. It is not possible to design the resource as a simple element of a bog-standard pack, but it is possible to design as an in-coming and out-coming stream, that creates a synergy between internal and external parts and so it gives the birth to the building organism that starts living in its context.
Moreover, the structural crisis (not just temporary/financial) asks long-lasting things, things that work, and things that do not cost too much on equal benefits. This is the real and the biggest transformation!

2. Requirements and performance in summer conditions (by M. Cannaviello)

The use of wood as a building element for every part of the envelope components, (for the cladding for example) it is linked to the energetic requirements imposed by the current law on the one hand and by the ability to grant suitable comfort conditions on the other hand.
The possibility to build wooden houses in the Mediterranean area, and so in a warm temperate temperate Mediterranean subtropical climate, invites us to evaluate as prevalent the technological and design control of all the parameters related to the energy performance in summer: the thermal energy for cooling, the net thermal energy for dehumidification and the primary energy for summer air conditioning.
Currently (and let us hope for not too much time) the law is related to the first one, that has to say to the net energy need for cooling.
This means that we are in a temporary phase where just the energy performance of building envelope are evaluated.
In particular, the Art. 4 of the D.P.R. 59/09 defines the minimum requirements for new buildings and old ones that can be restored, and introduces an indicator to evaluate the building envelope performance in summer. (Epe, invol).
The energy performance index of a building envelope in summer is equal to the ratio between thermal energy annual need for cooling and the net surface, for the residential building or the volume for the other types of buildings.
This performance index, calculated as established by the law UNI TS 11300 – 1, does not have to be greater than established thresholds, which are fixed according to the use purpose and climate area.
Other performance requirements have been established by the D.Lgs 192/2005 concerning opaque components of building envelopes.
In addition to the thermal insulation test, with the respect of the maximum thermal transmittance value, there are other requirements for the thermal inertia of opaque components.
At the beginning, the D.Lgs 192/2005 established to verify that the outward mass of the opaque walls (vertical, horizontal and sloping) is more than 230 kg/m^2 in places with a high radiation value on the horizontal level; the outward mass is the mass for every surface without plaster.
This requirement seems to be the reason why the mild cladding was disappearing (as wood cladding), because of the need to grant a good thermal inertia of the buildings.
Then the D.P.R. 59/2009 established an alternative requirement: the periodic thermal transmittance.
The periodic thermal transmittance is an index able to evaluate the capacity of an opaque building element (wall or roof) to shift and reduce the thermal stream in it in 24 hours.
The periodic thermal transmittance is an index able to evaluate the “inertial” capacity of the walls or of the roofs.
Above all, in the Mediterranean area, the thermal inertia of an opaque element is a necessary requirement for the summer comfort. It determines a reduction of the thermal swing according to the external environment and a remarkable reduction of the energy need for cooling thanks to the change of the night thermal peak.
The thermal inertia of the envelope is considered to define the net energy need for cooling and heating, as established by the law UNI TS 11300 – 1.
In particular, the ability to collect the opaque element (measurable through time constant) constrains the use factor of free gains. In winter, higher is the factor greater is the building ability to use free supplies to compensate dispersions.
In summer, the equation used by UNI/TS 11300-1 is different and the use factor in free gains conditions the incoming thermal stream for transmission and ventilation. This means that a high thermal inertia and so a high use factor of free gains reduces the so-called “Summer Returns”.
Respecting the periodic thermal transmittance does not mean just respecting a law, but granting more comfort, above all in summer, reducing energy need.
The requirement offers the advantage to be achievable also by light components and so it possible to build wooden houses in Mediterranean area.

Another important aspect is the solar absorption of the opaque elements. The new version of the 2014 UNITS11300 – I underlines this aspect introducing in the transmission thermal exchange a new term for the gains caused by an incident solar radiation on the opaque elements. Therefore, it is quite delicate the cladding cover and cover choice that are mainly hit by incident solar radiation.

3. The Need-Performance Approach of UNITS11300:2014(by A. Violano)

A more efficient management of the building system for the environmental wellness considers the energy saving managed both by the thermal dispersion reduction and above all by the reduction of the need and renewable energy through the use of the solar system (active and/or passive) and to the natural ventilation. These solutions affect above all the envelope.

The goal is addressing to design choices through an evaluation system approach of the energy-environmental loads of materials, of the building techniques and of the different house systems, which in general correspond to the lowest resources consumption and environmental impacts.

When choosing building materials and systems, it is important to incentivize the techniques and local traditional materials appreciation, well translated in an innovative way, and the products' choice to be eco-compatible and recyclable. From these points of view, wood is a material with a very good performance. In the Mediterranean area, the use of wood is traditionally linked to building roofs, floors, finishes (windows and doors), but it is rarely used for buildings and cladding, because the prevalent need is the control of free solar gains.

In particular, the new law UNITS11300:2014 Part I modifies and expands the procedure for solar thermal contribution (for opaque and windowed components), evaluating the contribution of all passive and active gains that can contribute to energy saving. In particular, for the transparent envelope, the factor of the exposition to the solar radiation Fw in no more constant equal to 0,9, but it is a function of glass (single, double and triple) of the exposure and of the month.

For the opaque envelope, the thermal energy gain caused by solar radiation is considered as a reduction of the thermal energy quantity lost for the transmission.

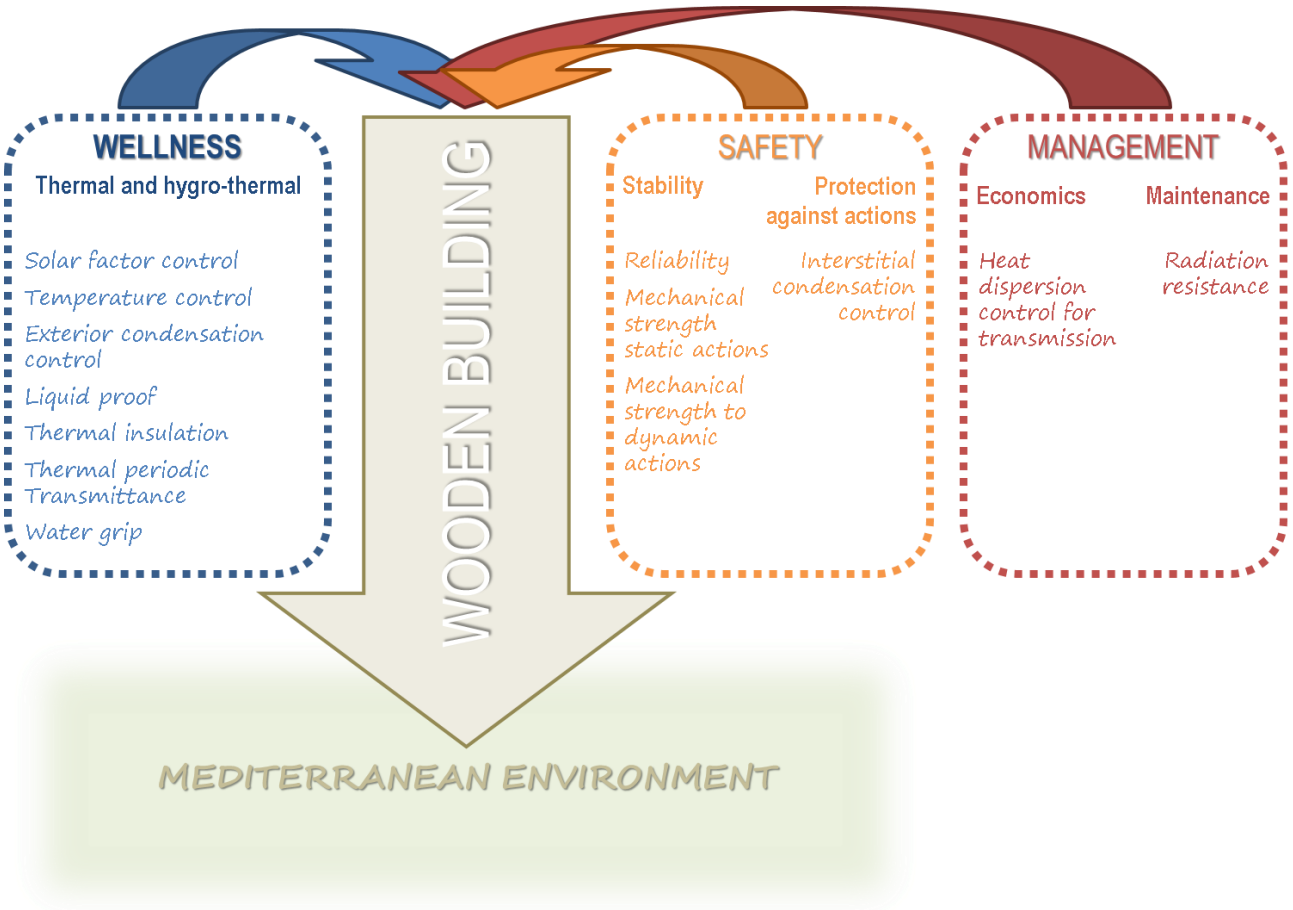


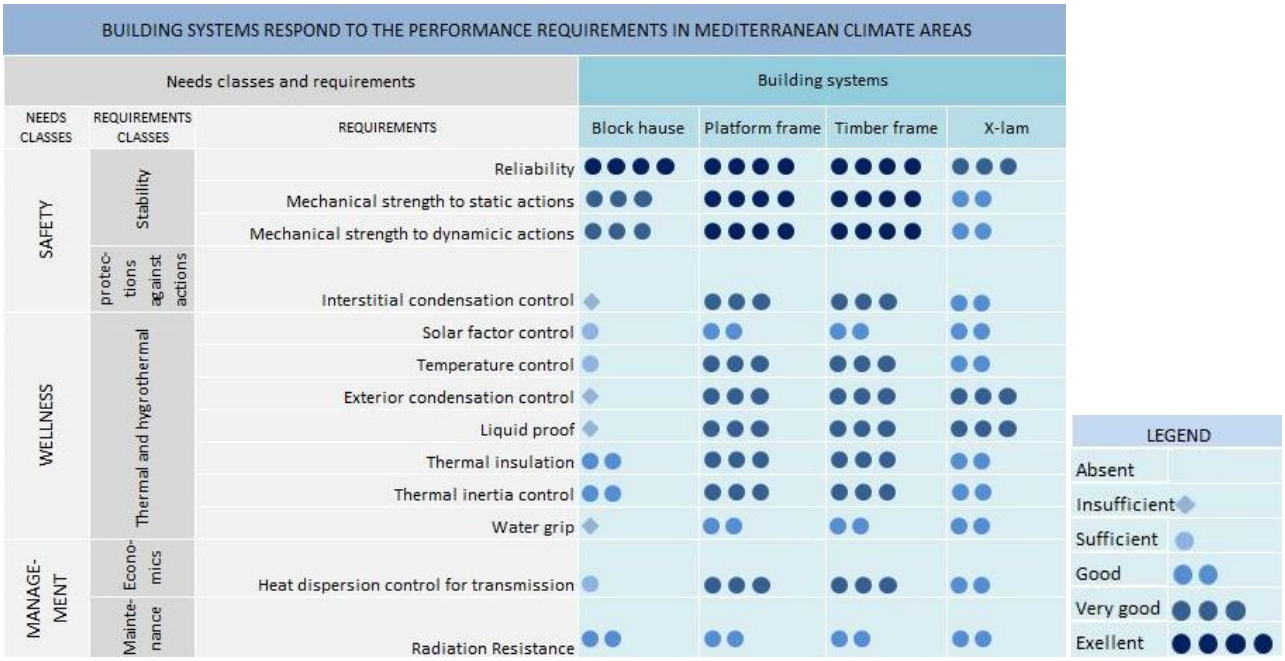
Fig.1: Significant requirements for a wooden building in the Mediterranean environment

For the evaluation of the thermal-physique properties of the building opaque elements and for the calculation of the periodic thermal transmittance, it is possible to refer to the structure abacus that forms the building opaque elements according to the law UNI/TR 11552:2014.
For some bioclimatic solution, as solar greenhouses or trumpets walls, the law is UNI EN ISO 13790:2008. In these cases, the amount of thermal energy caused by direct solar radiation on opaque components considers both the direct thermal stream and the indirect one that goes in the volume heated by the greenhouse through the internal opaque partition.
The performance of the wooden envelope in Mediterranean climate areas, integrated with technology solutions such as solar greenhouses, solar ventilated walls (Trumpet Walls), opaque components with closed or open strongly ventilated air cavity, solar ventilated elements, opaque elements with transparent insulation, shading system,... They have to consider the solar thermal gains.
As said before, the most important requirements to evaluate the wooden building use in the Mediterranean area are the periodic thermal transmittance and the solar radiation control of the opaque envelope components.
Specialized studies show that to improve performances in a dynamic regime of the wooden buildings and to reach suitable performances in terms of periodic thermal transmittance, it is necessary to make stratigraphies with a double insulating layer (external-internal). In addition, the insulating material choice has to be done not just for its conductivity, but also for its diffusivity and not least, for its eco-compatibility.

4. The opportunity from the construction market (by A. Della Cioppa)

Wood has always been used in building and in the last years, it is coming again in the fore thanks to more attention paid to the sustainability in building and to an important technological innovation. This is a consequence also in the market field, where wooden houses are more and more demanded, thanks to a new awareness about the advantages to build with wood in terms of building quality, healthiness, earthquake safety and a good quality-price relationship.
So wood is able to give an important answer to the growing attention to energy and environmental problems, aiming for the role of main character in the green thanks to the ability of combining living comfort with an energy saving and the pulling down of the CO2 emission in the environment. [6]
At present, in Italy the energy control in summer regime is an important problem for wooden prefabricated designers above all because most part of the peninsula has a subtropical and Mediterranean climate.
Many researches showed how in Italy the consumption for air conditioning in summer is greater than heating in winter. So it is important for a correct project to grant thermal-hygrometric comfort in summer reducing the use of air-conditioning system and so the consumptions. [7]
Therefore, the research aims to define the possible technological solution useful to optimize the wooden envelope performance in Mediterranean climate area.
The research is divided into two phases: the first part is about collecting the information about firms specialized in wooden prefabricated houses. This enables us to understand deeply the current market supply characterized by different building systems provided with specific features.
Then, the second part is about the analysis of compulsory requirements as request by the Italian law to firms producing wooden prefabricated houses, about thermal insulation and thermal inertia of the buildings, and it considers a definition of the potential requirements that wooden houses should have if they were built in a Mediterranean climate area. With the first part of the research, the most used building techniques to build wooden houses are four. They are:
1. *Block house,* consisting of wooden slats or trunks overlapping directly on the building site, to build the self-supporting walls thanks to special 3D clamps;
2. *Platform frame* consisting of assembling the single walls directly in a firm, following a 2D frame structure, they may be subsequently enveloped with various finishing materials;
3. *Timber Frame* consisting of assembling directly on the building site, wood beams and pillars joined with a complex system of joints. Also in this case, the envelope can be done using various materials;
4. *X-lam*, consisting of assembling in a firm the multilayer walls, the layers form a cross structure and are pasted together. The walls are covered with various finishing materials.
The first kind is the oldest and the most rustic, typical on mountains with a heavy structure but with big limits about the dimensions of rooms and the different shape that the building may have, because of the length of the usable axes or trunks. The other kind have in common the finishes versatility that makes them more similar to the traditional building made with other materials.
The second, the third and the fourth type have in common the versatility of finishing which makes them more similar to traditional constructions made with other material.
The timber frame is the favorite kind by builders because it is possible to adopt an important design freedom and architectural solutions. The Panel House enables a huge design simplicity and maybe just a little advantage in terms of building costs and time. This is more standardized penalizing design and

personalization. Analyzing and comparing wooden houses building systems, there is a table in which there are all the needs and requirements according to the UNI laws to define the building and the systems involved (environmental and technological). In the table, there are just the most important requirements and the main features of wooden houses according to climate conditions of Mediterranean climate areas.
This analysis showed that, about safety, the building systems have a good attitude to keep unchanged the supporting functions of the structural elements, according to external climate conditions with a small curve for x-lam system that evaluating the dissipative capacity and thanks to the Structural Factor q0, it is less strong than others are.



Tab.1: Building Systems Respond To The Performance Requirements In Mediterranean Climate Areas' Scheme

FIRMS' COMPARISON - COMPULSORY REQUIREMENTS				
BUILDING ELEMENT EXTERNAL WALL	**BUILDING SYSTEM__Platform Frame**			
FEATURES	**Firm A**	**Firm B**	**Firm C**	**Firm D**
Transmittance (W/mq.K)	0,14	0,16	0,14	0,13
Shift	---	12 h	13 h	14 h
Thickness	31 cm.	31,4 cm.	29 cm.	27/34,6 cm.
Structural material	White or red spruce	Scandinavian pine	---	Conifer
Material	Hardwood	Plywood	Hardwood	Plywood
Vapor Barrier	yes	yes	no	yes
Cover	Wood conglomerate - Masonite	OSB Panel (oriented strand board)	OSB Panel (oriented strand board)	OSB Panel (oriented strand board)
Waterproofing	yes	no	no	no
Internal Insulation	Wooden fibre	Wood wool	Wooden fibre or mineral wool	Wood wool
External Insulation	Various materials	Wood wool + Magnesite	Wooden fibre or mineral wool	Rock wool or cork
Anchors to the foundations	Steel brackets	Steel threaded boards or pressure plugs	---	Steel threded boards and chemical resin or through pressure plugs
Earthquake resistance	yes	yes	yes	yes

Tab. 2 Firms' comparison about compulsory requirements' when building external walls

FIRMS' COMPARISON - COMPULSORY REQUIREMENTS				
BUILDING ELEMENT	**BUILDING SYSTEM_Platform Frame**			
ROOF COVER				
FEATURES	**Firm A**	**Firm B**	**Firm C**	**Firm D**
Transmittance (W/mq.K)	---	0,17	0,16	0,20
Shift	---	5 h	13 h	11,4 h
Thickness	25,2 cm.	28 cm.	22 cm.	20,5/27 cm.
Structural material	Spruce	Spruce		Conifer
Material	Hardwood	Plywood	Hardwood	Plywood
Vapor Barrier	yes	yes	no	yes
Cover	Fireproof plasterboard	OSB panel (oriented strand board)	OSB panel (oriented strand board)	OSB panel (oriented strand board)
Waterproofing	Slated Sheath	Slated Sheath	Grip cloth	Slated Sheath
Insulation	Mineral wool	Polystyrene XPS	Wooden fibre or mineral wool	Rock wool or wooden fibre
Anchors to the walls	Steel plate	---	---	---
Ventilated roof	no	yes	yes	yes

Tab. 3 Firms' comparison about compulsory requirements' when building a roof cover

The thermal-hygrometric requirements underline less favorable results for the Block House system. This system is made up of a unique wooden block, where a good external insulation is not allowed unlike other systems that have multilayer walls created to improve the performance. Also for managing, in terms of economy, the Block House system is the result of having low performance features for the Mediterranean climate.
For this building system that, as already written before, hasn't got a good insulation, heat dispersions are greater than other building systems and also for the control of thermal inertia, it has a lower performance than other systems and so more energy is needed for heating, but also for cooling.
To compare some important firms there are some table to show some building elements features that can be found in the datasheets about compulsory requirements provided by the firms themselves.
The considered building elements are the external walls and the roof because these elements are the border between internal and external and so thanks to the analyses it is possible to understand the building behaviour, according to the Mediterranean climate.
The most important data are the transmittance, the shift and the thickness. Comparing these data is useful to understand if there is a direct relationship among them. In fact, the cover thickness varies from 22cm to 28cm and the transmittance values are quite the same for every firm while the shift varies a lot. For covers, the shift is from 5 hours minimum to 13 hours maximum. This data is very important for the Mediterranean climate because in these areas the law impose a 12 hours shift to grant internal wellness and an energy consumption saving. From the tables, it is clear that the firms use different materials for the buildings, covers and insulation without a significant variation of the compulsory requirements.
The result consists of prefabricated wooden house that can be a good alternative to the traditional buildings also in Mediterranean climate areas but nothing has to be left to chance. The first thing to do is a careful design for the technological solution integration to grant an environmental all-year comfort.
For this reason, it is necessary to balance as best as possible the winter and summer condition. Therefore, the energy design is essential to have comfort not only in winter, but also in summer. [7]

Bibliographical References

[1] CAMPIOLI, Andrea, GIURDANELLA, Valeria, LAVAGNA Monica. Energia per costruire, energia per abitare. In: Costruire in laterizio, n. 134/2011, p. 60-65

[2] CANNAVIELLO Monica, VIOLANO Antonella. *Certificazione e qualità energetica degli edifici*. Milano: Franco Angeli Ed., 2012

[3] CAROLA, Fabrizio. *Vivendo, pensando, facendo…memorie di un architetto.*Napoli: Intra MoeniaPublisher, 2004. 203-204

[4] CRAWFORD, Robert H.*Life Cycle Assessment in the Built Environment*. London: Taylor and Francis, 2011

[5] REED Bill. The Integrative Design Guide to Green Building: Redefining the Practice of Sustainability. New Jersey: John Wiley&Sons Ed., 2009

[6] Web: http://knowtransfer.unitn.it/4/edilizia-sostenibile-e-costruzioni-legno

[7] Web: http://www.technowood.it/15-blog/130-progettazione-una-casa-in-legno-per-clima-mediterraneo

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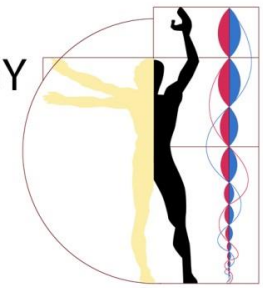

Innovative fence systems as best practice for the sustainable construction site

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Abstract
Urban construction sites can be considered real temporary architectures. They often persist for a long time and have significant impact on the surrounding environment, however, they remain usually in the background compared to the finished work, since they constitute a "transition" phase.
Many experiences since the early Nineties, highlighted how the construction site should be investigated not only for technical issues. In part, it becomes an opportunity in order to valorize the affected space, to make citizens stakeholders of the transformation, and to convert discomfort conditions into positive effects.
This paper pointes out some results of a research aimed to highlight, through the comparison of international and national experiences, how the fence system of a construction site, conceived as an abstract and material border between old and new, present and future, safe and unsafe, as the passage place of material flows, people, languages and information, becomes, in the contemporary urban reality, also an ideal place to experiment new design methodologies and strategies.
Therefore, the contribution aims to define, with respect to these analysis categories, and through the best practice examination (ecological, transparent, energy active, interactive, media and art fences), design solutions which best resize the conflict between the costs and opportunities generated by the urban transformation plants.

Keywords: sustainable construction site, fence, innovation, urban landscape, transformation

1. Introduction
From the city to the neighborhood, until the individual housing unit, the research for quality of spaces passes through multifocal reading of users needs that verify through fruition, the coherence between goals achieved and that ones expected by the actors of the planning.
Urban planning strategies, local actions, planning of open and confined spaces, up to the detail of technological components, are the tools by which are realized the decisions that aim at sustainability, in the three dimensions of social equity, environmental protection and economic-functional efficiency.
The recourse to calculation models more or less complex and simulation and evaluation instruments to support decisions of the designer in every phase of development, from the meta-design one, to the construction site and management, ensures, or appears to ensure, the control of the transformation process of the built environment.
However, within the whole building process, the implementation phase of the construction site has never been completely reworked from the environmental and social perspective.
Therefore, research has investigated the logics of planning of construction equipment on a urban scale, identifying, according to the scope of intervention, actions, dynamics and potential goals of quality development in "environment, energy, function, perception and management "of urban landscape, made possible thanks to a new approach to the construction site and its frontier. The construction site areas are mostly experienced by the community as a sort of injury in the city, a change of sceneries that may result in discomfort and lack of confidence of inhabitants, instead of a temporary presence and essential opportunity for the transformation and modernization of the urban environment. It is considered, therefore, a priority to dedicate particular attention to the integration of construction sites in the urban and environmental surrounding reality.

This research contribution provides, starting from the origin of the expression "construction site event", an analysis of the different types of confinement devices of construction site areas in the urban sector. It focuses in particular the attention on the spread, to which we are witnessing in the last years, of innovative fences installations, able to provide added value to the transformation area and to qualify the surrounding urban space.

2. The phenomenon of "construction sites event" in the urban cultural landscape: the French model

Nowadays, more and more frequently in relation to occasions of great relevance, we hear about "building sites event". Maria Cristina Venanzi in occasion of the Olympic Turin case, provides a definition about it: *"that one of construction site event is a term commonly used today by the experts to describe a communication activity that accompanies a construction site in an inhabited area throughout its life, with the aim of containing the discomforts caused by the works and of counterbalancing them with a positive contribution in terms of citizens participation. An activity that allows to marry the public interest with the interests of businesses and customers: the involvement of citizens, in fact, provides an opportunity of knowledge, it encourages a sense of belonging to the places, it educates to the urban maintenance, it prevents or mitigates the conflicts, it facilitates a regular working execution".*

The construction site event, in summary is a strategic response to several questions:

- How can construction sites be perceived by the community not as a source of discomfort, but as a positive process of renovation of spaces?
- How can the construction site be a connecting bridge between the "before" and "after"?
- How to take advantage of the duration, often long-lived, of construction sites as a useful period to forge a relationship with the citizens reinforcing the sense of re-appropriation and that one of identity?

The origin of the concept of "construction site event" dates back to the first trial occurred in France in 1994, by an intuition of Gianfranco Dioguardi, owner of the construction company, with the aim to heal the wound that the construction site would have created in the urban structure.

The occasion to develop this business philosophy has been the construction of an underground car park under the historic Piazza dei Celestini in Lyon (Céléstins chantier èvènement). It's an important construction site and particularly impactful, which could have had not a few negative effects on the environmental surrounding, but that, because of the originality and creativity with which it was organised, became itself a milestone in the affirmation of the Dioguardi building company in France.

The accompanying plan, implemented throughout the duration of works, was designed to counterbalance the discomforts resulting from the construction site operations, developing participation initiatives to facilitate relationships with merchants and resident inhabitants. This plan can be summarised in the following phases:

- identification of the graphic identity (through preparation of a logo and related applications);
- creation of partnerships with prestigious institutions;
- realisation of a newsletter;
- creation of multimedia supports;
- monitoring and reporting environmental conditions of the construction site area;
- preparation of a space for installations related to the advancement of works;
- realisation of a school-construction site with a route in job-formation for unemployed young people;
- organisation of events and contact with media.

The construction site, in this way, is integrated with the city through a set of initiatives focused mainly on three key words:

- information, to explain to the users what and how was being made;
- education, to involve children, through design labs, theatrical construction and animation;
- formation, to initiate to the working world some unemployed young people through a school-construction site.

Following the same structure of the French model, on the first event site of Lyon, several experiences of this kind took place in France and then in Germany, as in Stuttgart with the project called "Baustelle-Marketing", with the aim of eliminate, from the numerous construction sites in the city, at least for a day, technical cartels only destined to insiders giving the opportunity to citizens to benefit from a non-uncomfortable environment. In our Country, however, the most significant experiences were developed by the Municipalities of Turin,

Milan and Rome, that have used this technique achieving very encouraging results. The first experience took place in Turin in 1997 with the realisation of a new complex for offices.
Therefore, the method of the "construction sites event" was born, initially as an instrument to relate the construction site with the surrounding area and at the same time to promote the image of the enterprise, and then it's revealed with the time also a very useful tool to forge a consensus on urban operations in progress, to build strategic alliances with institutional partners and to reinforce enterprise culture.
Under the name of "construction site event" is meant to group, so, those types of interventions that constitute exceptional events for the city. The restoration of historical buildings (such as La Scala in Milan, the Trevi Fountain and the Colosseum in Rome), requalification interventions (such as the Cloud project for the redevelopment of the Aurora Quartier in Turin), interventions of new constructions (among the most recent the Olympic cities of Turin and London), the requalification of disused areas, the recovery of production complexes, are all examples of "construction site events" whose importance and representativeness are not limited only to the narrow area of the neighbourhood but have a significant relief in the city.
Without limits to creativity, for several urban construction sites, to valorise the particular moment of transformation, there is the establishment of observation points (the so-called "windows on the construction site"), organisation of guided tours (either real or virtual), decorative and informative treatment of fences, setting up of websites and exhibition spaces, until the organisation of real events around and inside the construction site, in compatibility with safety requirements. This type of activities, developed for the valorisation and the communication of construction site, are becoming increasingly common. They found a growing success in the communities hosting these initiatives. This was evidenced by the strong increase in demands for activities in this area.
In the case of this kind of actions the fence of the construction site, generally, is the element that communicates separation and discomfort between what is inside and what is outside. To use the confinement devices to valorise and explain the construction site, to create information points along the perimeter of the fences, and installations to promote the operations of transformation, represents a very efficient way to involve and inform the local population and the potential users of the changes in progress.
To encourage communication and participation actions, both during the project and during the implementation, as in the case of the urban construction sites of a certain level works, improves comprehension and acceptability of the intervention and helps to strengthen the social capital.
The construction site, therefore, must be considered also as a moment of knowledge and development of the area. When communication is managed properly and efficiently the results represent a very significant added value capable of mitigate the conflicts that in many cases the construction of new architectural interventions generates. In particular, great metropolises such as London, Berlin and Hong Kong (about which several examples will be examined), offer daily examples of construction sites fences innovative and unique, able to mitigate the impact of the transformation on urban spaces of fruition.
This is why the adoption of the method of the "construction sites event" should provide the condition for an appropriate urban transformation, innovative but also ordinarily applicable.

3. The passage of the flows through the border construction site

The delimitation of the construction site, as an ideal element and border material between the old and the new, the existing and the future, the safe and the unsafe, as a place of material flows, goods, people, transformations, information, languages, in today's urban condition becomes even the ideal object of incubation of a planning and experimental methodology. In particular, the fence can act the role of technological "smart" element able to mitigate negative impacts and transform the construction site into a good of positive utility.
The fence of the construction site, traditionally, is the confinement system of the construction site’s area, having the function of regulating access to the working areas and protecting employees and third parties against risks resulting from interferences between the activities taking place in the area inside and around the construction site. The fence, however, does not respond only to these functions, it is the device through which occurs the passage of different kinds of flows. Thanks to the studies carried out it has been possible to define several macro categories of flows that ordinarily cross a traditional fence, comparing them with those that cross a smart fence. (MELCHIORRE, 2014)
By analyzing the typological and technological characteristics of traditional fences, which are the most used in any type of construction site, and composed basically of three kinds of technological elements (ref. NORM UNI 8290:1981), such as vertical structure, basic structure and closures, it's shown that regardless of the

degree of permeability and introspection, dimensions, materials of partition and connection systems, the flows passing through are different from those affecting an innovative fence.
It has been possible, therefore, to identify five macro categories and related subcategories of flows running through a traditional fence, comparing them with those concerning, instead, a smart fence. (Tab. 1 e Tab. 2).

Macro-categories	Flows type				
	Matter	***People***	***Resources***	***Information***	***Languages***
Sub-categories	- Materials - Transport means	- Direct users (workers)	- Renewable energy;	- On the work to be realized (table construction site)	- Verbal

Tab. 1: Typologies of flows Traditional fence

Macro-categories	Flows type				
	Matter	***People***	***Resources***	***Information***	***Languages***
Sub-categories	- Materials - Transport means	- Direct users (workers) - Indirect users - Potential users.	-Renewable energy; - No renewable energy; - Water; -Vegetation	- On the work to be realized (table construction site) - On the site; - Environ mental information; - Advertising; - Tourism info	- Verbal - Non verbal (acoustic, visual, tactile, olfactory)

Tab. 2: Typologies of flows Smart fence

According to the different categories of flows, and to the interaction that they have with the border element of the construction site, they have been identified three typologies of flow-construction site interaction. These interactions can be identified according to the passage through the fence, full, partial or zero, on input or output of flows referring to the area of the construction site (Fig. 1):
- Typology A (external Interactions): they are those interactions that occur when flows interact with the border without crossing it, neither input nor output, as happens, for example, for the indirect users or also for the flows of information, which remain located on the border.
- Typology B (input flows): These are those flows running through in input the border of the construction site, from outside to inside, as in the case of materials or means of transport, but also for different types of users, such as direct users (insiders), or even potential users (tourists), which can go directly within the transformation area, when it is permitted.
- Typology C (Output flows): These are the flows that cross the fence from the inside to the outside of the construction site. As it occurs for material flows (materials and means of transport), to direct and potential users, or even for the flows of information on the site, that from the inside of the construction site can be spread in output to the surrounding urban context.

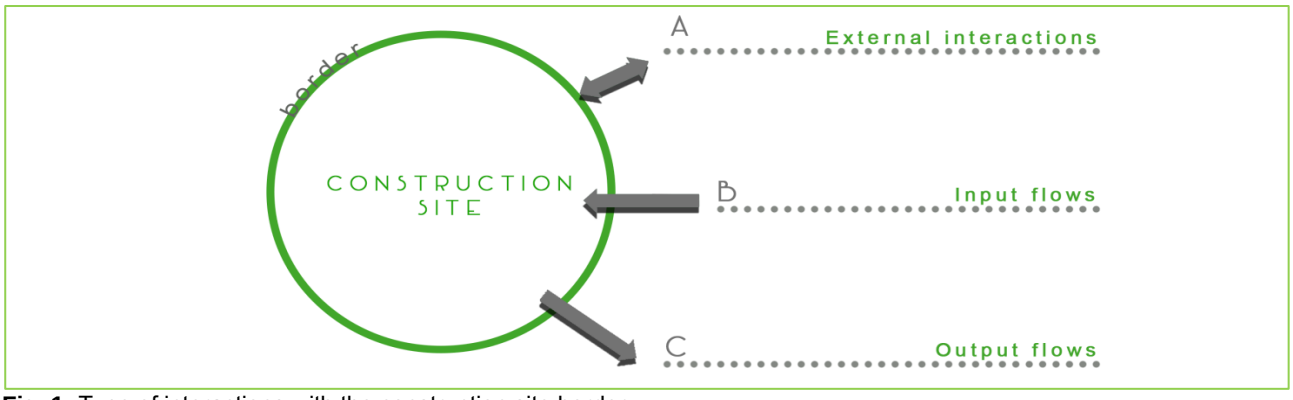

Fig. 1: Type of interactions with the construction site border

Sub-categories of flows	Flows-frontier Interactions			
	FLOWS	***A***	***B***	***C***
Matter	Material			
	Transport means			
People	Direct users			
	Indirect users			
	Potential users			
Resources	Renewable energy			
	No renewable energy			
	Water			
	Vegetation			
Information	On the work to realize			
	On the site			
	Environmental info			
	Advertising			
	Tourism info			
Languages	Verbal			
	Non verbal (acoustic, visual, tactile, olfactory)			

Tab. 3: Flows-frontier Interactions

4. Innovative fence systems: best practices

Conscious to move in a universe full of innovative ideas, only realized projects were selected, trying to give a reading in terms of "positive effects" of using these particular new generation screenings, able to trigger active processes of participation, integration and communication in the urban environment.
The increasing attention of the actors of planning even to the implementation phase of the building process, especially in urban contexts of particular value, has contributed to the spread in the territory of different types of innovative fences, conceived and designed ad hoc in relation to both construction site area itself and to the work to be carried out, and taking into account the inscription of this "temporary architecture" in the context. The research work carried out led to the identification of certain types of fences realized both at a national and international level, of which a few best practices are provided. In particular, these systems have been grouped into five main categories: ecological (green), interactive, transparent, art and advertising fences.

4.1 Green screens: where the lives intersects in the city

Nature always prevails on architecture and buildings, taking slowly the right redemption on the human work. Just think about wild plants, regardless sprouting in dry stone walls, they penetrate into the gaps of the asphalt or into the frames of windows. The plant walls or green façades, fascination of romantic architects, botanical hazard or decorative virtuosity, have by now become an integral part of the architectural artefact. The naturalization of steel skeletons, facades of buildings, multilevel parking areas, and even the temporary fencing of construction sites, of which is emblematic the "Green Screen" project by Klein Dytham, are all expressions of the endless figurative, morphological and poetic possibilities that natural element can play within the architectural project.
The so-called "green screen", used for the installation of the vertical walls of the construction site fences, are so, temporary walls covered by vegetation, whose use is aimed to hide building interventions that are invasive and of high impact for the urban context hosting them. The adoption of this particular type of fence provides to the surrounding environment, not only an aesthetic benefit, by improving the view of the urban landscape, but also adds all the other typical benefits of vegetation: reduction of air pollution, dust reduction, better thermal regulation and also a good sound insulation. It's in this way that the fence of the construction site by simple separation element becomes a multifunctional element.
Green Screen is a living shielding, of a length of 274 meters, realized in 2003 in the town of Omotosando in Tokyo. The project of the fence, a work by Klein Dytham Architect, was built to hide the works of a very considerable sized construction site by Tadao Ando. (Fig. 2)

The fence is scanned in vertical bands of different widths, alternating with 13 different kinds of evergreen plants and panels with graphic patterns that reflect the same theme of green. In this way, the users, rather than suffer the inconveniences due to the presence of the construction site, can instead enjoy the refreshing green offered by the wall, almost as if they are walking in a park. Because of the originality of this system, the project won the award “Best Environment Award” in 2004 in the ID Magazine annual competition of design.



Fig. 2: Green Green Screen by Klein Dytham Architect_ Tokyo

4.2 Digital screens: the interest of the city for the interaction

The spread of information and interactive technologies in the contemporary city, and the implications that these have on everyday life, represent topics of great interest in design, both at an architectural and at a urban scale, embracing both public and private sectors.

The research has shown that, because of the interactive capabilities offered by these systems, we are witnessing to the exponential spread, in large urban areas, of construction site’s dynamic and interactive fences.

On the confining walls are, in fact, more and more frequently installed Wi-Fi technologies, multimedia sensors, LED screens, aimed to offer to the users who interact with them a multi-sensorial experience. In addition, in this way, the shielding becomes a tool for information exchange.

Making a reference to this typology, the work of research has led to the selection and analysis of some cases of study, which are characterized by their singularity; among them are mentioned *the iFly Virgin Wonderwall* realised in Tokyo in 2000, the *Song Board of London*, the *Walking Men 99* whose installations have been built in several cities (such as New York, Sydney, Perm, Israel), and the *WeCantiere* created in Florence.

The last one is a digital, innovative and sustainable construction site. Mentana Square, which is the place that hosts the construction site for the renovation of the historic building of the Chamber of Commerce of Florence from 2013, is characterised by a fence consisting of 140 meters of panels, marked by images of the history of the Chamber of Commerce, the eldest one in Italy (1770) and LED lights to make attractive and acceptable a construction site in the downtown of Florence, which will be extended until 2016, and with which 7,000 square meters will be recovered.

While, within the working area, they are operating to give birth to the new home of enterprises, outside, it’s possible to live the area of Mentana Square in a so unusual and challenging way. These are the characteristics of the first *WeCantiere* project in Italy. The event goal was to involve in the works residents, visitors and tourists, thanks to LED lights with proximity sensors, green materials, Wi-Fi satellite free access, web portal with the history of the ancient arts and the progresses of works. In the portal, in addition to the telling of the history, is possible to follow the evolution of works; reconstructions of how it will be the new office and the photo gallery of the excavations. The web space relates the construction site with network and social networks by using QRcodes present on the system of protective panelling of the construction site. Through the QRcodes, the camera of smartphones and tablets decodes tags to access to the web portal, offering a multimedia integrative and multilingual experience. A project that gave birth to a place where culture, information and emotions can be exchanged and shared. (Fig. 3)



Fig. 3: WeCantiere_ Piazza Mentana Firenze

4.3 Transparent screens: take a look at what's to come

Another innovative typology of fence is the so called transparent one, adopted to make visible to the users the entire construction process, resulting in a sort of window on the construction site. An example of this typology is the "Diary" project realized in Japan by the SOUP DESIGN Team. It is a wall entirely consisting of glass cases, inside of which are reported separately recycling materials used for the construction, and are provided in an exhaustive way information on the type and quantity of materials used. In this way the fence performs in an intelligent and original way the function of informing about what is happening in the construction process. (Fig. 4)

Another example of transparent fence is offered, at a national level, from the restoration site of the Trevi Fountain in Rome, which is still in a state of work in progress. The fence was built with transparent panels, and, on the prospect of the fountain, works have been arranged in phases: from the central prospect, to switch to the two sides. After a month from the opening of the construction site they have been registered over 250 thousand tourists and Roman citizens attracted by the particular system adopted, that allows, for the first time, to get into the construction site and to see the fountain from a completely new perspective.

With such measures they obtained the opposite effect to what the traders and locals feared would have happened with the opening of the construction site: instead of a decrease in the flow of users visiting the historic fountain there has even been an increase of tourists, confirming it as a winning strategy adopted by the designers.



Fig. 4: "DIARY" Making The Process Of Construction Transparent by SOUP DESIGN and constructors TAISEI DESIGN_ Ginza TOKYO

4.4 Fences of communication: art and advertising

Less innovative but among the most popular for a long time, are the fences of construction site used as support for advertising inserts, or for illustrations and artistic integrations. In this way, the fence itself becomes an artwork, which qualifies the affected area and is itself a source of attraction for the users. From the research, it was also found out that another strategy often used for the fences is to make available to the street artists, such as the writers, the closing panels as support to realise their own artworks on the spot. An example of this type of initiative is provided by the construction site for the renovation of Paone Palace in L'Aquila. In this case, to make less dark the coverage of the construction site, the owners of Paone Tatozzi Palace, the first private building in the historic centre to start the reconstruction works, have decided to commit to some young writers the decoration of the particle boards that divide the scaffolding from the street. The realisation of the murals was a real extemporaneous artistic event, which involved young urban artists from all over Italy. (Fig. 5)

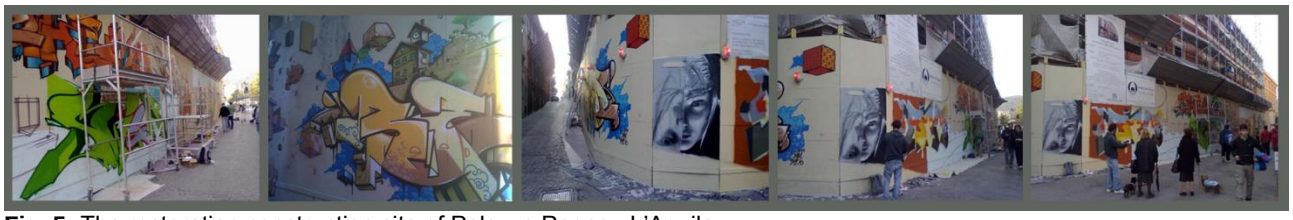

Fig. 5: The restoration construction site of Palazzo Paone_ L'Aquila

5. Conclusions

Who said that a construction site is the blackout of a monument, a historic building, a square, a street, or area in general?

Is it unavoidable that the opening of a construction or infrastructural site commences a moment to be forgotten, hidden and deleted of the city's history?
Of course, the construction site is made of noise, disorder, dust. It involves discomforts and new problems for urban living, but if skilfully managed it can become far from being a simple set of noisy and dirty ruins, materials, equipment and scaffolding.
As part of the transformation of urban space, with particular attention to the theme of sustainable construction site, is therefore clear the need of change in operating practices.
To understand that change and formulate new hypotheses of intervention may be appropriate a comparison between the previous implementing techniques and the experimentation of new applicative methodologies.
The construction site does not have to be seen as a closed object, separated, whose raison of being is purely technical, but as a moment of transformation, an instrument of culture, communication, valorisation and participation.
According to this approach, the user/spectator becomes conscious of the transformation of the built environment in which he daily lives and, in this way, the city, as Hub resources concentrator, gains from its transformation the added value of a real and also perceived sustainability, at long-term.

Bibliographical References

[1] LA DELFA, Salvatore, CANTONE, Fernanda. *The architecture of the site. Characters and strategies for operation on the building*. Roma: Gangemi Editore, 2012.

[2] BARDELLI, Pier Giovanni, COPPO, Secondino. *Il cantiere edile. Prassi, innovazione, esperienze.* Palermo: Dario Flaccovio Editore, 2010. ISBN 8857900134, 9788857900131.

[3] FRANCHINO, Rossella, RINALDI, Sergio, VIOLANO, Antonella. *Innovative methods for the sustainable construction site*. In XXXII IAHS World Congress, Sustainability of the Housing project. Trento, 21-25 settembre 2004. ISBN 88-8443-071-2

[4] VIOLANO, Antonella*. Sustainable building site: indicators to manage the transformation*. In: International Journal of "Housing Policies and Urban Economics" (HoPUE) n° 1-2014. ISSN 2385-1031, 2385-0671.

[5] FRANCHINO, Rossella, RINALDI, Sergio, VIOLANO, Antonella. Il cantiere edilizio sostenibile. In: Il Progetto Sostenibile - Ricerca e tecnologie per l'ambiente costruito, Edicom edizioni - Milano - n° 09 marzo 2006, p. 54- 63.

[6] MELCHIORRE, Lucia. *The role of fence in the sustainable construction site management*. In Proceedings: Quaesti 2014 - The 2nd Virtual Multidisciplinary Conference. Zilina, Slovakia, December 15 – 19, 2014. ISSN 1339-5572, ISBN 978-80-554-0959-7, p. 352-357.

[7] CIRAFICI, Alessandra, MELCHIORRE, Lucia, MUZZILLO, Francesca, VIOLANO, Antonella. *Public space and contemporary city: the places of transformation*. In: International Journal of "Housing Policies and Urban Economics" (HoPUE) vol. 2 n° 1- 2015.

[8] LOSASSO, Mario*. Progetto e innovazione. Nuovi scenari per la costruzione e la sostenibilità del progetto architettonico*. Napoli: Clean, 2005.

[9] DIOGUARDI, Gianfranco. *Ripensare la città*. Roma: Donzelli Editore, 2001.

[10] VIJAYAN, Abhilash, KUMAR, Ashok. *A Review of Tools to Asses the Sustainability in Building Construction*, Wiley Interscience, 2005.

[11] SCLAVI, Marianella, ROMANO, Iolanda, GUERCIO, Sergio, PILLON, Andrea, ROBIGLIO, Matteo, TOUSSAINT, Isabelle. *Avventure Urbane. Progettare la città con gli abitanti*. Milano: Elèuthera, 2014. ISBN 9788896904633.

[12] MARTINA, Anna. *Comunicare la città. Il caso di Torino olimpica.* Torino: Bruno Mondadori Editore, 2006. ISBN 88-424-2001-8.

[13] http://www.avventuraurbana.it

[14] http://www.cantieredicomunicazione.com

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The Basilica of Santa Restituta in Naples. Towards an information and interactive model.

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Abstract
Has recently started a research aimed at the creation of an hypertextual information model on the Basilica of Santa Restituta in Naples Cathedral. It is one of the few Christian buildings still exist in the historical fabric of the city of Naples, which is, as is known, a millennial documentary palimpsest. The research aims at the creation of a hypertextual information model that will allow a virtual tour of the exceptional monument.
The last systematic studies on the Basilica date back to the 70s of the last century, in an extensive program of restoration of the Cathedral, the results of which were published to its conclusion.
The research - which we present the first results - has been inspired by an acquisition of data from a wide and significant iconographic and bibliographic research as well as from a survey made with technologies and advanced procedures and it identifies its first application in the Chapel of St. Mary of the Principle.

Keywords: Santa Restituta, survey, hypertextual model

1. Introduction
The old town of Naples is an historical-documentary palimpsest of extreme interest for the important evidence of millenary stratification that it preserves. Among them, great attention should be payed to those of the early Christian era that, despite the many changes that occurred over several centuries, are still recognizable in the churches of *S. Giorgio Maggiore* (with the nave truncated for the enlargement of *via Duomo* in the nineteenth century), *S. Giovanni Maggiore* (next to *via Mezzocannone*), *S. Maria di Pietrasanta* (in *via Tribunali*) and, especially, in the *Basilica of Santa Restituta* included in the fourteenth-century cathedral with the adjacent Baptistery of *S. Giovanni in Fontes*.
Recently was started a research aimed at the development of an hypertextual information model useful to virtual tour of the *Basilica of Santa Restituta*. This chance has been very useful to allow new investigations for the knowledge of this unique monument. The last systematic studies on the Basilica date back to the 70s of last century and have been conducted in an extensive program of restoration of the Naples Cathedral of which *Santa Restituta* is, nowadays, the equivalent of one of the chapels overlooking the main nave. Among the main results of this restoration will signal the roof refurbishment of the apse that led to the creation of new structures to supporting the false vault of the apsidal basin and a contextual and meaningful campaign of archaeological investigations directed especially to the area under the current floor of the basilica. The results of those jobs - which were designed and directed by prof. eng. Roberto Di Stefano - were regularly published at its conclusion [1] and allowed to set up an important museum of the monument. Current research - which we present the first results - started with a preliminary literature search and iconography as well as from a survey carried out with advanced technologies and procedures. Although developed systematically throughout the Basilica, we anticipate, in this communication, some results for the Oratory of *S. Maria del Principio*.

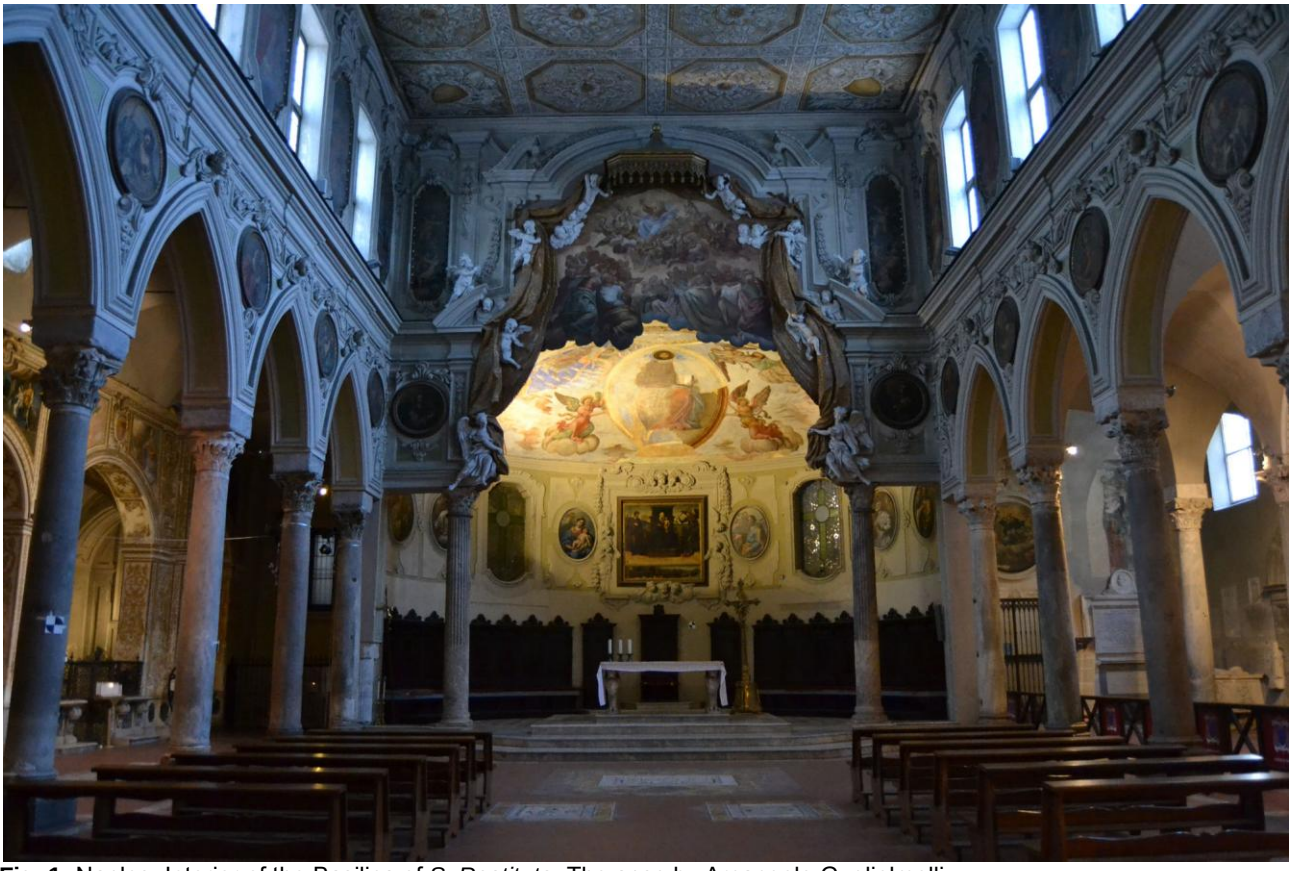

Fig. 1: Naples. Interior of the Basilica of *S. Restituta*. The apse by Arcangelo Guglielmelli.

2. The Basilica of Santa Restituta

The *Basilica of Santa Restituta* consisted originally, like the other Constantinian basilicas, into five naves with an apse that concluded the main nave. In the middle ages, the Basilica was included, for half of its original development, in the new construction of the cathedral; so, to reduce the substantial height difference between the new cathedral, floor was raised - with an extensive coverage - so that the gap was reduced to a few steps. Thanks to the orthogonal directions of the planimetric installations of the two churches, the reduction of the ancient Basilica occurred so that its counter is constituted by a part of the left outer wall of the new Cathedral; leaning to it there is the choir - modified in the seventeenth century by Arcangelo Guglielmelli who also designed a new structure in the apse (Fig. 1) - where you can also see traces of previous artistic representations. As a result of the elevation of the floor the height of the columns (the foundations of which were incorporated in the filling) was reduced and they were equipped with new fake bases; so that at the end of the fourteenth -century transformations was modified their relationship with pointed arches and their proportion to height. During restoration of the 70s of the last century and the activity of archaeological restoration, were brought to light the ancient bases that are currently visible through glass plates positioned in the floor near some columns.

Among the changes suffered over time by the Basilica one that has mainly affected the spatial perception is certainly the one that involved the transformation in chapels of the outer naves. As a result, today the Basilica has three naves, of which the central culminating in the apse and the two sides lined with chapels and ending in a smaller apse. At the end of the right nave there is the access to the Baptistery of *S. Giovanni in Fontes*, whose floor is at original height and, therefore, lower compared to the present Basilica floor. In the left nave, the last three modules are grouped in the Oratory dedicated to *S. Maria del Principio* (Figs. 2-3).

3. Survey activities

Throughout the Basilica survey activities were carried out through the use of laser scanner Leica C10 and HDS3000. First was prepared a draft sensing digital faithfully carried out for the purpose, after several site inspections useful to examine the conditions of light (natural and artificial) and the practicality of the spaces for the best positioning of the instruments. For the metric control of the cloud unions resulting from successive scans there were acquired numerous direct measurements and also have been used a lot of two-dimensional white/black targets. The use of targets allowed to facilitate the activities of union of point clouds and ensure better control of the final result. Each scan was in fact done so that you could always see at least three targets referable to the next and previous scans. The overall activity was facilitated by the limited size of the architectonical place and by the possibility to directly measure many elements perfectly recognizable

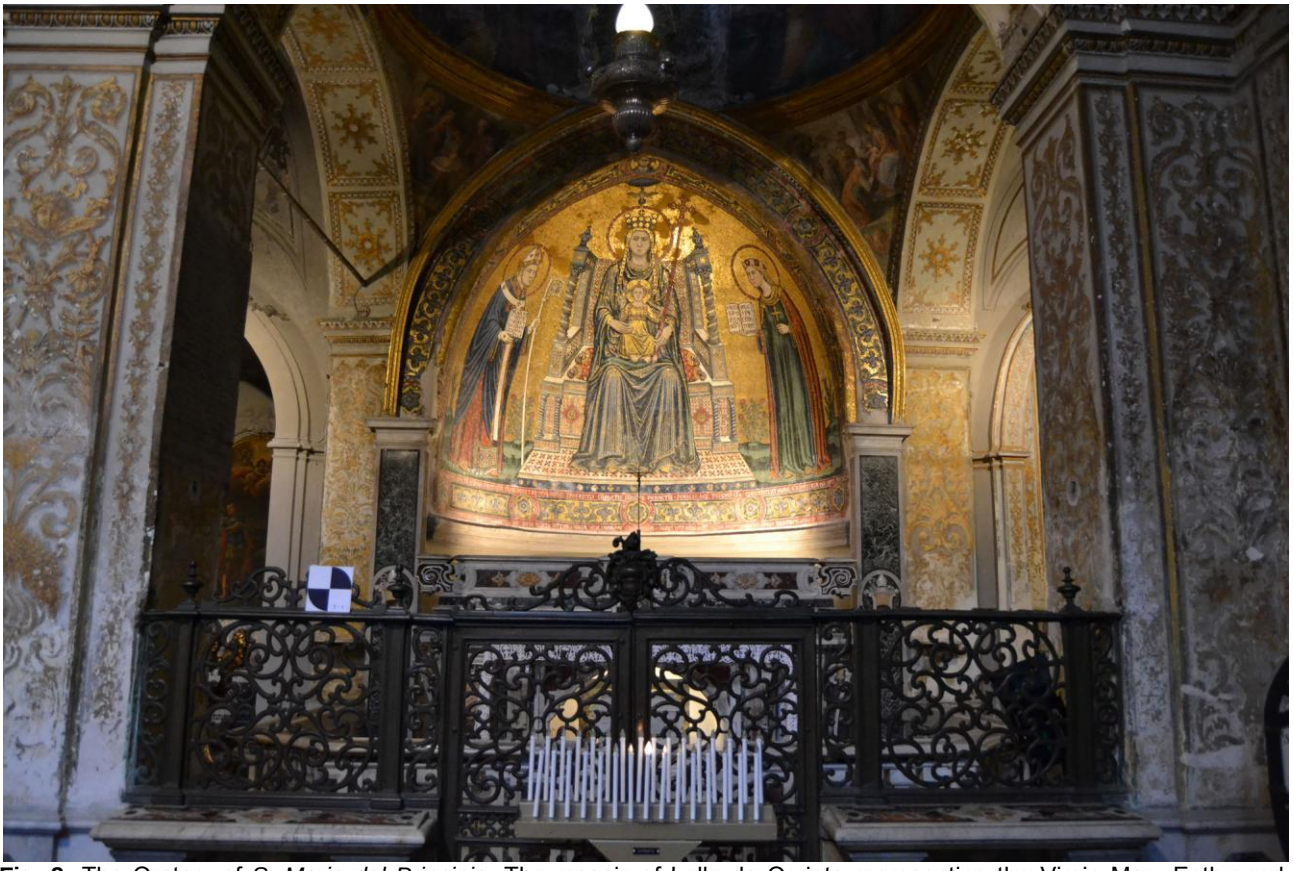

Fig. 2: The Oratory of *S. Maria del Principio*. The mosaic of Lello da Orvieto representing the Virgin Mary Enthroned between St. Gennaro and S. Restituta, 1322



Fig. 3: The Oratory of *S. Maria del Principio*. The side wings.

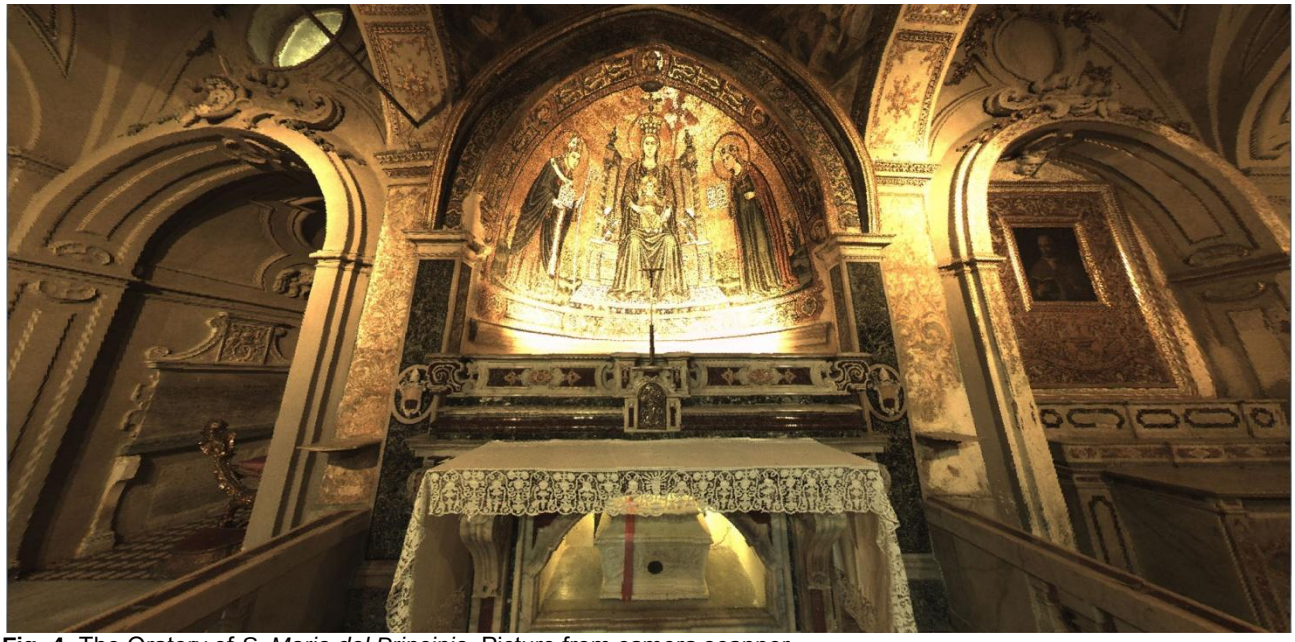

Fig. 4: The Oratory of *S. Maria del Principio*. Picture from camera scanner.

in laser scans. Scanning activity was accompanied by a constant photographic documentation, done either with the integrated camera scanner (Fig. 4) with both external camera so you can rely on high-quality images. The field work also reflected in timely registration in a specific "diary". Survey activity of the Oratory of *S. Maria del Principio* was addressed to the documentation of both the place as a whole and some of its peculiar elements. The Oratory, which is a palimpsest of memories of various kinds, is one of the most interesting examples of fourteenth century transformations. Tradition says that it is built on the first Neapolitan place of worship dedicated to the Virgin Mary, hence the name. Currently it is made up of three parts together to form a whole, of which the central presents in the apse the rich mosaic of Lello da Orvieto of 1322 with the Virgin Mary Enthroned between St. Gennaro and S. Restituta. On the side walls are hanging two plutei (Fig. 5) of the thirteenth century of extraordinary interest, placed at the beginning of the eighteenth century.



Fig. 5: The Oratory of *S. Maria del Principio*. Pluteus with The Story of Joseph and His Brethren.

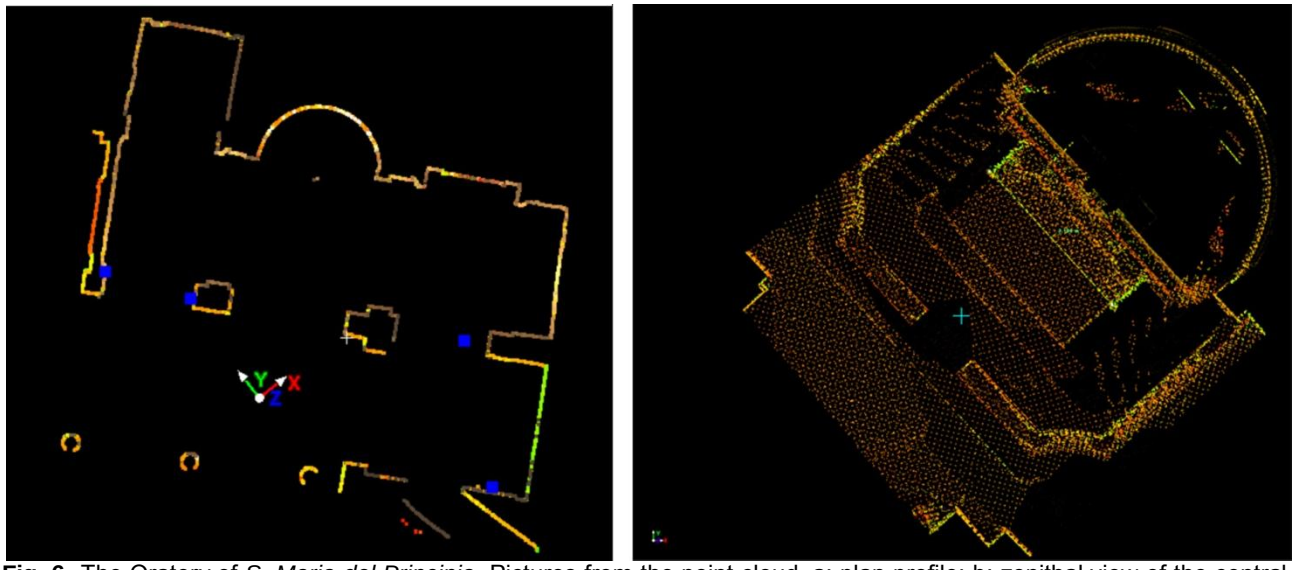

Fig. 6: The Oratory of *S. Maria del Principio*. Pictures from the point cloud. a: plan profile; b: zenithal view of the central chapel.

4. Post-processing activities

Post-processing activities began with the analysis and cleaning of individual scans in order of their union. From the union of point clouds are derived the plan (in various elaborations: the profile and the zenithal view of the whole and partial, Figs. 6a, b) and the section (Fig. 7). A special processing involved the two plutei applied to the vertical walls of the Oratory. Here it shows the case of the left pluteus - depicting scenes of "The Story of Joseph and His Brethren" narrated in the Book of Genesis - for which was made a specific meshing of the cloud (Fig. 8) for the purpose of comparison with its photographic documentation. The comparison between the two images allows you to appreciate the wide field of investigation related to the use of laser scanning. Are ongoing processing modeling and connection with the information apparatus hypertext.

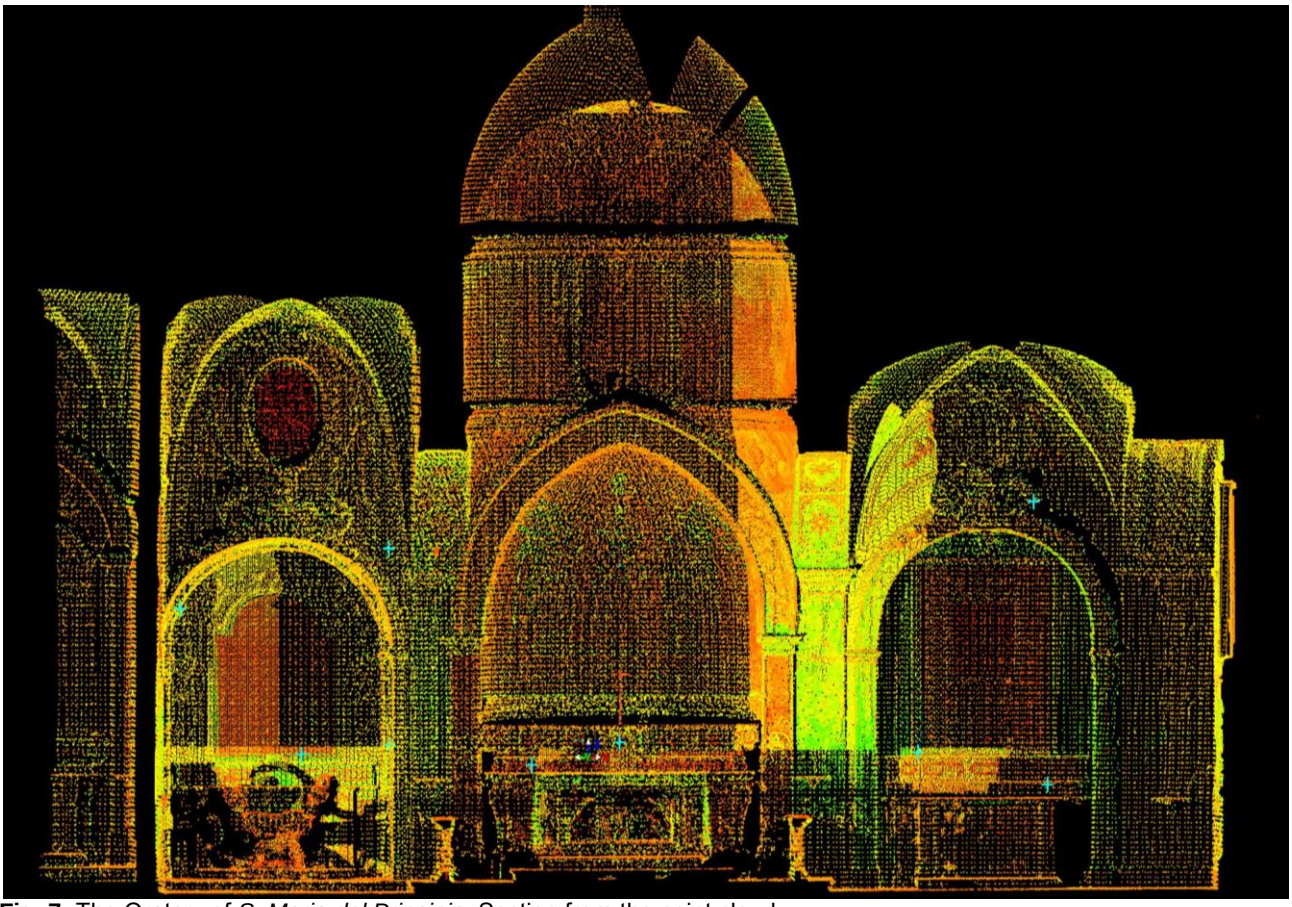

Fig. 7: The Oratory of *S. Maria del Principio*. Section from the point cloud.



Fig. 8: The Oratory of *S. Maria del Principio*. The left pluteus, picture from camera scanner.

Sections 1 and 2 are by G.C.Cundari; section 3 is by G.M. Bagordo; section 4 is by M.R. Cundari.
Although the responsibilities of the individual sections, the authors want to emphasize how this paper - such as conducting the research - is the result of their full and constant cooperation.
The research program is carried out, with the coordination of Cesare Cundari, by architects Giovanni Maria Bagordo, Gian Carlo Cundari and Maria Rosaria Cundari; the activities of data acquisition was also attended by eng. Giuseppe Antuono, the arch. Valentina Albano and p. i. Salvatore De Stefano. In the program also participates prof. Andrea Giordano of the University of Padua.

Bibliographical References

[1] DI STEFANO, Roberto. *La Cattedrale di Napoli. Storia. Restauro. Scoperte. Ritrovamenti.* With notes for the history of the restorations by Silvana DI STEFANO. Napoli: Editoriale scientifica, 1975.

[2] DOVERE, Ugo. *La Basilica di Santa Restituta*. Milano: Ed. 24ORE Cultura, 2010.

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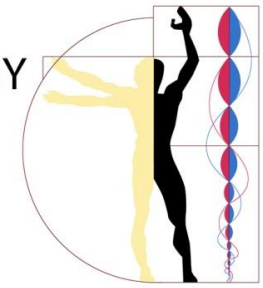

Multisensory Visiting Experience in Immersive Virtual Reality Environment

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Abstract
In a visiting experience at a cultural site too often the visual stimulus highly prevails over the other sensory stimuli. This statement is even truer talking about archaeological areas, where non-visual stimuli are only left to the tourist's imagination.
By focusing on the influence that the auditory stimulus may play on every individual subject, a multisensory visiting experience at an archeological site in an immersive virtual reality environment is presented in this study. In particular, the paper discuss on an integrated virtual reconstruction of a site in the archaeological area of Pompeii, the *Teatro Grande*. The environment has been modeled as it appears now, after a recent renovation in 2010; the scene has been integrated with auditory information that really take into account the site's acoustic signature, that is the acoustic information set associated with that specific place.

Keywords: Ancient theatres, immersive virtual reality, multisensory visiting; acoustics

1. Introduction
Inside museums and archaeological sites several aspects may influence the quality of the visit experienced by the visitors. The main aspects are cultural (e.g. type, number and historical relevance of attractions), physical (e.g. geometry of spaces, layout, lighting) and of management (e.g. fruition and promotion of a cultural asset, arrangement of cultural attractions, scheduling, grouping and paths of visitors). Taking into account that for a cultural site, and particularly for archaeological ones, the main goal is a successful communication of historical information, the way through which the visitor experiences the cultural asset may play a fundamental role.
In the last decade, with the widespread of interactive systems, more and more museums have added to the traditional fruition systems (e.g. textual cartels, audio guides) a large number of multimedia contents to enrich the experience of a cultural asset. This choice might increase the budgets of museum activities, drawing the attention of a wider and more diversified audience, promoting the knowledge of archaeological heritage [1].
Among the innovative systems of fruition, the immersive virtual reality (IVR) represents one of the most effective. In fact, with this tool it is possible to simulate complex environments in multisensory mode, by means of visual reconstructions (actual/past; static/animated), acoustic simulations or other physic stimuli (temperature, humidity, smell) with an high sense of being there. Moreover, several studies have been conducted on the effectiveness of this tool applied to the reconstruction and the fruition of environments [2].
The ancient theatres show particular inclination to multisensory fruition's systems. In facts, such places are not just majestic or small architectural structures, but rather places created in order to allow artistic performances, with specific acoustic requirements. These requirements were investigated by several authors by means of three-dimensional models able to characterize the acoustic quality and understand the physic phenomena occurring in the different parts of the theatre [3-7].
Starting from former studies on the site's acoustic characteristics [3], a multisensory visiting experience at the *Teatro Grande* of Pompeii, has been carried out by means of an IVR simulation.

2. Methodology

2.1 Graphic modelling

The implementation of the virtual scenario has been structured into several phases. Firstly, the information about the current state of the site has been retrieved. Through site visits and literature researches [8], it has been possible to carry out an analysis on the theatre's main characteristics. Information about the materials have been collected in situ too; by means of a careful photographic collection a textures database for graphic model has been created. Afterwards, the information collected in situ have been integrated with the plan surveys and the sections found in bibliography [8].
Starting from the 3D model (Fig.2) used in a previous study [3], a more detailed model has been revised by means of a 3D modelling software. The photographic dataset was processed using an image editor and a texture library has been obtained for a correct model mapping. Eventually, the entire model was mapped in the various details. At the end, the entire model was imported into the Virtual Reality software for managing simultaneously: the virtual interactions, the visual and acoustic elements and events. Moreover, to enhance the realism of the scene, at the general graphic, lighting and reflection effects were introduced. Additionally, avatars sitting on the stands and representing the audience have been also added to the scene, and on the stage a theatrical performance has been staged. In order to achieve a result as realistic as possible, the avatars have been animated independently each of others.



Fig. 1: View of the *Teatro Grande* of Pompeii (actual state)

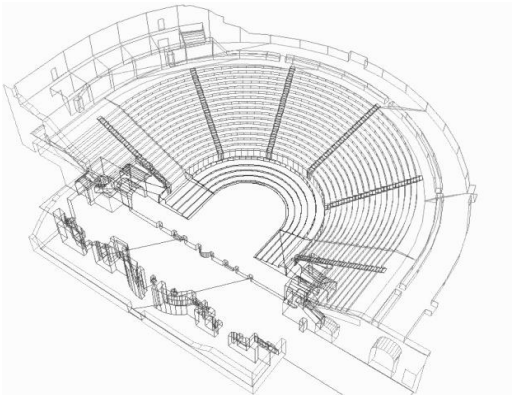

Fig. 2: 3D model

2.2 Acoustic modeling

In order to reproduce the specific set of acoustic information related to the *Teatro Grande*, the main acoustic parameters have been evaluated by means of the acoustic modeling software Odeon, taking into account the geometric characteristics and the materials of the theatre. Starting from a previous study [3] in which the variations of the *Teatro Grande* acoustic parameters in different historical periods were evaluated, a new data processing has been carried out in order to identify the values of

the main acoustic parameters, according to the positions of the receivers in the environment. In particular, a sound source was positioned on the orchestra and ten different receiver points were distributed homogeneously on the *media cavea* (Fig.3).

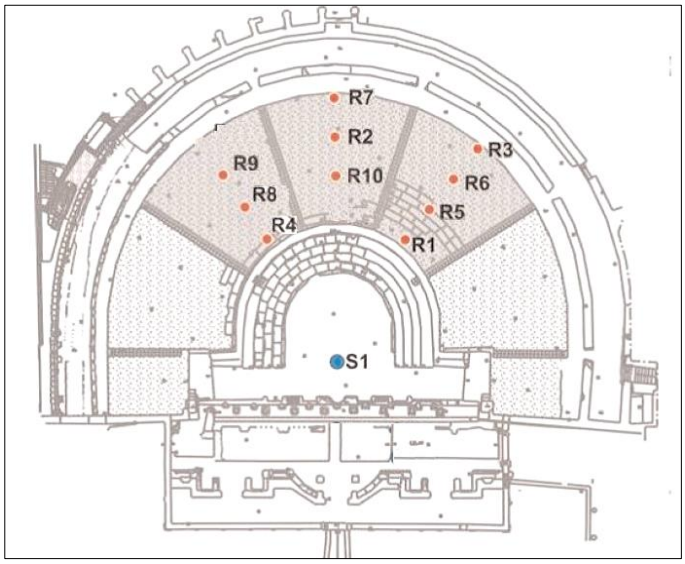

Fig. 3: Source-receivers scheme.

In the following figures, the main acoustic parameters, as the T_{30}, C_{80}, D_{50} and SPL values, for each receiver point and octave band are shown.

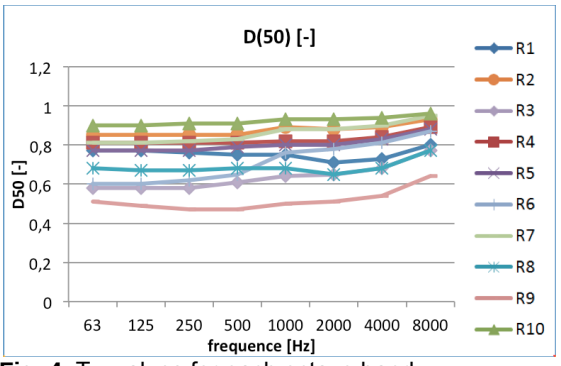

Fig. 4: T_{30} values for each octave band.

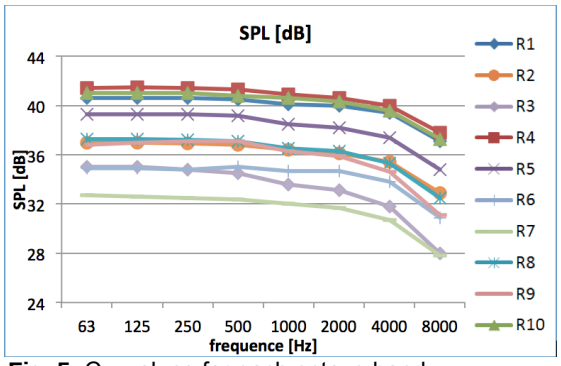

Fig. 5: C_{80} values for each octave band.

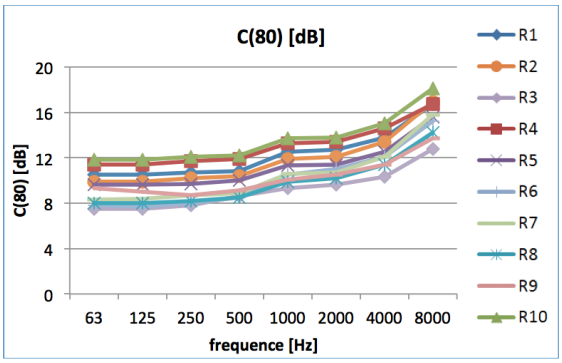

Fig. 6: D_{50} values for each octave band.

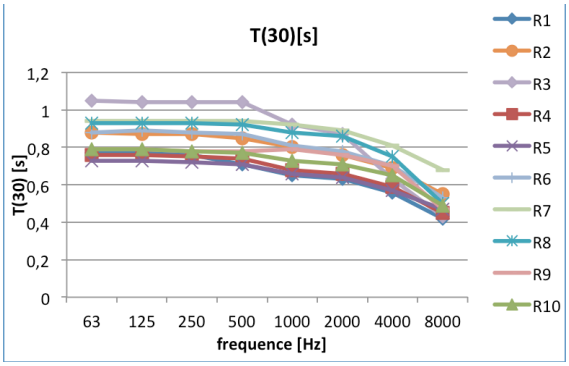

Fig. 7: SPL values for each octave band.

The next step consisted in the evaluation of the binaural room impulse responses (BRIR) between the source and receiver's positions within the theatre.

For three out of the ten receivers, where the tourist will experience the visit, the corresponding BRIRs have been calculated. This data-set represents the starting point that will allow to recreate the auditory stimulus during the visit at the archaeological site. In fact with the convolution of any anechoic audio signal with the BRIR, it is possible to generate a binaural output signal that includes all the physical effects (e.g. spreading, air absorption) and the interactions which occurred to the anechoic signal during the propagation path (reverberation, scattering, HRTF).
In order to provide a spatialized sound, at least on the horizontal plane of the head, in Odeon, 72 fake sound sources were located on a circumference of 1 m around the receiver (5° steps), as reported in figure 8. With the receiver's gaze pointed toward each of the 72 fake sound sources and with the source S as the only active source, 72 different BRIRs have been calculated. These binaural signals were then implemented in the Virtual Reality software. Furthermore, a specific routine in Python, able to active for each head orientation the corresponding binaural audio signal, was created.
In this way the listener will be free to rotate his head and to explore the theatre, perceiving all the acoustic information coherently with his position and gaze.

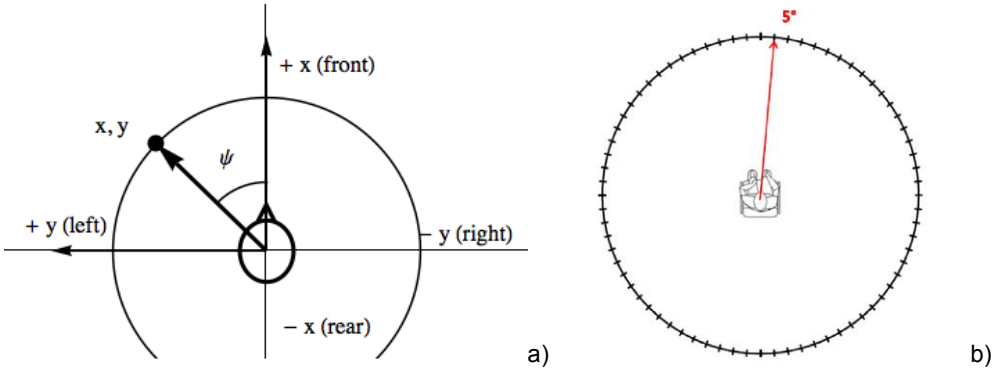

Fig. 8- a) Scheme of the head orientation related to a generic sound source: the sound source is located in the horizontal plane at the (x,y) position; the angle ψ represents the shift between the line of vision of the listener (front) and the sound source direction. b) Scheme of the set of the 72 audio signals

2.3 System Settings

The setting of the system for the virtual exploration can take place in different ways: fully immersive, by means of a head-mounted display or inside a CAVE (Cave Automatic Virtual Environment), or it can simply be explored by desktop. A possible configuration of the tool was carried out in the anechoic chamber of the Built Environmental Control Laboratory of the Second University of Naples. The chamber is a cube with side dimension of 5m. It was equipped with a workstation and the virtual scenarios were presented through a IVR system implemented with the eMagin Z800 3D Visor (Fig.9). The visor presented stereoscopic images at 800×600 resolution, refreshed at 60 Hz. Graphical and audio contents were managed using the software WorldViz 4.0. The audio signal was reproduced by means of headphones. The system was calibrated, in order to reproduce correctly the auditory conditions at the listener's ear. Head's movement (orientation and position) were tracked using the 6 d.o.f. motion tracking system Polhemus Patriot.

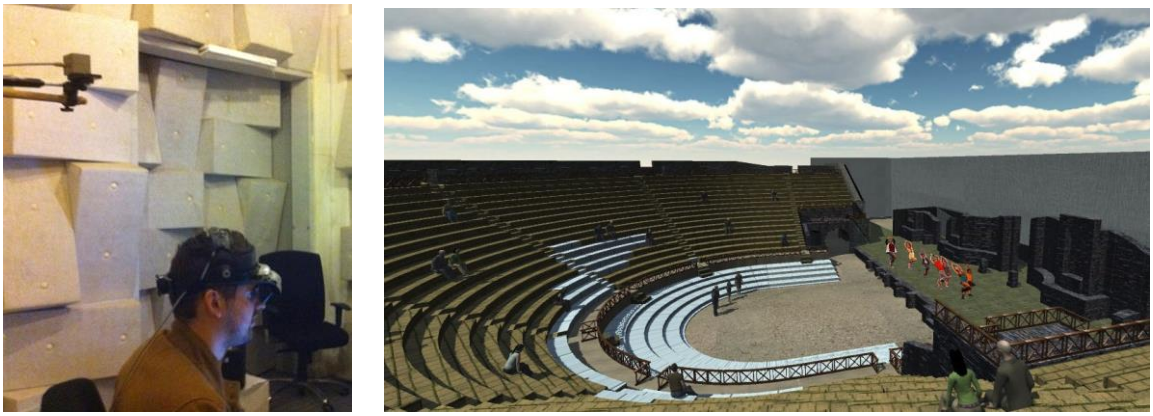

Fig. 9- A tester during the multisensory visiting experience of the *Teatro Grande*

When the scenario started, the participant was projected in the virtual *Teatro Grande*, completely immersed in the environment and located on the *cavea*. Therefore, in the simulation the subject was in the role of a spectator during the course of an entertaining event.

3. Discussion

In order to promote the site and to make it more attractive, multisensory visits can be implemented in several ways for the fruition of archaeological areas or museums. Multisensory visits could be experienced directly on site, in the real site or in virtual rooms, besides could be uploaded on online platforms, in order to allow a remote immersive experience.
For ancient theatres, where the auditory stimuli are essential for a better understanding of the archaeological site, besides a reliable visual reconstruction of the theatres, an accurate acoustic simulation may create a unique experience for the visitor, able to fully transport him back in time.

References

[1] Goulding C. 2000. The museum environment and the visitor experience. European Journal of Marketing, vol. 34, n. 3-4, 2000, p. 261-278.
[2] Maffei L., Masullo M., Pascale A., Ruggiero G., Puyana V.. 2015. On the Validity of Immersive Virtual Reality as tool for multisensory evaluation of urban spaces. 6th International Building Physics Conference, Torino, 2015. (In press)
[3] Iannace G., Trematerra A., Masullo M. The Large Theatre of Pompeii: Acoustic Evolution. Building Acoustics, vol. 20, n. 3, 2013, p. 215–227.
[4] Iannace G., Maffei L., Masullo M. 2011. La riscoperta del teatro antico: il teatro romano di Benevento. Rivista Italiana di Acustica, vol. 35, n. 4, p. 53–58.
[5] Iannace, G., & Mazzoni, S. 2014. Vicende storiche e ricostruzione virtuale dell'acustica del theatrum tectum (o odeo) di Pompei. Dionysus ex machina V (159-179).
[6] Alfano D'Ambrosio F.R., Iannace G., Ianniello C., Ianniello E. "Velaria" in ancient roman theatres: can they have an acoustic role? Proc. 49th AiCARR International Conference, Rome, 2014.
[7] Iannace G., Trematerra A. The rediscovery of Benevento Roman Theatre Acoustics. Journal of Cultural Heritage, vol. 15, 2013, p. 698–703.
[8] De Vos A., De Vos M., Pompei, Ercolano, Stabia. Casa editrice Giuseppe Laterza & figli. Roma, 2014.

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Consolidation with reinforced concrete for the ecclesiastical architecture in l'Aquila (Italy): observations after the earthquake

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Abstract
The work aims to describe the experience of three representative churches, the Churches of St.Maria del Carmine, St.Agostino and the Basilica of St.Bernardino, placed in the historical centre of L'Aquila before and after the 2009 earthquake. In fact, all of them were destroyed, for the first time, during the 1703 earthquake, and then they underwent several restorations including the last one around 1920, which was carried out by using reinforced concrete, up until the great earthquake in 2009. The target is to investigate the influence of interventions in reinforced concrete carried out in the second half of the 20th century, in relation to the spread of the damage produced by the earthquake. In Italy, during that period, the use of r. c. technology developed also in the ecclesiastical architecture. The reluctance was mainly due to the difficulty in covering the interventions with a blanket of plaster and decorations, in order to make them unseen. Consequently, after the 2009 earthquake, the engineers, who had to work in emergency, without having time to examine the historical and architectural features of the buildings, were unprepared to tackle the post-earthquake consolidation. Sometimes, these interventions, aimed at improving the earthquake resistant measures of buildings, proved to be a failure, since they eventually produced collapses and became the cause of the most important damages in the post-earthquake works. In this sense, it is important to intend vulnerability as a function of these new consolidation techniques.

Keywords: ecclesiastical architecture, reinforced concrete, earthquake, vulnerability

1. The use of reinforced concrete in the Church of St. Maria del Carmine, St. Agostino and the Basilica of St. Bernardino and related Seismic Analysis [1]
In Italy, the introduction of the reinforced concrete took place together with the phenomenon of industrial expansion. In fact, it was in the last years of the nineteenth century that the market began requiring big-sized buildings. Thanks to its main features, namely good behavior in the presence of fire, it was appreciated for many advantages: among these there are the monolithic feature of the building and thus also its global static safety, the possibility of realizing complex shapes, the remarkable resistance to moisture, especially helpful for the foundations, the hygienic peculiarity of the structure and a presumed cheapness, for certain typologies. In addition, this new technique had the advantages of simplifying the execution compared to the traditional construction. From these considerations, it seems to emerge also an economic benefit from the use of this new construction technique [2]. Later, the reinforced concrete began to be used in the consolidation of the ecclesiastical architecture. The question is of great interest, above in the seismic zone. In fact, the box-shaped and linear construction that the reinforced concrete had allowed to the new structures built in that time, was considered a too poor architectural form for the ecclesiastical architecture. So, in the churches, almost always the use of such material was hidden with stucco decorations. In this way the engineer called in for the emergency was ever in front of an unexpected situation. In addition to this, from the structural point of view, the performed consolidation interventions have had almost never a positive effect, due to the difference between the stiffness, the weight and the composition of the two material that have to be combined: masonry and reinforced concrete. The restoration of the three churches below described , as can be seen, employed the new technology with no clear effects: sometimes, in fact, these interventions, aimed at improving the earthquake resistant measures of buildings, proved to be a failure, eventually producing collapses and became the cause of the most important damages in the post-earthquake works.

The seismic behavior of a Church can be examined through different methods of analysis. The ones considered in this work are essentially three: the method of macro-elements, characterized by a structural response substantially independent from the one of the whole church (facade, room, apse, side walls, principal arch, etc..), and the different ways of damages could be synthesized in a fundamental number of failure mechanisms [3-4]; the method of finite elements referred to a medium scale of observation i.e. the single element and its specific joints with the others that can be commutated into forces and displacements; evaluation of levels of vulnerability through sheets of risk edited by technicians [5].

1.1 Case study: the Church of St. Maria del Carmine

The church was built inside the second circuit of L'Aquila walls, in the late thirteenth century. The façade, in the lower part dates from the fifteenth century, while the upper part and the interior have been added after the earthquake of 1703. In 1637, the body of the thirteenth century was enlarged by adding a polygonal chancel. The interior has a single aisle with lateral arches that define three fake chapels on each side, with a non-structural barrel vault. The cover is made of wood.

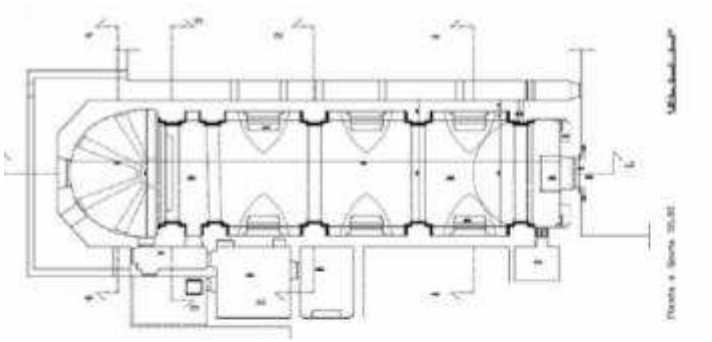


Fig. 1: Church of St. Maria del Carmine, L'Aquila (Italy), horizontal section.

The masonry analyzed is of three types: rough-hewn stone ashlar; squared stone ashlar; mix of brick / stone. enlargement of the 17th century and characterizes the upper part of the longitudinal walls and the apse. In a document dated 1924 by the *Sovraintendenza all'Arte Medievale e Moderna degli Abruzzi e Molise*, one can read that ... *because of the earthquakes that have affected the area*, the church needed a series of works to be performed, such as:

- Buttresses to reinforce the south wall of the church, which had been seriously threatened by the earthquake: In particular, they consisted of conjunction bridles connected with the adjacent wall of the building owned by the monastery, used to reinforce the existing ones with brick arches. In total 7 buttresses of reinforced concrete;
- ..... recovery and compensation of the failures in the vault and in the arches of the aisle;
- .... demolition of the lowered vault that supports the floor of the organ and of the parapet. Its reconstruction by means of plastered clay tiles in sight supported by double 12 cm-long T beams and above a floor in concrete tiles. The beams will be supported by an armed beam anchored to the north-south walls, consisting by two double 16 cm-long T beams of... an hollow brick parapet will protrude on this armed beam;
- 2 chains, one from south to north and one other at the level of the organ floor;
- general overhaul of the roof.

Almost all the interventions described were carried out in the period from 1924 till1974, with the addition of a curb in r. c. as crowning on the outer walls of the church [3,6]. The damage of the 2009 earthquake consists in an initial overturn of the façade, of the entrance portal and the stone cladding connected to it, of the apse and of the triumphal arch. The hammering produced by the reinforced concrete wall connecting with the adjacent building has resulted in failures to the lateral south wall, to the material attached to the pillars, and the break of external buttresses.

1.1.1 Damage and Vulnerability Analysis for the Church of St. Maria Del Carmine

From the analysis of the collected data, it is possible to argue that the macro-elements affected by the damage are the facade, the aisle, the lateral walls, the triumphal arch and the apse. The detected elements of vulnerability can be summarized as follows [3,6]:

- poor quality walls, lacking of diatones and cross connections;
- lack of links between the orthogonal walls;
- lack of links between the reinforced concrete curbs of the apse, and of the aisle;
- presence of connecting rigid elements (r.c. bridles);
- localized discontinuities (masonry textures from different eras, closure of old openings).

The pattern below shows the mechanisms activated with the indication, for each of them, of the level of vulnerability and damage. A summary of the main garrisons and of the vulnerability indicators for activated mechanism with the corresponding effectiveness is also shown [3].

MECHANISM	DESCRIPTION	DETECTED ANTI SEISMIC PRESIDIA	EFFECTIVENESS OF THE PRESIDIA	DETECTED VULNERABILITY	GRAVITY OF VULNERABILITY	DAMAGE	VULNERABILITY
M2	top of the facade	none	1	absence of link between orthogonal walls	2	serious	medium-high
				presence of rigid curbs	1		
M5	transverse response of the aisle	external buttresses	1	walls with high slenderness	2	serious	medium-high
		bodies adjoining outbuildings	1				
				arches	1		
		transversal chains	2				
				bridles of connection in r.c.	2		
M17	slide in the apse	light curbs	1	presence of large openings (possibly buffered)	2	moderate	medium
		chains	2				
M25	interactions in proximity of irregularity plane - elevation	presence of connection bridles in r.c.	2	high difference of slenderness between two adjoining bodies	2	serious	medium-high
				concentrated actions transmitted by the connection element (bridles)	3		

Fig. 2: Table I

Therefore, the presence of connection r.c. bridle in the macro-element M5, also because of its actions and the resulting difference in stiffness between the two adjacent buildings in the macro- M25, can be considered as an indicator of vulnerability on the one hand. While, on the other hand, the same presence of the bridle in M25 is included among the main earthquake-proof elements. In M5, one can observe that the bridles of

conjunction with the building to the south as well as the lack of joining between the two masonries of the longitudinal walls, made in different periods, caused mainly local damages, with a peak of maximum damage in the first two pillars of the aisle. These, affected by large vertical and diagonal lesions, suffered a lateral instability induced also by the slenderness (> 10)
In M25 the detachment of the outer wall from the longitudinal arches of the nave, together with widespread lesions visible in the parts framed by the arches, is due to the hammering caused by the r.c. bridles of conjunction with the former convent. The local punching effect produced by the concentrated actions transmitted by the bridles are also visible outside in the obvious out of plumb of the walls connected to them and in the breaking of vertical buttresses corresponding to the areas of greater detachment of the outer wall.
Similarly, the rigid curb of the macro-element M2 is considered as an element of vulnerability, while the presence of curbs in the macro-element M17 (although in conjunction with iron chains), is listed among the principal earthquake-proof that mitigate the sliding mechanisms in the apse. In fact, in M2 the summit r.c. curb with double inclination is an indicator of vulnerability, because it is a too heavy curb in relation to the thickness of the wall below (about 0.48 m). Nevertheless, its presence has partially hindered the tipping mechanism, while the arcuate lesions below the curb are due to local discontinuities.

1.1.2 Concluding remarks about Santa Maria Del Carmine
The structural analysis of the Church of Santa Maria del Carmine has highlighted a number of flaws but also hidden strengths. The negative element is definitely the poor quality of the masonry texture from the seventeenth century. Except the coating consisting in squared stone on the bottom of the facade, the church has two different typology of masonry. The oldest one, which is present in the lower part of the facade and of the outer longitudinal walls of the nave, and the most recent one, placed at the top of the facade and of the longitudinal walls, and in the whole apse. The texture of the ancient masonry, the so-called archaic unit of L'Aquila, is clearly visible from the outside, in the area that separates the Church from the former convent, which is now the headquarters of the Guardia di Finanza. Indeed, it is characterized by a medium-sized ashlar with summarily flattened faces, and by deformed and irregular brick courses, laid with plenty of mortar. On the contrary, on the external faces, the seventeenth-century masonry is made up of stone aggregates in small and squat form, only vaguely squared in some areas, while accurately squared in others, with fragments of bricks used to regularize the mortar beds and fill in the blanks. Inside the body of the masonry, the blocks are even more irregular in size and shape, and, from what it is possible to observe in correspondence of some fractures, completely missing the elements of the cross-connection between the paraments. This absence caused conspicuous swellings of the masonry in the apse, with partial expulsion of blocks, which can be seen in correspondence of some lesions. The so made masonry tends to detach very easily near the cantonal or near the junction nodes between the different elements of the structure. The building was also completed in several phases, during which the lack of interventions aimed to a structural link between the "new" and the "previous" is revealed. This negative aspect, which somehow complicates the recovery of the whole masonry unity, however has had also a positive effect. Indeed, the damage has not affected the whole structure, but only specific areas.

1.2 Case study: the Church of St. Agostino
The Church of St. Augustine was rebuilt after the earthquake of 1703 starting from a design made by Giovan Battista Contini, one of Bernini's pupils. It consists of a large central atrium of elliptical shape, apse and bell tower. The covers are made of wood, except for the lantern, which was replaced in the eighties with a metallic one, attached to underlying structures through a reinforced concrete curb. The earthquake led to the collapse of the lantern and serious lesions to the dome / drum / lantern system, to the body of the apse / presbytery, to the belfry, as well as the beginning of an overturning of the facade. Due to the elliptical shape, the dynamic response of the building to the stress caused by the earthquake developed along the longitudinal axis of the building body. The main elements of vulnerability detected are the mass of the dome, the pushing elements as the arches of the presbytery and apse, the asymmetric shape of the bell tower, the new cover of the lantern. The realization of the church in a single construction phase, the good quality of the masonry, the presence of effective contrast elements and the wooden elements, however, are components of the garrison.

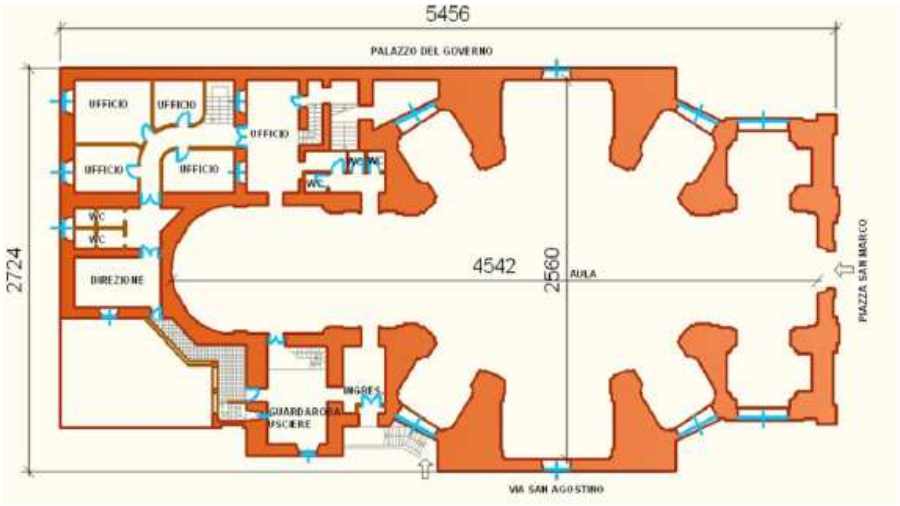


Fig. 3: Church of St. Agostino, L'Aquila (Italy), horizontal section.

The prevalence of this response compared to the cross ones seems to be motivated by two main factors: the longitudinal direction is that in which there is the major pushing by the dome (major axis); in the transverse direction more effective contrast elements are presents (very rigid buttresses, chains, etc.). The collapse of the lantern and the serious damage in the tower and belfry have proper peculiarities. The collapse of the lantern, in particular, may have been caused by the movement of the underlying dome and by the presence of the new metallic cover with rigid curb in reinforced concrete. The damage of the bell cell seems mainly attributable to a phenomenon of torsion resulting from its irregular shape, and to the presence of asymmetric constraints [1,7].

1.2.1 Damage and Vulnerability Analysis for the Church of St. Agostino

The case study presented here regards the seismic analysis of St. Agostino's Church in L'Aquila (profoundly damaged by the earthquake occurred in April 2009), by taking into account the in depth knowledge of the factory by following the three evaluation levels of seismic safety provided by the Italian seismic Guidelines for Cultural Heritage [4,11]. In particular, for LV1 (Level of Evaluation 1) all the analyses requested to fill the annexes of the Directive of December 10, 2007 were carried out, starting from the Module A, which is the "identifier registry", passing through the Module B, which concerns the study of "sensitivity factors" and ending with Module C, which considers the "morphology of the elements". From this examination, we concluded that the ground acceleration during the earthquake of April 6th 2009 exceeded the value of acceleration corresponding to the collapse limit. For LV2 (Level of Evaluation 2), we focused especially on the verification of all the macro-elements as a potential source of damage mechanisms. In particular, we found that the occurred mechanisms mostly concerned the facade, the aisle, the dome, the apse/presbytery, the roofing, the side chapels, the joints between horizontal and vertical alignment, and finally, the bell tower. Once we collected all the data regarding the site - the geometry of the building, the characteristics of the materials, the structure, the soil, etc.. - we carried out a dynamic FEM modal analysis on the structure, valid for the LV3 (Level of Evaluation 3). The observed damage shows the effects of a global response of the Church mainly in the longitudinal sense [7]. In particular, the following mechanisms of damage seem all attributable to this type of response:

- the cracks on the lateral walls of the atrium, which betray an overturning of the facade (Mechanism 1);
- the damage in the dome (Mechanism 14), with the crack on the median parallel to the apse (which is a typical "uncovering" mechanism) and the diagonal cracks on the segments, particularly evident in the two diagonal slices into the atrium (where the contrasting elements are not effective as for the apse);
- the damage that denounces the overturning of the apse and the detachment of the presbytery (Mechanism 16);
- the cracks on the lateral walls and on the vaults of the apse and presbytery (Mechanisms 17 and 18);
- the cracks on the vaults of the two major chapels (Mechanism 24).

The prevalence of this response compared to the cross ones - while it is obvious - seems also to be motivated by two main factors: the longitudinal direction in which there is the major pushing by the dome (major axis); the transverse direction in which there are more effective contrast elements (very rigid buttresses, overlapping structural pieces, and chains). The collapse of the lantern and the serious damage in the tower and belfry have proper peculiarities. The collapse of the lantern, in particular, could have been caused by the movement of the underlying dome and by the new metallic cover with rigid curb in reinforced concrete. The damage of the bell cell seems mainly attributable to a phenomenon of torsion resulting from its irregular shape, and by the presence of asymmetric constraints. The Macro-element M14, i.e. the Lantern,

shows a situation in which the reinforced concrete, used for the consolidation, works instead as an element of disorder. The lantern collapsed. The metal part of the dome fell on the covers below, while the stone columns collapsed partly inside the church (through the hole) and partly on the roof, causing damage and partial collapse. The lantern was quite slender, but had no large openings: the coverage, as above-mentioned, was rebuilt in the early 80s, by using a metallic structure supporting the stone columns below by means of a reinforced concrete curb.

1.2.2 Conclusions about the "Box-Behaviour" of the St. Agostino Church post Seismic Analysis
The works intends to evaluate, from the historical and architectural point of view, the "box-behavior" of the whole structure that has been recovered according to the specific analysis for macro-elements in order to keep an harmonious unity between function, form and reinstated static aspect. The graphic and detailed study of the static elements necessary for the yard restoration, which highlights the unity of the structure after the static consolidation, is a method rarely applied in combination with the verification of macro-elements, and at the same time manageable only by an expert in both architecture and structural mechanics. The restorer architect, who has the task of coordinating the competences within the static restoration project, cannot disregard a final graphic examination, taking into account the "before and after" deriving from the application of a static and/or dynamic model. The mere application of the results of finite elements and macro-elements are inadequate and not completely suited to the reality, because separated from the aspects concerning the material which the structure consists of. Conversely, the techniques applied by Structural Mechanics to continuous body, both in the elastic and non-elastic range, do not allow a fast application in practical cases and especially in an emergency. Thus, the implementation of a method that puts together, on medium scale, i.e. on structural portion, the computational speed of FEM and macroelements methods, and the meticulousness in the characterization of the material belonging at the traditional analysis of the continuous body in the inelastic field, would seem achievable only through a careful historiographical analysis of it.

1.3 Case study: the Basilica of St. Bernardino

The works for the construction of the Basilica of St. Bernardino da Siena began in 1454. The facade is squared according to the tradition of the city, designed by Nicola Filotesio in 1525, while the magnificent baroque appearance of the interior is due to the reconstruction of Sebastiano Cipriani, Giovanni Battista Contini and Filippo Barigioni, who reused the pre-existing masonry, after the collapse of the earthquake of 1703, which had destroyed the central aisle, the dome and the drum. The monument has undergone the collapse of the belfry, strong failures in the drum of the dome, which had been rebuilt after the collapse of the fifteenth century, and other very serious failures in the apse and in the longitudinal walls. The facade is essentially undamaged.

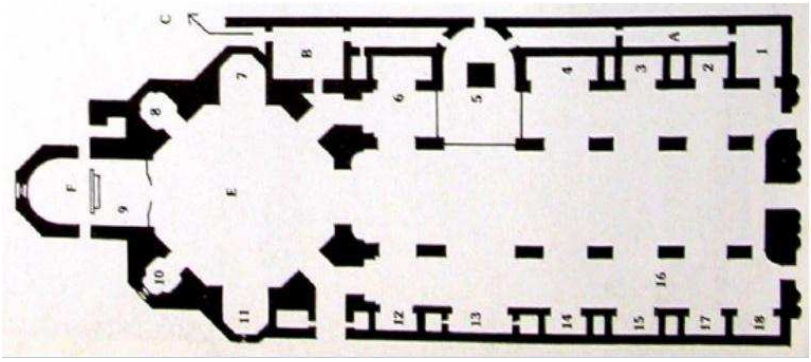


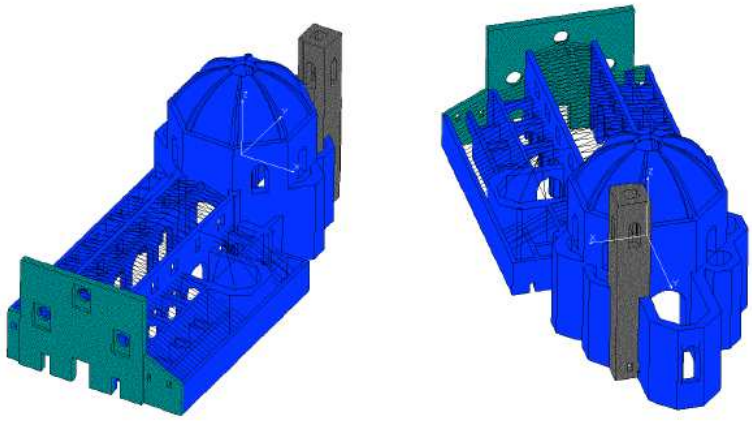
Fig. 4: Basilica of San Bernardino, L'Aquila (Italy), horizontal section.

Around 1960 a series of interventions on the Basilica were made. These interventions foresaw the use of reinforced concrete in the facade and in the bell tower. In addition, the roof of the church was entirely rebuilt by using prefabricated reinforced concrete beams, Varese type, in support of the hollow tiles in brick, with a jet of completion. The bell tower was lined with a 40 cm-thick layer of reinforced concrete up to the initial part of the belfry. The façade was completely dismantled, with proper numbering and cataloging of the blocks for the subsequent reconstruction, in order to allow the consolidation of the masonry and the insertion of a reinforced concrete structure. The casing of reinforced concrete, which continues for the entire height of the facade, consists of four vertical pillars founded on plinths developed inside and outside the Basilica. The pillars are connected transversely, as well as in the plane of the foundation and in the body of the facade, by reinforced concrete curbs. The curbs in correspondence of the gutter lines extend up to the perimeter of the

building walls, in order to create a link between the front and the rest of the Basilica. As regards the structural complexity, mainly due to the interventions of the '60s, it is necessary to identify the different construction techniques, in order to determine the mechanical characteristics for investigating the global behavior of the product.

1.3.1 Damage and Vulnerability Analysis for the Basilica of St. Bernardino

A first assessment of the structural capacity of the church can be carried out by the method introduced by Rondelet. The method is based on the relationship between the wall section and deck area [9]. The structure of the Basilica has an approximately ratio of 0,22 between the area of the masonry section and the covered area - a little lower than that of the Pantheon in Rome, which is equal to about 0,23. The calculation has been performed on the entire section of the church, even if the area of the dome, the bell tower and the chancel has higher percentages than that of the aisles. The calculated ratio is typical of the structures in which the dome is the dominant element [10,11]. Around 1960, a series of interventions on the Basilica were made. These interventions foresaw the use of reinforced concrete in the facade and in the bell tower. In addition, the roof of the church was entirely rebuilt by means of prefabricated reinforced concrete beams, Varese type, in support of hollow tiles in brick, with a jet of completion. The bell tower was lined with a 40cm-thick concrete reinforced layer up to the start share of the belfry. The façade was completely dismantled, by properly numbering and cataloging the blocks for the subsequent reconstruction, in order to allow the consolidation of the masonry and the insertion of a reinforced concrete structure. The casing of reinforced concrete, which continues for the entire height of the facade, consists of four vertical pillars founded on plinths developed inside and outside of the Basilica. The pillars are connected transversely either in the plane of the foundation or in the body of the facade by reinforced concrete curbs. The curbs in correspondence of the gutter lines extend themselves to the perimeter walls of the building, in order connect the front with the rest of the Basilica. As regards the structural complexity, mainly due to the interventions of the '60s, it is necessary to identify the different construction techniques, in order to determine the mechanical characteristics for investigating the global behavior of the product. In Figure 5 [10,11], the different mechanical properties of the materials are identified by different colours. The masonry, represented in blue, has been assigned elastic modulus of 2.0 GPa, Poisson's ratio 0.15 weight per volume unit equal to 16 kN/m3. While the bell tower, in grey, has been assigned elastic modulus equal to 2.4 GPa, Poisson ratio 0.15 and weight per unit of volume equal to16 kN/m3. Then the facade, in green, has been assigned elastic modulus of 4.0 GPa, Poisson's ratio 0.15 and weight per unit of volume equal to 16 kN/m3, and finally the roof, in black, has a modulus of elasticity assigned equal to 20.0 GPa, Poisson's ratio 0.15 weight per unit of volume equal to 30 kN/m3.



a) b)

Fig. 5: Framework of the different mechanical characteristics regarding the materials of the Basilica of San Bernardino. a) Main facade, three-dimensional view, b) Apse, axonometry.

The overall structural situation is therefore complex, and the various critical points have transformed themselves into weakness during the earthquake of April 6, 2009. As consequence of the earthquake occurred on April 6, 2009, the church of San Bernardino has suffered so heavy structural damage as to become one of the worst affected churches. The quake caused almost the total loss of the belfry, deep lesions to the dome, widespread damage to the surrounding structures. The lower part of the tower bell underwent the expulsion of the cornerstones, while the reinforced concrete part has remained intact. The dome is certainly the element mostly damaged by the earthquake, which caused an extensive crack pattern with an extremely dangerous situation at the extrados. Here, a system of damages that appears as a triangular clove, can be noticed. The crack pattern and the results of the investigation show that the damage

visible from the bottom seems to lead to a mechanism of shear failure in the longitudinal axis of the aisle, with the detachment - apparently more evident on left and less on right - of the side caps. Consequently, it seems to form an "arch" effect in the central part of the dome, adjoining the central aisle and the apse. The arch, acting as big "spur", has governed the seismic action supporting the dome, which has broken itself just where the side caps, backed by the spurs consisting of the side chapels with lower overall stiffness, have undergone the worst deformation. Finally, the support drum has undergone a series of general failures and, in particular, an extended deep crack both inside and outside the Church. In this case, it can be clearly seen the probable internal de-cohesion of the structure with loosening of the bonds between binder and masonry aggregates. Besides, there has been also a strong crack pattern in all the padding of the windows, with widespread lowering of the key bricks of the external plat bands. In addition, this situation is probably also present inside the under coatings, as it is shown by the crisis of the eardrum in the area corresponding to the detachment of the triangular element of the dome. Finally, spread cracks on the ledge with the break of small pieces of walls have emerged, some of which have been restored according to the safety regulations, during the first intervention phase. Therefore, it is necessary to investigate the structural analysis, by examining the stress state of the structure resulting from the analysis of loads due to the weight of the church, but especially by analyzing the structural model under the seismic action.

1.3.2 Stress Analysis

The global model of the basilica is subject to vertical actions due to the weight of the structures and to the weight of the roof. The following images show the evolution of the vertical tensions. The units of measure for the stress are kN/m2. The scale was set to facilitate the reading to 1.0 MPa. Figure 6 [10] shows, on the plan of the basilica, the values of the vertical tensions agents at the base of the model. You can see that the front wall and the pillars of the aisle prove to be the parts most stressed by vertical actions, while the outer sidewalls of the aisle are less stressed.

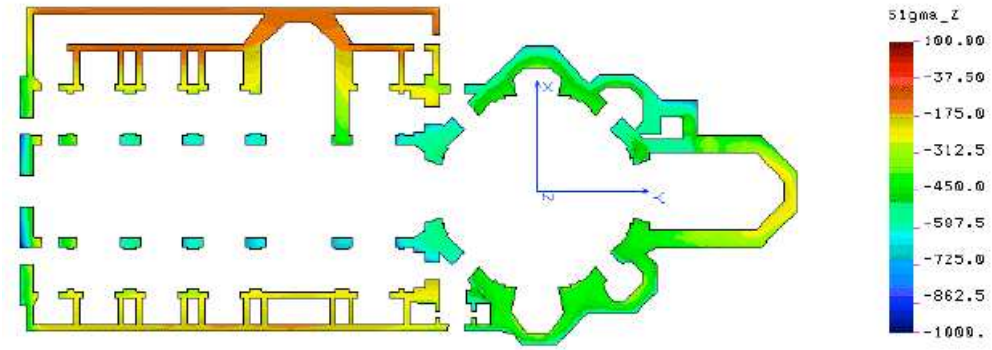


Fig. 6: Plan of the Basilica. Stress state.

The vertical stress at the base of the facade varies within a range of 0.4 - 1.0 MPa. The maximum value of the vertical tension is reached in the corner of the lateral opening and has a value of about 1.0 MPa. The stress on the outer side walls of the nave, instead, falls in a range between 0.08 - 0.3 MPa. At the base of the pillars of the nave, the maximum vertical stress varies between 0.6 and 0.8 MPa. Finally, the apse zone has maximum vertical tensions ranging from 0.2 to 0.5 MPa. Figures 7 [11,12] show the trend of the vertical stress in the basilica over the whole height of the church. Besides, the strong influence of the reinforced concrete cover and, in particular, of the heavy dome on the masonry structure below is evident. In any case, even if the values of the maximum stress are quite high, they remain acceptable for walls of good bill, due to their ability of compression resistance. The main problem is to understand the impact of the reinforced concrete cover on the brick structure in relation to the seismic force.

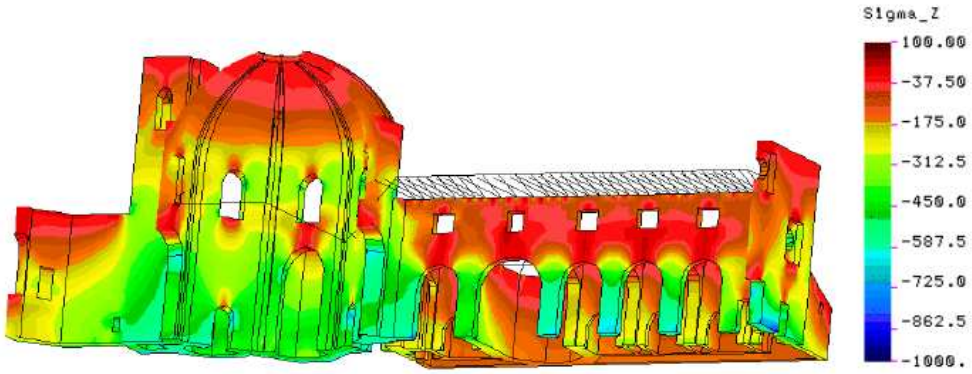


Fig. 7: Stress state in the structure. Sections sides

2.3.3 Modal Dynamic Analysis

To evaluate the seismic response of the structure, the modal analysis on the full model was carried out [10]. The building can be represented, from the dynamic behavior point of view, as the combination of several macro-elements, being very different from each other: the tower bell, the system dome-drum-pillars, the body of the main nave and chapels, the façade. In fact, if we examine the main modes of the structure vibration, it is possible to understand that the local modes that characterize each part of the structure are distinct, and in particular, the tower seems to be the element subject to major displacements. It is also interesting to underline the different behavior of the masonry structural elements and that of the reinforced concrete ones under the seismic action, and especially the behavior of the dome, which seems to behave as a body detached from the whole building.

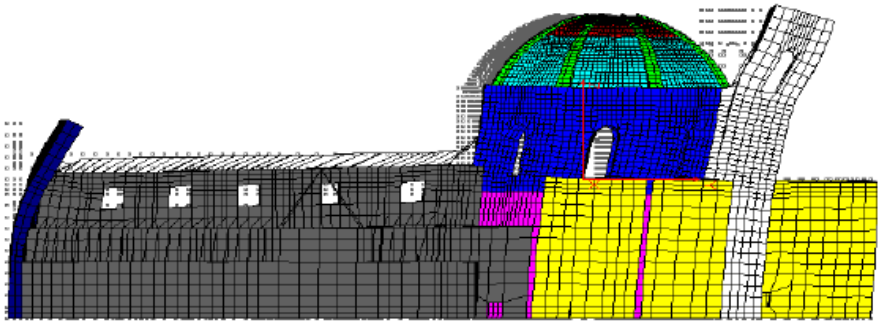


Fig. 8: Deformed by effect of an earthquake along the longitudinal axis [11] - side elevation

2.3.4. Concluding Remarks about the Basilica of St. Bernardino

The collapse of the dome can be described essentially by two mechanisms: a 'local' one, which normally affects a portion of the dome and the "global" one - much more important - derived from the seismic behavior of the whole structure. The local collapse mechanism of the dome affects the rib vault and the corresponding portion of the drum, and is therefore similar to the mechanism that characterizes an arch on a pillar. The detachment of the rib vault from the rest of the dome can be seen as beneficial to safety, but is burdensome in relation to the connection with the other cloves. On the other hand, at least one sail is detached from the principal rib and therefore is effectively disconnected from the adjacent segment of the dome. The two pieces can work only where compressive stress arises, because the contact is a mono-lateral constraint. It is also noted that the actual mechanism is activated on the rib vault just where the free drum has a greater height - in fact, the side chapels are less high than the longitudinal nave. The mechanism of global collapse, however, involves the whole complex formed by the dome, the drum and the eight support pillars: essentially, the entire structure supporting the dome. The rigid motion of the dome and the drum as a whole is dominated by inertial forces, which are oscillatory and therefore do not result in a unidirectional movement. It is assumed that upon rotation of the piers, the dome has been shaken by the oscillatory motion and has been raised from the pillars, making a jump. During the oscillatory movement, the crushing of the south pillars increased, while that of the north pillars decreased. The motion has produced the progressive plasticization of the areas that had kept the contact with the foundation and with the drum, causing a progressive reduction of the pillars resistance.

2. General Conclusions

The damage affecting the masonry structure can lead to disproportionate consequences, i.e. the global collapse. This extreme situation has to be avoided and, thus, structural monitoring is requested in those historical structures where the loss of human lives can occur and large economic consequences are expected. Generally speaking, masonry structures are inherently compartmentalized. Compartmentalization starts from the architectural plan of the building and is normally a result of the construction stages. Moreover, ageing and degradation further reduce the global box-behavior. The collapse mechanisms due to compartmentalization in masonry structures have been extensively studied by the macro-elements technique [13]. To summarize, it is possible to say that the positive effects are represented by the limitation of the collapsed area, i.e. the damage may be confined to limited portions or elements. On the other hand, one can say that the negative effect is that these partial collapses, although limited, are "facilitated" by the compartmentalization. Masonry structures are often consolidated through techniques that entail the use of reinforced concrete, via curbs or beams, to ensure box-behavior under seismic actions. The effectiveness of these interventions is now widely discussed after the recent earthquakes [1,13]. The desired box-behavior sometimes was provided, whereas in other situations concrete beams caused the collapse of whole masonry walls between the upper and lower curbs.

Bibliographical References

[1] Cennamo C., Di Fiore M., Structural, seismic and geotechnical analysis of the St. Agostino Church in L'aquila (Italy). Revista de Ingenerìa de Construcciòn, vol. 28, p. 7-20, ISSN: 0716- 2952, 2013.

[2] Ientile R. (a cura di) , Architetture in cemento armato. Orientamenti per la conservazione, Atti Giornata di studio su "Il ciclo di vita delle architetture in cemento armato: l'approccio ingegneristico

[3] Anselmi C., Casapulla C., Cristilli C., De Rosa E, Galizia F., Gargiulo M., Lauro F., Maione A., Pizzi A., "Sisma Abruzzo 2009: Valutazione danni e vulnerabilità della Chiesa di Santa Maria del Carmine – L'Aquila", Università degli Studi di Napoli Federico II, Dipartimento di Costruzioni e Metodi Matematici in Architettura, 2010.

[4] Eurocode 8: Design of structures for earthquake resistance, 2003.

[5] Ceravolo R., Demarie G. V., "Analisi sismica per livelli di conoscenza del patrimonio architettonico", CLUT, Torino, 2009

[6] Dipartimento di Ingegneria Strutturale (Politecnico di Milano), "Scheda di 1° livello per il rilie vo della tipologia e della qualità della muratura", Milano.

[7] Calderini C. Lagomarsino S., "Chiesa di Sant'Agostino. Note storiche e costruttive. Lettura del danno e della vulnerabilità. Considerazioni sul restauro e la ricostruzione", Dipartimento di Ingegneria delle Costruzioni dell'Ambiente e del Territorio, Università degli Studi di Genova.

[8] Cennamo C., Chiaia B., D'Angelo S., Ferretti D. Seismic assessment and rehabilitation of a historical theater based on a macro-element strategy. International Journal of Architectural Heritage, vol. 5:3, p. 264-295, ISSN: 1558-3058, 2011.

[9] Rondelet G., "Trattato teorico e pratico dell'arte di edificare", traduzione italiana a cura di Basilio Soresina, Mantova, 1831

[10] Chiodi D., "Le 170 chiese di L'Aquila dal '200 al '900", L'Aquila 1988.

[11] Rocchi P., "Modelli matematici finalizzati al progetto di analisi e messa in sicurezza del complesso monumentale di San Bernardino in L'Aquila", 2010.

[12] Antonini O., "Chiese dell'Aquila", CARSA Edizioni, Sambuceto di S. Giovanni Teatino (CH), 2004.

[13] Cennamo C, Di Fiore M (2013). Best practice of structural retrofit: the SS. Rosario Church in Gesualdo, Italy. International Journal of Disaster Resilience in the Built Environment , vol. 4, p. 215-235, ISSN: 1759-5908

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Daylighting Measurements and Evaluation of the Energy Saving in an Historical Building

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Abstract
Usually, the daylighting data are available only for few locations and the daylight design for buildings takes into account only the Daylight Factor.
In the aim to evaluate the real availability of daylight for an existing building, a suitable experimental apparatus was set-up for daylighting data acquisition. Measurements for the internal daylighting illuminance distribution have been made during the winter for a room of an old historical building located in Aversa (Southern Italy).
For the acquisition period, the daylighting illuminance distribution inside the room allowed for evaluating the period in which the daylight is able to guarantee the target average illuminance value without the operation of the artificial lighting system. Considering the real daylight availability during the daily occupancy period of the room, the effective working intervals of the artificial lighting system and the real total electric energy for lighting during the reference period were evaluated.
The real LENI index for the room, based on the calculated energy consumption for lighting, was estimated and compared with that evaluated following the methodology proposed by the Italian Standard in order to define the reliability of the Italian Standard.

Keywords: LENI, energy saving, daylight, experimental daylight illuminance distribution, UNI EN 15193-2008.

1. Introduction
The use of daylight represents the best way for reducing the energy use for the lighting and to guarantee a good visual comfort. Through the knowledge of the daylight availability, the designers can select the best strategy for its correct use, avoiding discomfort effects caused by direct light of the sun or by daylight illuminance values too high.
Many studies have focused on studying the effects of the daylight on both the humans and the indoor environments [1-4], highlighting the potentiality of the daylight in order to enhance the visual comfort of building occupants and to reduce the energy consumption connected with lighting.
Nevertheless, the correct evaluation of the daylight illuminance values in a room is not easy due to its close relationship with the room location and orientation, the sun position, the season and the sky condition.
In order to estimate the energy consumption related to the artificial lighting taking into account the daylight contribution, the Italian Standard UNI EN 15193-2008 [5] introduces the numerical indicator Lighting Energy Numeric Indicator (LENI).
The LENI index (expressed in kWh/m^2·year) represents the energy annually used for lighting and it is calculated as the ratio between the total annual electric energy used for lighting (kWh/year) and the total useful floor area (m^2); the same index can also be used also for a single room rather than a whole building. The LENI index can be used for evaluating the efficiency of the lighting as well as for comparing different lighting systems or retrofitting actions. In fact, a low value of the LENI means a low use of energy for lighting and, subsequently, a greater efficiency of the lighting system.

If on the one hand, the proposed method gives benchmark values for different building types (office, hospital, restaurant, etc.) and permits to evaluate the effect of different lighting control logics, on the other side the daylight contribution is assessed using the static approach of the "daylight factor". Using the daylight factor approach it is not possible to quantify the real contribution of the natural lighting.
For these reasons, the daylighting data for the considered location should be used for a proper daylighting design and/or a correct evaluation of the daylight penetration in a room. Unfortunately, weather data are available only for few locations and many studies evaluating the performance of daylighting start with on-site measurements to quantify the actual contribution of the natural light [6-8].
The main aim of this study is then to obtain information about the daylighting illuminance distribution inside a reference room for a specific location and use the experimental data to estimate the accuracy of the energetic analysis based on the Italian Standard UNI EN 15193-2008 [5].
This analysis was conducted in an office of the Abbey of San Lorenzo ad Septimum, that is located in Aversa (southern Italy, latitude 40°59' - longitude 14°11') and hosts the Department of Architecture and Industrial Design "Luigi Vanvitelli" of the Second University of Naples.
The acquisitions of the daylight illuminance distribution inside the room were performed during the month of February. The experimental data were used to evaluate the daylight distribution and the interval in which the daylight is able to guarantee the target average illuminance value; the operating time of the artificial lighting system was limited to the periods during which the daylighting is not able to satisfy a fixed value of the mean illuminance.
For the artificial lighting system an on/off control strategy was considered; the luminaires were either switched on completely or switched off completely.
Knowing the operating hours and the electric load of the lighting system, the total electric energy for lighting was calculated and the value of the real LENI index of the room was estimated.
Finally, the real value of LENI so calculated was compared with that calculated according to the comprehensive method proposed by the UNI EN 15193-2008 [5].

2. Description of the experimental and simulation set-up

The office is located on the first floor of the Abbey, it has a floor area of about 26.0 m^2 and a height of about 5.45 m. The only window in the room is placed on the external side of the perimeter wall that has a thickness of about 1.00 m; it has a total surface of about 3.70 m^2 and a ratio glass area/total window area equal to 0.38.
The measurements of the daylight illuminance distribution inside the room were performed for the entire month of February using nine illuminancemeters T-10 manufactured by Konica Minolta with cosine correction, measuring range from 0.01 lx to 300 klx and accuracy of ±2%. The sensors were placed at 0.85 m from the floor level on support structures through which the horizontal position and the height of the sensors were adjusted. The measurement points were identified dividing the floor area of the room into nine equal small areas; the sensors were placed at the centre of each small area.
The Fig. 1a shows the layout and the size of the room with the identification of the points where the illuminance sensors were placed. A picture of the office was reported in the Fig. 1b. In this figure, it can be seen the position of the luxmeters, the support structures used to adjust the arrangement of the luxmeters and the window. The dimensions reported in the Fig. 1a are expressed in meters.
The photometric characteristics of the surfaces of the room were experimentally evaluated with the spectrophotometer Minolta CM – 2600d (size of integrating sphere: ø52 mm, wavelength range: from 360 nm to 740 nm and spectral reflectance: standard deviation within 0.1%). The reflectance values of each surface were obtained as the average value of the data recorded for three measurement points. The measurements were performed utilizing the standard illuminant D65 and considering the Specular Component Included (SCI).
The testing room is lighted by means of four fluorescent based luminaires with an electric power of 116 W for each one. The same experimental set-up used to acquire the daylight illuminance distribution inside the test room (the nine illuminance meters Konica Minolta T-10) was used to measure the illuminance value produced by the artificial lighting system. The measurements show that the four luminaires assure a mean illuminance value of 397 lux.
Starting from the experimental measurements on the existing artificial lighting system, the value of the electric power required to guarantee the target illuminance average value of 300 lx was estimated assuming that the electric power and light output vary linearly from the maximum to the minimum values. In this way a total electric power of about 351 W for the lighting was estimated and used for the LENI index calculation.

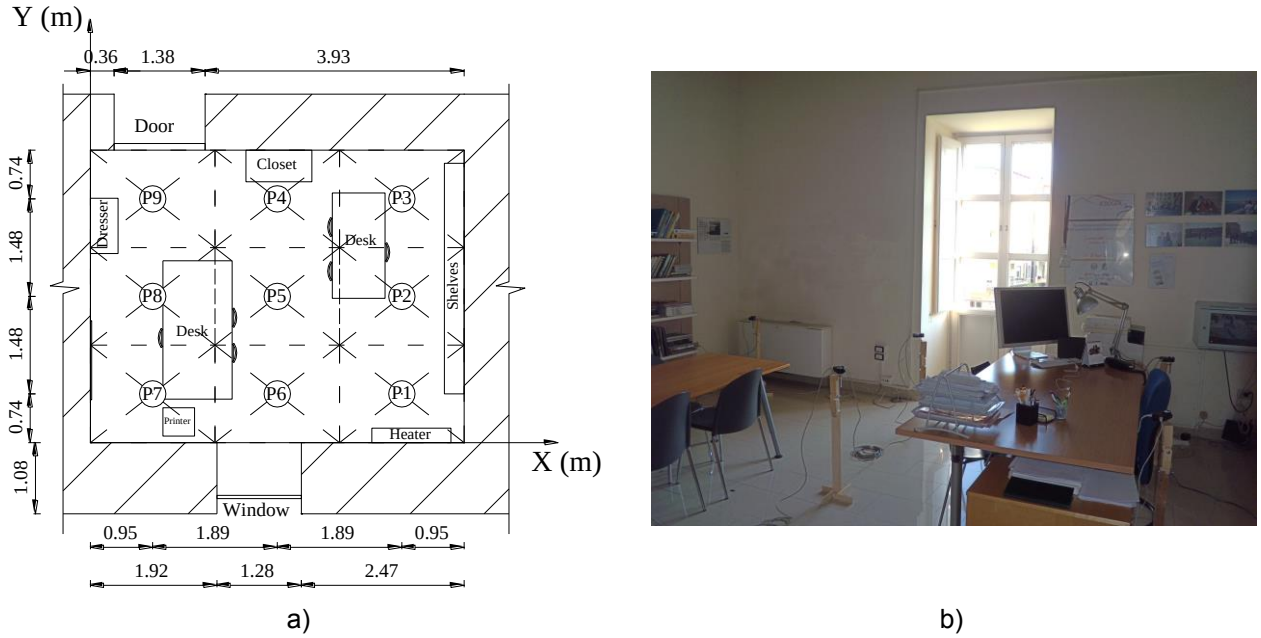


Fig. 1: (a) Reference room and identification of the points for illuminance measurements (measurements expressed in meters); (b) internal view of the office.

The experimental data relating to the geometrical and the photometrical characteristics of the room and the electric power of 351 W for the lighting system were used to characterize the virtual model in the simulation software DIALux [9] and calculate the LENI index on the basis of the UNI EN 15193-2008 [5].
The simulations were performed by assuming:

- No external obstruction;
- Calculation surface at 0.85 m above the floor and 0.50 m away from the walls;
- Target illuminance mean value of 300 lx;
- Manual control of the artificial lighting system;
- Orientation of the room 15° South-South West;
- Surface for LENI calculation equal to 24.80 m^2.

3. Methodology

In this study, using the experimental set-up earlier described, the daylight illuminance distribution in an office was acquired for the entire month of February in order to evaluate the real natural light penetration; from daylight illuminance values, the LENI index was calculated following two different approaches. The first approach uses the experimental data of the daylight illuminance distribution; the second uses the methodology described in the UNI EN 15193-2008 [5] for the annual and the monthly evaluations of the LENI.
The operating hours during the daylight time and the operating hours during the non-daylight time (required from the methodology UNI EN 15193-2008 [5]) were calculated considering the sunrise and the sunset times for the location of the office [10], considering an occupation period of 9 hours per day (between 08:00 – 17:00) and five days per week (from Monday to Friday).
In the Table 1, the values of the working days, the operating hours during the daylight time and the operating hours during the non-daylight time used for the estimation of the LENI index used for the two approaches are listed. The annual values were used in the simulation software DIALux [9] for the calculation of the LENI index according the UNI EN 15193-2008 [5].
In the first approach, the daylight illuminance values in the nine measuring points (Fig. 1a) were acquired simultaneously and stored every hour from 08:00 to 16:00.
The ability of the daylighting to guarantee a fixed illuminance value was evaluated in terms of average illuminance value; for each acquisition, the nine point illuminances were averaged and the mean daylight illuminance value so calculated was compared with the target illuminance mean value.
If the experimental average daylight illuminance values exceeded the target value, the artificial lighting system was assumed off for one hour, otherwise the lighting system was considered on.

Table 1: Working days, operating hours during the daylight time and operating hours during the non-daylight time.

Period considered	Working days (days)	Operating hours during the daylight time (hours)	Operating hours during the non-daylight time (hours)
February	20	180	0
Whole year	254	2286	14

The total operating hours of the lighting system were calculated summing each hour in which the artificial lighting worked.
The real LENI index ($LENI_{real}$) was evaluated by the following equation:

$$LENI_{real} = \frac{W_{\exp,feb}}{A} \quad (1)$$

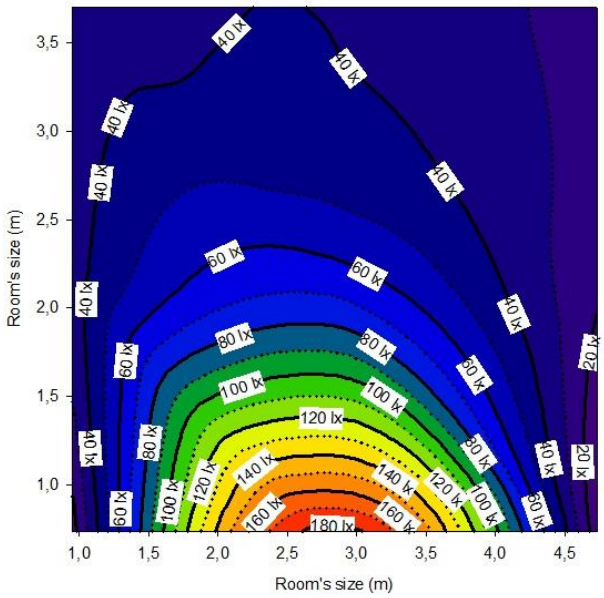
where $W_{exp,feb}$ is the total energy used for lighting during February and A represent the total useful floor area. Knowing the operating hours of the lighting system, the total energy $W_{exp,feb}$ can be simply calculated multiplying the operating hours for the lighting load.
In the second approach, the value of the LENI index was calculated according to the comprehensive method proposed by the UNI EN 15193-2008 [5]; in this study, the LENI value was calculated through the simulation program DIALux. Defining the virtual model of the room, the external obstruction and the occupancy characteristics, the program permits to evaluate both the annual and the monthly values of the LENI.

4. Results and discussion

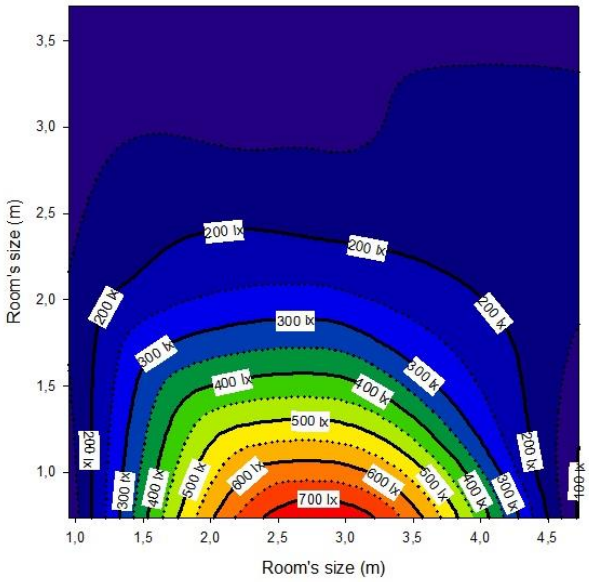
The values of the daylight illuminance distribution acquired during the month of February allowed to quantify the availability of the natural light inside the office as well as to evaluate the hours during which the daylighting is able to guarantee the target value of illuminance for a suitable visual comfort without the use of the artificial lighting system.
As reference, the Fig. 2 shows the experimental data acquired on February 9th 2015. The results were represented according to the reference system shown in Fig. 1a and display the point daylight illuminances acquired every hour from 08:00 (Fig. 2a) to 16:00 (Fig. 2i). Observing the results shown in the figures from Fig. 2a to Fig. 2i, it can be seen that the highest illuminance values were observed ever near the window and that, although the illuminance values vary following the external light, the light distribution is almost the same upon varying of the time of the day.
In the Fig. 3, the average daylight illuminance values calculated for the light distribution reported in the figures from 2a to 2i are shown; a black line represent the illuminance target value under which the lighting system was considered on. This figure highlights that, for the day considered, the lighting system worked for four hours, from 08:00 to 10:00 and from 13:00 to 15:00. It can be seen that the maximum mean illuminance value was equal to about 800 lux and was observed at 15:00.
Repeating the process followed for the reference day, the operating hours for the entire month of February were calculated. The results obtained are reported in the Table 2 that exhibits the hours in which the artificial lighting was considered on. From the data reported in the table, it can be noticed that on the 20 working days considered the lighting system:

- was switched on for a total of 98 hours during the month;
- was switched on all day long for 5 days (from 08:00 to 17:00).

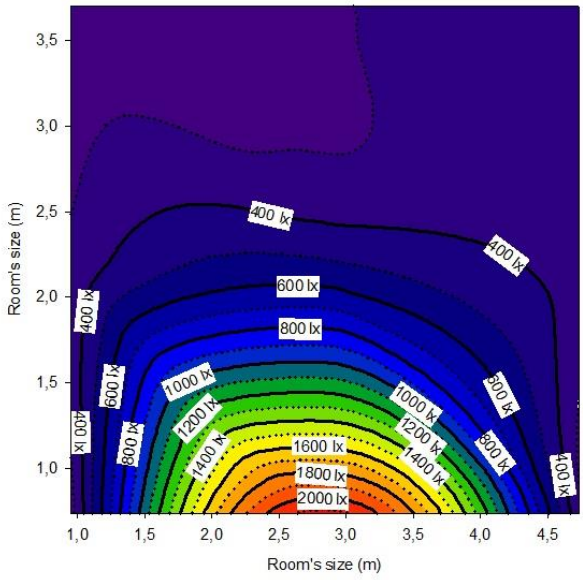
In addition the values reported in the table highlight that generally the operating time for the lighting system ranges from 2 up to 4 hours per day and that the average operating time of the light system is of 5 hours per day.
Finally, the LENI index for the month of February calculated according to the procedure suggested ($LENI_{real}$) and according to UNI EN 15193-2008 [5] were compared.


Room's size (m)
Room's size (m)
40 lx
60 lx
80 lx
100 lx
120 lx
140 lx
160 lx
180 lx
20 lx

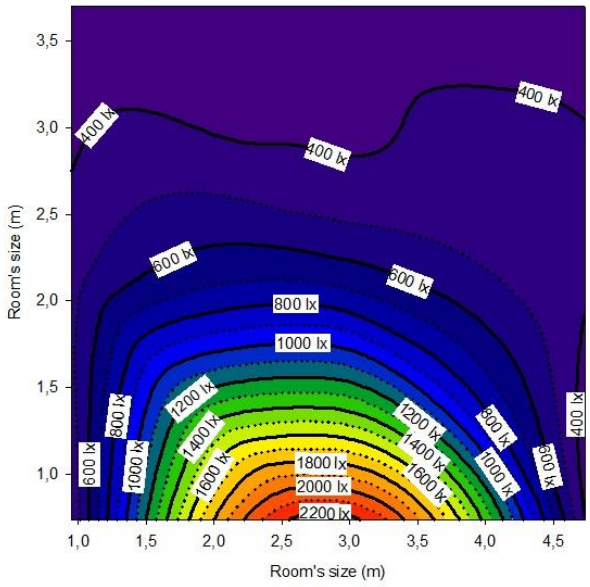
a)


Room's size (m)
Room's size (m)
200 lx
300 lx
400 lx
500 lx
600 lx
700 lx

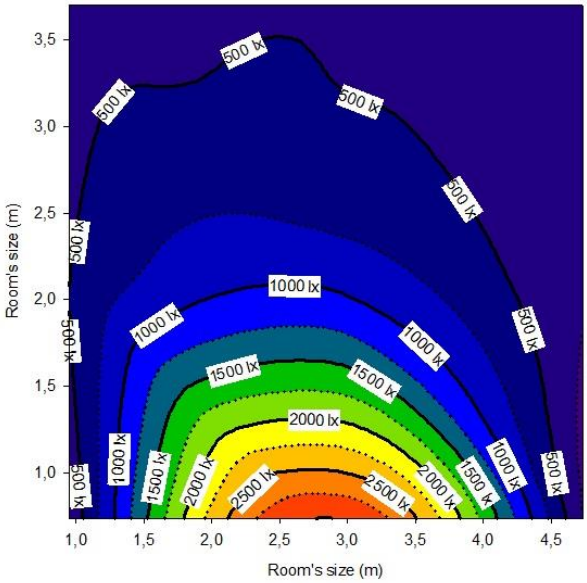
b)


Room's size (m)
Room's size (m)
400 lx
600 lx
800 lx
1000 lx
1200 lx
1400 lx
1600 lx
1800 lx
2000 lx

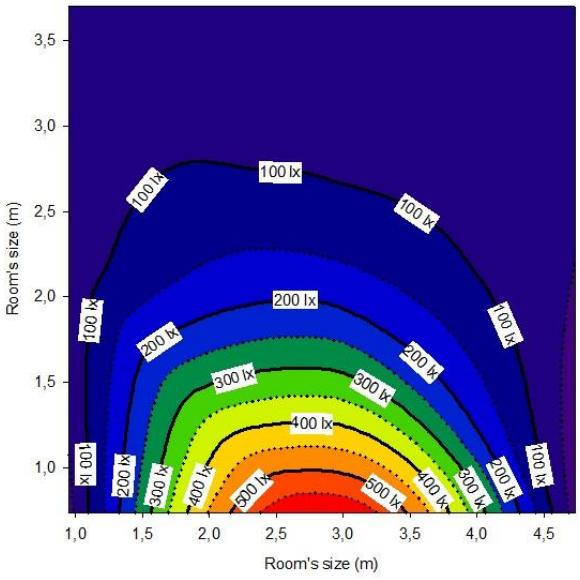
c)


Room's size (m)
Room's size (m)
400 lx
600 lx
800 lx
1000 lx
1200 lx
1400 lx
1600 lx
1800 lx
2000 lx
2200 lx

d)


Room's size (m)
Room's size (m)
500 lx
1000 lx
1500 lx
2000 lx
2500 lx

e)


Room's size (m)
Room's size (m)
100 lx
200 lx
300 lx
400 lx
500 lx

f)

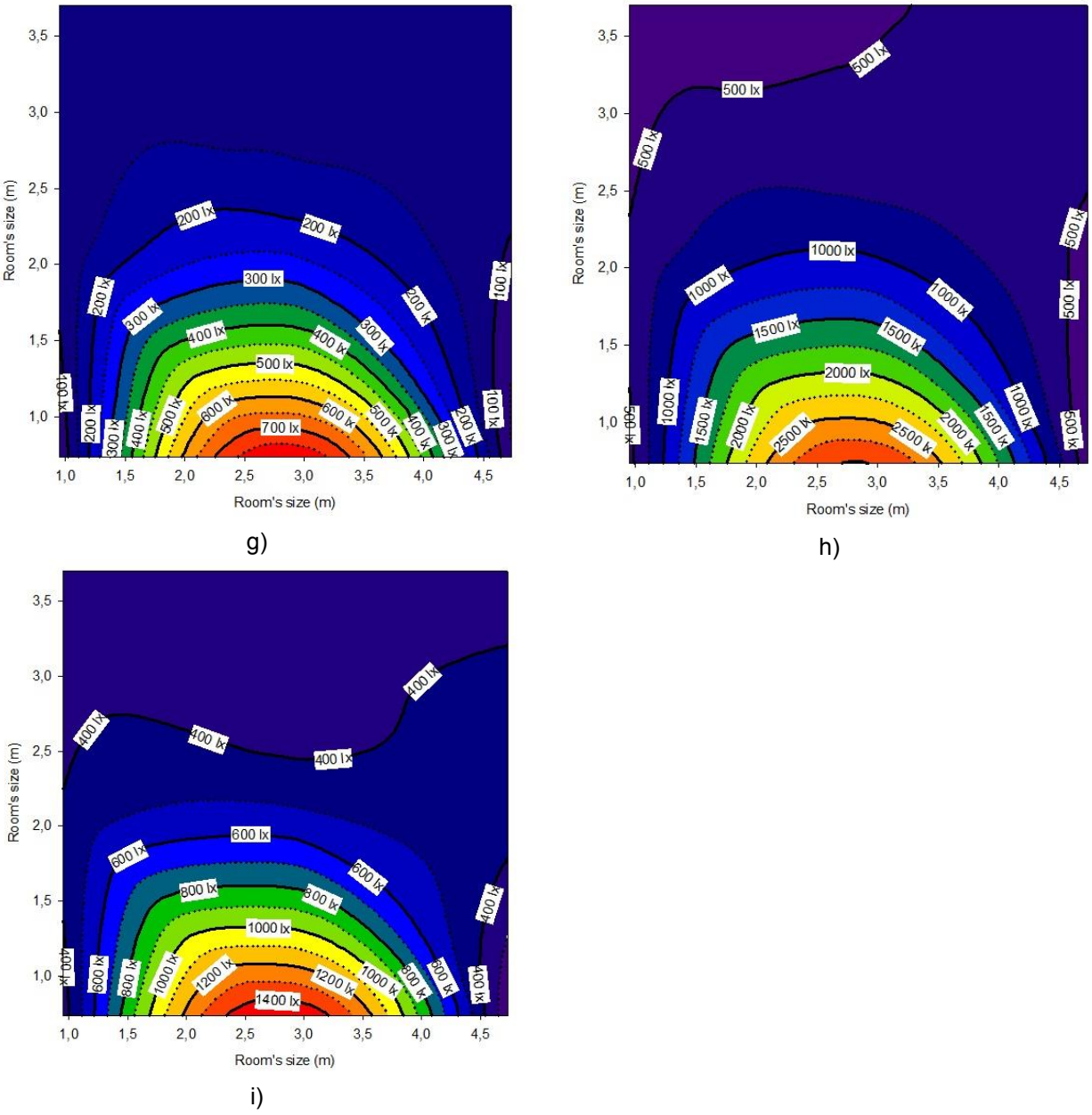


Fig. 2: Daylight illuminance distribution inside the office measured on February 9th 2015 at different hours of day, (a) 08:00; (b) 09:00; (c) 10:00; (d) 11:00; (e) 12:00; (f) 13:00; (g) 14:00; (h) 15:00; (i) 16:00.

In the Figs. 4a and 4b, the results obtained applying the two above-described approaches were reported in terms of LENI index and in terms of electric energy required for lighting.
From the values reported in the Fig. 4a, it can be inferred, for the considered period, that:

- the LENI index calculated according the methodology described by UNI EN 15193-2008 [5] is equal to 1.87 kWh/m^2;
- the $LENI_{real}$ index calculated using the experimental data is equal to 1.39 kWh/m^2;
- the $LENI_{real}$ index is lower than LENI calculated according the UNI EN 15193-2008 of about 26%.

The Fig. 4b shows the results obtained in terms of electric energy. The figure underlines that the method proposed in the UNI EN 15193-2008 overestimates the electric energy for lighting by about 12 kWh.

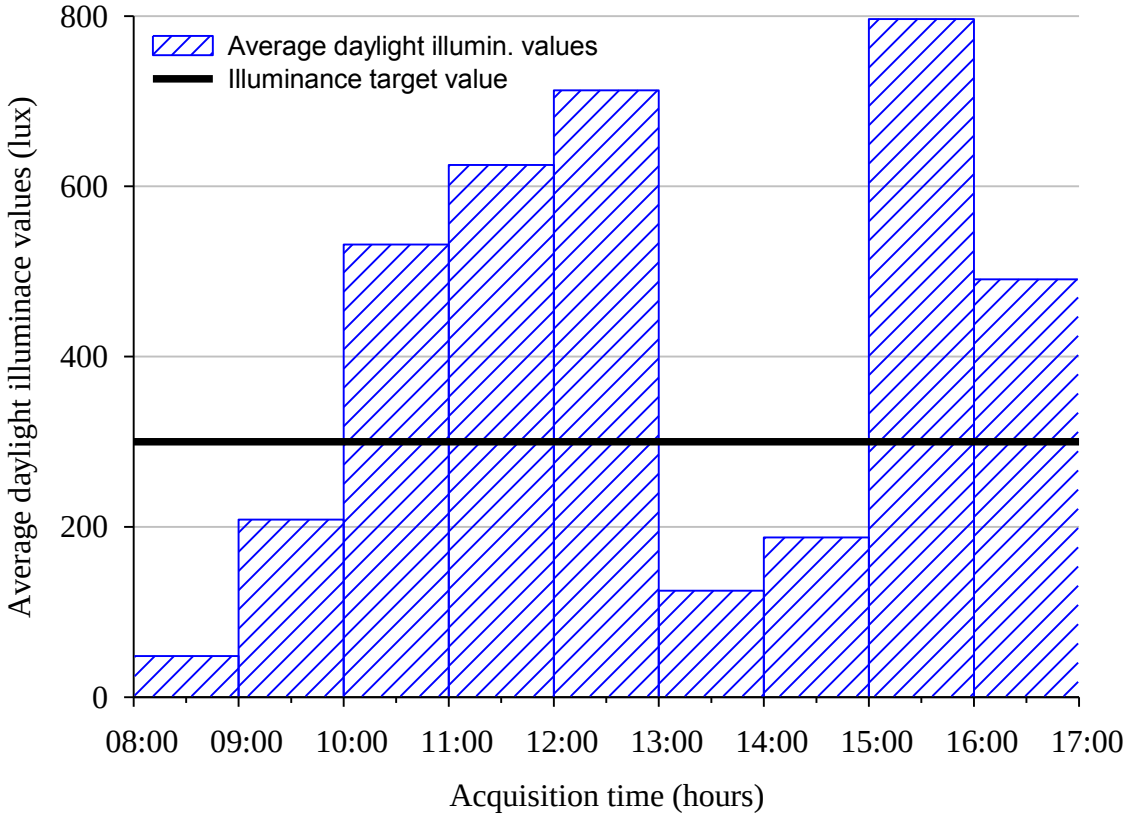


Fig. 3: The average daylight illuminance values calculated for the light distribution acquired on February 9th 2015 at different hours of day and the illuminance target value.

Table 2: Operating hours of the artificial lighting system 1 (on) - 0 (off).

	2-feb	3-feb	4-feb	5-feb	6-feb	9-feb	10-feb	11-feb	12-feb	13-feb
8-9	1	1	1	1	1	1	1	1	1	1
9-10	1	1	1	1	1	1	1	1	1	1
10-11	1	1	0	1	1	0	0	0	0	0
11-12	0	1	1	1	1	0	0	0	0	0
12-13	0	1	0	0	0	0	0	0	0	0
13-14	0	1	0	0	0	1	0	0	0	0
14-15	1	1	0	1	1	1	0	0	0	0
15-16	0	1	0	1	1	0	0	0	0	1
16-17	0	1	1	1	1	0	0	1	1	0
Operating hours	**4**	**9**	**4**	**7**	**7**	**4**	**2**	**3**	**3**	**3**

	16-feb	17-feb	18-feb	19-feb	20-feb	23-feb	24-feb	25-feb	26-feb	27-feb
8-9	1	1	1	1	1	1	1	1	1	1
9-10	1	1	1	1	1	1	1	1	1	1
10-11	1	1	0	0	0	0	1	1	1	1
11-12	1	0	0	0	0	0	1	1	0	1
12-13	1	0	0	0	0	0	1	1	0	1
13-14	1	0	0	0	0	0	1	1	0	1
14-15	1	0	0	0	0	1	1	1	0	1
15-16	1	0	0	0	0	0	1	1	0	1
16-17	1	0	0	0	0	0	1	1	1	1
Operating hours	**9**	**3**	**2**	**2**	**2**	**3**	**9**	**9**	**4**	**9**

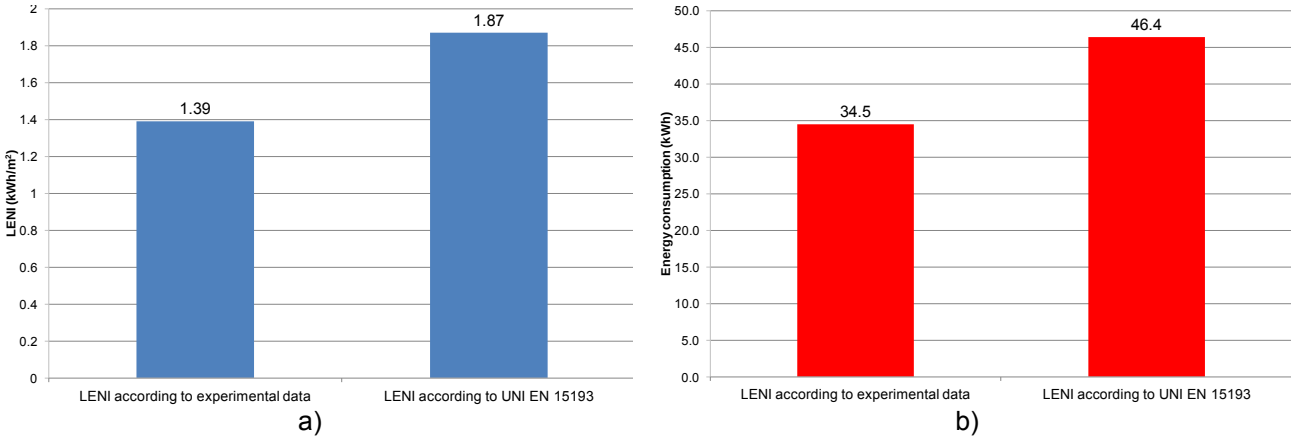


Fig. 4: Values of the LENI index calculated according the experimental data and the UNI EN 15193-2008 [5].

5. Conclusions

An office in the historical Abbey of San Lorenzo ad Septimum that houses the Department of Architecture and Industrial Design "Luigi Vanvitelli" of the Second University of Naples was investigated in order to understand the real daylight illuminance distribution for the entire month of February and evaluate the computing capacity of the Italian Standard UNI EN 15193-2008 [5].
Nine luxmeters were used to acquire the daylight illuminance distribution inside the reference room.
The LENI index was evaluated following two approaches, the first using the experimental daylight illuminance values and the second one using the comprehensive method proposed by the UNI EN 15193-2008 [5].
The results highlights that the method proposed by UNI EN 15193-2008 [5] overestimates the electric energy for lighting by about 26%.

Bibliographical References

[1] BELLIA, Laura, PEDACE, Alessia, BARBATO, Giuseppe. Winter and summer analysis of daylight characteristics in offices. Building and Environment, 2014, vol. 81, p. 150-161.

[2] SIBILIO, Sergio, ROSATO, Antonio, SCORPIO, Michelangelo. Daylighting design in a low energy building. In: Lux Europa 2013. Krakow; 2013, September 17-19, p. 251-256.

[3] ROSATO, Antonio, SCORPIO, Michelangelo, SIBILIO, Sergio. Use of a scale model under artificial sky for daylighting design. In: Napoli: La scuola di Pitagora editrice. Heritage Architecture Landesign focus on Conservation Regeneration Innovation Le vie dei Mercanti XI Forum Internazionale di Studi. Aversa. Capri, 2013, June 13-15, p. 1245-1252.

[4] SIBILIO, Sergio, FALCONETTI, Pasquale, ROSATO, Antonio, SCORPIO, Michelangelo. Effectiveness of light pipes in italy. In: ELPIT 2013, IV International Environmental Congress "Ecology and Life Protection of Industrial-Transport complexes". Togliatti-Samara, Russia, 2013, September 18-22, p. 170-176.

[5] EN 15193:2008. Energy performance of buildings - Energy requirements for lighting.

[6] BELLIA, Laura, d'AMBROSIO ALFANO, Francesca R, GIORDANO, Joselito, IANNIELLO, Elvira, RICCIO Giuseppe. Energy requalification of a historical building: A case study, Energy and Buildings, 2014, DOI: http://dx.doi.org/10.1016/j.enbuild.2014.10.060X.

[7] GUGLIERMETTI, Franco, LAUDANI, F, BISEGNA, Fabio. Definizione di criteri di diagnosi per una correzione delle stime di consumi energetici dovuti all'illuminazione, Report Ricerca di Sistema Elettrico, Report RdS/2013/142, Accordo di Programma Ministero dello Sviluppo Economico – ENEA, Settembre 2013.

[8] CHENA, Yuanyi, LIUA, Junjie, PEIA, Jingjing, CAOA, Xiaodong, CHENA, Qingyan, JIANG, Yi. Experimental and simulation study on the performance of daylightingin an industrial building and its energy saving potential. Energy and Buildings, 2014, vol. 73, p. 184–191.

[9] DIALux 4.12 DIAL GmbH, Germany.

[10] Referring Web Pages Web: http://www.sunearthtools.com/it/solar/sunrise-sunset-calendar.php. Available on 01 February 2015.

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Energy Needs Calculation of Italian Residential Builings Using a National Standard and a Dynamic Simulation Software

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Abstract
The energy consumption of the residential sector accounts for about 40% of the overall energy consumption in all industrialized countries. It is mainly due to the heating demand and is expected to grow significantly in the future. The depletion of natural resources, along with the increase in the global energy-related CO_2 emissions, will require making a greater effort in this sector through the improvement of envelope insulation as well as the use of more efficient and less polluting energy supply systems.
A number of options are currently available for building designers to answer the complex challenges of sustainability, with the selection of the more suitable solution requiring the careful evaluation of energy needs.
Italian Standards UNI/TS 11300 define a simplified methodology for calculation of energy need for space heating based on a number of reference performance; the same calculation can be performed by following a more accurate approach based on a dynamic whole-building simulation software.
In this paper, the energy need for space heating associated to a number of Italian buildings representing different periods of construction and sizes was calculated by means of the dynamic software TRNSYS 17 and then compared with that obtained by using the Italian Standards UNI/TS 11300 in order to estimate the relative difference as well as to assess the suitability of each method.

Keywords: residential sector, energy saving, sustainability, TRNSYS, UNI/TS 11300.

1. Introduction
The population growth, associated with the consequent demand of buildings, services and comfort, results in an increasing energy demand [1]. In recent years, building energy performance and energy saving issues have attracted a great deal of attention from the scientific community due to the fact that in developed countries buildings account for 30-40% of the total energy use. This is mainly due to the heating demand and is expected to grow significantly in the future.
The importance of these topics comes from the need to reduce fossil fuel consumption as well as from the government's necessity to reduce pollutant emissions. For these reasons, energy efficiency in buildings is now a prime energy policy objective at regional, national and international levels. A large number of countries has already developed energy certification procedures in order to rate the energy performance of buildings. For instance, the EU introduced the Directive 2002/91/CE [2] about Energy Performance of Buildings to monitor and reduce energy consumption. Through this directive, the European Community pointed out how the increase of energy efficiency is a point of strength within the set of measures and actions necessary to comply with the Kyoto Protocol.
The building-plant system design starts from the assessment of the heat loss of buildings and, consequently, the thermal loads. A number of options is available for building designers to answer the complex challenges of sustainability, and the selection of the most suitable solution requires a careful evaluation of the related energy consumptions.

In Italy, the calculation of energy need for heating is based on the standard UNI/TS 11300 [3] that defines the procedures for the national implementation of the UNI EN ISO 13790 [4]. This standard requires an energy analysis under steady-state conditions, which is applied through a simplified procedure (based on monthly average environmental temperature values and monthly average solar irradiation values) that is not able to accurately analyse real conditions.
Several investigations have highlighted the limitations connected to the steady-state features of climatic phenomena that neglect the transient nature of external temperature and solar irradiation [5]. In order to overcome the limitations highlighted through the application of the steady-state approach, a number of different methodologies are available in current literature to calculate the actual energy demand of buildings [6-8]. These include dynamic analysis, which allows to appreciate the climatic oscillations along time and can lead to correctly estimating the building energy performance, properly accounting for the dynamic properties of the structures as well as allowing for an accurate modelling process that reflects the actual building geometry [9,10].
The aim of this work is to present some simulations carried out with the dynamic software TRNSYS 17 [11] compared with the steady-state procedure suggested by the Italian standard UNI/TS 11300 [3]. The energy consumption for space heating has been assessed with reference to four residential buildings characterized by different construction dates and dimensions (a single-family house, a terraced house, a multi-family house, and an apartment block) located in the city of Turin (Italian climatic zone E). The buildings under investigation were identified and described within the international research project TABULA [12] performed from 2009 to 2012 with the support of Intelligent Energy Europe.

2. Description of buildings

This section presents the Italian building typologies analysed in this paper based on the information reported in the final report of the project TABULA co-funded by the Intelligent Energy Europe programme (IEE) [12]. The classification of the Italian residential building types has been supported by statistical data about the frequency distribution of the residential buildings, number of apartments in the buildings by construction period, frequency of the building construction and system types, most used energy carriers, etc. This information has been obtained from national statistical data sources, such as the National Institute of Statistics (ISTAT, Report 2004 from Census 2001), CRESME (Centre Economical, Social and Market Surveys in the Building Sector, CRESME, Report 2006) and the National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA, Energy Report 2008).
The classification has been performed by identifying 8 construction ages and 4 construction classes.
The construction age of the building defines a precise historical period that mirrors the significant geometrical and construction types from an energy point of view. In this paper, only the buildings built after the year 2005 were considered.
The following four constructions classes have been investigated:

a) Single-Family House (SFH), one or two floors single flat, detached or semi-detached house;
b) Terraced House (TH), one or two floors single flat, terraced;
c) Multi-Family House (MFH), small building characterised by a limited number of apartments (from 2 to 5 floors and up to 20 apartments);
d) Apartment Block (AB), big building characterised by a high number of apartments (more than 4 floors and more than 15 apartments).

Italy is characterised by six different climatic zones according to Italian Law [13], from “zone A” to “zone F” according to the number of heating degree-days. In this paper, the climatic “zone E” was considered, with it representing 4250 Italian municipalities out of a total of 8100.

The main geometrical features of the building classes are reported in Table 1.

Table. 1: Main geometrical data of the building classes.

Building size class	Gross heated volume (m^3)	Net floor area (m^2)	Window area (m^2)	Number of floors	Number of apartments
SFH	607	174	21.7	2	1
TH	519	127	15.9	2	1
MFH	2959	829	104.0	3	13
AB	8199	2124	270.0	7	31

A ratio of the frame area to the total window area equal to 0.20 was assumed. Each building class is characterized by envelope construction elements that are typical of the Italian building stock. The constructive features of the building classes are reported in Table 2.

Table. 2: Constructive features of the building classes.

Building size class	Roof	Ceiling	Floor	Wall	Window	Door
SFH	Pitched roof with brick-concrete slab, medium insulation	Ceiling with reinforced brick-concrete slab, high insulation	Concrete floor on soil, high insulation	Honeycomb bricks masonry (high thermal resistance), high insulation	Low-e double glass, air or other gas filled, wood frame	Double panel wooden door
TH	Pitched roof with brick-concrete slab, medium insulation	Ceiling with reinforced brick-concrete slab, high insulation	Concrete floor on soil, high insulation	Honeycomb bricks masonry (high thermal resistance), high insulation	Low-e double glass, air or other gas filled, wood frame	Double panel wooden door
MFH	Pitched roof with brick-concrete slab, medium insulation	Ceiling with reinforced brick-concrete slab, high insulation	Floor with reinforced brick-concrete slab, high insulation	Honeycomb bricks masonry (high thermal resistance), high insulation. Concrete masonry (also prefabricated), high insulation	Low-e double glass, air or other gas filled, wood frame	-
AB	Pitched roof with brick-concrete slab, medium insulation	Ceiling with reinforced brick-concrete slab, high insulation	Floor with reinforced brick-concrete slab, high insulation	Honeycomb bricks masonry (high thermal resistance), high insulation. Concrete masonry (also prefabricated), high insulation	Low-e double glass, air or other gas filled, wood frame	-

The ceiling is considered rather than the roof when the boundary of the upper floor (attic space) is an unconditioned space.
The construction period is closely related to the thermal insulation level of the building envelope components. According to the evolution of the national regulations on energy efficiency of buildings, the thermal insulation level of the building envelope is determined after the year 2005 by national regulations [13,14] and regional regulations which set maximum values of thermal transmittance (U). Table 3 reports the transmittance values of the building envelope components.

Table. 3: Transmittance values of the building envelope components (W/m^2K).

U_{roof}	$U_{ceiling}$	U_{floor}	U_{wall}	U_{window}	U_{door}
0.74	0.30	0.33	0.34	2.2	1.7

According to the European Standard EN12831:2003 [15], the indoor air set point temperature was established at 20 °C and, according to the Italian Law [13], the duration of the heating season was defined depending on the Italian climatic zone. In this work, the building is located in Turin (climatic zone E) and duration of 183 days (from October 15th to April 15th) was considered for the heating season. Daily continuous operation time for the heating system without intermittence was considered.
The building was modelled considering a single thermal zone.
According to UNI/TS 11300 [3], an infiltration air exchange rate equal to 0.3 h^{-1} was assumed. A reduction factor for permanent shading equal to 0.2 was also considered.

3. Methodology

In order to estimate the energy need for space heating associated to the above-mentioned four Italian buildings, two different approaches were considered. The first was the application of the standard UNI/TS 11300 [3] using a steady-state method; the second was performed through the dynamic simulation software TRNSYS 17 [11], widely used in literature to evaluate the energy performance of buildings upon varying the operating scenarios [16-21].

In the next section, the two approaches are described in more detail. In the last section, the main results associated to both the steady-state and dynamic calculations are reported and compared in detail.

3.1 Steady-state approach based on the Standard UNI/TS 11300

The standard UNI/TS 11300 [3] is based on a simplified procedure that considers monthly average environmental temperature values and monthly average solar irradiation values. These values are used in the simplified equation that allows to calculate the buildings annual heating need under steady-state conditions ($Q_{H,nd}$):

$$Q_{H,nd} = Q_{H,ht} - \eta_{H,gn} \cdot Q_{gn} = \left(Q_{H,tr} + Q_{H,ve}\right) - \eta_{H,gn} \cdot \left(Q_{\text{int}} + Q_{sol}\right) \quad (1)$$

where:

- $Q_{H,tr}$ and $Q_{H,ve}$ are the transmission and ventilation heat exchange during heating season (their sum is $Q_{H,ht}$);
- Q_{int} and Q_{sol} represent, respectively, the internal and solar gains (their sum is Q_{gn});
- $\eta_{H,gn}$ is the heating utilization factor (it is a reduction factor for the heat gains, introduced to compensate additional heat losses that occur when heat gains exceed the calculated heat losses).

These utilization factors depend on different parameters, as reported in the following equation:

$$\eta_{H,gn} = f\left(Q_{gn}, Q_{H,ht}, C, U\right) \quad (2)$$

where C is the internal heat capacity of the building and U is the thermal transmittance.
The total heat transfer by transmission ($Q_{H,tr}$) was calculated considering the following formula:

$$Q_{H,tr} = H_{tr,adj} \cdot \left(\theta_{\text{int},set,H} - \theta_e\right) \cdot t + \left(\sum_k F_{r,k} \cdot \phi_{r,mn,k}\right) \cdot t \quad (3)$$

where:

- $H_{tr,adj}$ is the overall heat transfer coefficient by transmission of the zone [22];
- $\theta_{int,set,H}$ is the set-point temperature of the building zone for heating;
- θ_e is the ambient temperature;
- t is the duration of the calculation step, determined according to [13];
- $F_{r,k}$ is the form factor between the building component k and the sky;
- $\phi_{r,mn,k}$ is the extra heat flow due to infrared radiation to the sky from the building component k, time-averaged.

The total heat transfer by ventilation ($Q_{H,ve}$) was calculated considering the following equation:

$$Q_{H,ve} = H_{ve,adj} \cdot \left(\theta_{\text{int},set,H} - \theta_e\right) \cdot t \quad (4)$$

where $H_{ve,adj}$ is the overall heat transfer coefficient by ventilation [4].

In this work, the ambient temperature was assumed to be constant and equal to 5.2°C [12] during the whole duration of the calculation period.
The heat flow by internal (ϕ_{int}) and solar (ϕ_{sol}) gains were calculated by the following equations:

$$\phi_{\text{int}} = 5.294 \cdot A_f - 0.01557 \cdot A_f^2 \quad (5)$$

$$\phi_{sol} = F_{sh,ob,k} \cdot A_{sol,k} \cdot I_{sol,k} \quad (6)$$

where:

- A_f is the effective area of the floor;

- $F_{sh,ob,k}$ is the shading reduction factor for external obstacles for the solar effective collection area of surface k;
- $A_{sol,k}$ is the effective collecting area of surface k with a given orientation and tilt angle in the considered zone or space;
- $I_{sol,k}$ is the mean energy of the solar irradiation over the time of calculation per square meter of the collecting area of surface k, with a given orientation and tilt angle.

The values of I_{sol} considered with this approach are reported in Table 4 as a function of the wall orientation.

Table. 4: Constant values of I_{sol} used to identify solar gains as a function of the wall orientation.

I_{sol} (kWh/m²a)			
North	**South**	**East**	**West**
131.4	521.5	310.8	310.8

3.2 Dynamic approach

The dynamic approach is based on the dynamic simulation software TRNSYS 17 [11], where each physical piece of the thermodynamic equipment is modelled with a component (named "Type") that is a FORTRAN source code model; a large number of built-in library and user-developed models are available in TRNSYS. In the following, the main features of the Types used in this study for the simulating project are described in detail.

The building was modelled in TRNSYS 3D [11], with it being a plug-in for SketchUp [23] based on the open source program OpenStudio [24]. The building model contains 3D geometric information that are required for the detailed radiation calculations. Figure 1 reports the four buildings modelled with TRNSYS 3D.

The 3D building models were imported in TRNSYS17 [11] by using the Type56a (included in TRNSYS library) that was used for modelling the building envelope, indoor air set-point temperature, infiltration, shading and internal gains.

Type15-6 (included in TRNSYS library) was used for reading the external Meteonorm weather data file of Turin.

The whole year was simulated by using a simulation time step equal to 0.5 hours during the heating season.

The value of the internal gains are considered equal to the values used with steady-state approach.

TRNSYS 17 allows to appreciate the oscillations of the external temperature and solar irradiation over time, properly accounting for the dynamic properties of the structures as well as the actual building geometry.

4. Results and discussion

The evaluation of the energy need for space heating is performed in this section by using both the Italian standard UNI/TS 11300 (steady-state approach) and TRNSYS 17 (transient approach). This allowed to perform a direct comparison between the two calculation methods with reference to four construction classes (SFH, TH, MFH and AB) built after the year 2005. This comparison was performed considering the following parameter ΔE:

$$\Delta E = \frac{Q_{H,d} - Q_{H,nd}}{Q_{H,d}} \tag{7}$$

where $Q_{H,d}$ is the thermal energy evaluated by using the dynamic approach.

Figure 2 reports the thermal energy per unit of floor area obtained with the software TRNSYS 17 as a function of the simulation period for the four types of buildings under investigation. This figure highlights that:

1) whatever the building type is, the maximum unit energy consumption is the one associated to the month of January;
2) whatever the building type is, the minimum energy consumption is the one associated to the month of April;
3) the annual unit thermal energy requirement is maximum for the Terraced House and minimum for the Apartment Block.

Figure 3 compares the results associated to the dynamic approach with those calculated based on the Italian Standard UNI/TS 11300 by using the parameter ΔE.

This figure highlights that, whatever the building type is, the values of ΔE are always positive: this means that the steady-state approach underestimates the space heating consumptions derived from the transient simulations. The values of ΔE range from 7.4% (in the case of the Terraced House) up to 22.7% (in the case of the Apartment Block).

The difference between the two approaches can be ascribed to two main factors:

1) a wrong estimation of the external temperature assumed by the steady-state approach as constant and equal to 5.2°C that affect the calculation of both the transmission and infiltration loads;
2) an overestimation of the solar gains by the Italian Standard UNI/TS 11300 due to a simplified calculation based on monthly average values of solar irradiation.

Figure 4 compares the values of the ambient temperature used by UNI/TS 11300 and TRNSYS 17 as a function of the simulation period. This figure highlights that the external temperature assumed by the steady-state approach is greater than the values used by the transient approach during about 78% of the heating period, with a maximum difference equal to 14.8°C and an average difference equal to 4.1°C. This is one the main reason because of the the steady-state approach underestimates the energy need for space heating.

Figure 5 reports the parameter ΔI_{sol} as a function of the wall orientation. The values of ΔI_{sol} are defined as follows:

$$\Delta I_{sol} = \frac{I_{sol,d} - I_{sol,nd}}{I_{sol,d}} \quad (8)$$

where $I_{sol,d}$ and $I_{sol,nd}$ are, respectively, the energy of solar irradiation over the whole time of calculation per square meter of collecting area of the surface, with a given orientation and tilt angle, evaluated by using the dynamic approach and steady-state approach, respectively.
Figure 5 highlights that, when the wall orientations are South, East and West, the values of ΔI_{sol} are negative: this means that the steady-state approach overestimates the solar irradiation if compared to the transient simulations, with a percentage difference ranging from -21% (in the case of West) up to -4% (in the case of South); only in the case of the wall orientation is North, the values of ΔI_{sol} are positive.

5. Conclusions

Four Italian buildings built after the year 2005 and representing four different construction classes (Single-Family House, Terraced House, Multi-Family House and Apartment Block) were analysed in order to estimate the energy needs for space heating. Two different approaches have been considered and described: the first one is represented by the application of the standard UNI/TS 11300 and the second one is performed through the dynamic simulation software TRNSYS 17. This allowed to perform a direct comparison between the two calculation methods.
The analysis highlighted that the steady-state approach underestimates the space heating requirements derived from the transient simulations with a percentage difference ranging from 7.4% (in the case of the Terraced House) up to 22.7% (in the case of the Apartment Block).

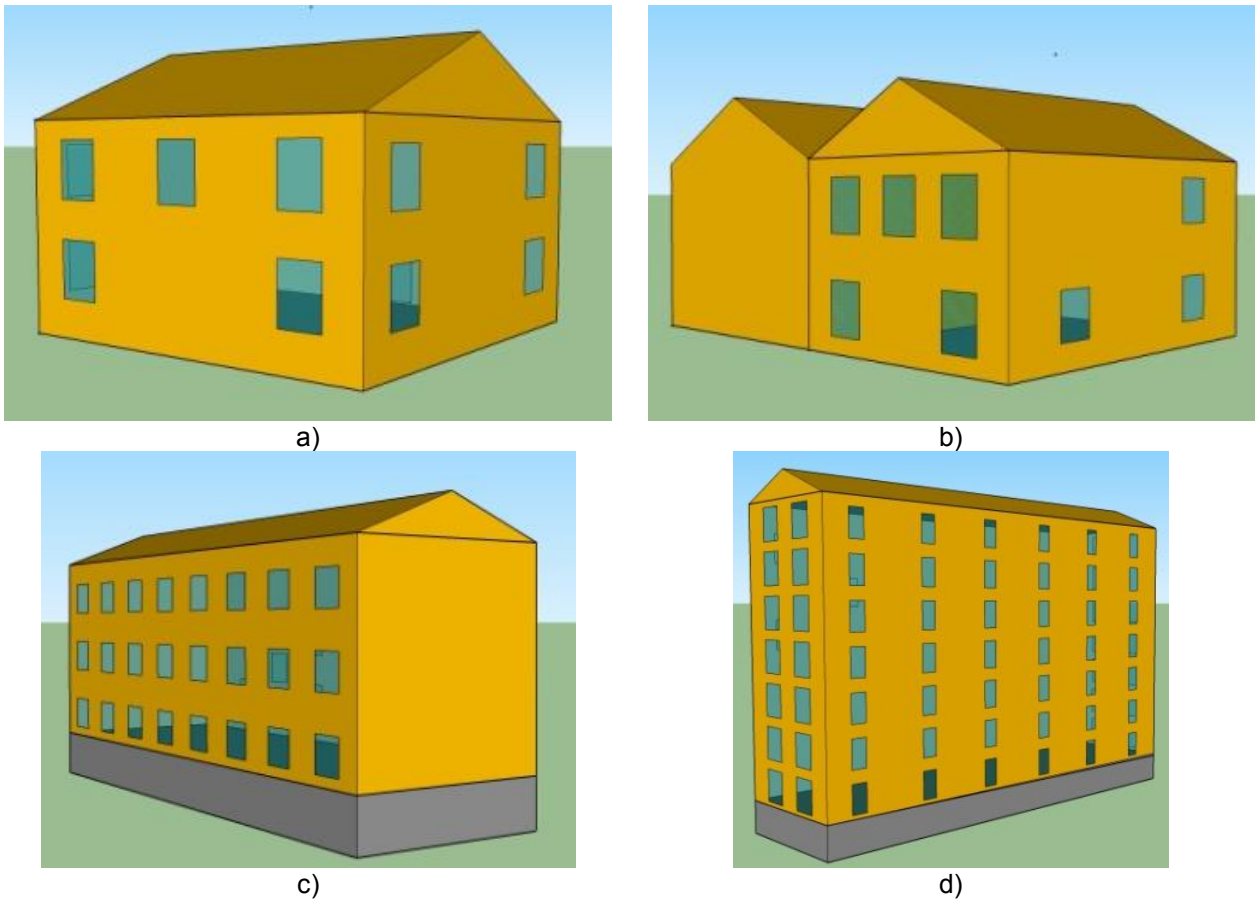

Fig. 1: Building classes modelled by TRNSYS 3D; a) Single-Family House (SFH), b) Terraced House (TH), c) Multi-Family House (MFH), d) Apartment Block (AB).

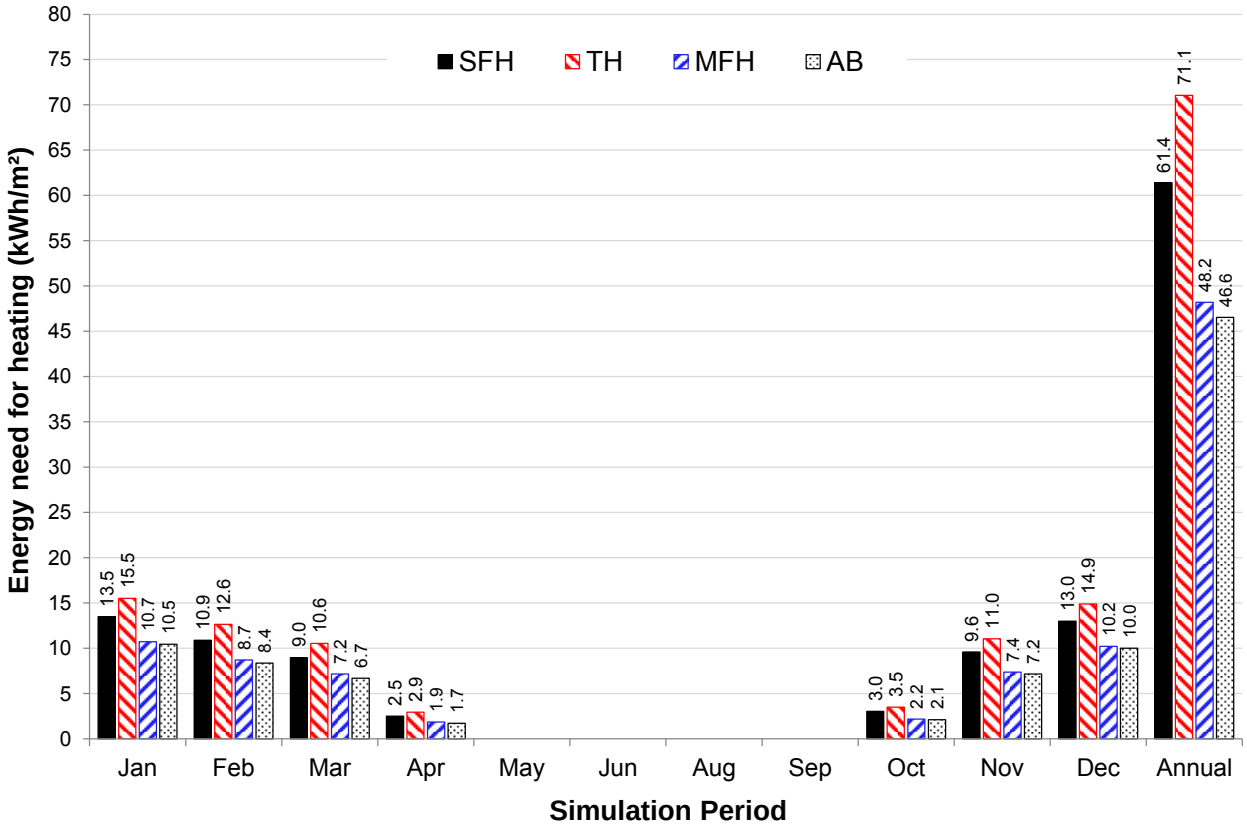

Fig. 2: Energy need for heating as a function of the simulation period and the building size class.

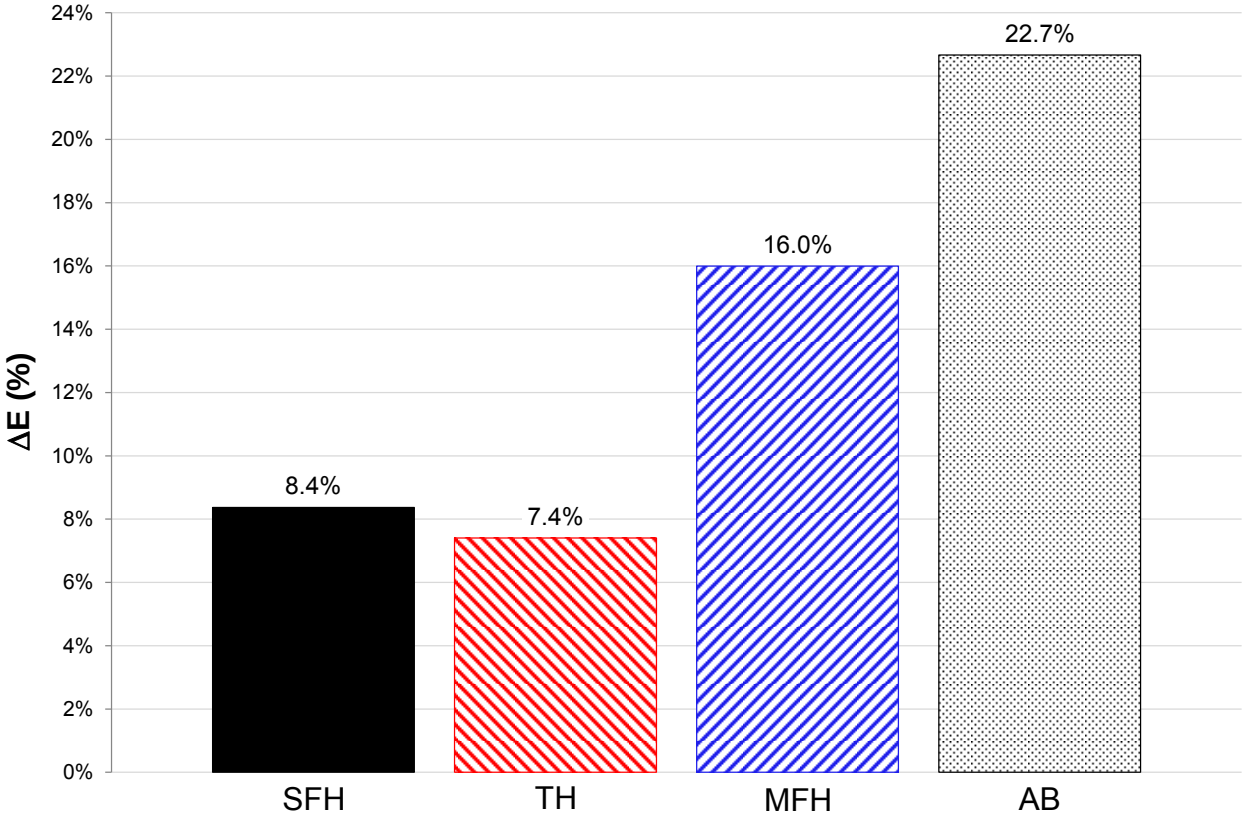

Fig. 3: Values of ΔE between steady-state and dynamic approach.

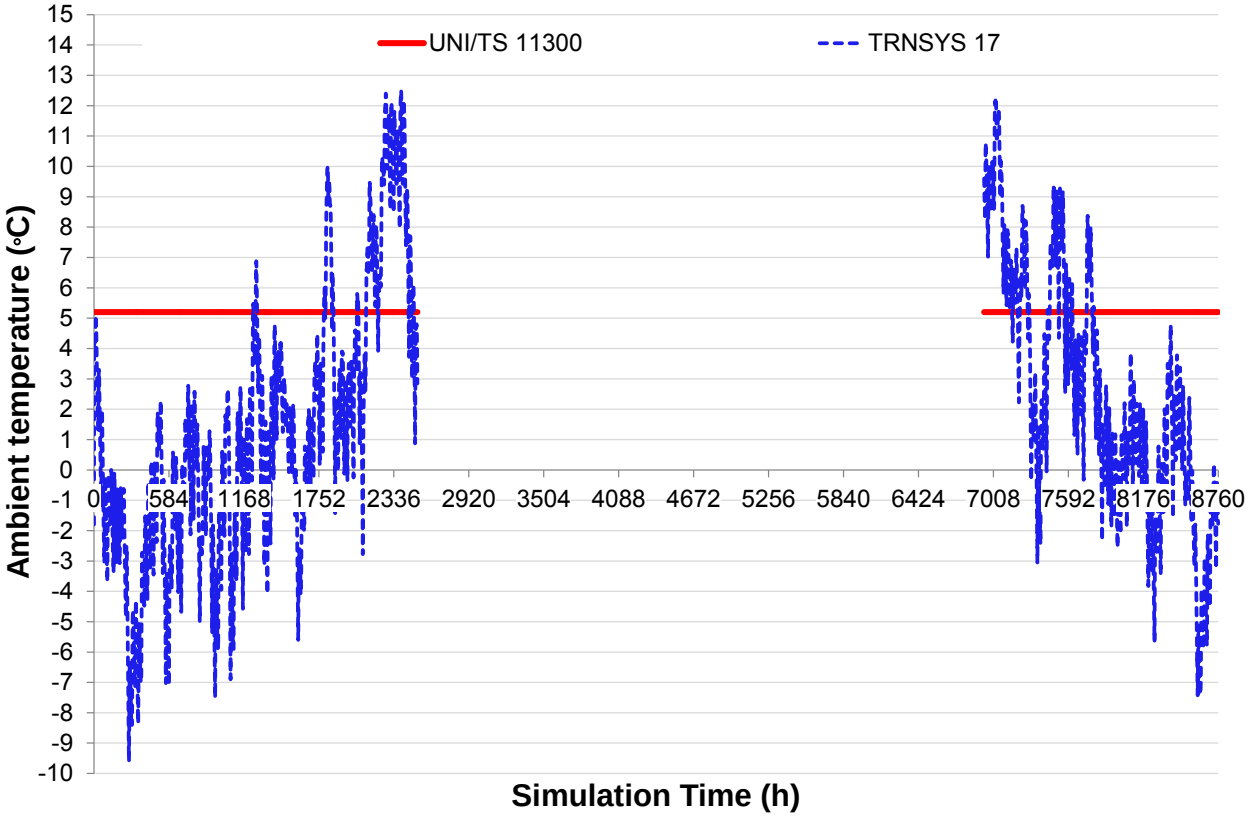

Fig. 4: Values of ambient temperature used by UNI/TS 11300 and TRNSYS 17.

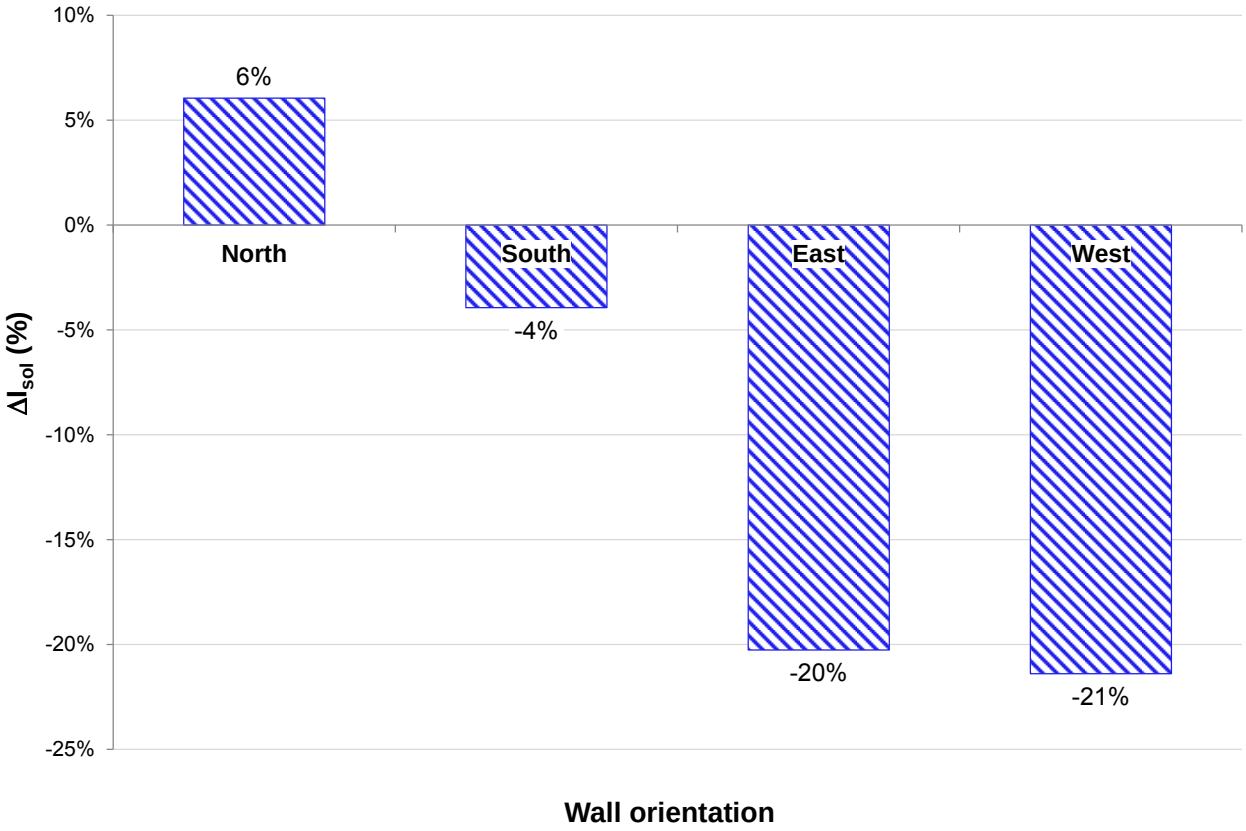

Fig. 5: Values of ΔI_{sol} between UNI/TS 11300 and TRNSYS 17.

Bibliographical References

[1] World energy outlook. IEA, International Energy Agency; 2013.

[2] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

[3] UNI/TS 11300. Energy performances of buildings e Part 1, Part 2; UNI Italian company for standardization, UNI Italian company for standardization. 2008. Milan: Italy; 2008.

[4] EN ISO 13790, Energy performance of buildings – Calculation of energy use for heating and cooling, 2008.

[5] DE LIETO VOLLARO, Roberto, GUATTARI, Claudia, EVANGELISTI, Luca, BATTISTA, Gabriele, CARNIELO, Emiliano, GORI, Paola. Building energy performance analysis: A case study. Energy and Buildings 2015, vol. 87, p. 87-94.

[6] FUMO, Nelson. MAGO, Pedro, LUCK, Rogelio. Methodology to estimate building energy consumption using Energy Plus Benchmark Models. Energy and Buildings, 2010, vol. 42, p. 2331-2337.

[7] MAGNIER, Laurent, HAGHIGHAT, Fariborz. Multi objective optimization of building design using TRNSYS simulations, genetic algorithm, and artificial neural network. Building and Environment, 2010, vol. 45, p. 739-746.

[8] FUMO, Nelson. A review on the basics of building energy estimation. Renewable and Sustainable Energy Reviews, 2014, vol. 31, p. 53-60.

[9] EVANGELISTI, Luca, BATTISTA, Gabriele, GUATTARI, Claudia, BASILICATA, Carmine, DE LIETO VOLLARO, Roberto. Influence of the thermal inertia in the European simplified procedures for the assessment of buildings' energy performance, 2014, Sustainability 6, p. 4514-4524.

[10] EVANGELISTI, Luca, BATTISTA, Gabriele, GUATTARI, Claudia, BASILICATA, Carmine, DE LIETO VOLLARO, Roberto. Analysis of two models for evaluating energy performance of different buildings, 2014, Sustainability 6, p. 5311-5321.

[11] TRNSYS 17, <http://www.trnsys.com/>.

[12] TABULA, <http://episcope.eu/iee-project/tabula/>

[13] Decree of President of Italian Republic n.412/93 <http://efficienzaenergetica.acs.enea.it/doc/dpr412-93.pdf>

[14] Italian Decree n. 311/06 < http://www.artechint.com/attestato-energetico.pdf >

[15] EN 12831:2003. Heating systems in buildings - Method for calculation of the design heat load.

[16] CIAMPI, Giovanni, ROSATO, Antonio, SIBILIO, Sergio. Yearly operation of a building-integrated microcogeneration system in south Italy: energy and economic analyses. International Journal of Low-Carbon Technologies, 2014, vol. 9, p. 331-346.

[17] ROSATO, Antonio, SIBILIO, Sergio, CIAMPI, Giovanni. Energy, environmental and economic dynamic performance assessment of different micro-cogeneration systems in a residential application. Applied Thermal Engineering, 2013, vol. 59, p. 599-617.

[18] ROSATO, Antonio, SIBILIO, Sergio, CIAMPI, Giovanni. Dynamic performance assessment of a building-integrated cogeneration system for an Italian residential application. Energy and Buildings, 2013, vol. 64, p. 343-358.

[19] ROSATO, Antonio, SIBILIO, Sergio, SCORPIO, Michelangelo. Dynamic performance assessment of a residential building-integrated cogeneration system under different boundary conditions. Part I: Energy analysis. Energy Conversion and Management, 2014, vol. 79, p. 731-748.

[20] ROSATO, Antonio, SIBILIO, Sergio, SCORPIO, Michelangelo. Dynamic performance assessment of a residential building-integrated cogeneration system under different boundary conditions. Part II: environmental and economic analyses. Energy Conversion Management, 2014, vol. 79, p. 749-770.

[21] CIAMPI, Giovanni, ROSATO, Antonio, SCORPIO, Michelangelo, SIBILIO, Sergio. Experimental analysis of a micro-trigeneration system composed of a micro-cogenerator coupled with an electric chiller. Applied Thermal Engineering, 2014, vol. 73, p. 1307-1320.

[22] EN ISO 13789:2008. Thermal performance of buildings – Transmission and ventilation heat transfer coefficients – Calculation method.

[23] SketchUp, <http://www.sketchup.com/it>

[24] OpenStudio, <https://www.openstudio.net/>

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Analysis of Historic Urban Fabric of Sariyer in Istanbul In Terms of Sustainability And Proposals For Its Conservation

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Abstract
Hosting many civilizations throughout history, the historic urban fabric of Sariyer, situated in the north coastal side of Bosphorus in Istanbul, Turkey, has been majorly a summer resort until 19th century. In the region, where the main source of living was the fishery since the earliest times, permanent settlements were started to be seen after 19th century. Especially after the second half of the 20th century, major problems of the city, like social changes due to migrations, rapid population growth and unqualified implementations in the urban fabric, affected Sariyer as well. Although the conservation studies around Bosphorus could not be proceeded continuously especially after 1970s, Sariyer is still in a valuable location, pursuing to protect it's local characteristics, providing liveability at local quarter scale, keeping some of its historic buildings and also providing the inhabitants qualified living spaces in a closer relationship with nature. For the sake of ensuring the continuity of values and characteristics owned by an area, solely a physical conservation cannot be assumed as sufficient anymore, but social, cultural, economic and ecological balance should be constituted with an integrated approach. Within this framework, this study will analyse the historic site of Sariyer as a case study for Bosphorus villages and its historic residential buildings to make necessary conservation proposals in terms of sustainability at environmental and building scales.

Key words: Istanbul, Sariyer, historic environment, conservation, sustainability.

1. Problem Statement
For the sake of ensuring the continuity of original historic characteristics of a historic site, solely a physical conservation cannot be assumed as sufficient anymore, but social, cultural, economic and ecological balance should be constituted with an integrated approach. Within this framework, the aim of this study is to analyze the historic site of Sariyer District, as a sample area for other Bosphorus villages under the influence of severe urbanization in Istanbul to make necessary conservation proposals in terms of sustainability at environmental and building scales.

2. Theoretical and Conceptual Framework: Conservation and Sustainability
The aim of historic site conservation, which is one of the most important spatial reflections of culture, is both to sustain the original characteristics of urban fabric today, and to transfer it to the future as a historical document and a source of cultural identity. Within this context, the concept of sustainability, which basically depends on the concepts of 'continuity' and 'persistence', stands at the basis of historic conservation [1].
One of the most important principles for the persistence of historic environment and cultural heritage is the preservation of its authenticity [2]. Authenticity, preventing the 'standardization', which is one of the biggest problems of city planning, provides the legibility of different cultures through space and its usage [3]. In this sense, the concept of 'spirit of place', which is the urban expression of authenticity, emerges as an alternative model in the studies of sustainability [4]. For the sustainability of cultural heritage, accurate conservation policies must be developed and realistic management plans must be prepared convenient for the region. For this reason, other than creating the delusion of a museum city and taking the authenticity principle as the origin; it is necessary to take the advantage of existing cultural values, preparing the correct social and economic development strategies and fulfilling the needs of today, without losing the environment-life quality.

3. General Characteristics of The Study Area From Past to Present

The study area including the historic cores of Sariyer and Yenimahalle quarters (Fig. 1 & 2) are two neighbouring Bosphorus villages (Fig. 3), which are thought to be together since old times, due to their commercial and social integrity. Topographically, Sariyer is more flat with a valley character, which is actually a streambed, cutting the coastal line perpendicularly with many traditional dwellings along.

Contrary to Sariyer quarter, Yenimahalle has a hillside character, due to its volcanic steep geography. For this reason, the urban fabric of Yenimahalle gradually rises with the topography parallel to the coastal line. Apart from these, a row of waterfront single houses (which is known as 'yali' in Turkish) along the coastal line of the study area is a typical characteristic for Bosphorus villages.

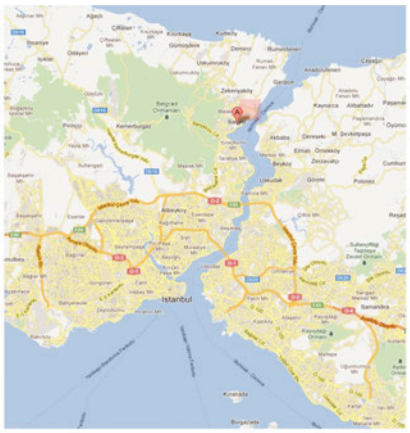




Fig. 1 (left): Location of the study area in Istanbul (https://maps.google.com/, 02, 2013).
Fig. 2 (right): Location of Sariyer in Bosphorus (https://maps.google.com/, 02, 2013).



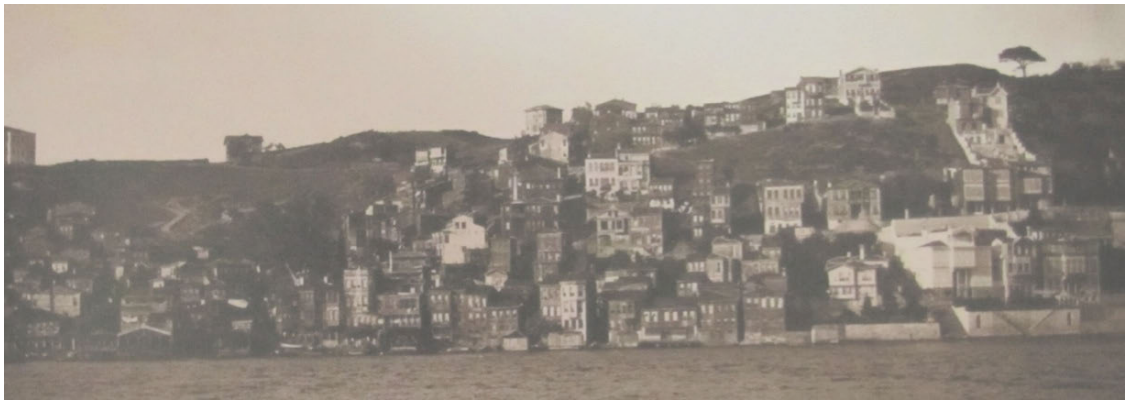
Fig. 3: Boundary of the study area in the district (1-Sariyer, 2-Yenimahalle) (https://maps.google.com/, 02, 2014).

3.1. Social Characteristics

Sariyer was known to be a traditional quarter, which has been densely and modestly lived till the end of 19th century [5]. The biggest migrations to Sariyer were from Balkans and from Black Sea Region of Turkey, which occurred especially after the Russo-Turkish War in 1877-78, increasing even more after Balkan Wars, World War I and Turkish War of Independence. Both Sariyer and Yenimahalle were the oldest fishing villages of Istanbul going back to Byzantine Period [6] and agricultural activities have been always dominant in the local economy. In the Ottoman Period, majorly the Greeks and Armenians, minorly Jews and Turks preferred Yenimahalle to settle and use the area as a summer resort [7] [8]. For supporting the development of new settlement areas along Bosphorus in 1930s, the maritime services were decided to be continued during not only summer, but also whole year. This decision increased the popularity of this district parallel to other Bosphorus villages [9]. The rate of non-Muslim groups gradually decreased, due to population exchange during Early Republican Period, and also depending on the continuing immigrations of Greeks and Armenians to other countries for political reasons especially between 1960 and 1980 [10].

3.2. Environmental Characteristics

In the study area, being located within the natural and cultural sites, also comprising a large number of qualified historic buildings within its boundaries, it is found out that there occurred corruptions and unqualified changes both in nature and in the traditional urban fabric, due to false implementations in time (Fig. 4 & Fig. 5). Despite its natural advantages like its close location to the sea and large green areas, as well as the buildings within gardens, the study area has access to the sea only at a few public areas on the coastal line. The rest of the coastal line is in the private ownership and use by the waterfront houses, which is the original situation for the Bosphorus coastal line.



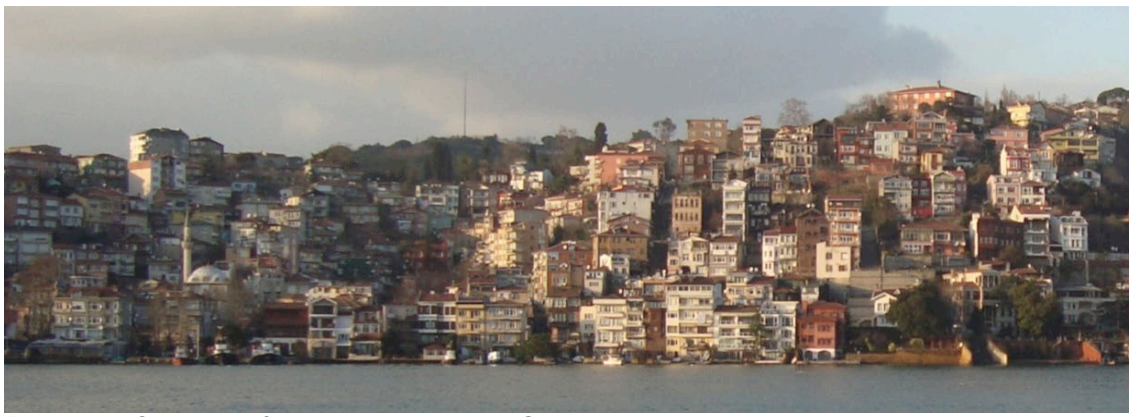


Fig. 4 (top): Silhouette of Yenimahalle in 1900s (Genim, 2006: 819; Anonim, 1900).
Fig. 5 (bottom): Silhouette of Yenimahalle in 2012 (Kaptanoglu, 2012).

Additionally, various topographic conditions by the seaside create many viewpoints, which is an important environmental prosperity. Despite the existence of authentic environmental qualities like dead-end streets and the streets with stairs (Fig.6, 7, 8) as can be seen in the Bosphorus frequently, there are no original street pavements (Fig.9) left in the study area. On the other hand, the traffic congestions due to vehicles' parking along the main arteries are one of the major problems of the study area today.



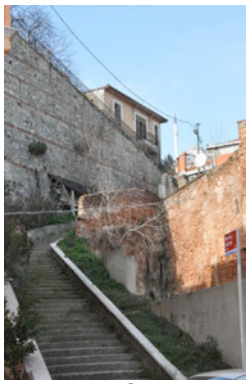






Fig.6, Fig.7, Fig.8 (left three photos) Streets with stairs from Yenimahalle (Kaptanoglu, 2013).
Fig.9 (right): The original street pavement of Aziz Efendi Street in Yenimahalle in 1971 (IRCICA Archives)

3.3. Architectural Characteristics

When the architectural characteristics of the historic urban fabric are analysed today, the earliest monumental building existing in the area is Sariyer Turkish Bath (Fig.8) from around late 16th century. The other monumental buildings in the area; Ali Kethuda Mosque (Fig.10 & Fig.11) dates back to late 17th century and St. Prodromus Church (Fig.9) dates back to 19th century. The district, which is famous with its local spring water, has a number of fountains from 17th, 18th and 19th centuries. Today, the historic dwellings, which are from late 19th and early 20th centuries, constitute only 18% of the total buildings in the district. On the other hand, reinforced concrete buildings mostly constructed after 1970s have the majority of the area with 57%. The traditional buildings have up to four storeys, when reinforced concrete buildings have five or more storeys. The highest buildings are just 9% in the study area, but can be easily perceived as prominently incompatible in the silhouette, related with quite steep topographic conditions. It is important that 78% of the all buildings are totally used at a high rate, when 8% are not used at all, as they are mostly at different stages of restoration.

Apart from this, 63% of the buildings are used for residential, when 19% are used for commercial purposes. Dual usage of the buildings that is commercial at the ground floors and residential at the upper floors can be mostly seen in Sariyer area, when Yenimahalle is mostly composed of solely residential buildings. In addition, there are a few different functions in the area, like healthcare, education and public as well.





Fig. 8 (left): View of Turkish Bath from Hamam Street (http://www.envanter.gov.tr, 2014).
Fig. 9 (left): The entrance door of St. Prodromus Church on Ibni Sina Street (Kaptanoglu, 2013).





Fig. 10 (left): View of Ali Kethuda Mosque from the sea in the old times (Balcı, 1998: 70).
Fig. 11(right): View of Ali Kethuda Mosque from the sea in 2013 (Kaptanoglu, 2013).

8% of the buildings are original traditional historic buildings, with composite structural systems, being masonry at their foundations and ground floors, and timber structure at the upper floors. Whereas, 43% of the buildings are new buildings with reinforced concrete structures, which exists at the highest rate in the study area ruining the integrity of the historic urban fabric. 12% of the buildings are reconstructed buildings with reinforced concrete structures with timber cladding. 4% of the buildings are Early Republican Period (1923-1938) buildings, which are brick masonry with reinforced concrete floors and are compatible buildings in the historic environment.

Besides, from the point of structural condition, 9% of the historic buildings are in ‘good condition’, excluding the reinforced concrete new buildings. On the other hand, the rate of reconstructed historic buildings is 12% unfortunately, done according to the previous period of conservation decisions with reinforced structure and

timber facade claddings. In the area, when the reconstructed 'historic' buildings constitute one extreme group of 'alteration analysis', there are no 'unaltered' historic buildings, which reflect the problems in conservation obviously. In addition, the rates of 'little altered' historic buildings are 8% and 'moderately altered' historic buildings are 6% in the area.
Depending on the typological analysis of the residential buildings in the study area, it can be said that the original building-plot relations are preserved. There are two types of locations as 'with garden' and 'without garden' enriching this historic environment. Furthermore, the existing different facade typologies of residential buildings are 'with projection', 'with balcony' and 'with both projection and balcony'.

4. Evaluation of the Study Area from the Point of Sustainability

With respect to the qualifications the study area has, it is of significant value with its location by the sea, close to green areas and with the residential buildings that are generally with gardens, as well as its public spaces. In addition, the fact that quite widely known local spring water is currently sold and consumed; the existence of local agricultural products and fishing as ongoing practices are important values concerning nature. However, current disruption of the previous agricultural lands in Sariyer Valley and having the valley filled with buildings are problems of major importance.

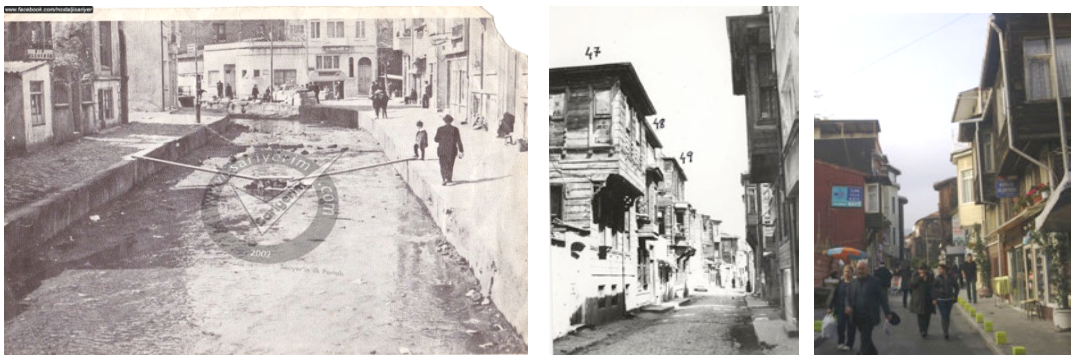


Fig. 12 (left): Sariyer Stream before it was filled (www.facebook/ sariyernostalji.com, 2014).
Fig. 13 (middle): View from Dursun Fakih Street in 1950s (Ayse Unlu Archive).
Fig. 14 (right): View from Dursun Fakih Street in 2014 (Kaptanoglu, 2014).

Furthermore, having Sariyer Stream (Fig. 12) filled and today's major road being constructed over it constitute yet one misfortunate situation that caused the loss of a significant natural value in the area. In addition, wastes released into the sea from fishing boats and cargo ships establish another significant environmental problem still today. Yet, providing control for the use of natural resources, and choosing alternative energy sources in our daily lives and in transportation may create a living space with high living standards. Moreover, building an environment of higher quality through waste management and having perfectible green areas are important issues. By the way, as long as the resources are not used in ways that foster productivity, wastes are not managed efficiently and agricultural lands are permitted to urbanization; more environmental issues should be expected. Furthermore, with the construction of 3rd Bosphorus Bridge, disruption of the landscape in conjunction with the increase in the population of settlements that are located on the northern side of Istanbul and the increasing destruction towards the northern forest areas of the city are expected to be the significant threats for the area.
Sustaining the original functions in the monumental and traditional residential buildings, as well as the persistence of the buildings in use at a rate of 78% are important data regarding the physical environment. Furthermore, buildings having mixed use with residential and commercial functions, as well as the traditional buildings that have maximum three floors above the ground floor can also be considered as authentic for the area. In addition, the richness of vista points related with the sloped topography and the sea, together with the dead end streets and streets with stairs are among the environmental characteristics reflecting the features of the historic traditional district. However, the loss of physical qualities of the traditional buildings due to the change of their original functions, unqualified additions to the historic buildings, their gardens and the existence of reconstructed buildings within the area with a rate of 12%, together with the reinforced concrete new buildings at a rate of 43%, much more than the historic buildings are among the major existing problems of the study area (Fig. 13 & Fig. 14). Additionally, the aboveground power and phone cables, as well as the inadequate street signs are other problems in the traditional urban fabric waiting to be solved.
From a socio-cultural aspect, the study area being located by the Bosphorus considered to be one of the most popular areas in the world, having a multicultural identity through centuries and its ongoing traditional

neighbourhood culture, despite the multitude of variables, constitute significant values. On the other hand, most of the first residents having left the study area, the lack of public areas despite the dense residential used with a rate of 63%; the existing cultural values getting inadequate recognition from today's residents and insufficient level of studies with respect to cultural tourism are among vital issues.





Fig. 15 (right): One of the traditional local shops in Yenimahalle, Karakutuk Ave. no: 9 (Kaptanoglu, 2014).
Fig. 16 (middle): Yenimahalle Jetty Square in 1900s (Genim, 2006: 823; Anonim, 1900).
Fig. 17 (right): Yenimahalle Jetty Square used as a park today (Kaptanoglu, 2013).

For the local economy, it is considerable to have local shops (Fig. 15) persisting today in commercially dense areas. Among the other existing values are the positive effects on tourism related with the nearby sea and the nature (Fig. 16 & Fig. 17) keeping the regional economy vibrant and the traditional tastes that have been inherited for generations. On the other hand, the lack of a correct management plan regarding the cultural values has a negative impact on the regional economy. The appearance of the shop windows of both historic and new buildings in the commercial zone is mostly unqualified and unaesthetic.
With the existing conventional ferries and sea buses, important, as well as the new subway transportation in progress for the area with the addition of new stations, public transportation has been improved to an extent, but still waiting to be further developed. Moreover, access to public open areas and public services at a walking distance is an important opportunity. In addition, the noise pollution increasing on main arteries and the irregular parking areas on the sides of the roads cause disorder in the district.

5. Conservation Proposals in Terms of Sustainability

5.1. At Environmental Scale

When the study area is handled at environmental scale, traffic as one of the major problems of Istanbul, is the primary reason of air pollution and facade pollution for the historic buildings. For the progress of short distance transportation, pedestrian movement should be encouraged through the improvement of pedestrian walkways and pavements at universal design standards, considering handicapped people and babies in carts, as well as cycling should be supported at flat areas by the provision of necessary bicycle paths and parking points at frequent points around public areas. The road on Sariyer Stream, which used to be on the route to picnic areas in history along with trees and timber residential buildings, is proposed to be removed partially to revitalize the stream and an important natural component is planned to be restored. With this purpose, public transportation must be supported and technological innovations must also be utilized.
Another important potential to be developed for the public transportation in the study area, is the proliferation of maritime transportation between Bosphorus villages and the city centre. Within this context, Yenimahalle Jetty can be reconstructed depending on the adequate amount of documentation like the approved restoration project approved by the Conservation Council.
Besides, controlled usage of the energy resources and alternative energy systems must be utilized both for the historic and the new buildings. For example, it is possible to achieve lower annual heating and cooling energy consumptions in the study area being located in the moderate climatic zone with the use of air source heat pump, which can be installed in the gardens in a less apparent way and has lower costs. Solar energy, which is another renewable and clean energy source, is known to contain significant potential for our country. However, it is necessary to use the methods and products that do not disturb the authenticity of the historic buildings and the site.
Some of the old wells in the gardens fed from Sariyer Stream are desiccated today. Revitalization of the stream will affect the waterways to the wells and this will increase the use of well water again. However, it is also necessary to provide controlled use of local spring water sources. In addition, necessary regulations should be implemented ensuring the re-use of rainwater and grey water to get use of them for suitable cleaning purposes, or can also be used for garden irrigation.

On the other hand, it is necessary to increase the studies to prevent the violations at transit passages through Bosphorus, as it is much more difficult to clean the fuel spread onto the seawater than to compensate the loss of property and life, in case of an accident by the passing ships.
Above all, waste control regulations must be revised, as well as the provision of regional waste collection and treatment systems in the study area. Management of construction wastes, which constitute the majority of the existing solid wastes, is an important requirement in the world and in our country. In this sense, their reuse is important within the framework of sustainability.
For the provision of a healthy environment for the inhabitants of the district, public green areas that are decreasing gradually, should not be allowed to become built areas, as well as the residential gardens should be developed with the awareness of their importance as areas of biodiversity and landscape. On the contrary, it is recommended to increase the public areas on the coastal line.
Apart from these, the old traditional artisanal jobs, like basketry and workmanship of tinner, are proposed to be continued in their own units in the commercial zone.
About the urban fabric, the dead-end streets and the streets with stairs should be kept, revealing the original street pavements underneath and widespreading the traditional materials in the area.

5.2. At Architectural Scale
Parallel to the resolution with the number 660 of Classification, Maintenance and Repair of Immovable Cultural Assets, certain intervention types are proposed for the repair works to be held in the site, considering the condition of buildings as well as the level of deterioration. The intervention groups are composed in three groups as; the buildings registered within the frame of the Construction Law of Bosphorus no: 2960, traditional buildings that are proposed to be registered and new buildings with no historic value.

1) For the historic buildings (either registered or proposed to be registered):
- 3% of the historic buildings, which are in need of *'extensive intervention'*, are abandoned buildings in very poor condition with important physical damages that may cause collapse or demolish unless urgent restoration intervention is provided. In the reconstruction of these buildings, which pose danger to their environment, reusable original materials should be sorted; for instance intact timber and brick materials of the load bearing systems and timber facings on facades should be reserved for reuse.
For the buildings at a rate of 12% that had lost their authenticity, due to unqualified restorations by the use of reinforced concrete structural systems with timber claddings at the façades; are proposed to be reconstructed depending on their previous measured drawing projects and other reliable detailed documentation, using their authentic structural systems and materials. Apart from this, the registered buildings that were burnt down or collapsed structurally, leaving their plot empty, are proposed to be reconstructed depending on their measured drawings and all documentation. Likewise, the commercial buildings, which has been ruined due to increasing commercial functions and lost most of its authentic properties, should be protected in order to return these qualities. Nevertheless, the originally dual functioned buildings (shop in the entrance floor and residence in the upper floors) have to be protected with care (Fig. 18 & Fig. 19)





'Fig. 18 (left): Mandıra Str. in Sariyer no:5 & Fig. 19 (mid-left): Baglar Str. no:13 in Yenimahalle (Kaptanoglu, 2013) as 'extensive intervention' examples.
Fig. 20 (mid-right): Baglar Yolu Str. No: 26, Fig. 21 (right): Dursun Fakih Str. No:15 (Kaptanoglu, 2013) as 'partial intervention' examples.

- Traditional buildings, which necessitate *'partial intervention'*, are those still in use, despite their structural deteriorations and disintegrations externally (Fig. 20 & Fig. 21). In the repair of these buildings, which constitute 6% of the historic buildings, structural systems should be reinforced with original techniques, or with modern techniques, if necessary. For the modern products, the priority should be given to those that are

made of reusable materials. For the buildings with comprehensively altered façade claddings and architectural elements (especially replacing with incompatible but affordable PVC based elements), they should be restored according to the available visual and written documents about the building, as well as depending on the related building typology within the site.
Few residential buildings from the Early Republican Period built with brick masonry and reinforced concrete, which are continuously spoilt, due to unqualified interventions, are proposed to registered and taken under conservation (Fig. 22).




Fig. 22 (left): Early Republican Period buildign example from Selimiye Str. no:25 in Yenimahalle (Kaptanoglu, 2013)
Fig. 23 (middle): Koru Mandira Str. no:2 in Sariyer & Fig. 24 (right): Karakutuk Str. no:49 in Yenimahalle (Kaptanoglu, 2013) as 'simple repair' examples.

- The historic building group at a rate of 9% in the site necessitate *'simple repair',* which are composed of the buildings with minimum structural problems and partial material problems at their original architectural elements or a few being replaced with incompatible or unqualified new architectural elements. These buildings, which only necessitate external interventions, but mostly staying authentic at the interior, are advised to be repaired with environment friendly construction materials. (Fig. 23 & Fig. 24)

2) For the new buildings, which constitute the majority of the study area, their integration to the historic site is aimed primarily.
For this group of new buildings, which are usually compatible within the traditional urban fabric, keeping their original plot sizes and masses, the proposals taking the street scale into account should be preferred, instead of a restricted and unhealthy building scale. First of all, the use of compatible colours and materials at the façades, replacement of architectural elements with proportions according to the traditional building typology, rearrangement of balconies and other projections can be counted as the first necessary interventions for the new buildings.
Besides, the reinforced concrete new buildings, which have incompatible character within the historic environment at a rate of 9%, should be reduced at height and rearranged at the façade. Especially for the reinforced concrete buildings and in all interventions to be made, sustainable and reusable demolition should be preferred. In order to establish a healthy residential environment, environment friendly building technologies and materials should be favoured for new building projects.
Additionally, since the shop windows play an important role in the economy of the study area, the shop signs and posters should be redesigned in accordance with the traditional fabric; external elements such as air conditioners and electric wires that cause pollution at the façades should be removed. In the market area, commercial use at ground floors and basements of traditional residential buildings caused unqualified changes at the original façades. Proliferation of commercial use in this type of buildings should be prevented or restricted.



Fig. 25: Illegal squatter area surrounding Sariyer District at behind (Kaptanoglu, 2013).

For the new buildings, which are located outside the study area, obviously ruining the general silhouette, with a legal demolition order to be applied, but cannot be implemented due to many socio-economic problems. This complicated problem necessitates the public participation of many actors for a healthy solution. (Fig. 25)

6. Result

Within the context of the conservation project and the analytical study with an emphasis on sustainability which this paper is based on, the conservation proposals are made at both environmental and architectural scales for different types of buildings comprised in the study area. Apart from the proposals for the physical environment, the social environment is also handled to enrich the social reinforcement through developing the required public areas with the aim to improve the sense of belonging of the inhabitants living in the district and support them to produce solutions for the existing problems primarily with their own effort.

The study area owns the necessary characteristics and potentials to provide and present qualified life opportunities, being located by the Bosphorus and very close to north forests of Istanbul as the most important source of clean air. Although it is known that many cultural assets in the district are lost in the past, there are also many other historic values to be protected, with an emphasis on sustainability and a revised historic conservation approach, depending on a more responsible multidirectional understanding for the nature.

Bibliographical References:

[1] Gunay, Z. (2010), *Neoliberal Kentlesme Dinamikleri Cercevesinde Tarihi Cevrenin Surdurulebilirligi: Surdurulebilir Kentsel Koruma Modeli,* Ph.D Thesis on City and Regional Planning, ITU, Istanbul, p.53.

[2] Ibid, p.62.

[3] Konuk, S. (2009), *Bir Planlama Yaklasim Bicimi Olarak Kulturel Surdurulebilirlik: Kumkapi ornegi,* Master Thesis, ITU, Istanbul, p.19.

[4] Newman P. & Jeddings I. (2008), *Cities as Sustainable Ecosystems, Principles and Practices,* Island Press, Washington, p.146.

[5] Genim, S. (2000), *Konstantiniyye'den Istanbul'a 19. Yuzyil Ortalarindan 20. Yuzyilda Bogazici'nin Rumeli Yakasi Fotograflari,* Suna ve İnan Kirac Vakfi Istanbul Arastirmalari Enstitusu Kataloglar Dizisi, Istanbul, p.796.

[6] Hurel, H. (2010), Istanbul'un Ansiklopedik Oykusu, Kapi Publications, Istanbul, p.669.

[7] Balci, I. (2006), *Sariyer, Asiyan'dan Kisirkaya'ya*, Ilkbiz Press, Istanbul, p.23.

[8] Mazak, A. Mazak, M., (2008), *Dersaadet'in Sayfiye Semti Sariyer*, Sariyer Municipality, Istanbul, p.20.

[9] Tutel, E. (2008), *Sirket-i Hayriye,* İletisim Publications, Istanbul, p.20.

[10] Balci, I., p.47.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
Aversa, Capri 11-12-13 June 2015

Art and Technology. The Guggenheim Museum Helsinki

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Abstract
The plan appears to be as the rest of a pietrified fossil forest. Individual elements, like gigantic tree- trunks carved and excavated, are put together to form a unitary whole around common distribution spaces.
The new museum is inserted in an available building plot through a planimetric multicellular structure that refers to the major sights of the city.
All exhibition areas, event rooms, shops with the ramp that arrives to upper levels, are displayed around common areas similar to covered "urban squares". These, are crossed by vertical passages wich gather up the context and build a careful game of visual interesections between the inside and the outside.
The cover's building is in a slight excavation to concentric circular pattern that recalls the internal veins of tree- trunk. It is covered to put up the garden sculpture and is oriented toward the topical points of the city.

Keywords: Structure, Exhibition, Urban, Intersection, City.

1. Section
From a symbolic point of view, the plan appears to be as the rest of a pietrified fossil forest. Individual elements, like gigantic carved and excavated tree -trunks, are put together to form a unitary whole around common distribution spaces.
From a urban point of view instead, the new museum is inserted in a avaliable building plot through a multicellular planimetric structure that refers to the major sights of the city.
In architectural terms, the new museum is made up some large "Collector' rooms" connected to each other. These autonomous bodies may seclude themselves or take part together into the expositive course.
The museal complex consists in a continuous rooms' body with a spherical volumetry restrained to the inside of frames of hexagonal and planimetric matrix. The interior spaces look like a dig made in solid alive body, as if the exhibition visitors' course had impressed his movements inside of hard material of the origin.
The atrium's body, in the northern area, with its relevant functions of orientation, has a coffee-shop on the ground floor and a sea-view restaurant on the first floor.
All exhibition areas, event rooms, shops with the ramp that arrives to the upper levels, are displayed around common areas similar to covered "urban squares". On the ground floor, it is supposed to be the accesses to the various exhibition galleries organized around the multipurpose zone which joints from the entrance in conformity with terrain and prospective axes.
On the adjacent side, in the direction of the road, there is the shopping-area wich has a helicoidal ramp into the centre.
From the same ramp it is possible to access to the upper floors where there are offices, administrative activities and control museum's units.
The building's covers assume a particular, symbolic and architectural meaning: these are slightly in excavation work with a circular and concentric modulation that recalls the internal veins of the tree-trunk.
In functional terms, the covering is organized to accomodate the garden-sculpture and it is based towards the topical points of the city to capture the main urban monuments from an altimetrical position of a panoramic effect.

The used materials are durable. The exterior is made of glossy colored ceramic and the interior of treated maple wood.
The transparent surfaces are made of opalescent glass, with a variable opacity in operation of external brightness to allow a perfect lightining-technique omogeneity. The opalescent glass surfaces affect the amount in the upper zones for the meeting areas (the restaurant and events). The upper expositive-floor, from wich is possible to observe the lower floor in double height, is deprived of natural light sources to allow the paintings and grafics' installation with the targeted artificial light sources.
The structure is made of metal box-frames contained, in the space, the outer sharp volume and internal curvilinear volume. The space allows to lodge all necessary sistems and to set up a ventilated wall useful for the overall energy saving.

This work is the International Design Competition with Geneviève Hanssen, Caterina Belardo, Stefania Di Donato, Marco Russo.



Fig. 1: General Plan



Fig. 2: Prospectical view

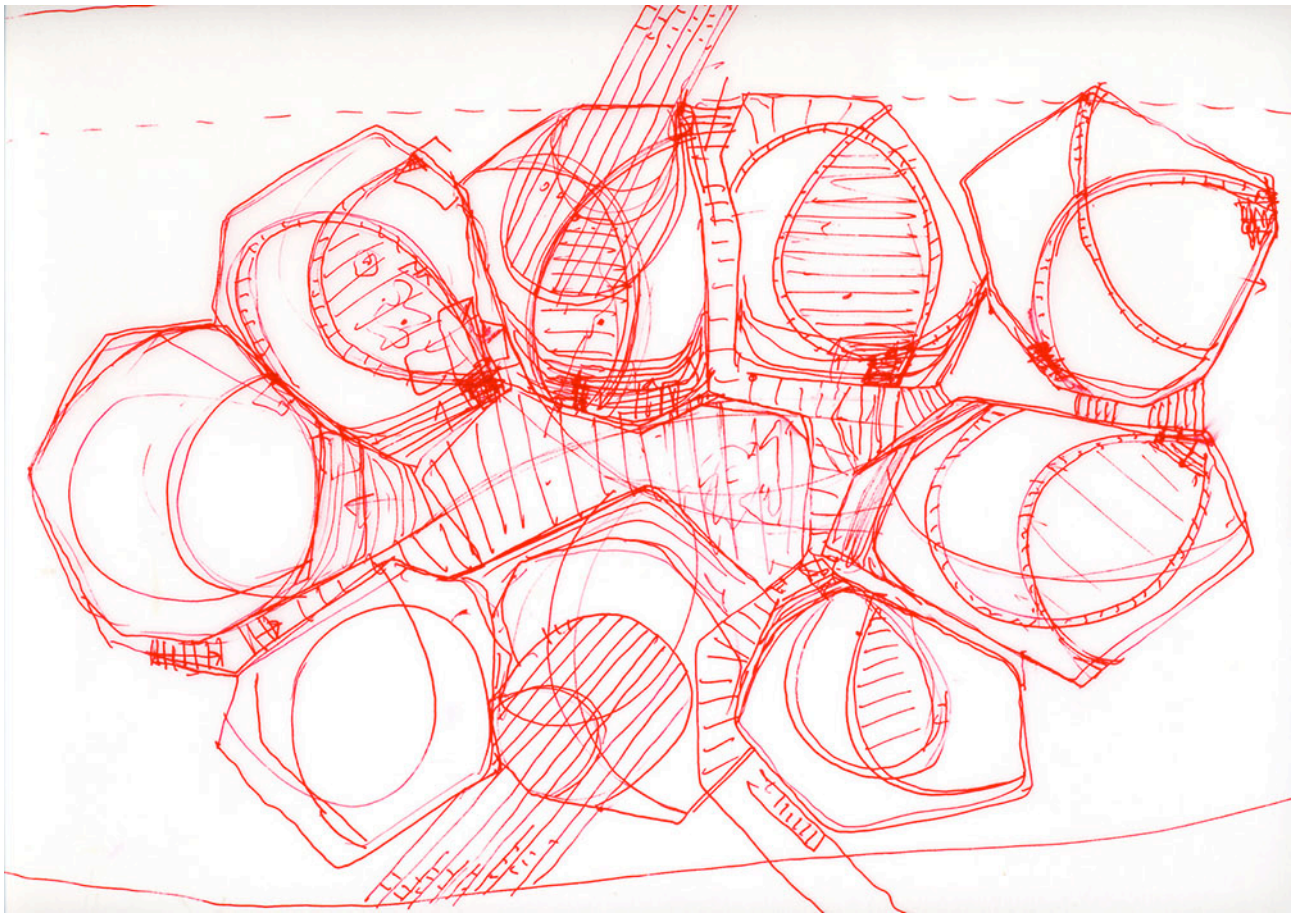

Fig. 3: Sketch

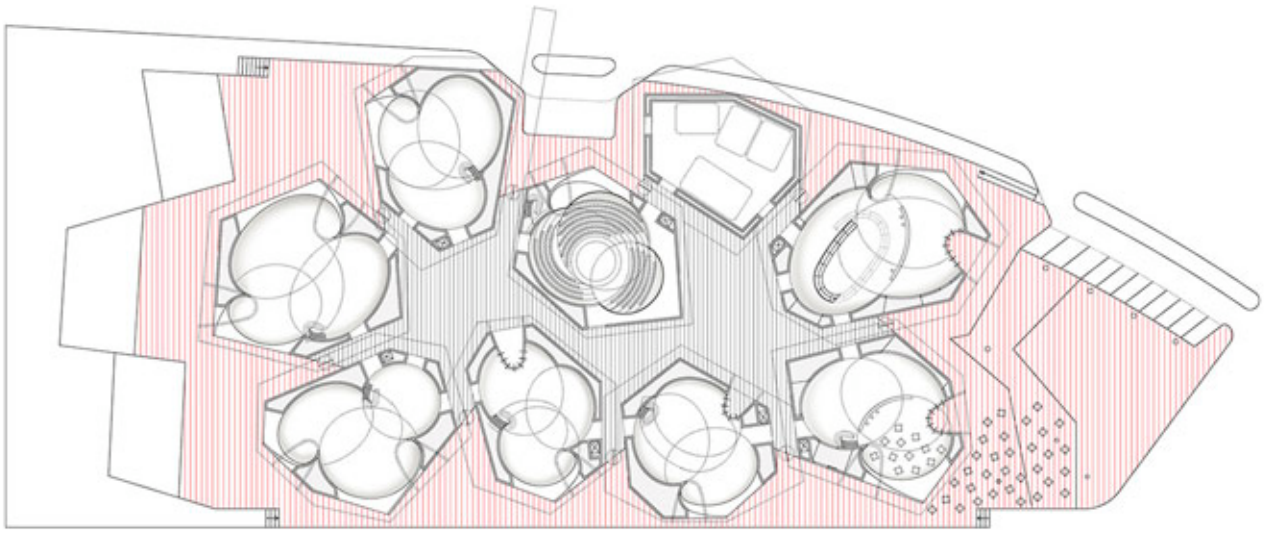

Fig. 4: Ground floor

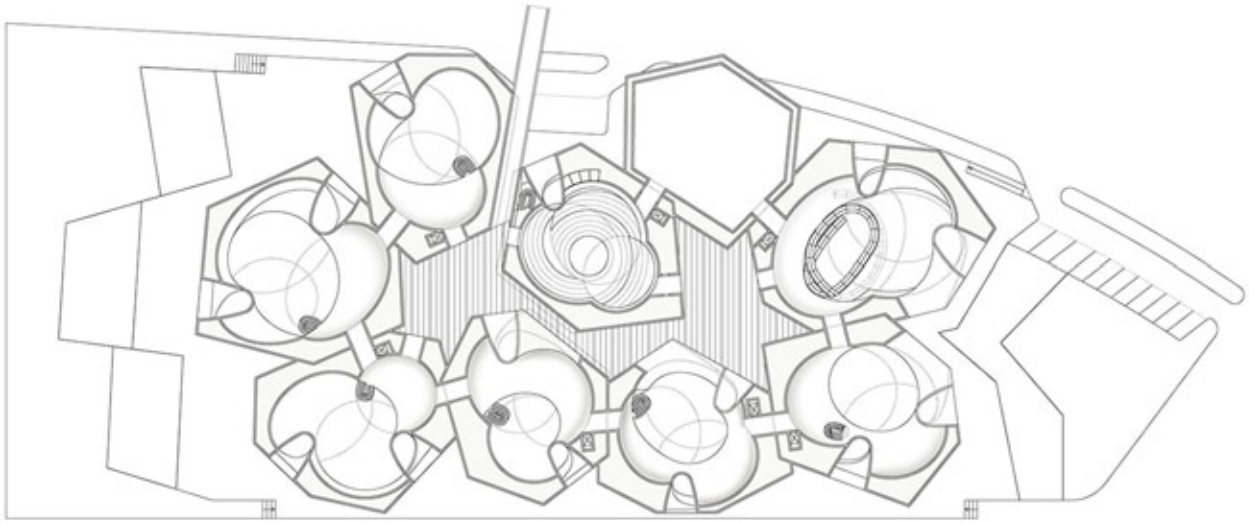

Fig. 5: First floor

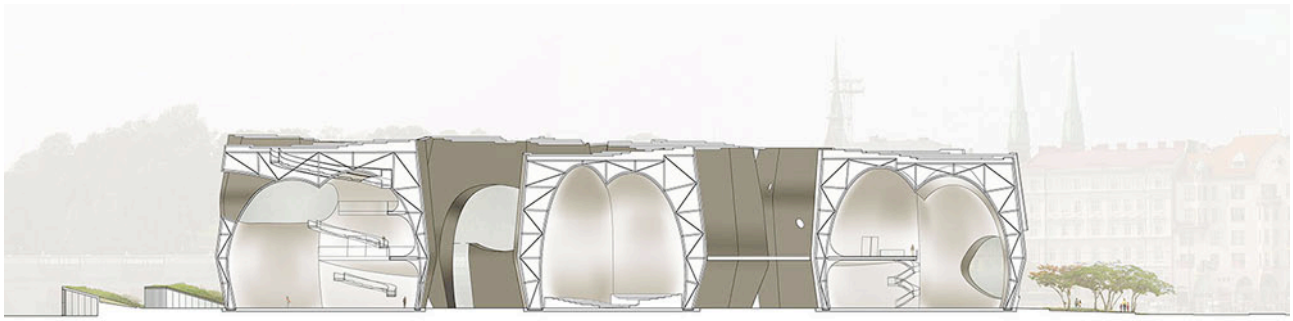

Fig. 6: Longitudinal section



Fig. 7: Longitudinal section

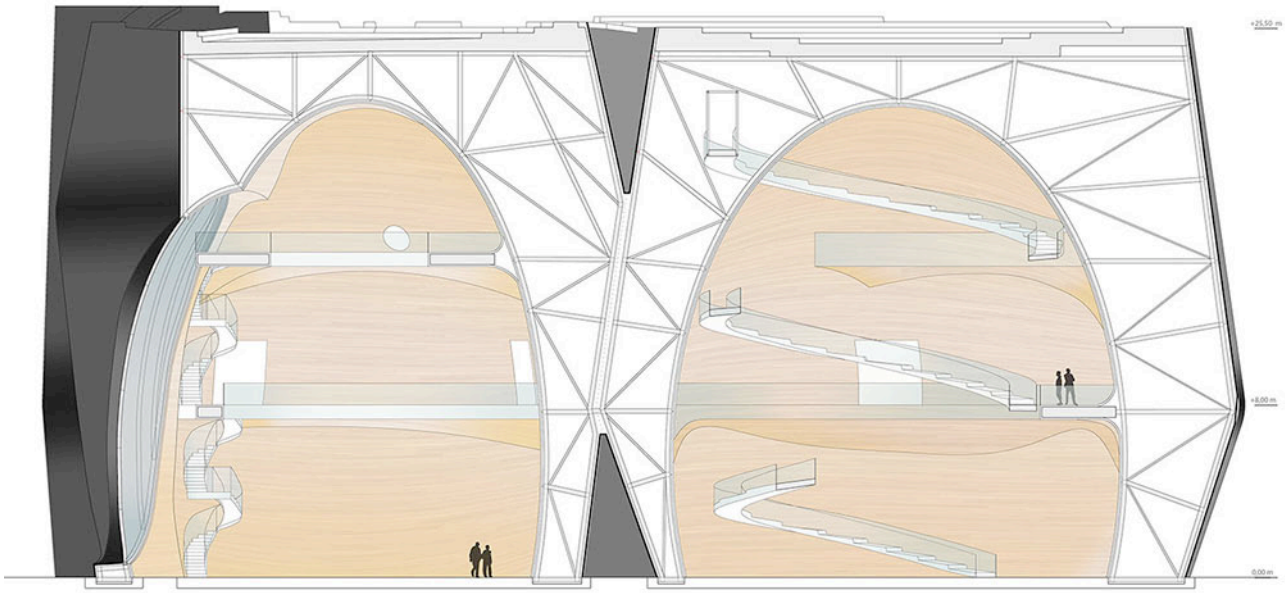

Fig. 8: Cross section



Fig. 9: Detail



Fig. 10: Entrance hall



Fig. 11: Front view



Fig. 12: Exposition hall

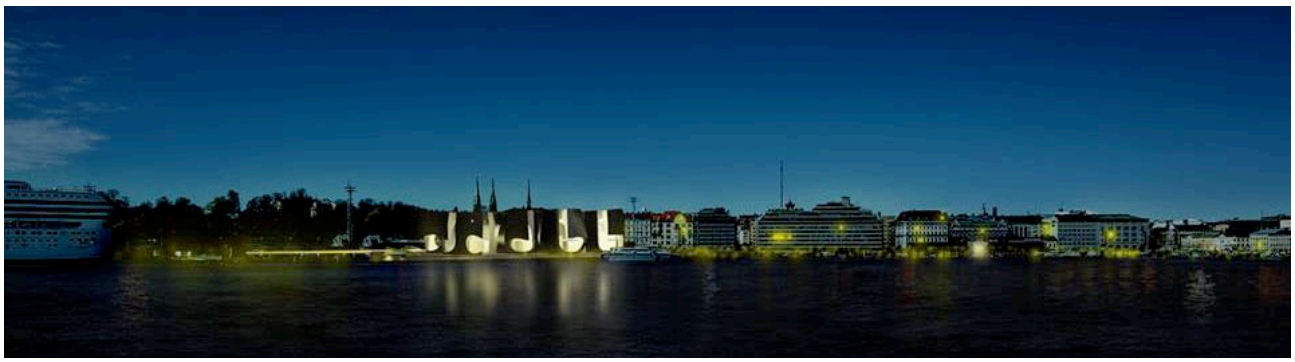

Fig. 13: Front view



Fig. 14: Prospectical view



Fig. 15: Prospectical view

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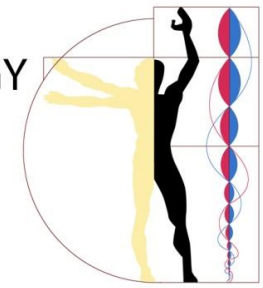

Structural modeling and conservation of single columns in archaeological areas

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Abstract
Conflicts between conservation and safety assume in the archaeological areas a determinant role, since the constructions to be evaluated are ruins. In these areas safeguard of heritage, safeguard of tourists and exigencies of fruition cannot coincide. An emblematic case in the Pompeii site is the safeguard of isolated constructions made of superimposed rigid blocks, such as isolated columns, groups of columns connected with a trabeation, jambs made of grey tuff cutted blocks without connections with the walls behind. The original state of the elements is often compromised by cracks, out of plane configurations, material detach. Often the archaeological exigency is the preservation of the defects in order to record historical facts. Usually repairs are made by sealing the cracks with grout, reattaching of stone piece with mortar only or pins. The choice of the structural model to assess the seismic vulnerability of elements strongly influences the types of interventions, and this is a significant point in the case of Pompeii.
In this paper the out of plane behaviour of superimposed masonry blocks is examined. A significant role is played by the material parameters, often difficult to evaluate. The safety assessment and the comparison with the conservation need can lead to different approach to the cultural heritage with respect to ordinary constructions.

Keywords: structural modeling, experimental tests, rigid blocks, masonry, out plane

1. Introduction

The need for conservation of monumental architecture, the more representative expression of the cultural heritage, is essential. The pressing objective of achieving security considering that a balance between conservation and security is a crucial element in the interventions choice. It must be considered that the awareness of the value and nature of both the construction and the environment can avoid irreparable damage. In particular, in the archaeological areas the issue of security is understood not only as protection of heritage, but also as tourist safety and possible of use of heritage, aspects that unfortunately do not always coincide [1]. The building technique of dry stone masonry is one of the oldest techniques surviving in the present days. Great part of historical heritage are dry stone masonry made by assembling stone blocks without mortar joints. Even structures characterized by the presence of mortar joints present signs of mechanical degradation in the mortar highlighting how the influence of the mortar on the overall structural behavior is quite negligible [2].
Many of these structures are located in seismically active areas, such as the archaeological site of Pompeii.

Emblematic is the case of isolated elements, groups of columns with trabeation, aqueduct towers, large tuff blocks jambs that characterize the popular Via dell'Abbondanza [3]. These large rigid dry masonry elements with considerable vertical development were realized without connections the backwalls. Their non linear dynamic behavior is quite complex as it may imply both the sliding and the oscillation of the blocks [4].
Many of the blocks present diffused cracks, out plane, gaps and detachments with safety risks for visitors [5]. The choice of the structural model is crucial for the evaluation of the seismic vulnerability of structures in order to minimize the danger to human health and preserve the existing cultural heritage. The most appropriate and specific interventions should be chosen to safeguard the conservation of the historical and archaeological heritage.
The first analytical studies that developed equivalent static or linearized models for the simply supported block subjected to out plane forces can be considered those by Priestley [6], who applied a principle of energy equivalence to these types of structures. An extensive bibliography on the subject is contained in the doctoral thesis by Doherty [7] and on the following papers by the same author who developed simple constitutive relations in the case of out of plane masonry walls. Simplified models based on such behavior have been used in applications to buildings, considering the effects of transverse walls and slab. The simple kinematic model with SDOF, in which the considerations on static equilibrium give the limit value of the horizontal force to the threshold of oscillation, gives rise to a simple bilinear relationship and the limit displacement is obtainable. Generally mortar is assumed cracked in order to not taking into account its contribute. The bilinear model does not consider the real behavior, which is strongly influenced by the deformation of the materials involved and the support conditions [8]. The trilinear model proposed by Doherty to take into account the real behavior of the masonry is based on the observation of qualitative results of experimental tests carried out on brick masonry panels of. It has been the starting point for similar models in which experimental parameters more simply determined are involved [9].



Fig. 1: Rigid vertical blocks in Via dell'Abbondanza

Experimental data are crucial parameters for the mechanical characterization of the problem. Often some of them, like the friction between the two blocks in the case of superimposed dry blocks [10] or between the structural element and the support surface are taken without reference to laboratory tests [11].
Recent studies concern the experimental determination of the value of the friction coefficient [12].
This work presents the assessments of jambs consisting of superimposed rigid blocks that fill the archaeological site of Pompeii, in both cases of dry and jointed masonry. The analysis is developed considering as a key point the two contemporary needs of conservation and reduction of vulnerability.

2. The kinematic problem and real behaviour

2.1. The kinematic problem

The behavior of a jamb, which in the Pompei case study is composed by several blocks of Nocera tuff, can be assimilated to a set of rigid blocks simply supported on a plane surface. The bound at the top can be considered, depending on whether or not the lintels are present [13].

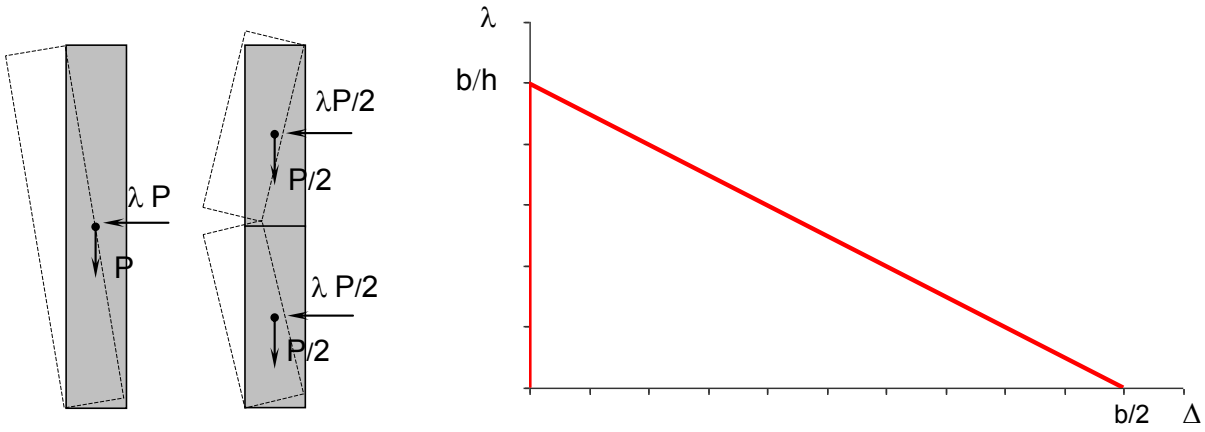

Fig. 2: Kinematic problem of simple rigid block and two superimposed bonded blocks

Assuming the complete absence of mortar, as in the case of Pompei jamb, or otherwise considering any mortar joint completely cracked, a bilinear diagram expresses the limit equilibrium relation between the load F and the significant displacement Δ, both in the case of the cantilever and simply supported beam. The picture is shown in Figure 1.

2.2 The trilinear models

The real behavior of the jamb, in the case of large displacements is similar to the theoretical one, while significant deviations can be observed in the small displacements range. In the models above cited the actual behavior is modeled with a trilinear constitutive diagram. The model developed by the Australian research group introduces a secant stiffness defined by the value of the displacement Δ_2, obtained experimentally as percentage of the last displacement Δ_u.

The behavior of the structural element is then fixed by the two displacements Δ_1 and Δ_2, both experimentally derived by means of tests on shaking table performed on masonry panels subjected to out of plane loads. The first displacement takes into account the reduction of the initial stiffness, the second is linked to the strength reduction.

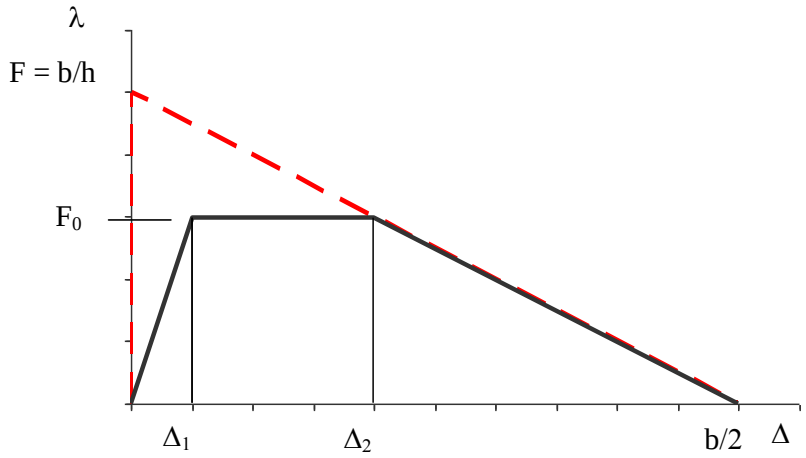

Fig. 3: Doherty's trilatera model (2000)

The values of displacements and Δ_1 e Δ_2 are obtained as a percentage of the ultimate displacement, fixed in the following table in three different damage conditions: not degraded, moderately degraded and significantly degraded. While the first condition is quite objective, the other two are strongly dependent from the observer, since there is a qualitative parameter to define them.

The moderately degraded masonry presents corresponds to almost intact mortar joints, while the very degraded masonry has strongly cracked mortar joints.

Table 1. Experimental evaluation of Δ_1 and Δ_2

DETERIORATION OF THE MASONRY	Δ_1/Δ_u	Δ_2/Δ_u
Not degraded	6%	28%
Moderately degraded	13%	40%
Significantly degraded	20%	50%

The experimental determination of the two mechanical parameters necessary for the construction of the curve F-Δ is therefore not at all simple. A recent paper by Guadagnuolo proposed to evaluate the limit load F_0 as a function of the tensile strength of the joint. The constitutive behaviour is so that characterized by:

- a linear initial section which takes into account the stiffness of the considered masonry. It should be considered that the real behavior of the masonry in tha case of small displacements is well represented by a straight line;
- a constant range, characterized by the achievement of the tensile strength of the block-mortar interface;
- a final slope coincident with the behavior defined by the linearized kinematics (equilibrium relations).

The values obtained with the model described above applied to tuff masonry coincide with those evaluated in the case of walls moderately degraded. The experimental tests necessary for the identification of the model are of course less complex than the Australian ones. Moreover, the strong dependence of the failure mechanism on the tensile strength of the mortar is confirmed in a recent study of the same research group [14]. The hypothesis of a totally experimental derivation has been partly removed.

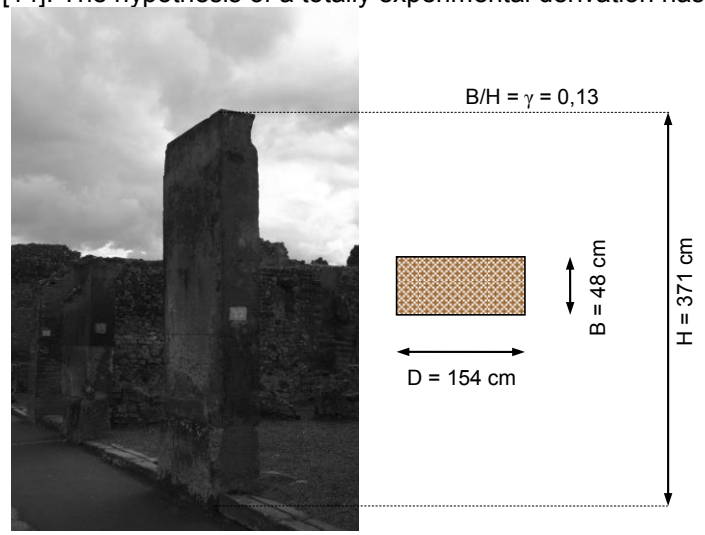

Fig. 4: Case study

In the case of Pompeian mortars, in which proportions of the components and conditions of maturation are not known, there are no direct information on the tensile strength. In addition, the Pompeii mortars have been "cooked" at high temperatures during the eruption of 79 AD and have suffered the damages due to two thousand years of weather changes. According the jamb geometry in Figure 4 and taking into account an interface tensile strength of 0.12 MP the proposed trilinear diagram is that shown in Figure 5.

2.2 The real behavior

The real behavior of block structures in out of plane range differs from bilinear constitutive model. The restraint forces, which in the case of vertical loads only have centered resultant force, tend in presence of horizontal forces to move towards the compressed edge of the section. The migration speed of reaction forces is highly dependent on the loads and the Young's modulus of the blocks.

The higher the modulus, the more close to the equilibrium slope is the curve describing the real behavior. Priestley has developed a model that takes into account the actual behavior assuming null tensile strength of the mortar and a stress-block distribution on the compressed edge.

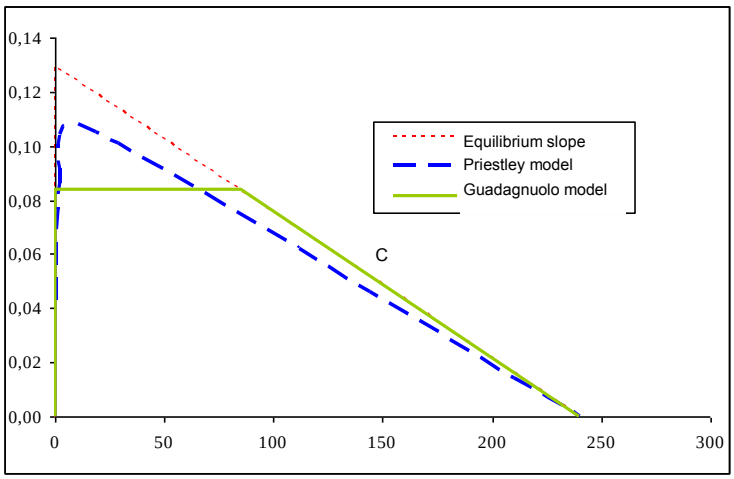

Fig. 5: Behavior patterns of a jamb in out of plane load

The Priestley model for tuff masonry panels is compared with the Guadagnuolo model and reported in the above figure.

3. The dynamic problem

The dynamics of the single block simply supported on a moving base has been extensively studied, starting from the fundamental paper by Housner [15] up to the identification of possible types of motion [16] and the criteria for the initiation of a motion type rather than another [17]. The study of the dynamic response of several superimposed blocks simply supported one on the other or even connected by lintels is more complex from the analytical point of view.

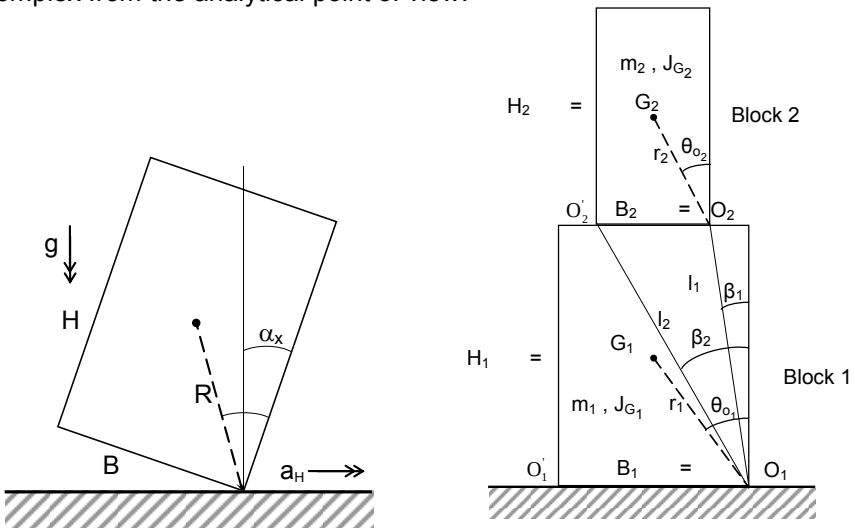

Fig. 6: Schemes for the dynamic analysis of rigid blocks

Crucial in the dynamic case too is the knowledge of the material parameters defining the problem: geometry, coefficient of friction, excitation shape. As can be seen from the analysis of Figure 6, the simple superposition of two blocks significantly increases the number of variables necessary for the definition of the differential equations of motion governing the problem. The solution was developed for the case of two blocks [18, 19]. It should be noted that in the case of several blocks there is a large number of possible configurations as it can be seen from the below figure [18].

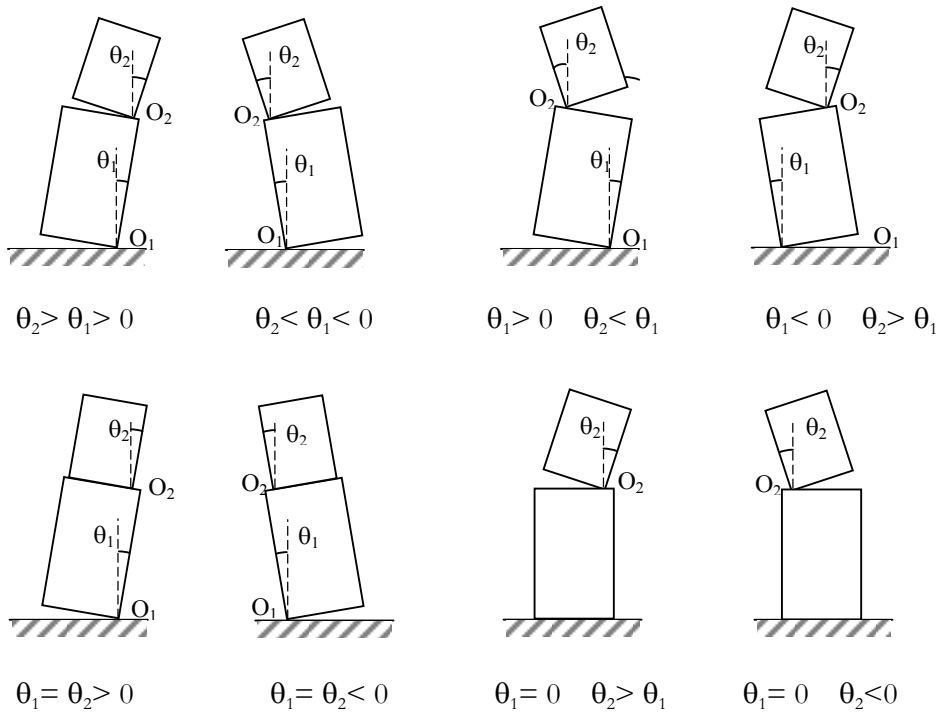

Fig. 7: Possible configurations in two superimposed blocks (by Spanos et al., 2001)

The configurations examined by Spanos reflect real situations that actually can be found in the jambs of Pompeii. In Figure 7 below the variation of verticality for only the upper part of the jamb (a), the variation of the support conditions of the blocks because of cracking (b) and the case study (c) can be observed.



Fig. 8: Some examples of superimposed blocks in Pompei: forward rotation (a), cracked blocks (b), intact jamb (c)

In the work of Spanos above cited the equations of motion for the dynamic analysis of the system consisting of two blocks are also derived. The starting point is one of the configurations shown in previous figure 7. Transitions from one configuration to another are possible and in fact the authors propose an approach for the dynamic analysis of the transition process. Nevertheless an approach to the global problem is not developed and the global analysis is an open problem.

3.1. The kinematic problem

Shenton (1996) developes some simple relations to define the quality of the expected motion depending on the geometry of the block: sliding, slide-rocking, rocking, rest. The motion involving uplift is usually excluded from the analysis. Assuming that the jamb of Pompei of Figure 6 is constituted by a single block, the motion

possible, given the geometry of the jamb, is of only two types: oscillation with impacts on the two edges at the base or rest (the block moves with the same motion of the basis). The space of possible motions is shown in Figure 7 with the shaded area. The parameters involved are the friction φ between the support surface and the block, the acceleration A_g of the support surface and the slenderness γ, also shown in the previous figure 6.

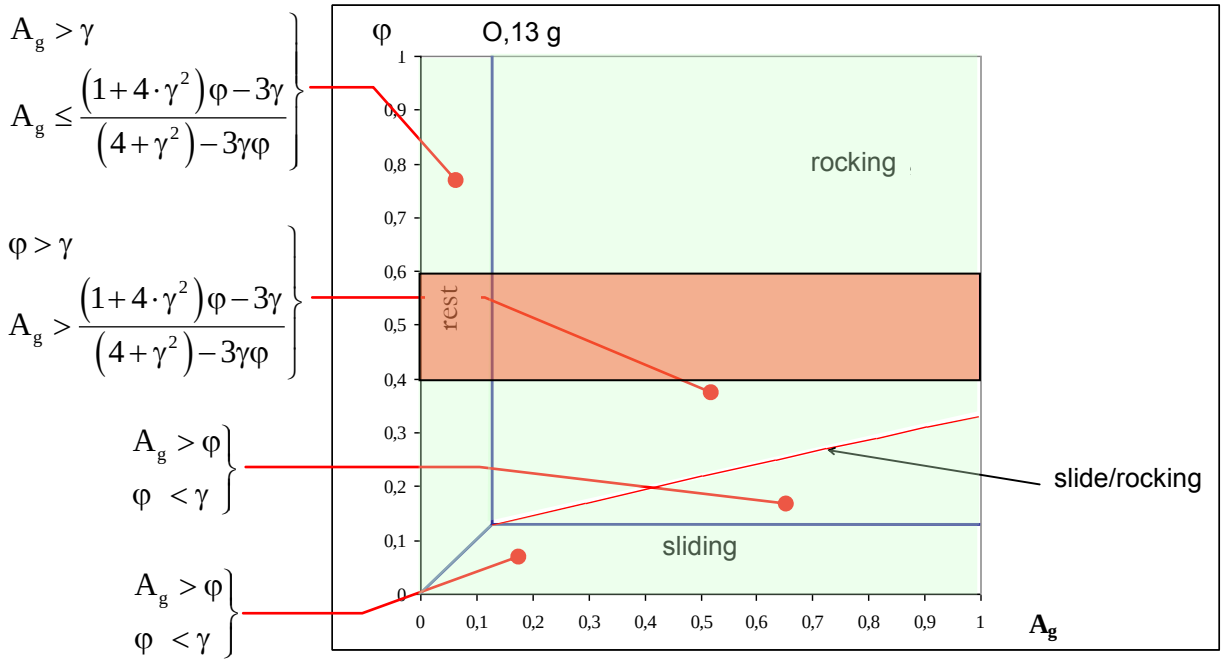

Fig. 9: Shenton plan for the jamb of Pompeii

In determining the type of motion the friction coefficient thus assumes an essential role. A series of tests on blocks simply placed on a vibrating table unidirectional sinusoidal motion has been performed [19]. The coefficients of friction between the block and the supporting surface has been evaluated by laboratory tests too. It can be said that the range of coefficients of friction in the figure is sufficiently suitable for the real case examined. Naturally, no indication is provided for the Nocera tuff blocks that compose the jamb. The two motions shown are in fact possible for friction values in a wider range. Recent numerical analysis were conducted by the authors to evaluate the dynamic responses of a single block with harmonic base forcing [19]. In the following figure the time histories for the displacement and the speed of the block (left) and plans phase (right) in case of chaotic response are shown as an example.

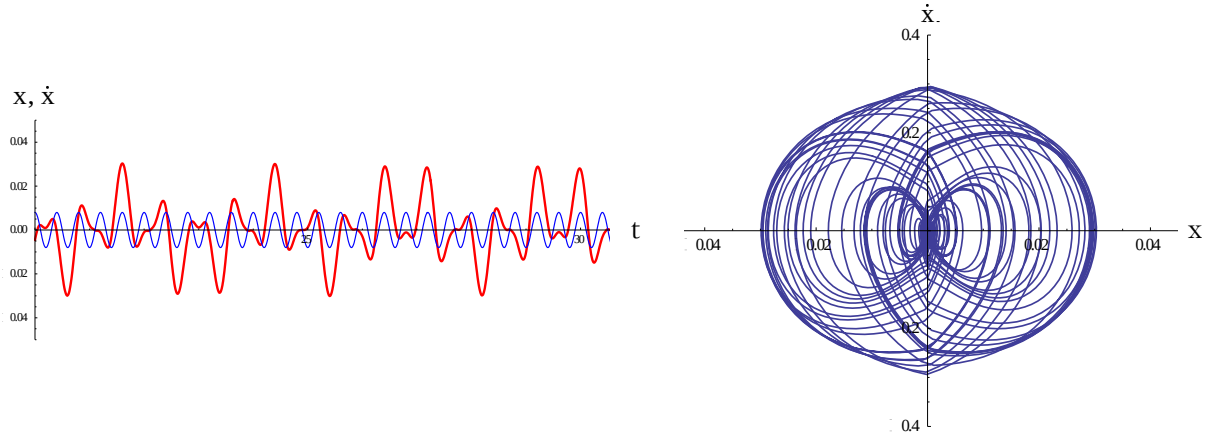

Fig.10: Time histories and phase plans for a single block with harmonic forcing.

In the cases examined by the authors for the coefficients of friction and other materials parameters reasonable values were assumed.

3.2. Dynamic of two overlapping blocks

The dynamic of two superimposed blocks starts from the analysis of the possible configurations.

The response of two superimposed blocks in free oscillations have been analyzed, while the analysis of forced oscillations is under development. The following figure shows the diagrams of the rotations and the phase plane of the two blocks simply in free oscillations.

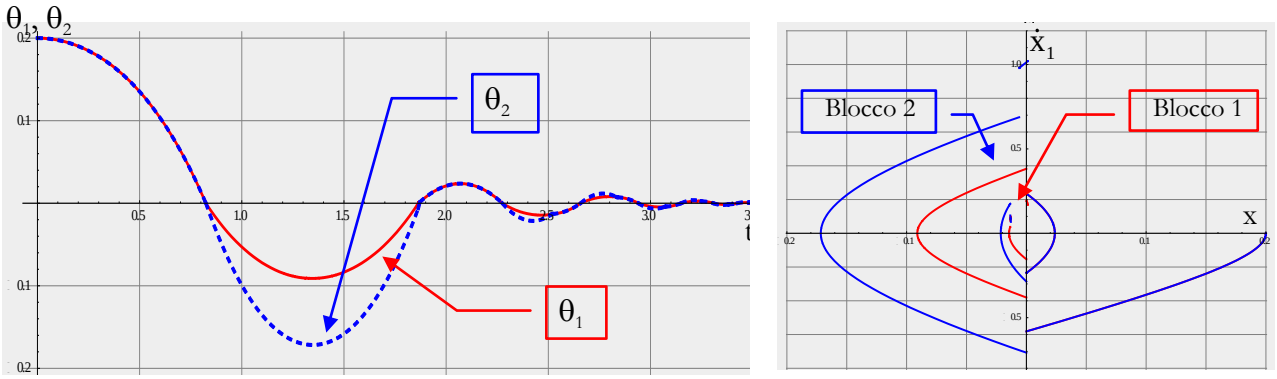

Fig. 11: Diagram of rotation and the phase plane for two overlapping blocks in free oscillation

Dynamic analysis is then possible, and future developments of the study will provide dynamic more information about the behaviourr of two or more blocks simply supported one on another. The theoretical analysis, however, does not take into account the progressive damage of the block subjected to the impact with the ground plane. The condition of the impact is therefore never desirable for structural elements that compose the archaeological heritage.

4. Final considerations

The mechanical behavior of jambs formed by superimposed blocks, present in large numbers in the archaeological area of Pompei, is still under study and the approaches in the literature do not fully define the key aspects of the problem. Many are in fact the experimental parameters necessary for its identification. Despite this, from the analysis of the available models, especially those derived from kinematics, it can be said that bilateral equilibrium condition, for which no material parameters are needed, is in each case the reference model for the jambs. More sophisticated analysis, such as the dynamic ones, can provide quantitative assessments of safety with reference to the seismic characteristics of the site. The actual state of the study may enable the construction of the response spectra of the jamb consisting of one or more blocks.

Bibliographical References

[1] Bergamasco, I.; Gesualdo, A.; Monaco, M.; Savino, M.T. (2014) Modellazione strutturale e prove sperimentali tra conservazione e sicurezza: l'area archeologica di Pompei , Proc. Workshop SAFE MONUMENTS. Tra conservazione e sicurezza di edifici monumentali e del costruito storico, Firenze, 28 marzo 2014, Collegio degli Ingegneri della Toscana Srl editore, ISBN 978 88 940 31003, pp. 167-177.

[2] Smoljanovic´ H., Z˘ivaljic´ N., Nikolic Z. (2013) A combined finite-discrete element analysis of dry stone masonry structures, *Engineering Structures* vol. 52, pp. 89–100;

[3] Bergamasco I., Carpani B., Clemente P., Papaccio V. (2012) Seismic Preservation of the Archaeological Sites: the case of Pompeii, *Structural Analysis of Historical Constructions*, Jerzi Jasienko ed., ISSN 0860-2395, DWE Wroclaw, Poland;

[4] Dimitri R., De Lorenzis L., Zavarise G. (2011) Numerical study on the dynamic behavior of masonry columns and arches on buttresses with the discrete element method, *Engineering Structures* vol. 33, pp. 3172–3188;

[5] Bergamasco I., Papaccio V., Carpani B., Clemente P., Saitta F. M. (2012). Seismic Preservation of the Archaeological Site of Pompeii. Preliminary Analyses Knowledge, *Diagnostics and Preservation of Cultural Heritage*, ENEA, Roma;

[6] Paulay, T., Priestley, M.J.N. (1992) *Seismic design of reinforced concrete and masonry buildings*, Wiley, New York.

[7] Doherty, K.H. (2000) An investigation of the weak links in the seismic load path of unreinforced masonry buildings, *Ph:D. Thesis*, Department of Civil and Environmental Engineering, University of Adelaide, Australia.

[8] Gilbert, M. & Melbourne, C. (1994) Rigid-block analysis of masonry structures , *The Structural Engineer*, vol. 72, n.21.

[9] Guadagnuolo M., Monaco M. (2009). Out of plane behaviour of unreinforced masonry walls . *In: Protection of Historical Buildings*. vol. 2, p. 1177-1180, London, New York:CRC Press, Taylor & Francis Group, ISBN: 9780415558051;

[10] Spanos P.D., Roussis P.C., Politis N.P.A. (2001) Dynamic analysis of stacked rigid blocks, *Soil Dynamics and Earthquake Engineering* vol. 21, pp. 559-578.

[11] Yim S.C.S., Lin H. (1991) Nonlinear impact and chaotic response of slender rocking objects, *Journal of Engineering Mechanics ASCE*, vol. 117 (9), pp. 2079–2100.

[12] Monaco M., Guadagnuolo M., Gesualdo A. (2014) The role of friction in the seismic risk mitigation of freestanding art objects, *Natural Hazards* DOI :10.1007/s11069-014-1076-9;

[13] Makris N., Vassiliou M.F. (2013) Planar rocking response and stability analysis of an array of free-standing columns capped with a freely supported rigid beam, *Earthquake Engineering & Structural Dynamics*, vol.42, pp. 431-449;

[14] Derakhshan, H, Griffith, M.C. & Ingham, J.M. (2013) Out-of-Plane Behavior of One-Way Spanning Unreinforced Masonry Walls, *Journal of Engineering Mechanics ASCE*, vol. 139, n. 4

[15] Housner, W.G. (1963) The behaviour of inverted pendulum structures during earthquake. *Bull. Seismol. Soc. Amer.*, 53 (2);

[16] Ishiyama, Y. (1982) Motions of rigid bodies and criteria for overturning by earthquake excitations. *Earthquake Engineering & Structural Dynamics*, 10 (5): 635-650. doi: 10.1002/eqe.4290100502.

[17] Shenton H.W. (1996) Criteria for initiation of slide, rock, and slide-rock rigid-body modes . *Journal of Engineering Mechanics ASCE*, vol. 122 (7), pp. 690-693;

[18] Spanos P.D., Roussis P.C., Politis N.P.A. (2001) Dynamic analysis of stacked rigid blocks, *Soil Dynamics and Earthquake Engineering* vol. 21, pp. 559-578;

[19] Gesualdo A., Iannuzzo A., Monaco M., Savino M.T. (2014) Dynamic analysis of freestanding rigid blocks, in: Civil-Comp Proceedings: 106, B.H.V. Topping and P. Iványi eds., Civil Comp Press, Kippen, Stirlingshire, U.K., ISBN 978-1-905088-61-4, doi:10.4203/ccp.106.144;

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Archaeological Environmental Park of Sennacherib's irrigation system (Iraqi Kurdistan)

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Abstract
The project concerns the study and the valorization of the complex of canals built by the Assyrian king Sennacherib at the beginning of VII cent. B.C. The irrigation system measures approximately 150 km in length and extends over a vast territory between Dohuk and Mosul (Iraqi Kurdistan). The various parts of the waterworks and celebratory works were built to supply water to the royal palaces and gardens of Nineveh, the new capital, and to irrigate the land surrounding the city.
The project carried on by the Institute for Technologies Applied to the Cultural Heritage is within the frame of the training program "Land of Ninive" entrusted to the University of Udine by the International Cooperation of the Italian Foreign Ministry.
The planning of the Archaeological- Environmental Park is using advanced and integrated survey techniques for the 3D documentation of Khinis, Jerwan and Maltai, Kurdistan's most important and fascinating sites, and satellite images as basic cartography.
The ongoing activities regard the defining of the Park's boundaries and actions to protect the landscape, to preserve the monuments and to improve their accessibility. Considering the vastness of the territory on which the canals are widespread, the Park is limited to the most important areas of Khinis and Jerwan but, via the Documentation Centre's Information System, it will be connected to the archaeological areas of Maltai, Faideh, Bandwai and other sites that may be identified in future surveys.

Keywords: Iraqi Kurdistan, Assyrian irrigation system, Archaeological Park, Assyrian bass-relieves, 3D survey

1. Background
The idea of creating an Archaeological-Environmental Park to protect, preserve and enhance the irrigation system built by Sennacherib grew out of the cooperation in progress between the University of Udine and the Italian National Research Council's Institute for Technologies Applied to the Cultural Heritage (ITABC) to carry out the program called *"The Land of Nineveh: Training for Enhancing the Cultural Heritage of Northern Kurdistan,"* which the Italian Foreign Ministry entrusted to the University of Udine and the direction of Prof. D. Morandi [1].
In the context of this extensive training program, which deals with essentially all the archaeological aspects and to a lesser degree those of documentation and architectural restoration, the task assigned to the ITABC working group coordinated by architect R. Orazi is to design the Archaeological-Environmental Park [2].
Designing the park requires a series of preliminary or parallel actions aimed at collecting the necessary geometric documentation with the use of modern architectural metric survey methods, assembling satellite images to gain knowledge of the territory in the absence of basic maps, drawing the park's boundaries and those of the archaeological or intangible areas and of the buffer zones, and defining the relevant easements and implementation rules.

Besides choosing sites for the park's reception, management and maintenance facilities, during this phase the project will indicate, for each archaeological area, actions aimed at protecting the landscape and the environment, maintaining the monument and planning for its access.
Several years ago the problem of preserving the Sennacherib irrigation system aroused the attention and concern of local government institutions and international organizations, including UNESCO [3] the Italian Foreign Ministry's Cooperation Department and, more recently, the World Monument Fund.
Indeed, despite the Sennacherib monumental complex's highly deteriorated state, because of its large area and the importance of its architectural, decorative and technical features and its historic values, it nonetheless meets some of the elective requirements established by UNESCO and defined by the World Heritage Committee..
In this regard, it should be noted that local government institutions will be able to use all the geometric, graphic and photographic documentation, together with the implementation indications and rules included in the final technical report (which will form an integral part of the archaeological-environmental park project) to support the proposal to include the Sennacherib irrigation system on UNESCO's World Heritage List (WHL).

2. Archaeological and landscape features

The irrigation system as a whole measures approximately 150 km in length and extends over a vast territory located in the governorates of Dohuk and Mosul.
The various parts of the waterworks and celebratory works were built by Sennacherib in four phases from 706 to 686 B.C. His purpose was to supply water to the royal palaces and gardens of Nineveh – a city neglected by his father, Sargon, but chosen by Sennacherib as his new capital – and to irrigate the land surrounding the city.
The first phase of Sennacherib's project concerned a series of canals located in the vicinity of Nineveh; these tapped water from the Khosr River near the village of Kisiri. The second phase was based on a survey made by Sennacherib himself near Mount Musri (now Jebel Bashiqah). Many springs were enlarged, 18 canals were built to feed water into the Khosr, marshes and cane-brakes were created, and a large park containing trees, fruit and animals of all kinds. The third phase concerned the so-called northern canals, which departed from the village of Rimussa (Jerrahiah); the last phase focussed on the set of canals that started in Khinis (Fig. 1) [4].
Though bearing in mind the system's overall importance in terms of technology, engineering, art and history, it is nonetheless possible to identify in it certain architectural features that will be shown here, using the first findings processed from our recent architectural metric survey.
The Khinis area seems to be of primary importance. Though the works here date from the last phase of construction, this was actually the starting point where the canal tapped water from the Gomel River. Moreover, it stands out as a major celebratory work comprising an incredible amount of bas-reliefs, inscriptions and technical works. Blocks of stone were quarried on both sides of the Gomel and rafted downstream to land at stone wharfs; dams and levees were built; tunnels were dug through the bedrock; ornamented niches were carved out at various heights along the whole rock wall; and artworks were created, signally the great bas-relief and the imposing monolith [5].
The relief, approximately 12 x 14 metres, showed king Sennacherib (on the sides of the panel) paying homage to the deities portrayed in the centre (Fig. 2).
In front of the relief, a huge monolith decorated on at least two sides marked the divide between the Gomel River and the head of the canal (Fig. 3). One stretch of the rock face, around 300 metres long, featured a great number of niches bearing inscriptions and bas-reliefs portraying Sennacherib.
The Jerwan aqueduct, located on the canal's route a few km from its head, is of equal importance for its technological aspects. After Khinis, the canal continues southward along the beautiful valley named for the village of Shifka; it maintains a slight slope that allows it to follow the piedmont contour. At the foot of the valley, the canal bends sharply westward, and after a few km it passes over a broad wadi on an impressive aqueduct some 280 m long (Fig. 4) [6].
Other architectural features are present in the area of the northern canals, which were built in the third construction phase. Outstanding among them are the reliefs of Maltai. They are situated on a very steep cliff-side overlooking the city of Dohuk, and appear to be the ones best preserved precisely because they are so hard to reach.
The Faideh bas-reliefs are just as important. They are situated farther south, perhaps at places where water was drawn off to irrigate the surrounding territory. Only their upper edges are visible; the rest is out of sight in the now-earth-filled canal. They are seriously threatened by cement companies operating only a few metres away.
Lastly, the archaeological area of the Wadi Bandwai and of the Shiru Malikta relief (image of the princess) is especially evocative, though the relief has been largely eroded away.

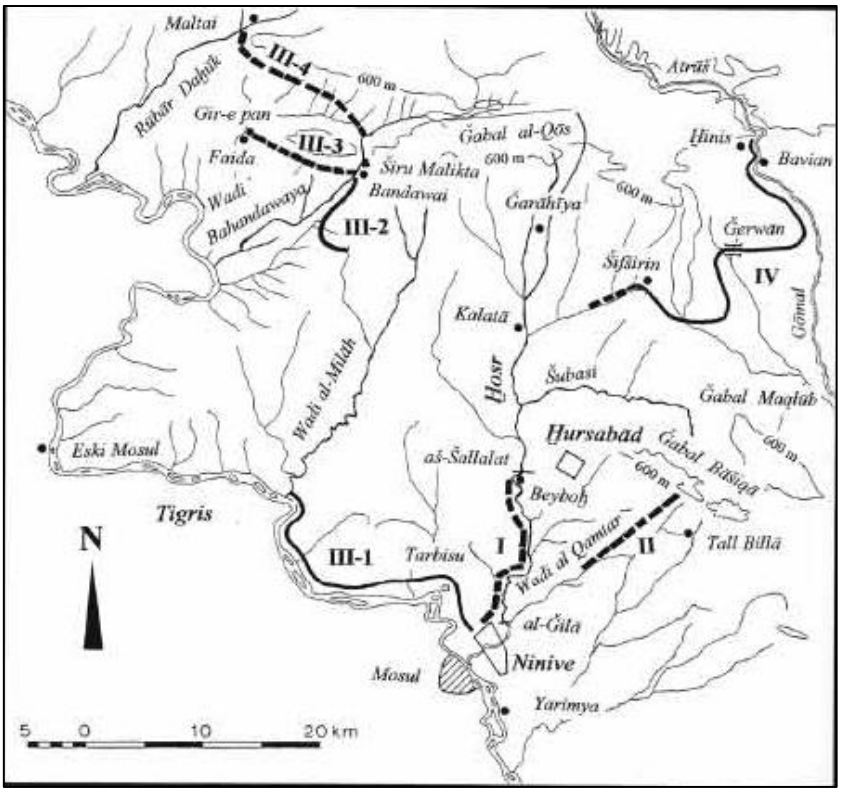

Fig. 1. The construction phases of Sennacherib's irrigation system [8]



Fig. 2. Khinis, a detailed view of the great bass-relief. On the left the sovereign Sennacherib.



Fig. 3. Khinis, a view of the collapsed monolith



Fig. 4. Jerwan, the remained structures for the passage of the wadi below the channel at the west end

3. Project of the Archaeological Environmental Park

3.1 The Park's boundaries

The boundaries of the Park created to protect the remnants of an irrigation complex that spread over much of Iraqi Kurdistan (3-4000 sq. km), and also over territories not included in the project's study area, will be determined by the need to identify an area whose size is sufficiently controllable, but has a wealth of important pre-existences. The latter will be visible in the Park and will constitute the poles of attraction of a system rich in archaeological vestiges that can be referred to through a computer program that will present them both in the framework of the complex canal network and in the reality of the specific archaeological area.

In sum, a museum system able to show the principal works present in the Park and continuously updated on the progress of research aimed at interrelating the archaeological and technical features present in the territory.

Based on these considerations, it seems natural to think that the Park area should contain the Khinis reliefs, the stretch of canal running parallel to the Gomel River through the Shifka Valley, and the Jerwan aqueduct. This area could be bordered on the east by the Gomel River and include the Tell Gomel site, historically related to the battle of Gaugamela; and could be bordered on the south by a buffer zone parallel to the canal. In this case, its size would be around 150-200 sq. km, or 15-20,000 hectares (Fig. 5).

Though the Maltai and Wadi Bandwai areas lie outside the Park's boundaries, they will be protected, will offer archaeological hiking trails, and will be connected to the Centre for the Documentation and Museumization of Sennacherib's Irrigation System, core of the Park's information and management apparatus.

The boundaries of the Park, the archaeological areas and the buffer zones will be defined on satellite images by georeferenced polygons so that the necessary geodetic references can be positioned on the territory.

The Park's constituent elements will be the archaeological areas and the artefacts they contain, the natural features (the Gomel and Khors rivers and the surrounding mountains), the Sennacherib Botanical Garden, the archaeological pathways and hiking trails, the reforestation areas and the recreational areas.

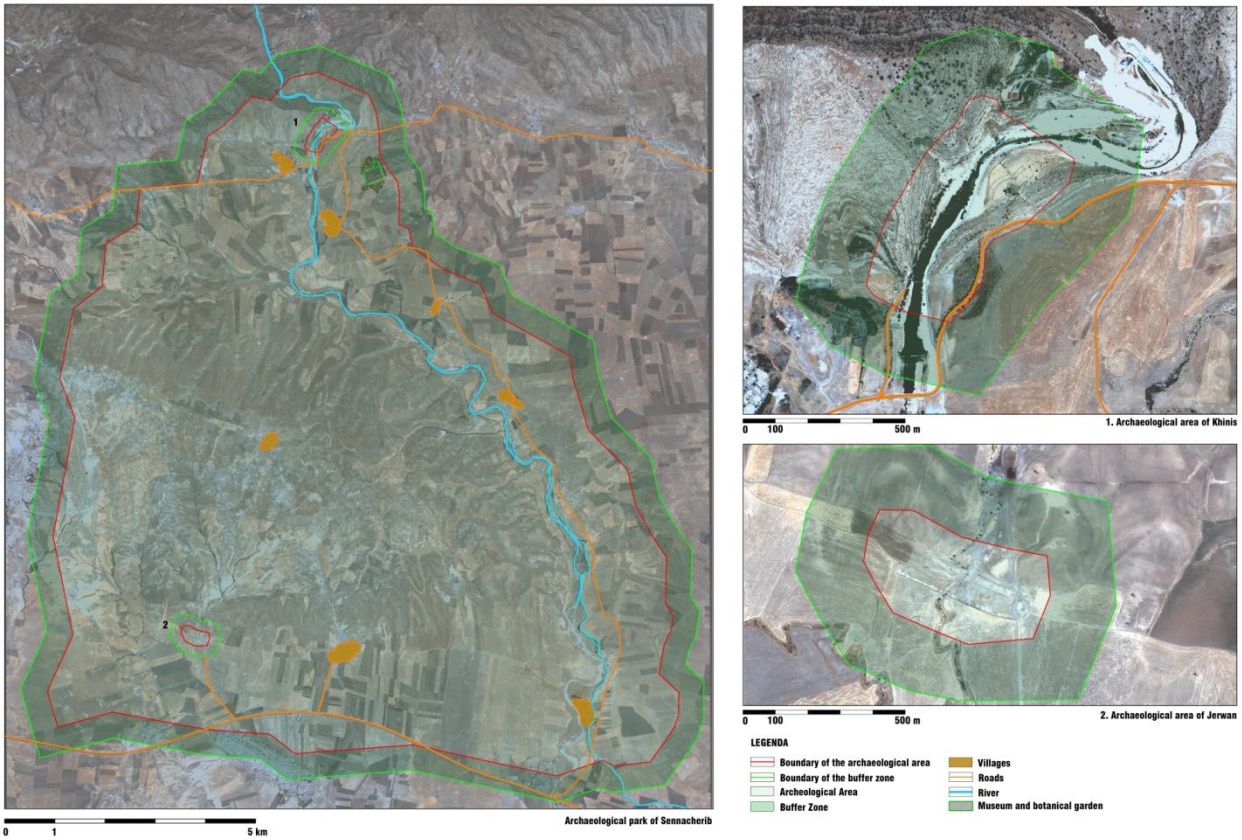

Fig. 5: Area of the Archaeological Environmental Park and of its buffer zone (on the left). A detail of the archaeological areas of Khinis and Jerwan (on the right).

3.2 Design criteria and park elements

The archaeological sites need to be protected from the negative effects of wind, rainfall, solar radiation and vegetation, and also from the many acts of vandalism. Other elements to be kept in mind are the obvious problems of waste treatment, emissions from internal and external motor vehicles, and uncontrolled exploitation of the site as a quarry for building materials.
In light of the foregoing, the following points will have to be considered in planning the park:

1. Protection of the sites from further factors of deterioration, and commencement of large-scale works of cleaning, stabilization and protection of all the reliefs and inscriptions, as well as of the cliff-sides connected with them.
2. The park area should not only stimulate visitors intellectually though multimedia information services, but also encourage physical and mental activities (picnic areas, playgrounds, areas for exercises of skill, for contact with plants and animals that are part of local and/or historical nature and culture).
3. An important part of the park will be “Sennacherib’s Garden”, where many varieties of local and historical flora can be grown, and which should include recreational areas with fountains, streams, educational itineraries and rest areas.
4. To increase people’s perception of the natural landscape in which the monuments were originally immersed, and to hide visual intrusions created by modern elements, the boundaries of the Park, the archaeological areas and the buffer zones will be marked off in part by planting trees and other screening vegetation.
5. Internal mobility will be provided solely by electric mini-trains consisting of an engine and carriages with a capacity of 6 to 8 passengers each. They will convey visitors from the assembly point to switching stations connected to selected points of interest, which visitors will head for on foot.
6. Activities carried on in the Park – both institutional ones related to research, information and education, and ancillary ones related to energy supply and logistics – will be managed by a dedicated information system.

The goal of the design process is thus to create a cultural and museum complex closely related to the natural resources and the characteristics of the landscape, but distinguishing between “sensitive areas” that need to be protected and “functional areas” that can host the Park’s infrastructure. Equipment used in the power system, waste collection and treatment, and technical services will be designed with care for the environment (solar energy, rainwater harvesting, cleaning with biological water, gardening with no use of toxic substances).

4. Project phases – Work performed and planned

4.1 Metric survey of architectural elements

The research activities presented here grew out of the intention to use innovative 3-D data-acquisition techniques to survey the spectacular enclave made up of the archaeological vestiges of Sennacherib’s irrigation system. Awareness that archaeological surveys are a fundamental tool for knowledge, documentation and analysis, preparatory to any project for recovering, restoring, preserving and enhancing the cultural heritage, stimulated the work whose acquisitions / renderings are briefly described in this report. The underlying purpose of the research project was to use advanced and integrated survey techniques to acquire in 3D the archaeologies of Khinis, Jerwan and Maltai, Kurdistan’s most important and fascinating sites, which preserve and conserve artefacts and ruins characterized by diversified and stratified happenings in natural and human history.
The sites thus turned into real open-air laboratories as their ruins were surveyed and rendered with innovative laser scanning and photogrammetric equipment, producing overviews, detailed scans and geometric comparisons. During these operations, we applied different measuring technologies with the intent of developing later on a procedure for integrating and managing the data flow so as to address different needs and purposes.
We used laser scanners such as the Zoller+Frölich Imager, whose range is on the order of 200 metres, and differential-phase lasers whose operating range is far lower but whose precision and transportability are greater (Fig. 6).

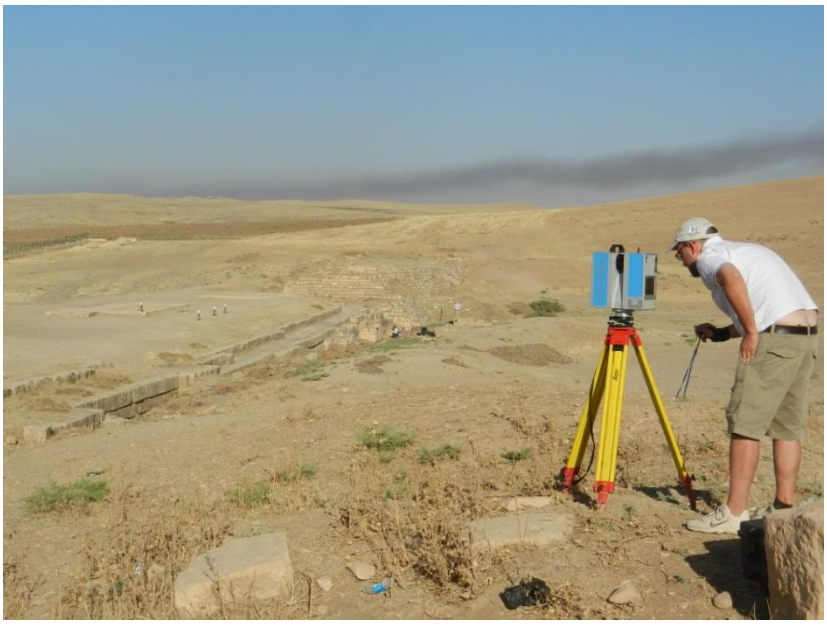

Fig. 6: Jerwan, starting the laser scanning of the monument

The survey group then shared their instrumentation and experiences in the field. Specifically, they tested the innovative potential of the Z+F Imager, which features extraordinary ranges and data acquisition speeds (more than a million points per second), which makes it possible to reduce onsite working time. The system used to obtain an overview of the territory was the Imager – Z+F Lara spot laser measurement system – with which scans were performed at a maximum resolution of approximately 1.6 mm at 20 metres (any higher resolution would have prejudiced the weight of the metadata to be treated later on).
Besides the so-called point clouds, as 3-D data we acquired a series of photographic shots (with no parallactic error) with which to construct so-called “panoramas” (the term “immersive photography” is also used) and to develop a true virtual tour that would enable people to visit, acquaint themselves with, investigate and enhance these archaeologies from afar. The field was then chosen as a reference scenario in order to compare the laser scanner systems used throughout the survey season: FARO Focus^{3D} and Z+F Imager 5006h. To this end, besides selecting a standard reference definition for all the acquisitions, we also used spherical targets.During the work on the field we viewed the Khinis complex and the Jerwan aqueduct in order to analyse the artefacts from an architectural standpoint and plan the metric survey operations.
In the case of Khinis, we measured the great bas-relief, the horseman relief, the fallen monolith and the whole cliff-side containing numerous niches with bas-reliefs and inscriptions. The Khinis complex is in a state of serious deterioration due to the erosion of a large part of the reliefs and the inscriptions, the destruction of the figures of deities and royal personages, and the digging of cliff-side tombs right through the reliefs. It is therefore desirable that the monolith is set upright again, despite all this damage, since the evocative overall image of the site could be re-established, giving even a sense of three-dimensionality to the bas-relief complex (Fig. 7).
At Khinis, the scanning was performed with a long-range laser scanner (Z+F Imager 5010, up to 180 metres) and a short-range scanner (FARO Focus^{3D}, up to 50 metres). The laser-scanner survey of the complex was then integrated with the photogrammetric survey of important details such as the great bas-relief (Fig. 7), , the monolith (Fig. 7), the horseman relief (Fig. 8). For what is regarding this last one, some investigation carried on in these last years [7] have speculated different interventions which has not been possible to recognize. The advanced state of deterioration has allowed only a partial reconstruction of the figure.
The survey work, then, began at the Jerwan acqueduct using the laser scanner Imager 5010 to scan the huge monument (280 m in length) in view of rendering the necessary AutoCad graphics (map, prospects, sections, details) (Fig. 9). The detailed survey of the inscriptions was made with the FARO Focus^{3D} laser and photogrammetric equipment (Fig. 10).

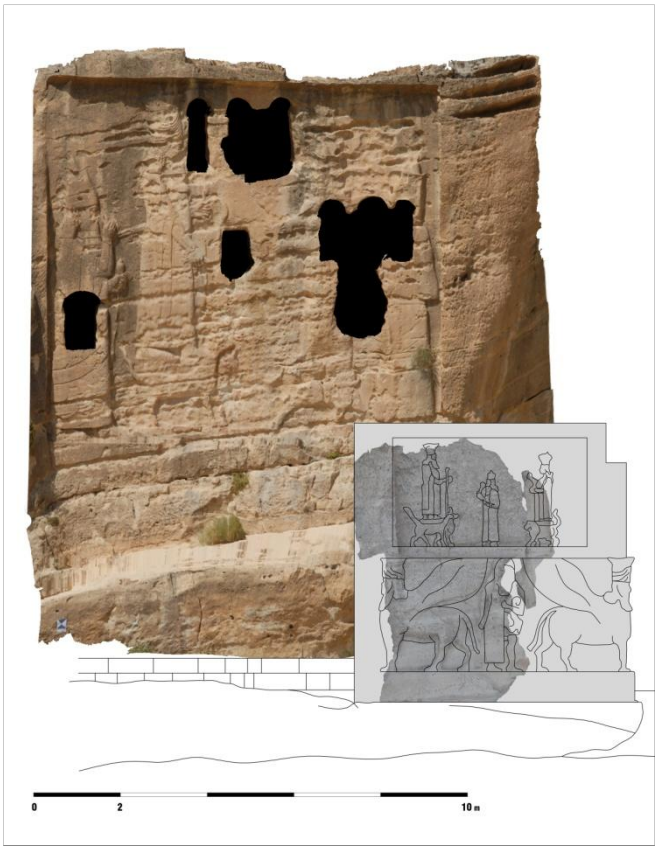

Fig. 7: Khinis. 3D model of the great bass-relief and reconstructed overlapping of the fallen monolith.

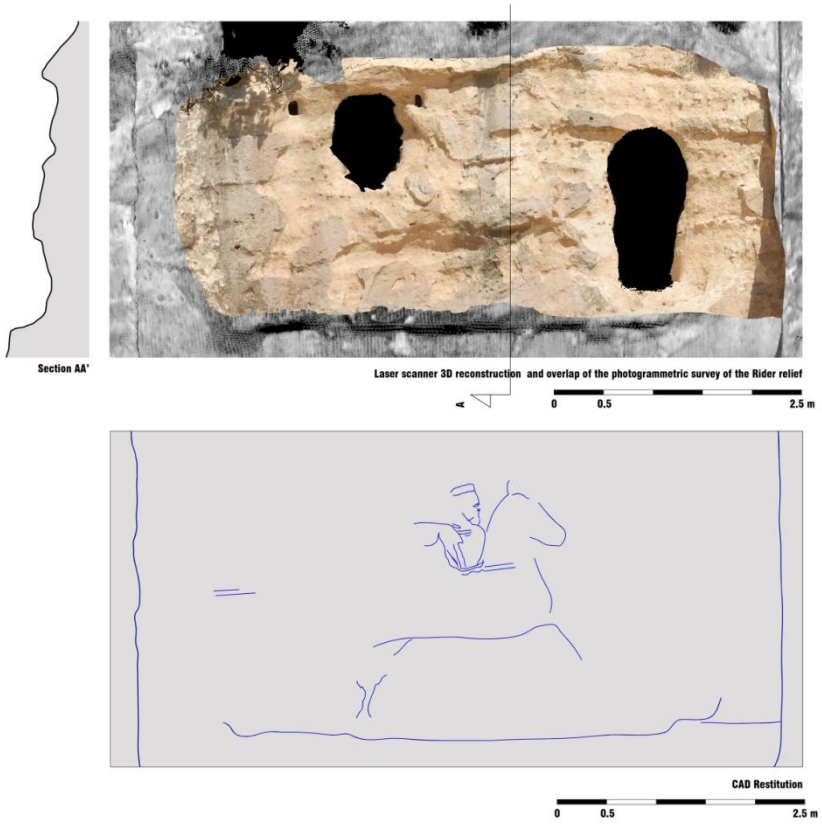

Fig. 8: Khinis. 3D model of the rider bass- relief which has suffered at least three different working phases (on the top) and a tentative of drawing the original shape.

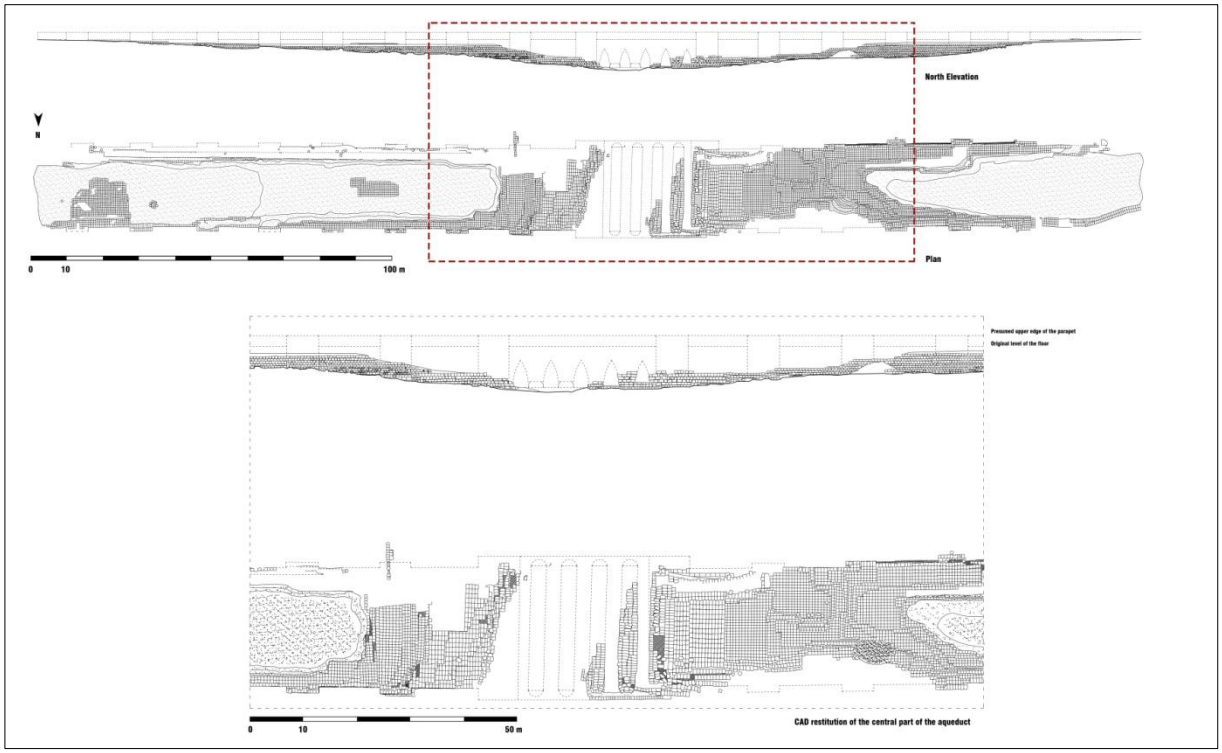

Fig. 9: The Jerwan acqueduct. Elevation and general map (above), a detail of the central part (down)

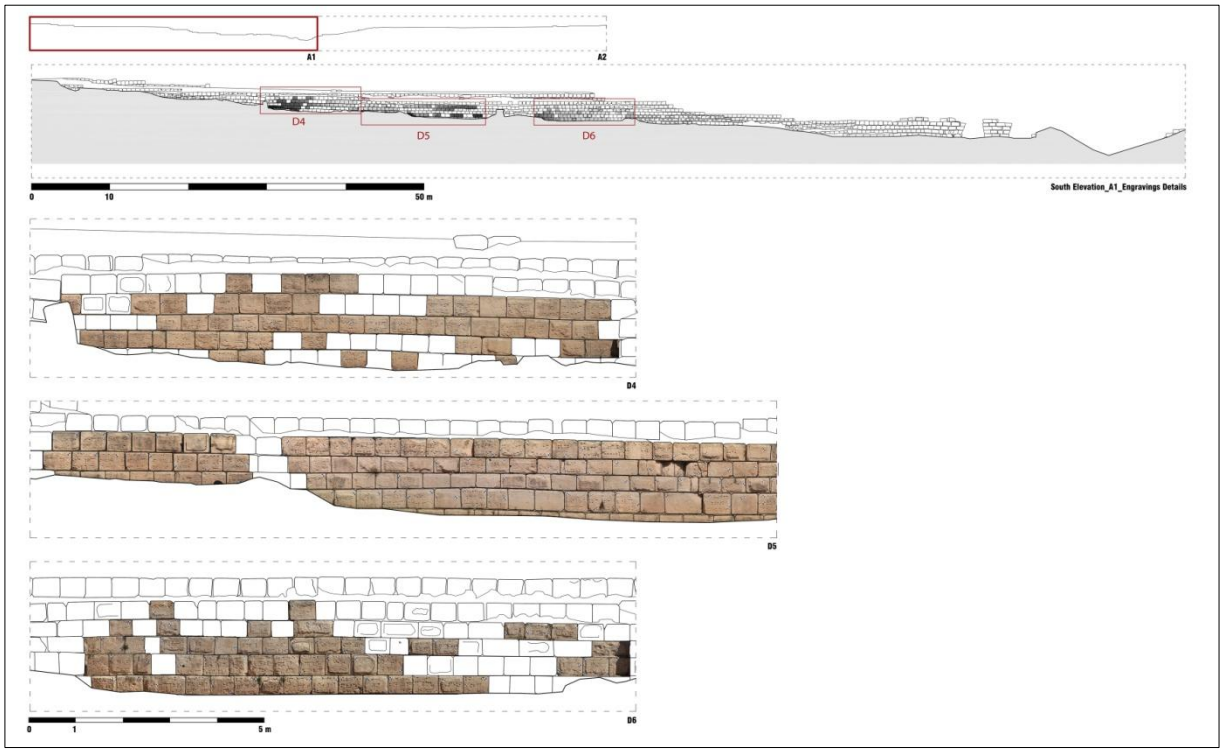

Fig. 10: The Jerwan acqueduct. Inscriptions of the south side of the acqueduct. This part was anciently restored and the blocks were replaced in a casual way.

4.2 Satellite imagery and GIS

Up to now the Sennacherib irrigation system has been studied mainly on the basis of satellite images [8], giving preference to older images produced with lower definition but available at more affordable costs (Corona images). Because they picture landscapes less disturbed by recent works, they enable a more accurate reading of the routes of the various canals.

For planning needs, and because of the need to establish a basic cartography and a more accurate model of the terrain, we used high-definition images (Pleiades 2013). The satellite images can make it easier to recognize the original stretches of the canals, which can sometimes be mistaken for trails or for the terrain contours of the various archaeological areas.

In the case of the archaeological areas of Khinis we have used stereoscopic satellite images to produce a DTM of the area.

The satellite images have been used as a cartographic base for the GIS of the Archaeological-Environmental Park which we are going to realize. The GIS will contain the graphic project in digital form, and at the same time the management plan required by UNESCO for every site entered in the WHL. The GIS's access levels will be differentiated for on-site operators and for tourists; for the latter, it will enable:

- knowledge of the organization of the Park's areas, and displays of images (photos, film footage, 3D views, AutoCAD graphics) of the archaeological structures included in it and their access routes;
- display and management of the operations of archaeological research, architectural restoration, consolidation of the cliff and restoration of the surfaces;
- management of tourist traffic;
- enhancement of the Park via a dedicated website that will publicize all the scientific and cultural events already scheduled or being planned.

Working group

Project leader: Roberto Orazi
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Park's GIS: Francesca Colosi, Eva Savina Malinverni
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Restitution: Luana D'Auria, Fausta Fiorillo, Silvia Salviani, Francesca Verri
AutoCAD elaboration: Luana D'Auria, Laura Mattioli

Bibliographical References

[1] MORANDI BONACOSSI, Daniele. *Progetto Archeologico Regionale "Terra di Ninive" , Kurdistan Iracheno, Iraq*, Udine, University of Udine, 2011

[2] ORAZI, Roberto. *Preliminary notes on planning the archaeological environmental park of Sennacherib*, in MORANDI Daniele (ed.), *Preliminary Report on the First Archaeological Research Campaign of the Italian Archaeological Mission to Assyria*, Udine: University of Udine, October 2012

[3] VAN ESS, Margarete. *Assessment of the Archaeological Sites of Khinnis and Jerwan (Dohuk Province, Kurdistan Regional Government, Iraq)*, Amman: UNESCO Iraq Office, January 2011

[4] BAGG, Ariel. *Irrigation in Northern Mesopotamia:Water for the Assyrian capitals (12th–7th centuries BC),* Tübingen: Universität Tübingen, 2000

[5] BACHMANN, Walter. *Felsrelieves in Assyrien. Bawian, Maltai und Gundük*, Leipzig: J.C. Hinrichs, 1927.

[6] JACOBSEN, Torskild and LLOYD, *Seton. Sennacherib's acqueduct at Jerwan*, Chicago Illinois: University of Chicago press, 1935

[7] READE, Julian Edgeworth, ANDERSON, Julie Renee. *Gunduk, Khanes, Gaugamela, Gali Zardak: notes on Navkur and nearby rock-cut sculptures in Kurdistan,* in *Zeitschrift für Assyriologie,* 103 (1), 2013, New York;Berlin: de Gruyter, 1939- 2015, ISSN: 1613-1150, pp. 68–122

[8] UR, Jason. *Sennacherib's Northern Assyrian Canals: New Insight from Satellite Imagery and Aerial Photography*, in *Iraq,* 67, 2005, London; British School of Archaeology in Iraq, 1934-2015, ISSN: 0021- 0889, pp. 317 - 345

HERITAGE and TECHNOLOGY
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Project for the Archaeological Park of Chan Chan, Peru

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Abstract
Chan Chan (Trujillo, Perù), the political, religious and administrative capital of the Chimu empire (2nd – 15th sec. A.D.), represents the largest pre-Columbian settlement built in adobe and since 1986 is inscribed in the UNESCO WHL. The Italian Mission in Perù of CNR- ITABC has been working in Chan Chan since 2002 in collaboration with the Ministerio de Cultura of Perù and with the support of the Ministry of Foreign Affairs in the study and documentation of the archaeological site.
During the last years the Italian Mission has started the project for the Archaeological Park of Chan Chan with the objectives to counter the uncontrolled urban development of the near Trujillo, to improve the visit of the archaeological complex and its territory and to develop the social and economic conditions of the local population by the organic development of the handicraft and touristic sectors. Once defined the boundaries and the respective zoning of the archaeological areas and of the buffer zone by mean of satellite images, we have started the photogrammetric and laser scanner 3D documentation of the main architectural typologies and the design of touristic itineraries. In order to allow the knowledge of the vast archaeological site, we are planning a virtual pre-visit to be shown in the local museum followed by the real acquaintance of the complex along pre-established itineraries to be explored with the help of environmentally friendly means of transport.

Keywords: Chan Chan, Mud Brick Architecture, Archaeological Park, Intangible heritage

1. The ancient city of Chan Chan
Chan Chan was the political, administrative and cultural capital of the Chimu Empire, one of the various civilizations that arose along the Peruvian coast since the beginning of our era and represents the greatest pre-Columbian settlement built in *adobe*. It is situated about 550 km. of Lima along the northern coast of Peru. The agriculture was the main source of sustenance and its diffusion was assured by a highly developed irrigation system. A series of channel transversely connected the various rivers that from the mountains flow into the Pacific Sea and distributed the water to the fields, winning the desert and bringing prosperity and wellness.
The most populated part of Chan Chan covers approximately 6 km^2, but the whole urbanized territory, which included urban and suburban paths, cultivated fields, walls and channels, spreads over more than 20 km^2, giving origin to an extremely complex and articulated urban structure that reflects a high level of social and economic organization (Fig. 1).
The central area presents nine monumental enclosures named palaces or *ciudadelas* and five *huacas* or stepped pyramids. Inside of the *ciudadelas* were placed wide ceremonial squares, small U – shaped rooms with a presumable ceremonial role (*audiencias*), a great number of warehouses and, in an internal and isolated area, the tomb of the sovereign, the so named *Plataforma de Entierro*, with the characteristic form of stepped pyramid.
The *ciudadelas* perimetric walls exceed, in some cases, 10 meters in height and 700 meters in length. All the enclosures are always aligned in a north – south direction, with an entrance door located generally at the centre of the northern side. Starting from 1100 A.D. (Chimu Medio), the enclosures assumed a typical



Fig. 1: Chan Chan. An aerial view of the monumental site (photo Consorcio Chimú, Odebrecht – Graña y Montero 1990).

tripartite scheme that characterizes, more or less unchanged, all the palatial complexes until the construction of Palacio Rivero, the most recent of the *ciudadelas* of Chan Chan [1].
The *huacas* were constructed with mud brick and pebbles and normally located inside fenced areas. The biggest *huacas* of Chan Chan are Toledo and Obispo, both so destroyed during the time of *Virreinato* that today it is impossible to reconstruct their original shape. Their function is not clear, but the discovery of treasures within their structure has suggested that they could be elitist *plataformas de entierro* or monumental religious buildings. The *huachaques* are sunken fields near the sea that, exploiting the natural depressions of the terrain, are fed directly by the subsoil humidity. In the *huachaques* the *campesinos* cultivated the *totora*, a typical reed used for the constructions and for the fabrication of mats, baskets and small boats [2].
The population of Chan Chan lived all around the *ciudadelas*, with different residential accommodations which revealed their social status. On the base of the hypothesis of the Harvard University, the aristocracy occupied some big complexes, defined elite compounds, which are today much degraded [3], on the contrary the common people, composed of farmers, fishermen and artisans, lived in popular quarters constructed with a building technique named *quincha,* which consists in a mixture of mud on a structure of reeds and wooden posts [4]. The different elements that constituted Chan Chan and enriched its territory were interconnected through a dense network of pathways, often elevated, that crossed the cultivated fields in order to reach strategic areas, very important from a practical or ceremonial point of view. The routes directed to the north (Camino Viejo y Camino Ceremonial) jointed the town with the large channels of irrigation and with the holy mountain of Cerro Cabras, whilst several paths were leading towards the east and south-east territories and connected the centre of the city with the cultivated fields and the gardens and with the temples and *huacas* distributed throughout the area.
Therefore, the monumental complex of Chan Chan is characterized not only by an extraordinary extension, but also by an internal organization and a richness of architectonic and decorative elements that make it one of the most important archaeological sites of the Latin America.

2. Planning the Archaeological Park: previous interventions

2.1 Aerial photogrammetric survey

The settlement has been known like Chimu capital from the first days of the *conquista*, thanks to the notes of the Hispanic reporters and, in a second moment, to the writings of European travellers interested in the Chimu civilization. In spite of this, the first archaeological investigations, addressed to discover the history and culture of the Chimu, date back to the end of XX century when some scholars, among which Max Uhle

(1899-1900) with his researches in the complexes of Huaca del Sol and Huaca de la Luna, defined a first chronological sequence for the Trujillo region.
Later, in the years 1948-50, Richard Shaedel of the National University of Trujillo started some archaeological excavations in Chan Chan, but the most important advance in knowledge is due to the systematic investigation that the Harvard University, under the direction of Michael Moseley and Carol Mac Key, conducted in the 70's for about 10 years. The researchers of Harvard proposed a chronological sequence of growth and development of the city and they carried out multiple studies about the economical, administrative, political and cultural aspects of the Chimu society [5]. The most important contribution for the knowledge of the site was an aerial photogrammetric survey of the whole town that until now represents the most complete map of the site and that, since then, it has been used as a topographic base for any future project.

2.2 UNESCO WHL and the Plan Maestro

In 1986 the archaeological complex of Chan Chan was accepted in the UNESCO WHL. In 1997, during the general session of the UNESCO World Heritage Committee held in Naples, it was recommended that the Peruvian Government drew up a Management Plan for Chan Chan as a necessary prerequisite for its inclusion among the Endangered World Heritage sites.
In 1998 this Plan was included in the cultural policy priorities of the Peruvian government. It was then elaborated by the institutionally competent body, the INC-LL (now Ministerio de Cultura), with the collaboration of the UNESCO World Heritage Committee, of ICCROM, and of the Getty Conservation Institute.
The *Plan Maestro de Conservación y Manejo del Complejo Arqueológico Chan Chan*, hereinafter called *Plan Maestro*, was approved by a Supreme Decree of the President of the Republic of Peru in January 2000. It thus represents a unique legal tool for conservation, enhancement and management. The *Plan Maestro* is organized in 7 programs and 153 projects related with the investigation, conservation, valorisation, protection, promotion and diffusion of the site and its territory with the aim of supporting the socio-economic development of the local population.

2.3 The Italian Mission in Peru

The MIPE (Italian Mission in Peru) of CNR-Institute for Technologies Applied to Cultural Heritage, has been operating in Chan Chan in collaboration with the Ministerio de Cultura since 2002, with the aim of fighting the architectural and territorial decay and of favouring the archaeological, economical and social valorisation of the site together with the development of tourism.
To this regard the MIPE has been pursuing the following three main objectives: the planning of the Archaeological Park of Chan Chan, the restoration and the virtual visit of Palacio Rivero and the support of local handicraft and tourism by mean of training courses arranged also with the help of the international cooperation.
In order to achieve these objectives, taking into account the impressive dimensions of the site, it was very important to take advantage of the potentiality of new methodology of investigation, such as the remote sensing techniques, the ICT processes to organize and archive geographical data, the modern techniques of three-dimensional survey.
The integration of different methodologies of analysis and the joint work of specialists of different disciplines, have strongly encourage the research, allowing the comparison among data of different nature and producing new interesting interpretative hypothesis [6, 7, 8].

3. The Archeological Park of Chan Chan: territorial survey and planning

3.1 The perimeter of the Archaeological Park

A primary objective of the Italian Mission is to plan the Archaeological Park of Chan Chan, following the guidelines of the *Plan Maestro* in collaboration with the Ministerio de Cultura and the local and regional institutions. We believe that a monument of such importance deserves protection by the wild urbanization that is affecting the area around Trujillo and that the site must be promoted and publicized at international level. The complex of Chan Chan, if properly exploited, may be a significant source of wellness for the local population and an opportunity for the socio-economic growth with clear occupational developments.
The first step for the planning of the Archaeological Park was to define the limits of the intangible area (in red in Fig. 2) and those of the buffer zone (in blue in Fig. 2) with the help of a differential GPS and the geo-referenced Quickbird satellite image.
During the 60s, an old polygonal planned to define the intangible area and designed by mean of a metric tape, had been approved by the Peruvian government. Its borders, no longer detectable on the ground, were a constant reason for contrasts between the Ministerio de Cultura and the *campesinos* living in the area. The new polygonal, equipped with absolute coordinates and positioned on the satellite image, was approved in

2008 by the National Technical Commission for Archaeology and the National Directorate of the Ministry of Culture and now it represents an effective tool for the protection of the site.
The border of the buffer zone, already foreseen in the *Plan Maestro* and absolutely indispensable in a highly urbanized area, is positioned at an average distance of 500 m. from that of the intangible area, and its perimeter has been defined in accordance with the Ministerio de Cultura and the Master Plan Office of Trujillo (PLANDET). The borders of the buffer zone were defined on the basis of the archaeological surveys and the analysis of satellite images that made possible to trace the localization of many ancient paths and to identify underground remains or archaeological structures currently unprotected. Together with the above mentioned Institutions, we are now working on land use standards and building restrictions for each one of the six areas in which the buffer zone has been divided.

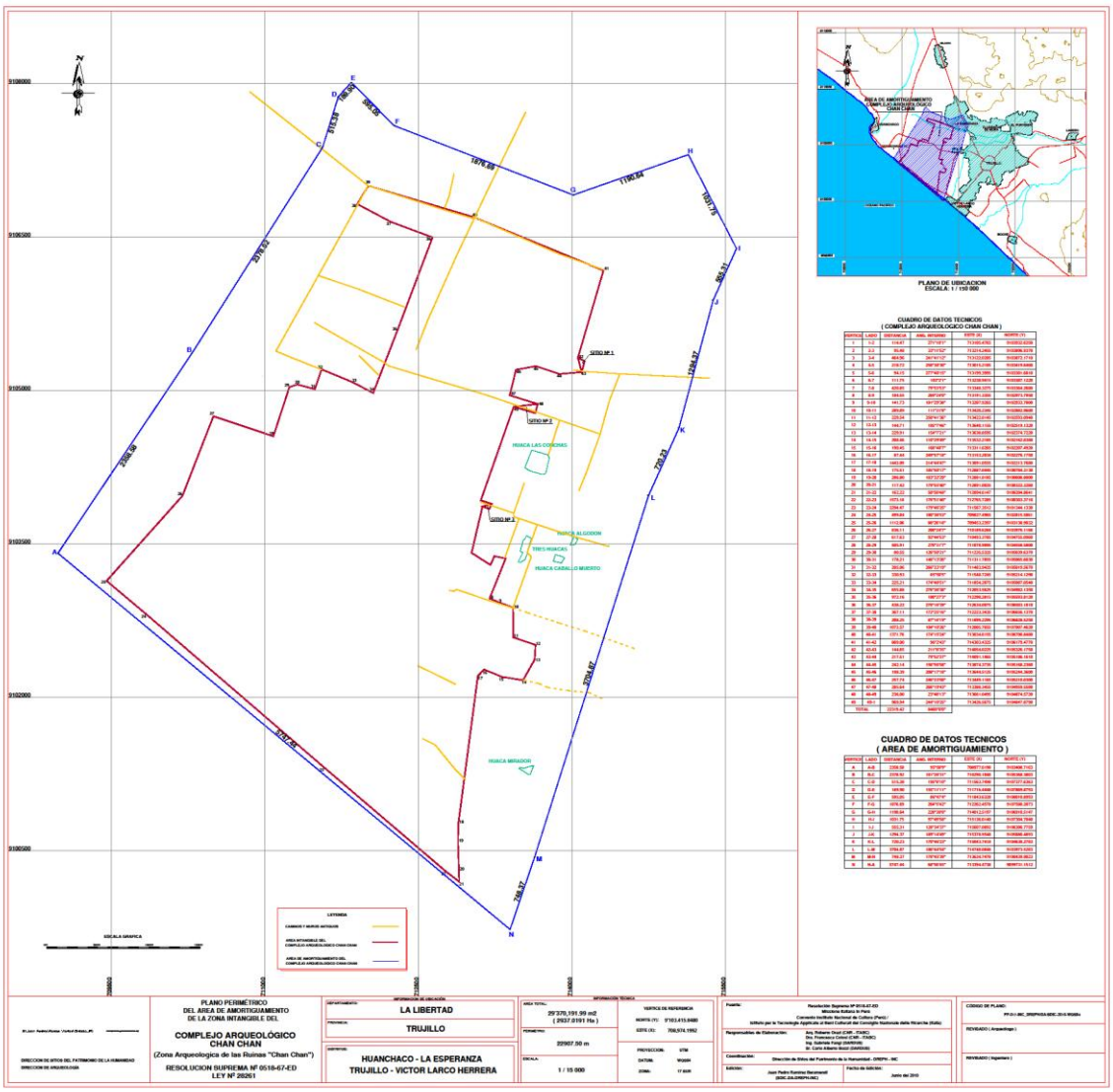

Fig. 2: The perimeter of Archaeological Park. In red the polygonal of the intangible area and, in blue, the buffer zone. Official map approved by Ministerio de Cultura.

3.2 Archaeological and architectural survey

The satellite Quickbird image (May 2003) has been used as a cartographic base for the localization of the archaeological and architectural structures that constitute the elements of the Archaeological Park. Some residential and functional typologies as palaces, *plataformas de entierro* (royal grave), truncated pyramids (*Huacas*), popular areas, *huachaques* (water reservoirs), necropolis have been positioned with differential GPS.

All the data collected in territorial survey have been archived in a GIS and have been used to produce a map of all the elements that constitute the town of Chan Chan and its territory (Fig. 3).
The archaeological and topographical data have been organised in different layers and associated to the relative attributes. The ancient paths (in yellow) allow to analyze the development of the town and its connection with the surrounding territory, while the archaeological and territorial elements, once that have been interrelated, give useful information on the special organization of the ancient settlement over time.
The truncated pyramids appear to be in connection with the roads that lead to the cultivated fields revealing a strong link between agricultural production and propitiatory rituals celebrated at the beginning of the good season. The popular quarters are distributed on the western limits of the town and along the *camino ceremonial* (ceremonial path). The great distribution of wells and cisterns underlines the importance of water in the life of the town and of the articulated irrigation system that exploited the streams running down by the Andes. Finally, on the satellite images, are clearly visible the *huachaques* or lowered parts of the territory submerged by clear water and used by the Chimu to cultivate the *totora*.

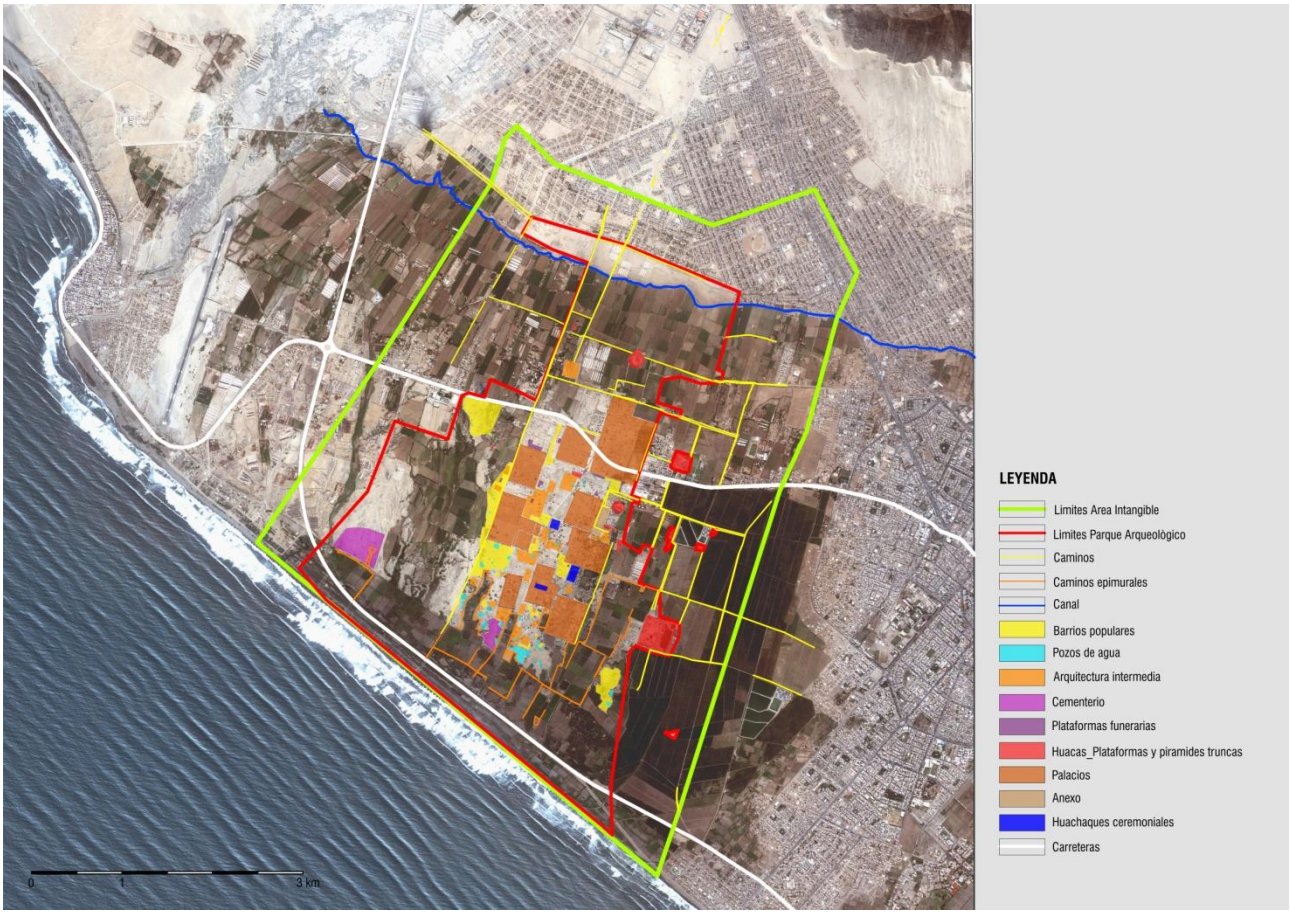

Fig. 3: Architectural typologies of the Archaeological Park.

3.3 General and detailed planning

On the base of the elements of the project contained in the *Plan Maestro*, an upgrade of its programs and of its technical indication has been achieved. Therefore a number of project drawings has been prepared that use the Harvard survey and the satellite image as cartographic base. The drawings are related to the following themes:

- Perimeter of the Archaeological Park and External mobility;
- Zoning of the intangible area (Fig. 4);
- Zoning of the buffer zone;
- Green and recreational areas (Fig. 5);
- Areas characterized by specific architectural typology (Fig. 3);
- General map of the Archaeological Park;
- Tourist itineraries and panoramic view points.

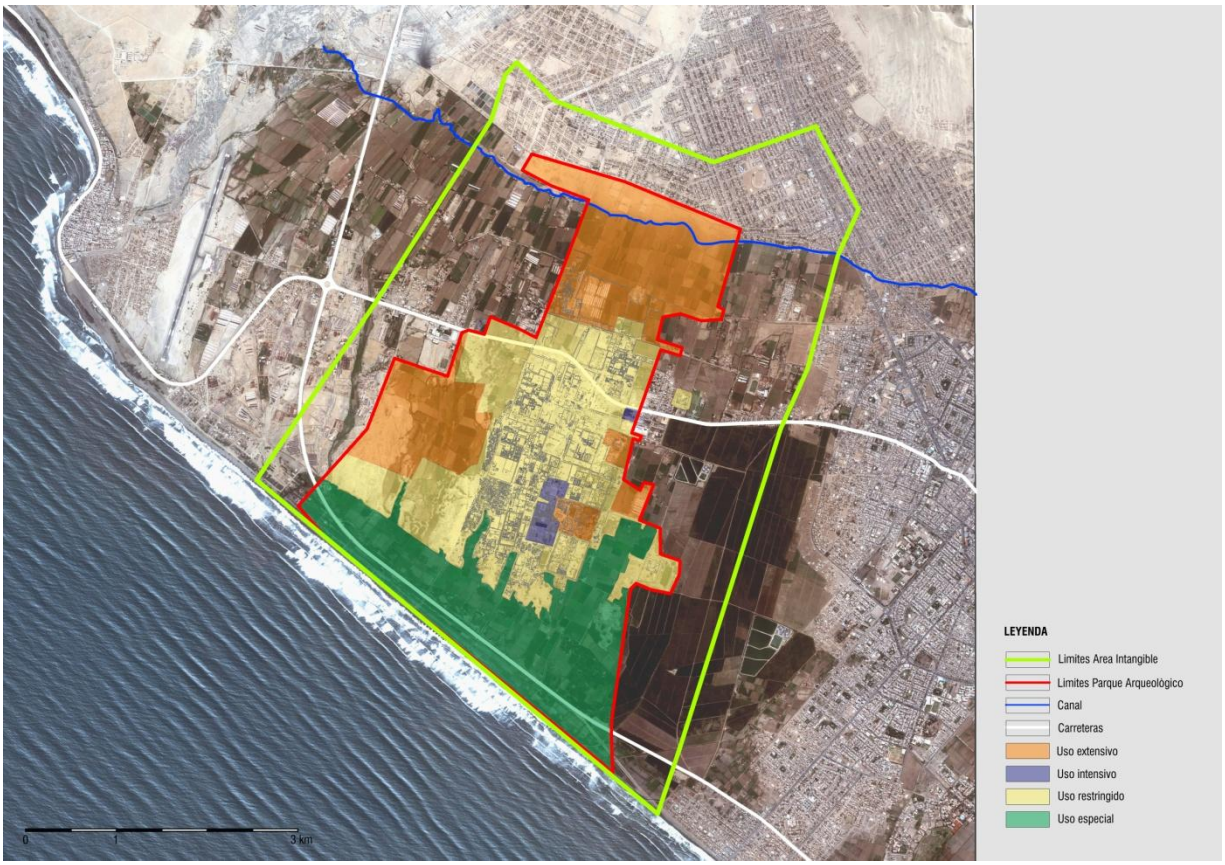

Fig. 4: Zoning of the intangible area.

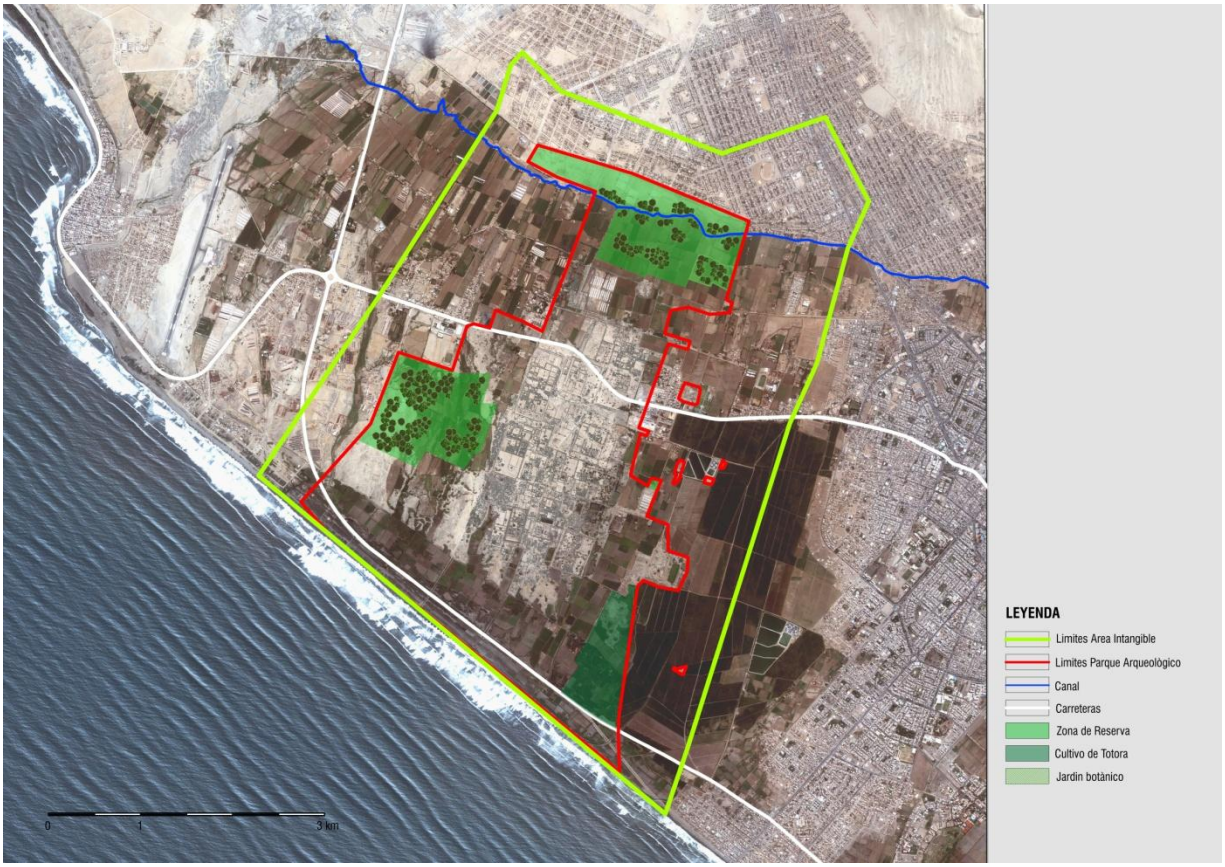

Fig. 5: Green and recreational areas.

The external mobility of the Archaeological Park is mainly based on a road which is connecting the village of Huanchaco and the near airport with the town of Trujillo, passing through Chan Chan and cutting the archaeological complex in two different parts. This road, inspired by an ancient route constructed by the Conquistadores through the palaces of Velarde and Bandelier, has produced an enormous injury to the integrity of the site.
A possible solution could be moving all the traffic now crossing Chan Chan, to the road by the sea (the so called *Avitamiento*) which is also connecting Trujillo with Huachaco.
For what is regarding the archaeological area, it was possible to provide a kind of very general zoning based on an intangible area containing palaces and monuments, the actual touristic area, limited to Tschudi palace but planned to be open to the whole complex, and a wide area (*huachaques*) positioned by the sea and intended for special use (cultivation of *totora*) (Fig. 4).
Finally, in order to transform the visit to the archaeological complex into a pleasant journey between architecture and nature, three green recreational areas have been proposed. They are located in the territories traditionally used for threes and cultivation and will be enriched with water streams, a botanical garden, recreational spots and the cultivation of the *totora* (Fig. 5).

3.4 Touristic itineraries

A number of touristic itineraries have been planned on the wide archaeological complex in order to allow the visitor to get in touch with the many structures that constitute the functional, ritual and social aspects of the town, but also with the many images of an urban and natural landscape which is mostly still untouched. The touristic itineraries have been surveyed using a DGPS mounted on an off-road vehicle and working in cinematic way in order to insert them within the GIS of the Archaeological Park. The different parts of every single route have been verified for what is concerning the accessibility both on foot and by car, identifying the critical points where it is necessary an intervention for the arrangement and the protection of the track (Fig. 6).



Fig. 6: A moment of the DGPS survey in cinematic way.

All the itineraries are starting from the Museo de Sitio from where, once that the tourist has terminated the visit of the Museum, het will be carried, by electric means of transport and along predefined itineraries, to parking zones from where he will be allowed to continue the visit on foot.
The following itineraries have been planned on the territory of the park (Fig. 7):
Itinerary 1:

- Museo de Sitio, Palacio Tschudi, Huachaque Huamachumo
- Palacio Bandelier, Huaca Toledo, Palacio Uhle

- Palacio Velarde, Palacio Laberinto, Camino Ceremonial, Museo de Sitio
- Palacio Rivero, view of Huachaque Grande and the sea;

Itinerary 2:

- Museo de Sitio, Camino Ceremonial, Huaca Obispo, Gran Chimù;

Itinerary 3:

- Museo de Sitio, laguna Toledo, Huaca el Higo, totorales, Palacio Rivero, Palacio Tschudi

Itinerary 4:

- Museo de Sitio, Camino Ceremonial, Palacio Velarde, Palacio Laberinto, view of Huachaque Grande, Palacio Rivero, Palacio Tschudi.

For every itinerary some panoramic view-points have been chosen from where 360° photographic panoramas have been realized. Both the itineraries and the panoramic view-points will be inserted in internet or shown in the Museo de Sitio in order to create a kind of pre-visit to the archaeological complex and allow the tourist to choose the preferred itinerary.

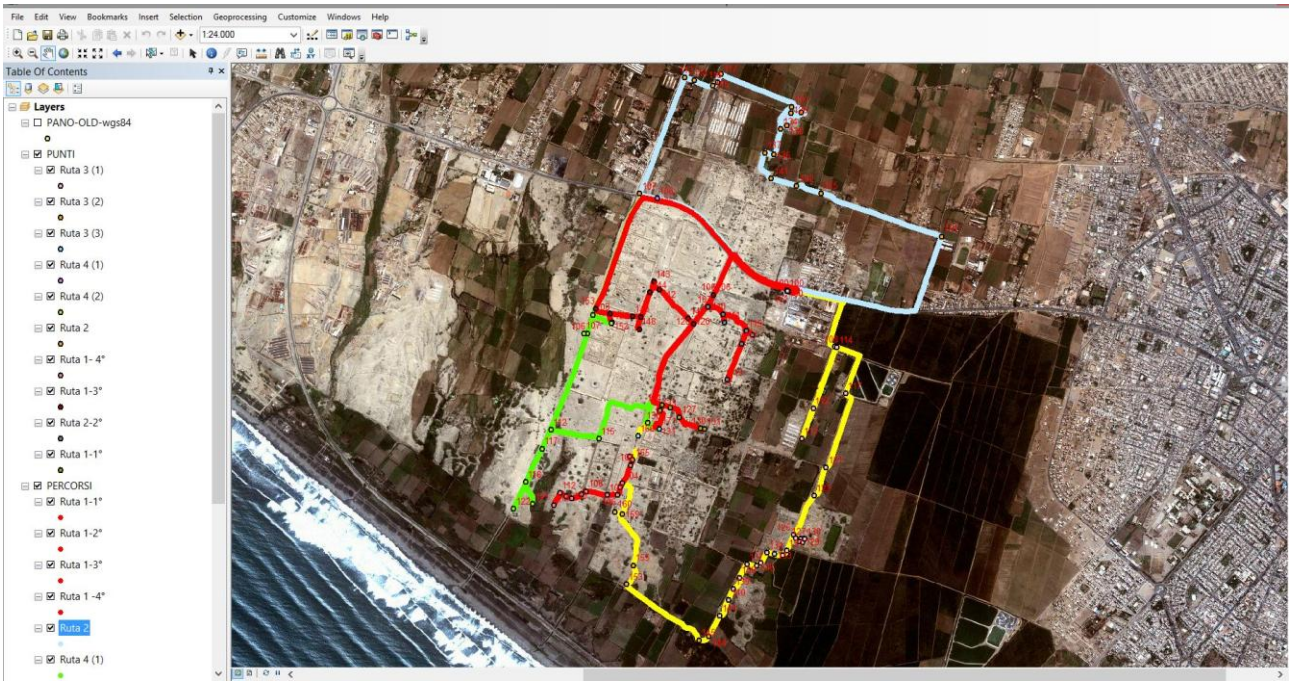

Fig. 7: GIS of the Archaeological Park. A view of the four itineraries.

3.5 Valorisation and training

By planning the Archaeological Park of Chan Chan we have realized that the cultural and natural resources of the ancient town can help to support the socio-economic development of the population traditionally and historically related to the site. For this reason we carried on the project *Support to the socio-economic development of the region of Chan Chan (Peru) - Training courses for ceramists,* in collaboration with the Instituto Italo Latino Americano (IILA), the Gobierno Regional La Libertad and with the municipality of Huanchaco (Fig. 8). The program has produced stages in Italy for Peruvian functionaries and artisans and two theoretical and practical training courses for the ceramists of the region. The activity was developed at the Museo de Sitio where a temporary laboratory was arranged and where a wood-fired oven and a coal furnace were built. The meaning of rehabilitating the traditional ceramic activities is in perfect connection with the needs of the local population which wants to preserve and enhance ancestral practices and techniques that, though still alive, are threatened with disappearing [9].

In this framework is placed our initiative for the realization of an eco-museum of the *totora*. The *totora*, a typical product of the northern coast of Peru was and is used, still now, for the construction of traditional boats (*caballito de totoras*), traditional houses (*casas de Tapa*), woven mats and handicraft signifying the



Fig. 8: Museo de Sitio. A view of the temporary laboratory for the ceramist's training course.

continuity of ancestral wisdom and technology, which contributes to the formation of regional and national identity as part of their intangible cultural heritage. In particular fishing with *caballito de totora* is a unique practice, which dates back to the Chimu culture, and that is carried on in no other part of the world but Huanchaco, a small fishing village near Chan Chan.

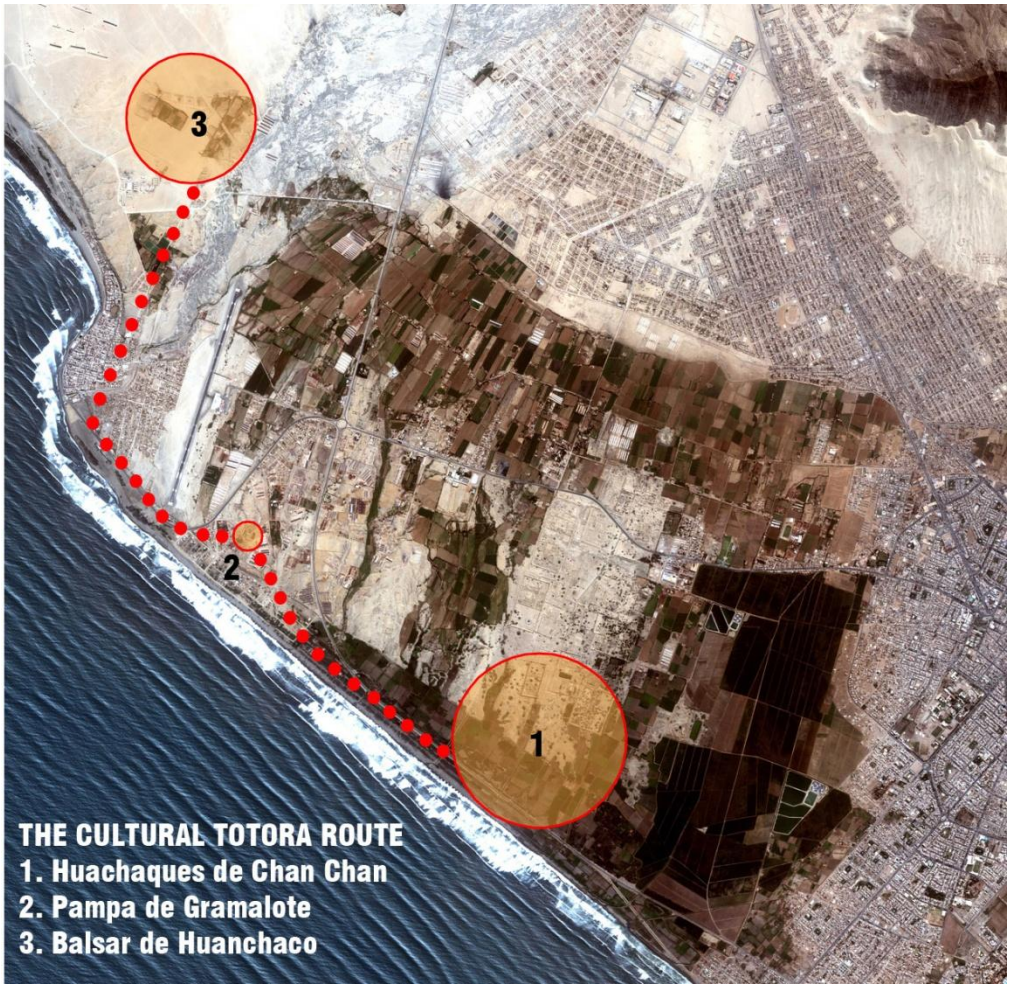

Fig. 9: The cultural-touristic *totora* route moving from Chan Chan, passing the site Pampa de Gramalote and ending at the Balsar of Huanchaco.

Unfortunately this peculiar commercial activity is going to be lost forever because today artisanal fisheries for human consumption has been reduced to subsistence level, altered by giant industrial fisheries for fish meal produced with modern and more costly effective means.
The project aims to provide support for the fishermen's minority, creating an "Eco-museum of the totora" and revitalizing the huachaques of Chan Chan and the Balsar of Huanchaco. The strategy involves the recovery and the integration of local initiatives that have been going on over the years, all oriented to the same goal though none of them could be completed. The main objective consists in gathering, in the Eco-museum of the totora, three protected areas, interesting from a touristic point of view, as the huachaques of Chan Chan, the Pampas de Gramalote (an archaeological site recently discovered along the coast) and the Balsar of Huanchaco, where the fishermen cultivate the totora (Fig. 9). The managing structure of this new cultural institution will reside in the Interpretation Centre which is a meeting place of the local community for the maintenance of their cultural identity and the conservation and enhancement of the *totora*'s ecosystem. The expected results are a strengthening of the tourist potential of the area and, as a consequence, the benefit for the local population, economically and ancestrally linked to the archaeological complexes of the coast.

Bibliographical References

[1] KOLATA, Alan. *Chronology and Settlement Growth at Chan Chan,* in MOSELEY Michael E., DAY Kent C. (eds), *Chan Chan: Andean desert city,* Albuquerque: University of New Messico Press, 1982 , pp. 67 – 84.

[2] CAMPANA DELGADO, Cristóbal. *Chan Chan del Chimo. Estudio de la ciudad de adobe más grande de América Latina,* Lima: Editorial Orus, 2006

[3] KLYMYSHYN, Uliana A. M. *Elite compounds in Chan Chan,* in MOSELEY Michael E., DAY Kent C. (eds), *Chan Chan: Andean desert city,* Albuquerque: University of New Messico Press, 1982 , pp. 119 -120

[4] TOPIC, John. R. *Lower- class Social and Economic Organization at Chan Chan,* in MOSELEY Michael E., DAY Kent C. (eds), *Chan Chan: Andean desert city,* Albuquerque: University of New Messico Press, 1982 , pp. 146 – 175

[5] MOSELEY Michael E., DAY Kent C. (eds), *Chan Chan: Andean desert city,* Albuquerque: University of New Messico Press, 1982

[6] COLOSI, Francesca, FANGI, Gabriele, GABRIELLI, Roberto, ORAZI, Roberto, ANGELINI, Andrea, BOZZI, Carlo Alberto. *Planning the Archaeological Park of Chan Chan (Perù) by means of satellite images, GIS and photogrammetry*, in *Journal of Cultural Heritage*, 10, 1, 2009, Paris: Elsevier, 1999 – 2015, ISSN: 1296-2074, pp. 27-34.

[7] COLOSI, Francesca, ORAZI, Roberto. *Studi e progetti per la creazione del Parco Archeologico di Chan Chan*, in ORSINI, Carolina, VENTUROLI, Sofia, *Thule. Rivista italiana di studi americanistici*, n. 30/31, aprile-ottobre 2010-2011, Lecce: Centro Studi Americanistici "Circolo Amerindiano" Onlus, 1996- 2015, ISSN: 1126-8611 pp. 139-172

[8] COLOSI, Francesca, GABRIELLI, Roberto, MALINVERNI, Eva Sabina, ORAZI, Roberto, in *Archeologia e* calcolatori, 24, 2013, Firenze: All'Insegna del Giglio, 1990-2015. ISSN: 1120-6861, pp. 187- 207

[9] COLOSI Francesca, ORAZI Roberto. *Valorización del Complejo Arqueológico de Chan Chan y desarrollo socioeconómico de su territorio*, Cuadernos IILA, Serie Cooperación 47, Roma: Stampa3, 2011,

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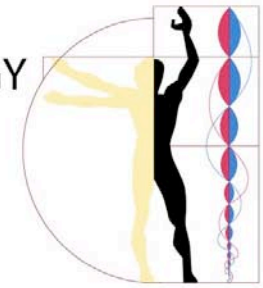

Empathic forms for relational spaces

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Abstract
In the era of pervading immaterial technology, the terms ***device, smart, cloud, table*** and ***web*** represent the instruments for the diffusion of knowledge, communication, and in-form-ation.
In the field of university research, in a moment in which we interact with a new generation of students called "**digital natives**", teaching staff can no longer ignore the modifications which are substantially taking shape through methods and forms.
The current lines of research in the field of **Interior Architecture** prefer the emotional and experiential aspects since mankind situated in a spatial environment builds a system of relations between himself and the others, devolving exclusively his operating towards the recovery of the interior/exterior debate in strict relation to psycho-anthropological, aesthetical and empathic values.
The space which surrounds mankind is, in fact, characterized and conditioned by a constellation of objects, evermore "**intelligent**" which oblige us to follow a difficult and ambiguous path in the reshaping and revision of the Architectural Interior, always more tied to the concept of "***Liquid Architecture***".
In this new dimension mankind needs a shared redistribution or connective and collaborative processes of interaction, losing sight of several dichotomies real/virtual, useful/useless, truth/fiction.
In this way, a new need of configuring information and the relationship is born translating them into new *collective identities* as well as new *connective interactions* strictly dependent on the phenomena of the empathic sharing of objects and spaces.

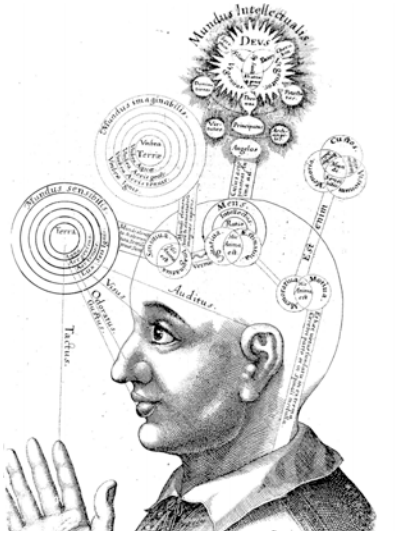
Keywords: Interior Architecture - Liquid Architecture - Technology - Emphatic space – Neuroscience

1. The architecture of form and function in space of empathic relationships
If today with the invasion of immaterial and/or digital technology, the world is going in a new direction, then where will we end up? Will the whole world be virtual? Will sensory perception be built by artificial intelligence? Will our understanding of the space/time relationship of our world be affected by these new technologies?
What will happen to a barefoot walk by the sea?

"...The exploration of outside is over, it's now time that you start the one within ..."
Walter Bonatti

The theme of this contribution is based on a cultural matrix imprinted on the **interior/exterior** dialectic, typical of the research field of Interior Architecture, studied in depth throughout the last century, with critical studies and considerations on sensory perception, visuality and the relationship between man and his thoughts. The limits, however, of such cultural attitudes, in design, highlight the superficiality that produces a lot of data derived from the psychic component which should represent the potential access key to new design ideas, in which **onnipolitano man** [1] lost in a context of overwhelming images, finds himself compelled to seek a new dimension of inner **well-being**.
The close connection between **architecture and psychology** testifies the need for a new measure of design, capable of intercepting a user's *empathic* expectations and emotions, which are often established in the act of using a **space** [2] and in the system of relations and interconnections that are

grafted with it. Design takes the form of an act and gesture of a deep relational nature, where the solution is not simply formal but springs from the emotional and physical product that becomes the product of *"thinking with your body"* [3]. In the re-visitation of the concept of *non-place* of Marc Augé, the famous French anthropologist, the vision of architecture interpreted in a *socio*-anthropological perspective in different psycho-anthropological directions supporting and confirming a change of direction that favours aspects of sensory psychology and environmental psychology, read through the latest scientific and empirical discoveries derived from **neuroscience** [4] is modified.
Specifically, the recognition of the value of the **brain-body** relationship in the deciphering of the space of the architectural interior becomes central to the culture of design, and finally in research abandons the form/function dialectic (*form follow function)*, visibility/rationality, to approach different forms of interpreting space through the brain/perception dialectic, feeling/emotion, in a clear holistic vision (*form follow feelings*) as described by **Harry Francis Mallgrave**. [5]
The statement *"gut feeling"* is famous, with it literally being translated as a "feeling/sensation in the stomach" that precisely opens to a legitimization of instinctive feeling, where aesthetics depend on a complex system of interconnected and intersubjective answers, where experience through dynamic-semantic messages uses the receptors-sensors of the brain. From recent studies released by the group "Lombardini22" Milano on the theme of "Empathy of Spaces" in Architecture related to neuroscience, the neuroscientist **Vittorio Gallese** speaking to a group of architects, designers in seminars and workshops on interdisciplinary design, introduced the theme of *"mirror neurons"* that allow to empathize not only with others, but also with the space around us. In fact, during the use of space, it is not possible to continue the rationality ignoring the connection with the emotional, design must be carried out thinking of architecture in relation to the syn-aesthetic system of objects, with man in space capturing the spirit of this relationship since *"... form follows emotion and not just the function ... architecture is no longer a result-subject of a process but a motor experience of the subject ..."* [6]
Cognitive science deals with the processes that sustain our perceptions, our thinking and behaviour through the contribution of the mind as the structure of thought and bodily interactions with the outside world to us, it is the key area of reference to open a new frontier that tends to a more holistic vision.
It is no coincidence that historically the discipline of Interior Architecture has always dealt with the relationship between man and space, based on the internal/external dialectic, investigating around the sphere of feeling and placing in close correlation architecture and psychoanalysis as explained by Mimmo Pesare who considers architecture a *"semantic pantograph"* of emotions and feelings of man projected externally. [7]
The interdisciplinary nature of the architectural design of interiors pushes **architects** and **designers** to examine more closely the processes that are the basis of our perceptions, our behaviour and our existence, involving the contributions currently derived from neuroscience, psychology as well as the phenomenological relationship of empathy that comes from a close relationship between body-mind with the environmental-architectural space.
The research lines that appear to be the most original and innovative, in fact, always start from the investigation of the phenomenological space "or proximity" [8] but widen duly the search of the relationships and interconnections that are realized within the system itself, emphasizing mainly the aspects that belong to the psychological dimension of man.



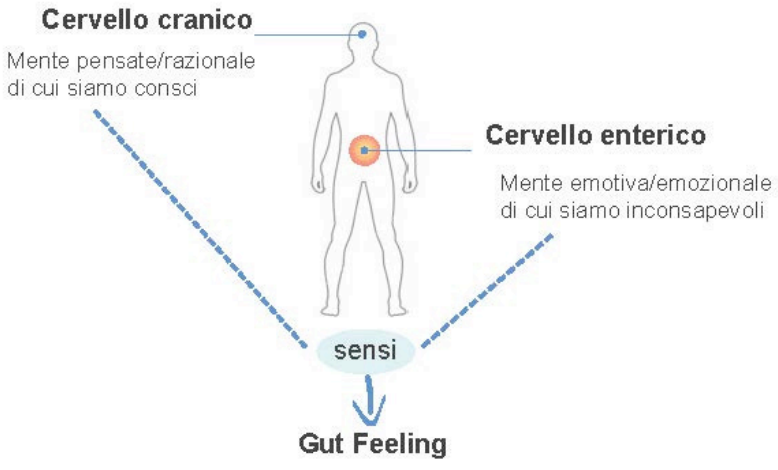


Fig.1: Illustration of the perception of the world according to the alchemist Robet Fludd
Fig.2: Schematic explanation of the concept of "Gut Feeling"

The current scenario characterized by the contemporary conditions of loss, alienation and apathy, can find a viable alternative route through the recovery of the sensory, perceptive and empathetic dimension, re-evaluating the use of digital technologies as a means of interpreting precisely education sharing, interaction, the interconnection taking the right orientation of proximity. The activities of measuring among the different scales, the feelings of man is a design exercise that has to free itself from the formal orientation of research, often controlled through the creation of plastic and organic forms, today in line with the achievements of the "archi-superstars", and must activate emotional interaction systems in which digital tools are instrumental in the empirical verification of space as well as the architecture itself. We have lost sight of the size of our being as **Gaetano Mirabella** wrote [9] and have given too much space to the technologies that have become instruments and systems capable of producing "sense prosthesis" for the exact understanding of the reality that surrounds man and where traditional aesthetics have failed to justify the excessive use of artificial intelligence and the collapse of the mind. We must reinterpret the sense of aesthetics in a contemporary key given that the ontological significance attached to reality is rife with new technologies that create a new dimension of info-aesthetics. [10]
It is useful to identify the structure of the interactive world clearly perceived in the Treaty *"Phénoménologie de la perception"* by **Maurice Merleau-Ponty** in which the concept of space [11] is described as: *"...space is not the scope (real or logical) in which things have, but the means by which it becomes possible to position things. That is to say that, rather than think of it as a kind of ether in which all things are immersed or abstractly conceived as a characteristic that is common to them, we must think of it as the universal power of their connections ... ".* It may therefore be complex to connect the idea of space derived from the founding fathers of the twentieth-century phenomenology with the outcomes and philosophical thought on the architecture produced by current technologies and dynamics of the digital and immaterial. In fact, these systems of connection and connected intelligence as defined by Derrick de Kerckhove build a system of networks of interactions that **Markos Novak** allows to define architecture as *"liquid architecture"*, to paraphrase the concept of Zygmud Bauhman of Liquid Modernity in which projecting the current shareholder structure of the relational system of the society of individuals and the physical and virtual space they occupy. This questions the current significance of digital technologies have become more and more pervasive. It means losing sight of the judgement value of their simple "performance" since the architecture must strive to seek to re-search for the depths of the human truth of beauty and being there where the reality of space acquires increasingly blurred boundaries.
The concept of **liquid architecture** [12] is based on the convergence of thoughts and actions that characterize the action of man in different scales and different circumstances that with the advent of ICT (Information and Communication Technologies) characterizes the configuration of a cyberspace, electronic and digital space, where it is possible to connect architecture with psychology, semiotics, anthropology and philosophy.

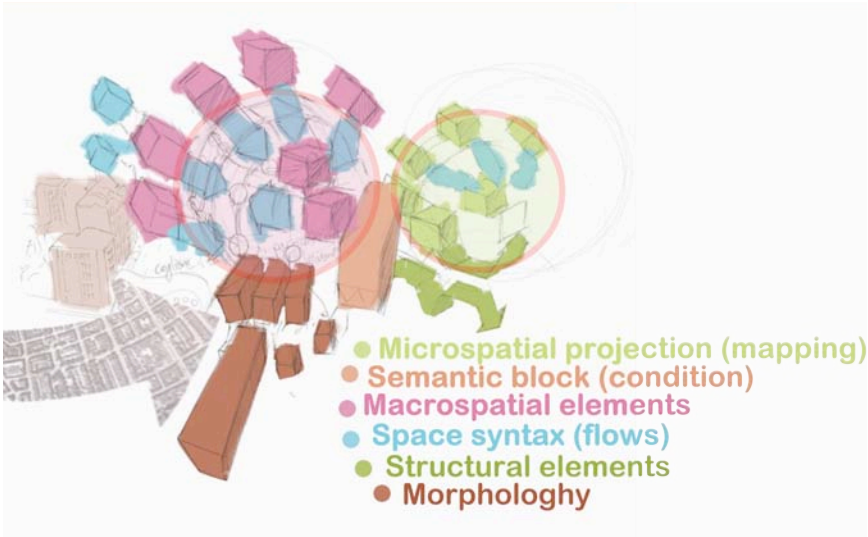


Fig.3: Meta-design process: brainstorming, in order to rework and synthetize the analysis-area (empathetic, physical and environmental). Group leader Edgar Uggiano

Thus, the thought of architecture at this point comes from **a liquid thought** that flows directly from the perception of the senses, connoting more and more architecture to be considered as *"... more marked on the scale of man perceiving, architecture as a built mental space, an architecture that houses the eye and the intellect, but leaves the body and other senses homeless...",* these are some of the

statements taken from Prof. arch. **Juhani Pallasmaa,** the highest expression of the Finnish school of architecture, based on sensory perception. The author criticizes the trend of the XXI century tending to the spectacle rather than to meet the needs of man, a *retinal architecture* [13], writing more than once, since it is intended as a summation of images only in progressive succession, too fast and without a real relationship with the sphere of phenomenological perception. It has essentially lost the sense of the image as **James Hillman** writes, American philosopher and psychoanalyst, since everything is now back to images, losing the sense of the underlying message to the image, current architectures have lost the relationship with the context, relationship with the user, are only stretched to fool the eye as if looking *"... through the window of a car, just passing within the same while behind the facade of the vacuum of nihilism ..."* [14]
Analysis of Interior Architectural could be addressed by basing it on a citationist technique that promotes multiple references related to the cultural debate of the twentieth century on the theme of architecture and the close relationship with psychology. In fact, it is not possible to ignore the epistemological studies from the beginning of the twentieth century by thinkers such as **Edmund Husserl** and **Martin Heidgger** which outlined the basics of philosophical thought on the concepts of space and system of relationship between man perceiving a subject and the object system of the surroundings. In the same way, it is not possible to neglect the latest determinations expressed in the thought of **Marcus Novak**, American architect, founder of fluid architecture and theorist of *Transarchitetture*, in his latest work *"Eduction"* in which he strives to interpret the laws of technological progress so as to provide a digital *"... echo of the virtual in the real ..."* demonstrating how important the current determination on the use of digital technology in the creation and design of architecture without losing sight of the dimension of reality. Novak is the forerunner of a futuristic phenomenology of space achieved through the definition of a third world between the real and virtual in which new design methods are capable of combining the results obtained from morphogenetic experiments carried out in cyberspace with physical reality and materials in which man tries to find himself. [15]
The reference to liquid architecture is closely related to currently used technological tools *devices, smart objects, cloud computing, tablet, web*, result and product of a consumer culture and the evolutionary progress of the media and its digital technology. The role of **media technology** in the field of the material and immaterial must inevitably be reduced to the position of an operating tool that multiplies and accelerates the quality of space, increasing the gap to the phenomenological culture where the "perception" is of primary importance compared to other ideological dimensions. As Italo Calvino stated in *"Six Themes for the Next Millennium"*, it is hard to deny the predominance of the eye in the contemporary world in which we are affected by a "shower of images" that haunt and cloud our mind, altering the space-time dynamics, therefore the design culture of Interior Architecture must move away from the oculocentric worldview, from the idea of a retinal architecture result of a haunting repetitive visual image, instant auto-poetic and seductive although apparently moving, for the benefit of a fuller, more multisensory spatial fruition, re-proposing "... the *ontological primacy* of the phenomenology ..." as in the past, promoted by M. Merleau-Ponty. [16]



Fig.4: Extract of lession about how to interpret the spirit and empatic connection of the place.
Group leader Designer Edgar Uggiano

In conclusion, the scientific evidence presented here promotes an interdisciplinary nature line of research that is currently in place in the schools of architecture and design, but mainly responds to the most current scientific determinations taken from cognitive science, psychology and neuroscience. The original nature of this line of research is substantiated in considering the central contribution of **digital technologies** and new media in the twenty-first century as the most effective means of control and management of space.
Our young people, *"digital natives",* through the use of the most advanced digital (computational technologies, parametric design, algorithmic modelling, generative design) orient scientific thought in the field of **interior design culture** to new scenarios orientated at including sensory, perceptual and psychological aspects on the basis of the potential offered by these tools and models that exceed the

exercise of *mimesis* placing the human dimension between the real and the virtual, between atoms and bits between, interior and exterior, in a new dialectical aesthetic.
The results of some design experiments carried out during the course of Architectural Design held by the **Prof. Arch. Marco Borrelli** in collaboration with the **designer Edgar Uggiano** in the second year of the Degree in Interior Architecture (APIA) at the Department of Architecture and Industrial Design "*Luigi Vanvitelli*" Second University Naples SUN in which the **theme of the project** assigned to my students was the ***Re-functionalization of some abandoned buildings*** *to activate virtuous processes of social integration and inclusion of vulnerable groups favouring new uses, new services to people through an approach of* **Consensus Design** [17], **Co-design** [18] also expressed through the use of digital technologies.
It started from the consideration that, today, the culture of design has privileged positions heedless of what the right balance between the rational and perceptive using as a pretext current digital tools (software + hardware + fabbing) that can solidify an idea neglecting the sense of belonging to a place and local culture expression of the local geni. Starting from the concept of *affordance* [19], it has come to identify particular systems of interpersonal relationships based on the senses of the people and the place which are the subject of the intervention, with an attempt being made to map an emotional geography so as to obtain a "culture of space".
It is the theme of the design of new uses, more rightly known as the theme of "urban renewal" that embodies the Vitruvian concept of *utilitas*, often misinterpreted since nowadays the meaning of the utility function is central. Through a brainstorming exercise, the design workshop, lead to a design objective in order to guess the meaning of the best utility to return to a community so that we can arrive at the choice of an intended use of a structure in line with current determinations of ethnographic design.
Are we sure that digital technologies allow for the best interpretation of the internal/external dialectic, the brain/body dialectic, the possibility of exchange between freedom/constraint? The message that comes out of the experimental design developed over time offers proposes some optimism to the extent that the discipline of Interior Architecture, in recent years, often marginalized, can recover the centrality in the design process to reach a more controlled balance of weights, measures and distances so as to achieve a path of collective well-being.

These following projects are the results of collaboration with **Edgar Uggiano** Designer Master II level and **Doriana Cacace** Interior and Fashion Designer both as a tutoring seniors of group of students, italian and foreigners, as mentioned beneath :
Group 1 Ciccone Eva, Marino Chiara, Martone Rossella
Group 2 Ildan Ilke, Yucel Varlik, Yigit Eda
Group 3 Corselli Salvatore, Incirciouglu Ceren, Altun Dicie
Group 4 Ciano Ciro, Mazzone Carolina

Bibliographical References

[1] Virilio Paul, talks of omnipolitan inhabitant meaning the citizen of the "city with no boundaries" which looses its time-spatial references in the new habitat produced from decease of sensorial stimulus.

[2] Hillman James, famous psycoanalist and american filosopher declares that "...space is not something neutral, but a generator of stages of consciousness … "

[3] Toija Jader, Speciani Francesca. Pensare col corpo. Lavoro spazi tempi, relazioni, abbigliamento, linguaggio, cibo, sessualità: ogni nostra scelta di vita ci cambia anche a livello fisico. Editore Pulsa pubblishing

[4] O'Keefe John, Moser May-Britt ed Moser Edvard. Nobel prize for Medicine 2014 for the study of the relations and connections between the brain and space behavior in the field of neuroscience, in USA Enviromental Psychology, in Finlandia Juhani Pallasmaa architect and filosopher teacher of Helsinki University of Technology

[5] Mallgrave Harry Francis. Architecture and Embodiment: The Implications of the New Sciences and humanities for design. Routledge Pubblishing, Marzo 2013

[6] Gallese Vittorio, Neuroscientist, professor of neurophysiology University of Parma attending the events in Lombardini22 Design Thinking

[7] Pesare Mimmo, General pedagogist researcher of University of Salento «the roots of psycho-dynamics of leaving». Dialegesthai. telematic magazine of filosophy [on line], year 10 (5 december 2008)

[8] Gangemi Virginia, Ordinary Prof Technology of Archtecture Federico II Napoli in “La prossemica: un nuovo apporto all’architettura? Op. Cit. Magazine of selection of Contemporary Art Reviews. ”

[9] Mirabella Gaetano. Pensiero liquido e crollo della mente. Verso un sentire pensante. Il corpo nell’epoca della Transunaturalità elettronica. Editore Palladio, Salerno 2009

[10] Lev Manovich, in *“Introduction to Info-Aesthetics”* in book titled Info-Aestetic Bloomsbury Academic 2015

[11] Maurice Merleau-Ponty. Phénoménologie de la perception. Éditions Gallimard, collection « Bibliothèque des Idées », Paris 1945

[12] Ciastellardi Matteo. Le architetture liquide. Dalle reti di pensiero al pensiero in rete. LED Edizioni Universitarie di lettere economia e diritto, Milano 2009

[13] Pallasmaa Juhani. The Eyes of the Skin. Architecture of the Sense. Wiley Editor, 2005

[14] James Hillman e Carlo Truppi, conversation about “The soul of places” dialogue on the rediscovery of the sense of beauty captured by the secret nature of places which lives between the soul and the world and humanity. Rizzoli 2004

[15] Novak Marcos, Oustands the concept of divergence and convergence giving relief the dominion of “transvergence” as an attitude of designing of new space .

[16] Merleau-Ponty Maurice. Phénoménologie de la perception. Éditions Gallimard, collection « Bibliothèque des Idées », Paris 1945

[17] Christopher Day, Rosie Parnell. Consensus Design: Socially inclusive process. Architectural Press, london 2003

[18] On the concept of **Co-design** “… which is to be intend as the designing praxis, that reconsiders the central role of the designer inside of the decision process of development and the realization of a latent necessity towards a community. This practice uses several relational roles shared in a process of conformation of activities of man toward its surroundings and himself. This happens both in a decisional manner in case of the designs on small scale, which involves a restrict community through a directly comparable way, as well as an empirical way on larger scale decrypting relations between urban-planning and projects of communitarian development. The process consists in the visualization of the perceptive relations in which individuals are welcomed from spatial conformations, from the characteristics of an object or of the relations of the same activities through emotional maps which expresses a spirit of the place. Through dialogue it’s possible to make everything deprived from contrasts with the environment of reference of the project, and in the designing practice it makes it accessible and attainable both the empathy as well as the ethnography of a place. Assessing the suitability of the actions to take towards the standards of life of a referred community with the elements of a territory which composes it and disposes of a common plan of actions between the designer and the layman...” Designer Edgar Uggiano

[19] James J. Gibson, in *L’approccio ecologico alla percezione visiva* in which he develops the concept of “*affordance*”

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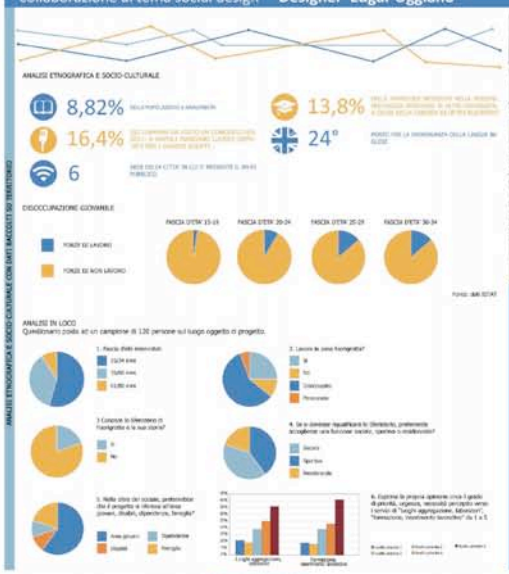
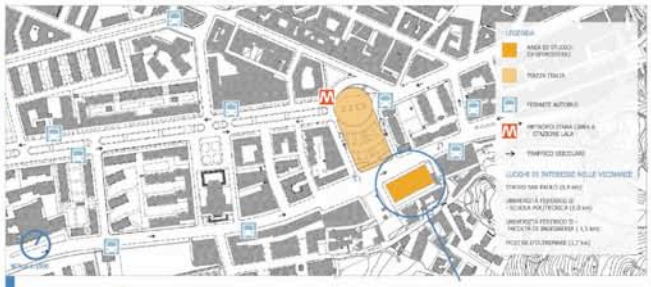
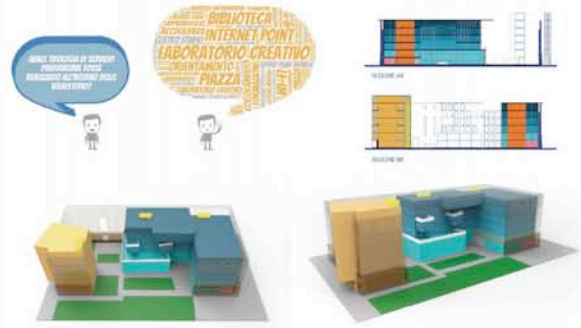
Tavola n. 1 Analisi territoriale

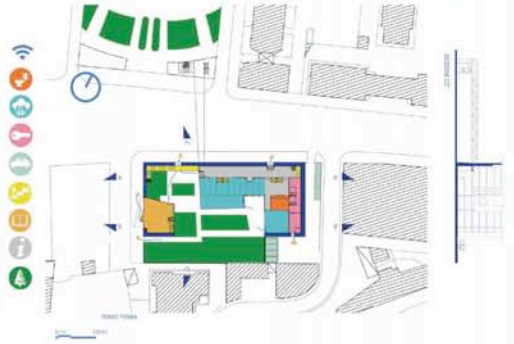
(Inquadramento territoriale planimetrico, analisi ambientale, analisi etnografica e socio-culturali con dati raccolti sul territorio)













SCHIZZI DI PROGETTO





VISTE INTERNE





VISTE ESTERNE

Dipartimento di Architettura e Disegno Industriale Luigi Vanvitelli

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TEMA DI RICERCA DI PROGETTAZIONE ARCHITETTONICA ED AMBIENTALE
RI-FUNZIONALIZZAZIONE DI AREE MARGINALI ED EDIFICI DISMESSI

Allievo : Ciccone Eva A87 000 115
Allievo : Marino Chiara A87 000 117
Allievo : Martone Rossella A87 000 110

LABORATORY FOR ARCHITECTURAL DESIGN

2014/2015

DEPARTEMENT OF ARCHITECTURE AND INTERIOR DESIGN
BACHELOR'S DEGREE IN:
ARCHITECTURE - INTERIOR DESIGN AND FOR AUTHONOMY

Prof. Arch. Marco Borrelli

colaboration in the theme for social design **Designer: Edgar Uggiano**

Theme of the year: Project for the Re-functionalization of an abandoned building in order to to reactivate virtuous processes of social integration and inclusion of "weak" social categories "" through new uses, and new services to individuals.
Case of study: Ex Sferisterio in Piazza Italia, Fuorigrotta, Naples

Drawing 1 Territorial Anlysis

(site plans, environemental analysis, social and cultural and etnographic analysis based on datas found on the site)

Urban Setting Plans





GROUND FLOOR



BRIDGE

2. FLOOR

PLANS 1:500



1. FLOOR



3. FLOOR



4. FLOOR



5. FLOOR

PROJECT AREA - SQUARE- PURPOSES





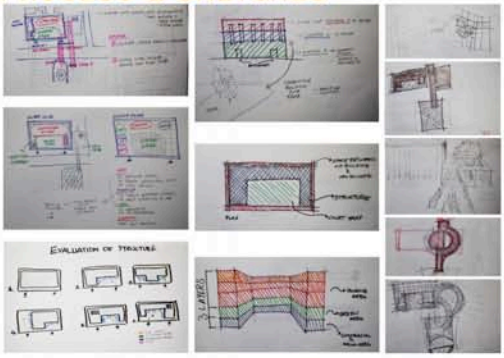


Graphics, schemes, synthesis elaborations

PURPOSES & IDEA MAP

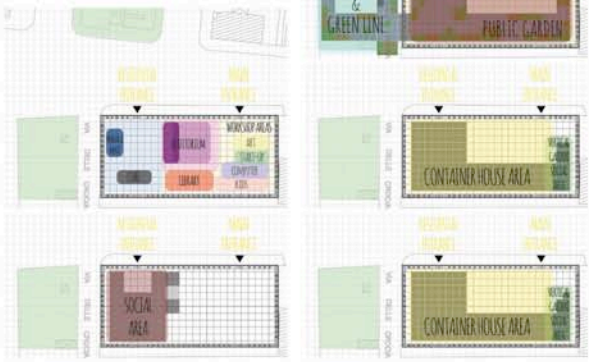


PROCESS & SKETCHES



FUNCTIONS & LEVEL ORGANIZATIONS



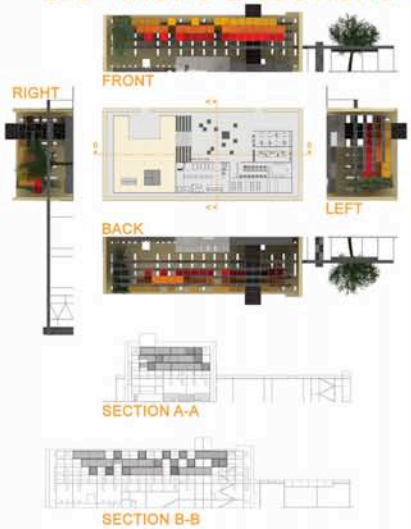


RENDERS - OUTSIDE & INSIDE



CONTAINER PLANS

ELEVATIONS & SECTIONS



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Student :ILKE YILDAN
Student :VARLIK YUCEL
Student :EDA YIGIT

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Tavola n. 1 Analisi territoriale

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There is a 8000 help request to Help Center of Naples central station. Of this a around 25000 outcasts. The %70 of this people are foreigner and %50 of this foreigners are from 18 to 40 years old. 130000 young people who lives in poverty in our region. 4000 homeless. 417000 family who lives in poverty.



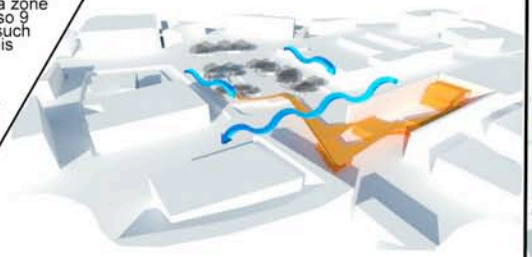
Around the area

There is a 76.000 inhabitants in Fuorigrotta zone and 4000 inhabitants in Piazza Italia. Also 9 restaurants and 27 commercial activities such as electronic shop, furniture shop etc. in this area.

PublicTransportation

There is a two metro line; line 2 and line 6. Also bus optionsand train line 9500000 passengers in per year and 2600 passengers in per day using the Campi Flegrei Station, Also 90000 passengers using the line2 and 1000 passengers using the line 6 in every day.

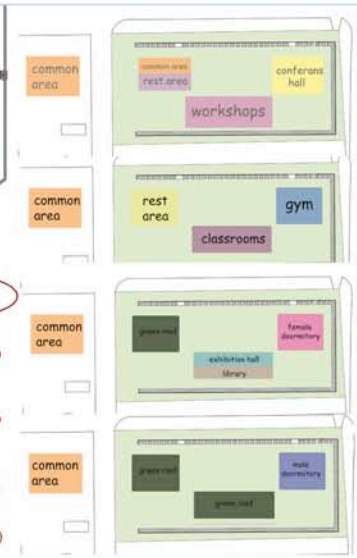
Building Orientation



Site Analysis











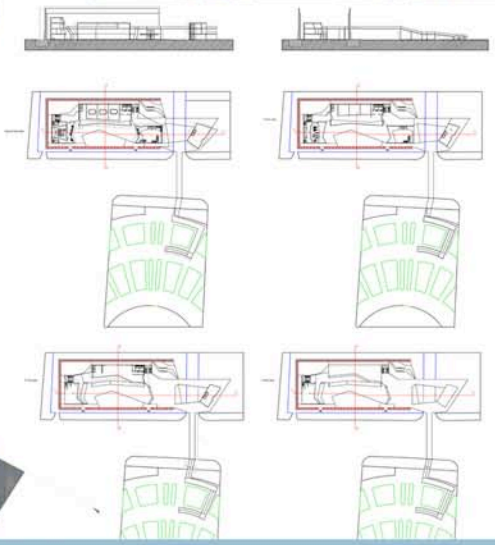


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Tavola UNICA













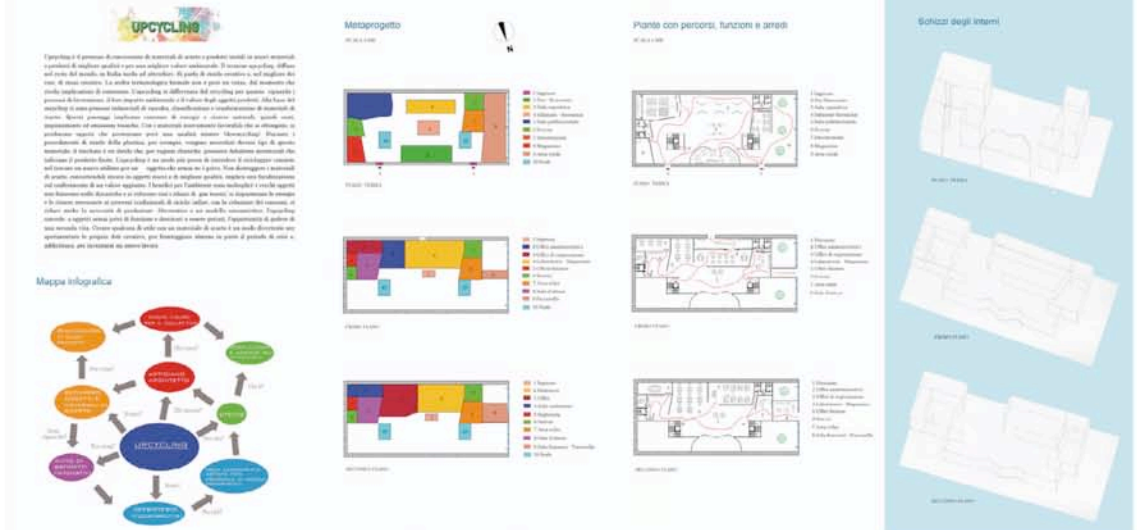

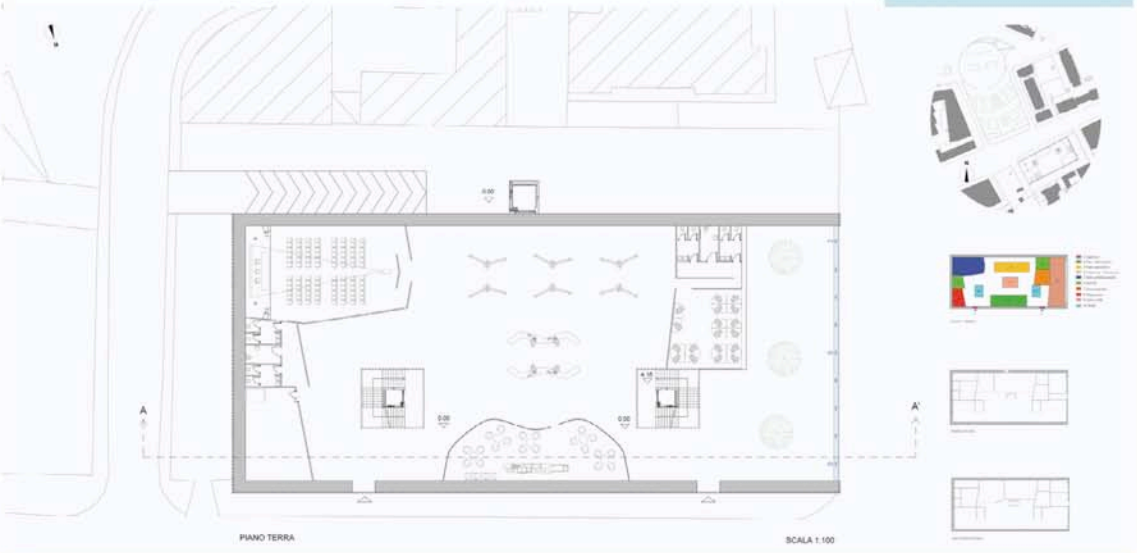

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HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
Aversa, Capri 11-12-13 June 2015

Remote Sensing: Hightech tool for law enforcement in crimes perpetrated against environment

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Abstract
Remote sensing is an operational tool for police to achieve high-tech and multi-disciplinary law enforcement. It is necessary to identify institutional organization in which to compose harmonization protocols with bordering states and non-governmental organizations for the protection of the environment: design and build supranational experts and researchers would be a first step to create operational procedures for international control of the territory and for fighting Criminal Organization, which uses environment to offend.
In recent years in doctrine and in law, environmental laws has lost its sense of body external to the community subject to safeguards: laws ‘for environment’ has exceeded its external dimension becoming the right of everyone ‘to environment’. Furthermore, the semantic value of the term 'citizen' has lost its territorial and nationalistic meaning: now the subject of protection related to the 'right to the environment' is the citizen of any nationality.

Keywords: law enforcement, remote sensing, environment, international organizations, territory.

1. Environment and International laws
Within Governments around the world as well as international organizations, environmental protection is recognized as an essential good of human beings. Protection becomes fundamental to fight against environmental offenses, the effects of which, in case of no control, could threaten the environmental health, biodiversity and the survival of the human species on this planet.



Fig. 1: The First Universal Session of the Governing Council/Global Ministerial Environment Forum of the United Nations Environment Programme (UNEP) at the United Nations Office in Nairobi, Kenya. February 2013

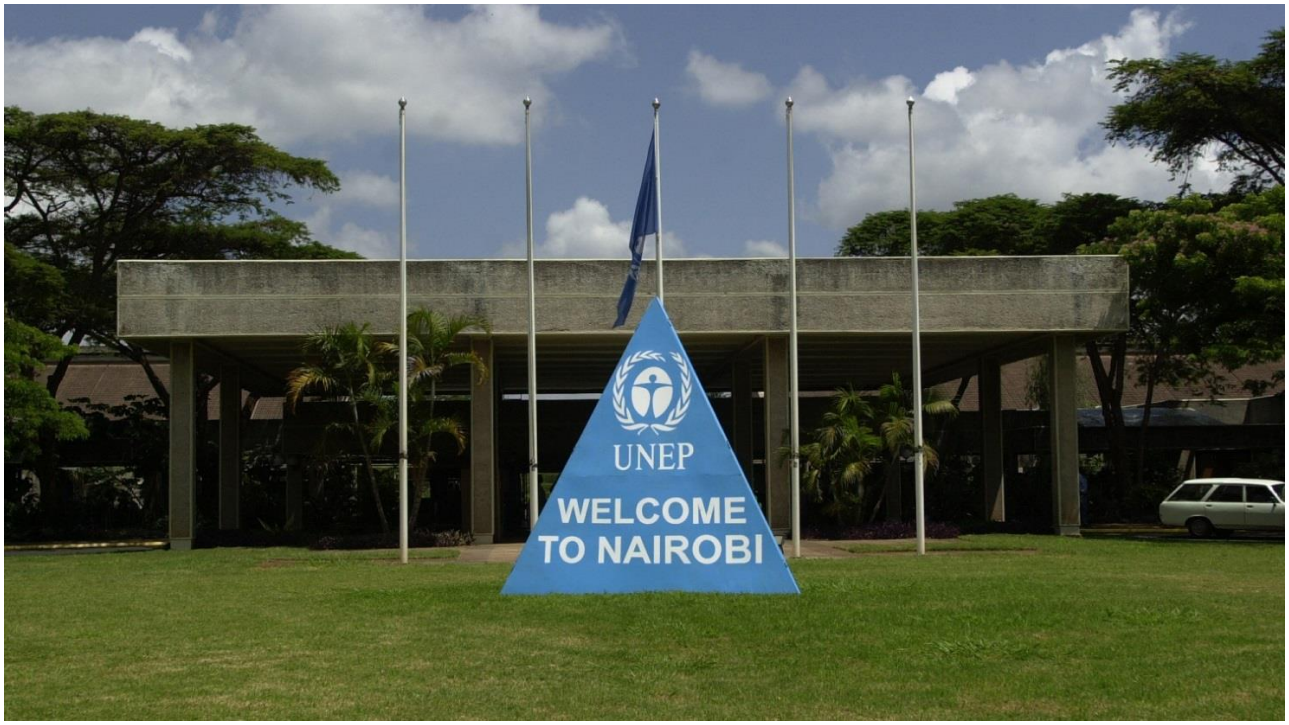

Fig. 2: UNEP Regional Office in Nairobi [http://www.iisd.ca/unepgc/21/05monday.html]

The United Nations (UN), through the United Nations Environment Programme (UNEP), is making big efforts in the international policy to regulate and limit the environmental impact of national policies or criminal organizations causing damage to the global ecosystem.
UNEP mission is “to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.” [1]
The national and international efforts made by Governments, non-governmental organizations as well as the international organizations are aimed at protecting the environment as a whole, taking care of the landscape, the health of the territories as well as the quality of inland sea-water.
The protection of airspaces and international waters had to be included into the national regulations of each State. Conversely about overseas waters, in their quite boundless spaces, international law has always shown the freedom to cross to its best advantage with very few limitations.
After the Second World War, in 1948, an international conference in Geneva founded the Inter-Governmental Maritime Consultative Organization (IMCO). The article 1(a) of the Convention established many purposes of the IMCO: "to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships".
In 1982, the IMCO was changed to International Maritime Organization (IMO), from 1982 based in London.
On 2 November of 1973 the International Maritime Organization (IMO) adopted The International Convention for the Prevention of Pollution from Ships (MARPOL) trying to enforce prevention of every-caused pollution of the marine environment by ships. MARPOL and its Protocol was fully enforced on 2 October 1983 and modified through the years until the VI Annex adopted in 2005.



Fig. 3: IMO headquarter in London [http://worldmaritimenews.com/archives/48747/imo-adopts-series-of-guidelines-on-meeting-in-london-uk/]

2. A case law originated by airborne remote sensing operations

The judgment passed some years ago by the Tribunal de Grande Instance du Havre is a very interesting case. In particular, with “n. de parquet 05000238” and “n. de judgement 607/2007”, an oil tanker, the A.S., was on trial for spilling hydrocarbons in the exclusive economic zone of France [2].
In particular, according to the sentence, on 5 of August 2004 two representatives of the Federal Service Management Unit of the North Sea Mathematical Models (MUMM) were on board of the Belgian Marine Environmental Control Aircraft (call sign AYB402) [3].

2.1 Technical activities carried out by the crew in flight

At 08:54 UTC, the experts in air surveillance and sea pollution recognition observed a patch in the wake of a passing ship.
The aircraft dropped to a flying height of 500 feet, above sea level, in order to record RGB and ultraviolet videos. At 08:57 UTC, the patch was acquired by airborne remote sensing equipment on board the aircraft.
At 09:00 UTC, operators determined the ship's position through the geographic coordinates, the course as well as the speed.



Fig. 4: Military aircraft B-02 / Belgian Maritime Environmental Control / Call sign: AYB402 [http://www.mumm.ac.be/CIS/CISfile/General_Information/gen-info-Aircraft.htm]

At 09:01 UTC the ship, the compartment and the port of destination were identified.
Subsequently, Belgian operators measured the length of the patch (8.89 kilometers) and its width (0.05 kilometers).
It was not possible to establish a radio contact with the tanker as the VHF radio on board of the ship was not working. Nor was it possible to take any fluid sample.

2.2 The investigations carried out at the port of destination

One day after, an inspection of the ship was made at the port of destination, in Amsterdam. That check revealed no anomaly to the ship's bilge pumps. No failures were identified in the systems connected to the ballast, in the engine room or in cargo holds. No discharge of oil nor the presence of water contaminated by hydrocarbons were noted in the board register. The infringement acquired by the Belgian aircraft was communicated to the French State by the diplomatic channel.



Fig. 5: Tribunal de Grande Instance du Havre [http://www.lehavre.fr/annuaire-des-equipements/tribunal-de-grande-instance-du-havre]

2.3 The process of analyzing the visible video conducted on data collected during the flight on 5 August

The analysis carried out after the surveillance flight with airborne remote sensing apparatus could establish, even during the pre-trial phase, then confirmed in the trial phase, as follows. First, operators identified a patch of hydrocarbons. Second, the patch appeared continuous in the wake of the ship under investigation and it has no interruption.
By looking at the images, one can see that before the ship there was no hydrocarbon trace. Further images show that no hydrocarbons remaining trace was at both sides of the ship.

2.4 UV images and the Bonn Agreement

The North Sea is protected by the Bonn Agreement [4]: that agreement is enforced by the Governments of the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Republic of Ireland, the Kingdom of the Netherlands, the Kingdom of Norway, the Kingdom of Sweden, the United Kingdom of Great Britain and Northern Ireland and the European Union.
All of these countries are cooperating in dealing with pollution of the North Sea by oil and other harmful substances, accidentally or voluntary spilled out. The scientific analysis carried out on December 20th confirmed that the colour of the substances revealed by the images is the one belonging to hydrocarbons [5].

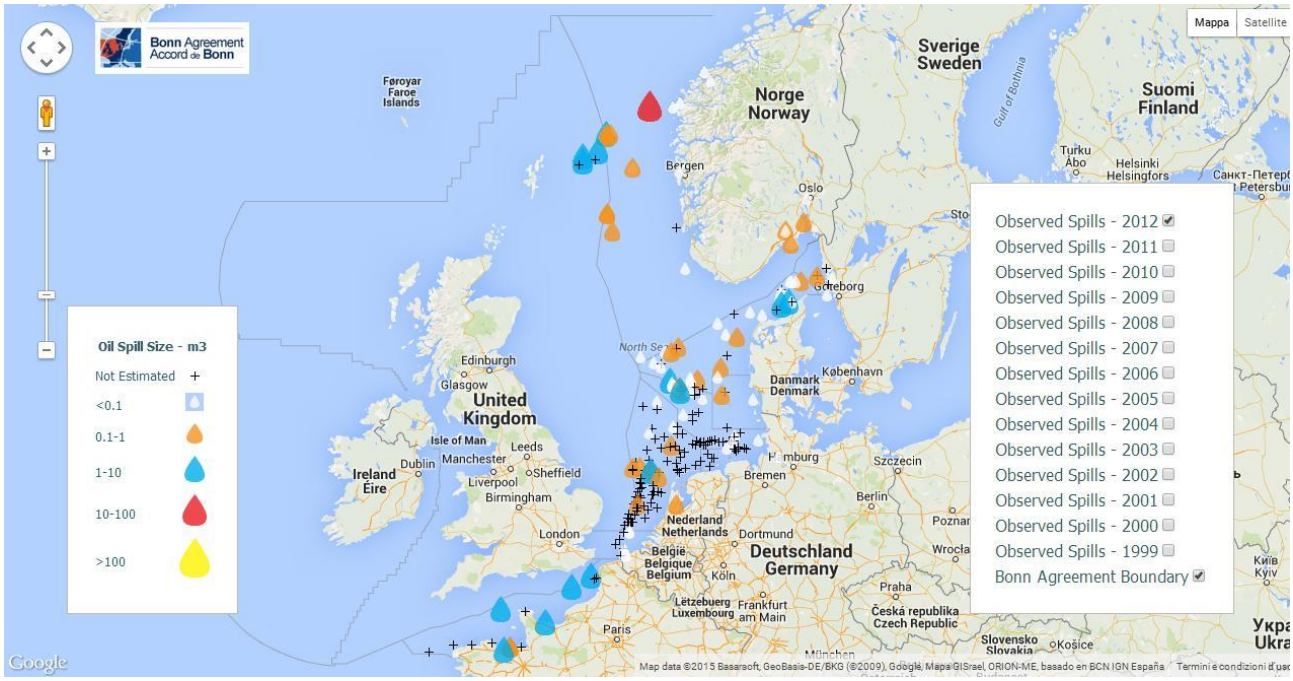

Fig. 6: Map of Spill Sizes and Locations. [http://www.bonnagreement.org/activities/aerial-surveillance]

From the sentence: “Moreover, the film obtained from ultraviolet scanner and ultraviolet n9 image makes appear white tape transparent continuously in the ships wake, and white packets in the most distant release of the ship. Images are characteristics of releases of oil products, ultraviolet scanner doing this be reflected in the appearance of this type rejected” [6].

2.5 Airborne remote sensing: evidence or proof?

The sentence at page 8 goes on answering that question: “If the defense argues that these photographs and films are, in the absence of levies, insufficient to demonstrate the existence of a discharge of oil, the levy of samples, assuming that it would be technically feasible, is not an essential element to prove the offense; is an evidence of such offense the direct visual observation from an aircraft, observation corroborated by RGB photographs and, as in the present case, films and photographs by ultraviolet scanner”. [7]



Fig. 7: Airborne technology are required for sea and land government.

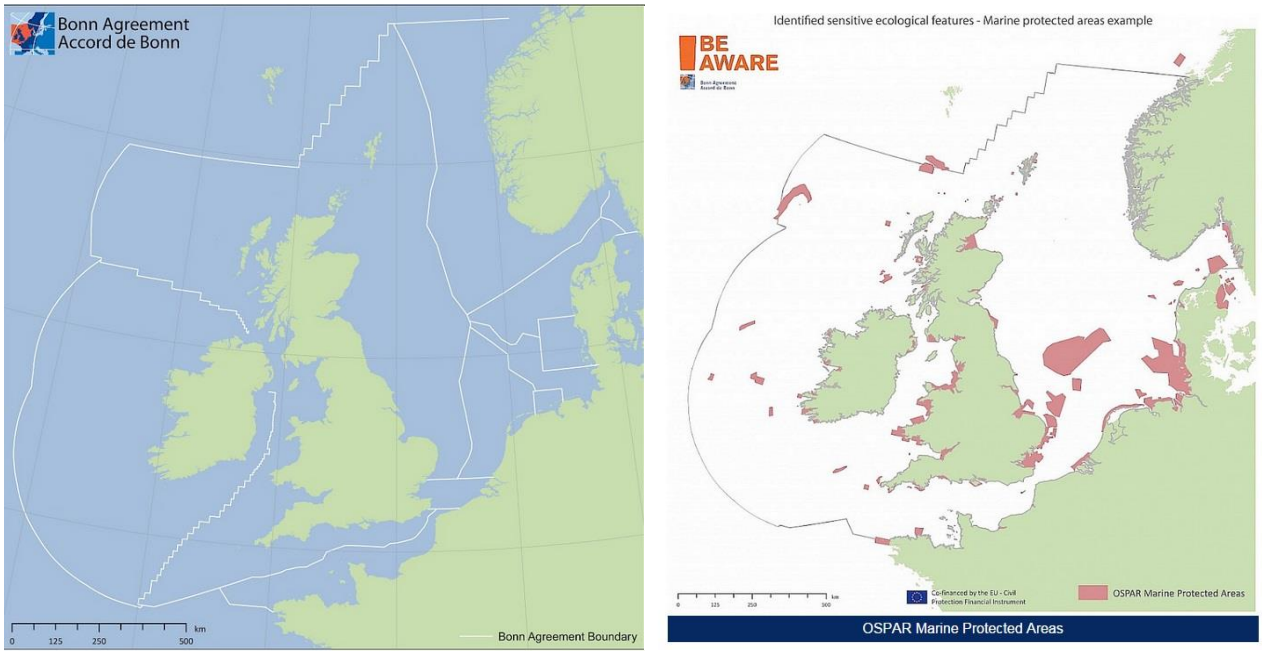

Fig. 8: Bonn Agreement boundaries and marine protected areas in the North Sea. [http://www.bonnagreement.org/about/north-sea]

3. Technology, scientist, police forces, jurisprudence and international organizations

In 1982, United Nations Convention on the Law of the Sea, Montego Bay Convention at art. 193 establishes: "States have the sovereign right to exploit their natural resources pursuant to their environmental policies and in accordance with their duty to protect and preserve the marine environment".



Fig. 9: Strait of Messina. There are many places in the Mediterranean Sea with huge maritime traffic in national and international waters.

In the par. 2, art. 194: “States shall take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with this Convention”. [8]
Today, through the representation of the territory, the use of the latest technology for the study of environmental changes, the knowledge of economic and pathological phenomena of criminal organizations, national and international Government can pursue a sustainable territorial control and development. [9]
The accidental or voluntary harms caused to the common environmental good, have devastating effects on the entire Earth's delicate balance, going beyond borders and national powers.
Technology and science offer the tools that may also have substantial effects in law contexts. This case law is an important legal instrument for law enforcement by airborne remote sensing technology that must be exported in other countries’ laws, including Italy.



Fig. 9: Procida Mount and Pozzuoli. The extent of the coastal territory requires the use of scientific instruments, latest technology and human resources from government institutions, police forces and scientific researchers in order to contribute to a sustainable use of available resources.

Bibliographical References

[1] For further in UNEP Mission: http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=43

[2] Andreone G., *Chronique de la Jurisprudence*, in *Annuaire du Droit de la Mer*, 2011, p. 553-570.

[3] Andreone G., Caligiuri A., Cataldi G. (sous la direction), *Droit de la mer et émergences environnementales - Law of the sea and environmental emergencies*, Napoli, Editoriale Scientifica, 404 p., 2012, ISBN: 9788863423488

[4] “The Bonn Agreement is the mechanism by which nine Governments of the Greater North Sea and its wider approaches, together with the European Union, cooperate in dealing with pollution of the North Sea by oil and other harmful substances. The signatories to the Agreement are the Governments of the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Republic of Ireland, the Kingdom of the Netherlands, the Kingdom of Norway, the Kingdom of Sweden, the United Kingdom of Great Britain and Northern Ireland and the European Union” - http://www.bonnagreement.org/

[5] Boon Agreement Counter Pollution Manual - http://www.bonnagreement.org/site/assets/files/3946/bonn_agreement_counter_pollution_manual.pdf .

[6] “*Par ailleurs, le film issu du scanner ultra-violet et l'image ultra-violet n9 font apparaitre un ruban blanc trasparent continu dans le sillage du navire, et des paquets blancs dans les rejets les plus eloignes... Ces images sont caracteristiques des rejets de produits hydrocarbures, le scanneur ultraviolet faisant se refleter sous cette apparence les rejetes de ce type*”.

[7] “*Si la defence soutient que ces photographies et films seraient, en l'absence de prelevements, insuffisants pour apporter la preuve de l'existence d'un rejet d'hydrocarbures, le prelevement d'echantillons, a supposer qu'il soit techniquement realisable, ne constitue pas un element essentiel pour prouver le delit, la preuve d'un tel delit pouvant etre rapportee par une observation visuelle directe a partir d'un aeronef, observation corroboree par des photographies en couler et, comme en l'espece, des films et photographies realisees par scanner ultra-violet*”.

[8] Angeloni M. M., Senese A., *Profili applicativi dei principali istituti del nuovo diritto del mare*, Bari, Cacucci, 404 p., 2001.

[9] GAMBARDELLA C., *Hyperspectral and thermal airborne surveying for the characterization and the monitoring of natural and anthropized environment*, (con Pasquale Argenziano, Alessandra Avella, Stefano Bastoni, Giuseppe Casbarra, Flaviano Tessitore), *Proceedings of Le Vie dei Mercanti. Heritage, Architecture, LanDesign. Focus on Conservation, Regeneration, Innovation* – Atti dell' XI Forum Internazionale di Studi, Aversa-Capri. Napoli 2013, ISBN: 978-88-6542-290-8.

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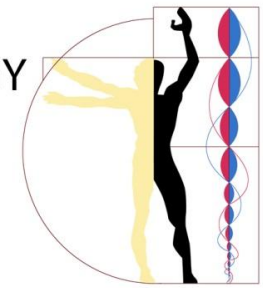

Innovative Strategies for Urban Regeneration in Coastal Areas – the Case Study of the Metropolitan Coast of Naples

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Abstract
Naples is a complex and controversial metropolitan city and so is its relation with the sea. In order to overcome the negative phase in which the city is going through and start a process of growth and development, recovering maritime identity may open new perspectives and enable the identification of development and urban regeneration processes.
In this context, new collaborative methods of lateral participations are taking hold – as an alternative to vertical models – through which realizing urban transformations, recognizing the sea as common good. A process innovation which enables the realization of more effective strategies for city regeneration, through new forms of participation, integrated into technological innovations.
The paper analyzes the case study of New York City waterfront regeneration where, by sharing its maritime culture, collaborative urban transformations were realized also with the support of the ICT.
As Jeremy Rifkin exposed [1], the idea is to create "collaborative commons", aimed at requalifying and promoting the metropolitan coast of Naples, which should come away from juridical-political-administrative perspective and, in the light of maritime culture, enhancing its regeneration.

Keywords: maritime identity, metropolitan city, urban development, smart city, collaborative commons, shared plan

1. Naples and the Metropolitan Coast[1]
Metropolitan city of Naples is a large community of more than three million of inhabitants gathered in 1.200 km2 of surface. It is a community including smaller communities and small, medium and big towns, which are seeking a spatial and functional arrangement that can assure its sustainable development in its three dimensions: environmental, social and economic.
Naples is the biggest seaside city in Italy and its territory has been almost entirely urbanized in the last decades. Neapolitan metropolitan coast – including environmentally, archeologically and landscape worthy areas, though deeply impoverished – extends over 200 km. The anthropic pressure of the 3 million of

[1] The paper has been developed in National Research Council by the "City and Architecture" research group, coordinated by Massimo Clemente, who has been conducting researches for years on the seaside cities and the metropolitan coast of Naples. For the latter issue it has been also set in motion a process of total involvement of scientists, specialists, stakeholders and the entire urban community which live on the coastline. Within the unitary work, the following contributions can be individuated in the paper: "Naples and the Metropolitan Coast" and "Toward a vision and a shared development plan for the Metropolitan Coast of Naples" has been carried out by Massimo Clemente; "The Metropolitan Coast regeneration: the sea from common good to commons", "Maritime culture and urban regeneration: NYC Waterfront Vision" and "ICT and smart approaches for urban regeneration" by Eleonora Giovene di Girasole. English Citations have been translated by the authors.

inhabitants affects this wide area, generating a coastal belt urbanization (300 m) of nearly 100% [2]. Along this structured coast, there are 28 between harbors and docks, with over 300 maritime works.
We have been talking about metropolitan area, metropolitan city, etc. since the mid-80's and the discussion generated the Law 142 in 1990 [3] [4] [5] [6] [7] [9] [10] [11] [12]. Almost thirty years have passed, but it's not just a political-administrative issue. In the meanwhile, economic and social processes have proceeded independently of administration: life in Naples is actually a metropolitan life. Economic and social transformations, as well as the entire territorial dimension, brought to a spatial situation which can be seen as "loose threads".
In this context, opposite leanings struggle with actions aimed at realizing a settlement able to release the area from the ongoing segregation.
Only a cultural and political shock, together with new perspectives and a wide participation, can unblock the evolutionary process of our territory through the birth of a cohesive and aware metropolitan community which can induce the future development of the city.
In order to overcome the negative phase and start a process of growth and development, Naples [13] [14] [15] [16] [17] [18] has two important resources to rely on: the sea and the metropolitan dimension, two pillars in the regeneration of the "Great Naples", as well as for a future heralding local development and sustainability.
The "vision from the sea" [19] opens new perspectives on the metropolitan area which, in the light of history and maritime identity, shows hidden features and discloses many resources whose value must be increased.
The cognitive vision of the cities from the sea is an interpretive methodology aimed at renovating the approach to coastal urban areas and focusing no longer just on the harbor waterfront but rather on the whole coastal urban belt, on mainland and water.
A reexamination of the history of Naples shows the deep maritime identity which can be examined in relation to the modern concept of environmental, social and economic sustainability.
The strong identity of seaside cities is based on the harmonious fusion between urban and maritime culture [20]: the sea can be the main resource to trigger processes of urban regeneration and local sustainable development.
We can recognize the sea as "common good" - a primary resource for urban regeneration that is able at the same time to promote local development processes, so urgent in these times of crisis. There is the need to identify what the metropolitan city intends to be, that is to say a vision in which we can define the long-term goals for the whole next decade, restarting from the sea as resource, common good or commons, on which to build a development policy of the metropolitan city and its competitiveness.
As Jerry Rifkin explained [1], the idea is to create "collaborative commons" with the intent of requalifying and enhancing the metropolitan coast along the entire Gulf line, islands included.
Collaborations are lateral, in order to avoid those obsolete forms of vertical participation, aiming at a swarm of "urban prosumers" [21], who share and realize the transformation of the metropolitan coast and the Gulf of Naples, in the interests of everybody.
In this scenario, it is very interesting to analyze the transformation process of the New York waterfront, where, restarting from its maritime culture, were realized some integrated urban transformations also through to a successful process of interaction between private citizens, stakeholders, organizations and institutions, taking advantage of the ICT potentiality too.
By analyzing NYC case study and the research conducted by Elinor Ostom about the collective goods [22], the paper offers a possible model to apply to the metropolitan coast of Naples, in order to realize a shared plan for its regeneration and its sustainable development, with the collaboration of all those subjects who, although heterogeneous, share the same vision of the sea as common good, and therefore as a resource, with the aim of enhancing the coast that borders one of the most beautiful Gulfs in the world.

2. The Metropolitan Coast Regeneration: the Sea from Common Good to Commons

The requalification of urban waterfront is one of the emerging themes in the XXth century urban policy of the seaside cities (New York, Marseille, Barcelona, Valencia, Boston, etc.) which have to face their conversion or requalification, taking back the sea and the bordering areas.
In these contexts, some urban-harbor regeneration processes and some projects to transform their waterfronts were realized and implemented through approaches, political choices, projects, actors and different resources [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34].
These actions represent one of the greatest opportunities for urban development of these days [35] [36] [37] [38] and they have often provided the occasion to realize wider processes of regeneration in which integrated urban transformations were realized and shared with the urban community, restarting from its "maritime culture" [39].
"Maritime culture" means realizing an overall redefinition of own urban structure starting from historic relation with the sea. This happens through the harmonious cohesion between maritime culture and urban culture

[19], that recreates what Konvitz [20] defined “Urban Maritime Culture”, which in the past enabled the cities to realize those progresses that led to their urban, economic and social development.
Nowadays we perceive the sea and the maritime culture as leading resources for urban regeneration and local development.
We can consider the sea as an “urban [41] [42] common good” [40] [22] [1] for the sake of city and urban community, strictly related to their identity and culture.
Common goods are characterized by the concept that the interest of each person is achieved along with other people’s interests, rather than against them (as it happens in private good) or independently of them (as it happens in public good) [43].
The sea as common good entails ensuring its fruition to everybody and the necessity of involving the members of urban community in its care and safeguard, both in decisions and in actions.
Thus, considering the sea as common good can enable the creation of those conditions of “common ground” which Elinor Ostrom [22] [44] saw as fundamental to fulfill the trust, the integrity and the reciprocity between the community members, which recognize some “shared rules” for using the good. A social commons is «the place in which it’s generated a collaborative spirit which enables a society to act as a cultural cohesive entity» [1].
First of all, we can identify the sea and the urban community as the “action arena”. This approach may be the key for a cultural revolution in a time when political systems are unable to generate opportunities of development; that is to say the turn from a “vertical” vision (which has already proved to be ineffective), to a “lateral” or “horizontal” vision, which involves a “city consumer” who is at the same time a “city producer” of qualities widespread on territory, who is able with his actions to weigh on public choices.
A collaborative city, where “prosumers” [22] [1] become “urban prosumers” [21], city consumers, connected in a network (virtual or real) become producers of their main necessities and the sustainability of the city, sharing the results and thus increasing their productivity. An energy flow which insists and takes part in city regeneration.
In this context, arises the problem of how “to produce the common good”, how to use it, how to arrange, what are the rules to follow, how anyone can contribute in order to maintain the system [22].
In other words, the goal is the construction, realized by urban community, prosumers and institutions, of a shared vision, based on own maritime culture, identifying the sea as common good to start from in realizing waterfront regeneration processes.

3. ICT and Smart Approaches for Urban Regeneration

In contemporary cities the link between urban development, life quality and new technologies is a pivotal issue. ICT and smart approaches assume particular relevance, since they can represent instruments intended to simplify activation, management and realization of processes of collaborative regeneration.
The Smart city [45] [46] is becoming the symbol of a new “utopia” which considers the urban growth as completely anchored in digital technologies [47].
However, if innovation has always been a crucial factor for meeting new needs of civilized societies, the smart city can’t just be a technological challenge. In order to really contribute to the sustainable development of the city [48] [49] and its community, technological innovation must be combined with social innovation [46] [50] [51] [52].
Collaborative strategies of lateral participation represent a process innovation which promotes the realization of more effective strategies aimed at the regeneration of the cities, also through technology innovation.
The ICT can have particular relevance in the relations between Institutions and citizens, since they can help objectives, problems and ideas emerge, and play a part in organizing and managing them, simplifying collaboration processes.
This change of perspective involves the participation of public institutions, which are no longer able to deal with the needs of an ever changing society, to solve its problems and give appropriate responses, but on the other hand can still reassess their role.
This process leads the Institutions to establish innovative rules to govern both the city and its transformations together with the citizens.
This could be realized organizing meetings with citizens and civil society, in which communicate and share ideas on the establishment and the definition of rules and procedures, in order to ensure the alliance between the local administration, the community and its civic, economic, cultural and social resources.
As monopolists who pursuit the interests of the community, the Institutions should be able to «support the shared and collaborative civic solution to the problems of general interest» [53], by using and managing new technologies.
Therefore, besides the already established instruments (such as the workshops, etc.), other ICT instruments can be taken into account to simplify social activation: some «collaborative digital platforms” through which citizens and urban communities could be part of the choices and proposals for the regeneration of the city» [54].

In other words, this means putting the citizens in condition to cooperate for purposes of general interest, facing city problems and common obstacles, gathering ideas or taking care of common good, under the coordination of public administration.
Cities, with their spaces between earth and sea, represents an important laboratory for the experimentation of innovative strategies of urban regeneration, based on the enhancement of maritime identity, cooperation and smart approach.

4. Maritime Culture and Urban Regeneration: NYC "Waterfront Vision"

An approach of this kind can be recognized in New York City development process; indeed, the city has undertaken an overall redefinition of its urban structure starting from its historic relation with the sea, through the projection of sea toward city [39] (Fig. 1, Fig. 2).
In NYC case study it is extremely interesting the realization in 2011 of a joint action plan (Waterfront Vision and Enhancement Strategy) for the sustainable requalification of the waterfront through the involvement and the participation of urban community, prosumers and associations in defining long term objectives.
New York is a historic city-harbor, which has 520 miles of seaboard, among which there are oceans, rivers, swamplands and bays; after decades of indifference, the city has started, since the 90's, a process aimed at taking back and redesign its waterfront. In NYC four fifth of the districts are islands and the fifth is a peninsula; it is a historic city-harbor and has always proved to be a hinge in the trade between the Ocean and the inland waters. Recently, the city has been modifying the way to perceive its relations with water, through the requalification of docklands, waterfront and behind areas.
The interventions along its multifaceted waterfront are intended to reconnect the city with the sea, turning into an opportunity of interconnection with the rest of the city [55], through an ever-changing process.
In 2011 the "Waterfront Vision and Enhancement Strategy" was pronounced (following the guidelines of the city planning of 1992), a co-op plan intended to redesign 520 miles of the city's waterfront. The plan is divided into two parts: the "Vision 2020. New York City Waterfront Comprehensive Plan" [56], which denotes the long-term goals for the next 10 years, and the "New York Agenda Waterfront City Action" [57], consisting in 130 priority projects to be completed in three years. The latter is going to integrate a series of redevelopment interventions for both the waterfront and the area around it, with a major focus on the requalification of the public space.
"Vision 2020" was characterized by an extensive public outreach, including public meetings in all five boroughs and discussions with thousands of community and waterfront stakeholders, which lasted more than a year. In the "New York City Waterfront Action Agenda" instead were presented the 130 priority projects to be implemented over the next three years to realize the eight goals. These interventions are integrated actions not only along the waterfront but also in the areas immediately forthcoming, the ones in which the redevelopment and the increase of public space become the backbone of the process.
"Waterfront Vision and Enhancement Strategy" was the result of an intense involvement of citizens and urban community, realized by the Administration both through traditional participatory processes (public meetings, public revisions, etc) and through innovative use of the ICT. Generally, New York is involving citizens and communicating with them in a more direct and significant way by means of social media, New York Mobile Apps [58], etc.
For the presentation of "Vision 2020" seven public workshops took place and, particularly, Metropolitan Waterfront Alliance (MWA) was engaged. MWA is a no-profit association concerned with protection of New York bay's water, with waterfront accessibility and building of public spaces for education, work and spare time [59].
It is the result of an uninterrupted participative process of various stakeholders which is not limited only to the objectives definition phase, but goes further: in the web with the "DCP Community Portal", for active participation in the political process and services provision to address evolving community needs, or with "How can we make our city a better place to live?" [60].
Through the "Interactive Map of Publicly Accessible Waterfront Spaces" [61], it is possible to identify and provide information about the city's inventory of publicly-accessible waterfront spaces. Trough "BYTES of the BIG APPLE" – a family of software, data and geographic base map files for the City of New York – among other things, it is possible to learn more about the Publicly Accessible Waterfront. The data contain information about waterfront areas accessible to the public that are either publicly owned or on private property [62].
Through ZoLa (Zoning and Land Use Application), available online, it is possible to consult the "Coastal Zone Boundary" [63].
The "Resource Mapping" enables people to keep up with all the works and the initiatives related to the waterfront. Through thematic maps it is possible to share information and data, also thanks to the use of the platform OASIS (The New York City Open Accessible Space Information System Cooperative) [64].
App [61] supplies a quicker way to access the myriad of initiatives and projects along the waterfront and links to the magazine Waterwire [66].

By using maps, the system “Who is doing what” [67] enables people to be directly linked to the sites of each partner/user/company involved in the wider process of waterfront requalification.
New York case study shows how it is possible, using the ICT, to prolong/extend the benefits of the administration on the physical environment of the city. Indeed, institutions have had a significant role in enhancing an urban culture interested in waterfront requalification and public space design, engaging the urban community from the moment of objectives definition, to the phase of monitoring as well as in the continuous proposal of ideas. The sea has been identified from community and prosumers as common good, a resource, a place where different needs can be satisfied following some established rules.
Sea, community and prosumers have become an “action arena”.
Prosumers have been part of the process and at the same time have contributed and made their requests in order to define the objectives (namely, the “rules”). No-profit organizations (as well as the urban community) concerning with urban environment, have been engaged in this process and have cooperated with different municipal authorities on initiatives and projects.
This process, defined by the Administration, has become a distinct and shared relational structure for the utilization of the resource of the sea, able to increase the wellness of the individual not in contradiction with the wellness of the community and the resource itself. Different parts (horizontal and vertical) have joined together, teamed up, cooperated for common good, have brought to light both factors of conflict and shared asleep values: they have become a community.

5. Toward a *Vision* and a *Shared Development Plan* for the Metropolitan Coast of Naples

What is the future of the Metropolitan Coast of Naples? Can the recovery of culture and maritime identity represent the key for reinterpreting our metropolitan territory? Can these be the key elements in the strategies of material, economic and civil metropolitan city regeneration, through a participatory and shared process? Therefore, can we identify a new “route” for the city, to be defined together with urban community, prosumers and institutions?
Finally, can this be the opportunity to build a vision which is going to realize a *shared plan* looking at the sea as *commons*, by identifying *shared objectives* for a sustainable development of the city, through horizontal, vertical and lateral processes, involving sea, waterfront and hinge areas with the rest of the city?
Metropolitan waterfront, with its multifaceted coast, is constantly a conflict area where public, private and corporatist interests collide, where entrepreneurs don’t invest money, where urban community is divided and public sphere can’t work. Relations between city and the sea are critical: barriers, lack of public spaces, physical and figurative inaccessibility. First and foremost, there is the difficult material/politic relationship harbor-city [68] [69].
Thus, the goal is to identify a common vision for the sustainable development of Naples, starting from its culture and its maritime identity. Maritime city is intended in a broad sense: non only a coastal city, maritime city-harbor, but also habitat of urban community indissolubly connected to the sea, seeing it as something to identify with.
Consequently, there is the need of defining a development model which is different and perhaps more effective.
Urban community, associations and stakeholders can play a central role in defining, implementing plans and projects and proposing interventions of waterfront transformation.
In this scenario, the idea of “collaborative commons” takes form, as Jeremy Rifkin explained, through the realization of a Waterfront Alliance for the Metropolitan coast of Naples, in order to realize a shared plan of development based on the recovery of Neapolitan maritime identity as a pillar for a sustainable development, that is to say, the sea as “urban common good”.
This is an ambitious project that necessarily requires the identification of innovative actions able to activate and relate to each other all the actors of the process, resolving personal conflicts and developing the area of overlap of different targets.
Starting from the analysis of New York waterfront regeneration projects and the framework built by Ostrom to examine the main elements of a collective system, we can think of using the sea not as an instrument of examination, but as a guide to build a collaborative structure for the regeneration of seaside cities.
We can consider that the “action arena” is made up of the horizontal forces of prosumers and the vertical forces (from the bottom) of the citizens, and those (from the high) of the institutions, that recognize the value of their maritime culture and tend to identify the sea as common good – a primary resource for urban regeneration, for promoting the processes of economic and local development.
The process for defining a shared vision may be actualized in a shared Action Plan, in which we will define rules, targets and shared values, that is to say the set of rules for the shared use (and the respect) of the sea as collective resource and the waterfront regeneration.
The ultimate purpose is to promote the regeneration process of the metropolitan waterfront in its double value of sea and land and its environmental, social and economics elements.

The Metropolitan City, being created today, could be configured in this way, with an open attitude toward the various components of society in the process of conception and setting the rules and during the collective creation of institutions [70].
To make all this workable, it is necessary to make innovations in organizational structures in order to get ready to rule in a different way together with the network of several stakeholders, through innovative methods and instruments such as the ICT, to involve and standardize the civic energies of urban community aiming at realizing the regeneration of the metropolitan city restarting from its maritime culture.



Fig. 1: A blue vision of waterfront from a green point: New York City from Central Park (Photo by Gaia Daldanise)



Fig. 2: New York City: Water Taxi approaching Manhattan on the Hudson River (Photo by Massimo Clemente)

Bibliographical References

[1] RIFKIN, Jeremy. *The Zero Marginal Cost Society*. 1ª ed. USA: Palgrave Macmillan, 2014.

[2] D'ASCOLA, Filippo. Urbanizzazione in aree costiere. In AA.VV. *Focus Acque e Ambiente Urbano, Qualità dell'ambiente urbano IX rapporto, ISPRA*. 1ª ed. Roma: Tiburtini srl., 2013.

[3] PACENTE, Carmine. *La città metropolitana nell'Unione europea. Programmazione comunitaria, esperienze europee a confronto e nuove prospettive*. 1ª ed. Milano: Egea, 2013.

[4] *Urbanistica Informazioni.* MOCCIA, Francesco Domenico. Per una metropoli resiliente. 2013, n.41, Roma: INU.

[5] TESTA, Paolo (ed). *Le Città Metropolitane*. 1ª ed. Roma: Cittalia Fondazione ANCI Ricerche, 2013.

[6] ALLULLI, Massimo. *Le politiche urbane in Italia, tra adattamento e frammentazione*. Roma: Cittalia Fondazione ANCI Ricerche, 2010.

[7] BARTALETTI, Fabrizio. *Le aree metropolitane in Italia e nel mondo*. 1ª ed. Torino: Bollati Boringhieri, 2009.

[8] COSTA, Paolo, TONIOLO, Mariolina (eds). *Aree metropolitane e sviluppo regionale*. 1ª ed. Milano: Franco Angeli, 2009.

[9] FORTE, Francesco. *Il ruolo delle aree metropolitane costiere del mediterraneo*. 1ª ed. Firenze: Alinea, 2003.

[10] FUBINI, Alex, CORSICO, Franco (eds). *Aree metropolitane in Italia*. 1ª ed. Milano: Franco Angeli, 1994.

[11] BEGUINOT, Corrado (ed). *Progetto strategico aree metropolitane e innovazione*. 1ª ed. Roma: CNR, 1993.

[12] AA.VV. *Incontro-scontro. La Città Metropolitana spazio-tempo-velocità per la città del XXI secolo*. 1ª ed. Napoli: Università degli studi di Napoli – DiPiST, 1991.

[13] FORTE, Francesco. *Napoli, la stagione della città metropolitana.* 1ª ed. Roma: Aracne, 2014.

[14] RUSSO, Michelangelo. Napoli e la sua costa. Contraddizioni di un territorio duale. In SAVINO, Michelangelo (ed). *Waterfront d'Italia. Piani politiche progetti*. 1ª ed. Milano: Franco Angeli, 2010.

[15] LOSASSO, Mario. *Riqualificare i litorali urbani. Progetti e tecnologie per interventi sostenibili sulla fascia costiera della città di Napoli*. 1ª ed. Napoli: Clean, 2006.

[16] VITALE, Antonio. *Ritrovare il mare. Linee guida per gli interventi di riqualificazione della fascia costiera di Napoli*. Napoli: Clean, 2006.

[17] PEZZA, Valeria. *Città e metropolitana. Vesuvio infrastrutture territorio*. 1ª ed. Napoli: Clean, 2005.

[18] AMIRANTE, Roberta. *Dalle stazioni al mare. La costa vesuviana tra descrizione e progetto*. 1ª ed. Napoli: Liguori, 2001.

[19] CLEMENTE, Massimo. *Città dal mare. L'arte di navigare e l'arte di costruire le città*. 1ª ed. Napoli: Editoriale Scientifica, 2011.

[20] *Journal of Urban History*. KONVITZ, Josef W. Port cities and Urban History. 1992, n.3, Sage Journals.

[21] CLEMENTE, Massimo. Innovative strategies for tourism in urban coastal areas. Research, training and experimentation in the case study of the metropolitan coast of Naples. Conference Presentation: *t-FORUM 2015 Global Conference: Tourism Intelligence in Action*, Napoli, 4-7 maggio, 2015.

[22] OSTROM, Elinor. *Governare i beni collettivi*. 1ª ed. Venezia: Marsilio, 2006. Translation of original book *Governing the Commons. The Evolution of Institutions for Collective Action*. New York Cambridge University Press,1990.

[23] SMITH Harry, GARCIA FERRARI, Maria Soledad (eds). *Waterfront Regeneration: Experiences in City-building*, 1ª ed. Routledge, 2013.

[24] *TRIA*. CLEMENTE, Massimo. Sea and the city: maritime identity for urban sustainable regeneration. 2013, n.11, Edizioni Scientifiche Italiane. Web http://www.tria.unina.it/index.php/tria/article/view/2095/2128.

[25] PAVIA, Rosario, DI VENOSA, Matteo. *Waterfront. Dal conflitto all'integrazione. From conflict to integration*. Trento: List, 2012.

[26] HEIN, Carola. *Port Cities: Dynamic Landscapes and Global Networks*. 1ª ed. London: Routledge, 2011.

[27] SAVINO, Michelangelo. *Waterfront d'Italia. Piani, Politiche, Progetti*. 1ª ed. Milano: Franco Angeli, 2010.

[28] FONTI, Luciano. *Porti-città-territori. Processi di riqualificazione e sviluppo*. 1ª ed. Firenze: Alinea, 2010.

[29] CARTA, Maurizio (ed). *Governare l'evoluzione. Principi, metodi e progetti per una urbanistica in azione*. 1ª ed. Milano: Franco Angeli, 2010.

[30] PAVIA, Rosario. Progetti urbani per la riqualificazione dei waterfront. In AA.VV. *Periferie? Paesaggi urbani in trasformazione*. Milano: Di Baio, 2005.

[31] MARSHALL, Richard (ed). *Waterfront in Post-Industrial Cities*. 1ª ed. London: Spon Press, 2001.

[32] HOYLE, Brian S. (ed). *City-ports, coastal zone and regional change. International perspectives on planning and management*. 1ª ed. United Kingdom: John Wiley and Sons Ltd, 1996.

[33] MALONE, Patrick (ed). *City Capital and Water*. 1ª ed. London: Routledge, 1996.

[34] BRUTTOMESSO, Rinio. *Waterfront. Una nuova frontiera per le città sull'acqua*. Venezia: Centro Internazionale Città d'Acqua, 1991.

[35] DÜNDAR, Şebnem Gökçen, KARATAS, Neslihan, ERDIN, Hilmi Evren, LORENS, Piotr (eds). *New Faces of Harbour Cities*. 1ª ed. Cambridge: Scholars Publishing, 2014.

[36] *Urban Policy and Research*. GU, Kai. Waterfront Regeneration: Experiences in City-Building. 2013, n. 31.

[37] *TRIA*. CLEMENTE, Massimo, GIOVENE DI GIRASOLE, Eleonora, OPPIDO, Stefania. Grandi e piccoli eventi nelle città di mare per mutamenti urbani sostenibili: i casi studio di Lorient e Valencia. 2010, n.9. Edizioni Scientifiche Italiane. Web http://www.tria.unina.it/index.php/tria/article/view/1297/1425.

[38] *Méditerranée.* GIOVINAZZI, Oriana. Città portuali e waterfront urbani: costruire scenari di trasformazione in contesti di conflitto. 2008, n.111. Web http://mediterranee.revues.org/2751.

[39] *ADVANCED ENGINEERING FORUM*. GIOVENE DI GIRASOLE, Eleonora. The Hinge Areas for Urban Regeneration in Seaside Cities: the High Line in Manhattan, NYC. 2014. n.11. Web 10.4028/www.scientific.net/AEF.11.102.

[40] *Sience*. HARDIN, Garret. The Tragedy of the Commons. 1968, n.162, pp. 1243-8.

[41] DONOLO, Carlo. *Identificare i beni comuni*. 2010. Web http://www.labsus.org/media/Carlo_Donolo3.pdf.

[42] MATTEI, Ugo. *Beni comuni, un manifesto*. 1ª ed. Bari: Laterza, 2011.

[43] ZAMAGNI, Stefano. *L'economia del bene comune*. 1ª ed. Roma: Città Nuova, 2007.

[44] OSTROM, Elinor, GARDNER, Roy, WALKER, James. *Rules, Games, and Common-pool Resources*. Unites State of America: The University of Michigan Press, 1994. Web http://www.press.umich.edu/pdf/9780472065462-fm.pdf.

[45] *Serie Research Memoranda.* CARAGLIU, Andrea, DEL BO, Chiara., NIJKAMP, Peter. *Smart Cities in Europe*. 2013, n.48. VU University Amsterdam, Faculty of Economics, Business Administration and Econometrics.

[46] GIFFINGER, Rudolf, FERTNER, Christian, KRAMAR, Hans, KALASEK, Robert, PICHLER-MILANOVIC, Nataša, MEIJERS, Evert. *Smart cities Ranking of European medium-sized cities*. Vienna: University of Technology, 2007. Web http://curis.ku.dk/ws/files/37640170/smart_cities_final_report.pdf.

[47] *City*. HOLLANDS, Robert G. Will the real smart city please stand up? 2008, 12, 3. Routladge.

[48] MOSTAFAVI, Mohsen, DOHERY, Gareth (eds.). *Ecological Urbanism*. 1ª ed. Zurigo: Lars Muller Publisher, 2010.

[49] CARTA, Maurizio. *Reimagining Urbanism. Città Creative, intelligenti ed ecologiche per i tempi che cambiano*. Trento-Barcelona: ListLab, 2013.

[50] RATTI, Carlo. *Architettura Open Source. Verso una progettazione aperta*. 1ª ed. Torino: Einaudi, 2014.

[51] ABB-Ambrosetti. *Smart Cities in Italia: un'opportunità nello spirito del Rinascimento per una nuova qualità della vita*. 2012. Web www.abb.it, www.ambrosetti.eu.

[52] *Sustainability*. FUSCO GIRARD, Luigi. Toward a Smart Sustainable Development of Port Cities/Areas: The Role of the "Historic Urban Landscape" Approach. 2013, *5*(10).

[53] *Aedon*. IAIONE, Christian. La città come bene comune. 2013, n.1, p.12. Web http://www.aedon.mulino.it/archivio/2013/1/iaione.htm

[54] VAN TIMMEREN, Arjan, HENRIQUEZ, Laurnce, REYNOLDS, Alexandra. *Illuminated City. From Smart to Intelligent Urban Environments*. 1ª ed. Delft: TU, 2015, p.164.

[55] CLEMENTE, Massimo, GIOVENE DI GIRASOLE, Eleonora. The ambivalent zone between land and sea – a new approach to collective spaces based on maritime identity of the cities by the sea. In MORGADO, Sofia, SANTOS, João Rafael (eds.). *AMBIVALENT LANDSCAPES Sorting out the present by designing the future, Public Space*s. Urban Cultures Conference, 2012.

[56] Waterfront Vision and Enhancement Strategy. Web http://www.nyc.gov/html/waves/html/about/about.shtml

[57] Vision 2020. New York City Comprehensive Waterfront Plan. Web http://www.nyc.gov/waterfront.

[58] Web http://www1.nyc.gov/connect/social-media-policy.page.

[59] Web http://www.waterfrontalliance.org/.

[60] Web http://nyc.changeby.us.

[61] Web http://www.nyc.gov/html/dcp/html/cwp/cw.shtml.

[62] Web http://www.nyc.gov/html/dcp/html/bytes/applbyte.shtml#waterfront.

[63] Web http://gis.nyc.gov/doitt/nycitymap/template?applicationName=ZOLA.

[64] Web http://www.oasisnyc.net.

[65] Web https://www.newyorkpass.com.

[66] Web http://www.nywaterway.com.

[67] Web http://nyintl.net.

[68] *TRIA Special Issue Il Mare e la Città Metropolitana di Napoli.* GASPARRINI, Carlo. Porto, spazio pubblico, città metropolitana. 2014, 13 (2). Web http://www.tria.unina.it/index.php/tria/issue/view/182/showToc.

[69] *TRIA Special Issue Il Mare e la Città Metropolitana di Napoli.* RUSSO, Michelangelo. Harbour waterfront: landscapes and potentialities of a contended space. 2014,13 (2). Web http://www.tria.unina.it/index.php/tria/issue/view/182/showToc.

[70] VETRITTO, Giovanni, VELO, Francesco. Una lezione per le politiche pubbliche: il governo delle realtà sociali complesse tra «pubblico» e «privato». In OSTROM, Elinor. *Governare i beni collettivi*. 1ª ed. Venezia: Marsilio, 2006.

HERITAGE and TECHNOLOGY
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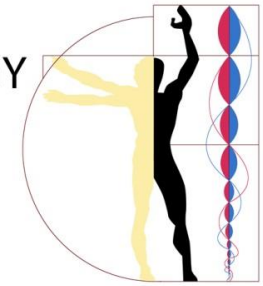

A Comparative Study of Ottoman and European Bridal Gowns During 18th and 19th Centuries

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Abstract

Marriage is a bond declaring the change of social stations of two young people to their social environment announced by a celebration called wedding. Wedding ceremony is the last point of wedding process comprised of a number of rituals and only thing that remains in the memory of attendants is the bridal gown: a symbol of the realization of dreams especially of the young bride. Concept of “clothes” which change and develop in time according to trends and “fashion” are very important economic activities in the Western world. This an activity, that evolves with every kind of social, economic, technological, political and cultural change and is accepted in the whole world and has assumed the same meaning everywhere. European fashion Turkey has followed during the Westernization process has also become the guiding light of changes in bridal gowns and Ottoman Palace has adapted European fashion in that regard almost at the same time with Europe.

Keywords: Bridal gown, European, Ottoman, wedding

1. Introduction

Marriage is a bond declaring the change of social stations of two young people to their social environment. This change is announced by a celebration called wedding. Wedding ceremony is the last point of wedding process compromised of a number of rituals and only thing that remains in the memory of attendants is the bridal gown, a symbol of the realization of dreams especially of the young bride. Importance of wedding, marking an important change and passage in the woman’s life, is underlined with a special costume, bridal gown. From time memorial to the present, people have always worn special costumes at their weddings, which is a special day in their lives. Tradition of wearing bridal gowns during weddings and bridal gowns have come into being with the purpose of referring meaning and value to the institution of marriage. Bridal gowns, which were among traditional costumes, have changed throughout time and assumed its current form. Despite becoming versatile according to life styles indifferent cultures in history and changing fashion trends in time, bridal gown has never lost its importance. Young woman dreams of herself in a magnificent bridal gown even before meeting a man she can marry. Wedding and wedding preparations, which is an important turning point in a young girl’s life, is the most enjoyable part of the process; sweet memories are attached with this costume and the gown is preserved during one’s lifetime. Concept of “clothes” which change and develop in time according to trends and “fashion” are very important economic activities in the Western world. This an activity, that evolves with every kind of social, economic, technological, political and cultural change and is accepted in the whole world and has assumed the same meaning everywhere. European fashion we have followed during the Westernization process has also become the guiding light of changes in bridal gowns and Ottoman Palace has adapted European fashion in that regard almost at the same time with Europe.

When written records about clothes in Ottoman period and examples at the Istanbul Topkapı Museum are examined, it is apparent that there are examples of many different types of bridal gowns in Ottoman period. Red is the color of choice for bridal gowns at the Ottoman Place. Besides red, which is known as the color of the Ottoman House, bright colors like purple, blue and pink are also used. The veil, which covers the face of the bride, is also red. In Ottoman Empire, duration of the wedding depended upon the social status of wedding party. Different gowns were worn on different days of the wedding ceremony. In 15th century, during the reign of Mehmed the Conqueror, brides wore a red caftan embroidered with diamond or silver threads and a loose robe with slits on both sides, made out of red silk cloth, embroidered with pearl or silver threads inside the caftan. Conical hat on the head of the bride is embellished from one end to another with jewels or tinsels depending upon the wealth of the bride. Red veil embellished with tinsels is attached to the top of the conical hat with a diamond pin. This type of veil has been worn in Istanbul till the 19th century. Father of the bride tied a belt or a sash around the bride's waist with a ceremony.
Starting with the beginning of 19th century, in all parts of Anatolia brides started to wear special Ottoman dress, ***bindallı*** during weddings. In 1857, daughter of Sultan Abdülmecid, Refia Sultan wore a bridal gown comprised of three piece skirt –***üç etek***- embroidered with pearl and diamond flowers. She wore a silk tulle shirt inside the skirt and small boots made from the same cloth of her gown on her feet. Tiara on her head, necklace around her neck, white gloves on her hands show Western influence has already begun. At Sadberk Hanım Museum in Istanbul, there is a turquoise satin bridal gown suit composed of a bridal caftan, loose robe and shoes from the 19th century. Part of the dress called "bridal caftan" or "bridal top" is open at the front, has fur inside and a back slit. It has long embroidered sleeves with fur wrist bands. Loose robe inside the caftan has long sleeves with a long tail skirt hugging the body. Sleeves, hems of the skirt and the collar are embroidered with silver threads. Two piece pink silk bridal gown embroidered with tinsels and silver threads estimated to be from 1890s at the same museum, belongs to the wife of famous painter Osman Hamdi Bey. Front of the gown is open and it has a square neckline, straps on the neck, long puffy sleeves, narrow wrist bands and gold buttons. Front of the skirt is long reaching the ground, back of the skirt has a tail. The waist of the skirt has a double folded frilled sash made from the same embroidered cloth and organza lace.
After 1870 with the influence of Western culture, far more light colored bridal gowns have come into fashion. White bridal gown was worn for the first time by the daughter of Sultan Abdülhamid, Naime Sultan during her marriage ceremony to Kemalettin Pasha in 1898. White bridal gown fashion, which started at the Ottoman Palace and became wide spread in time, became indispensable in 20th century. White bridal gown fashion starting at the Ottoman period, has come up to today without changing color. At Topkapı Palace Museum, there is the photograph of the bridal gown worn by Naime Sultan's daughter in 1917. White bridal gown, which exhibits influences of Western fashion, is adorned with a diamond tiara placed on top of the lace veil. Neckline and band of short sleeves are embellished with pearls. Bridal gown is accessorized with a pin on the torso, pendant on the neck, watch and diamond bracelets. After Sultan Abdülaziz liked European women's dresses during French Empress Eugenie's visit to Istanbul in 1869, ladies of the Ottoman Palace started to dress according to the fashion in Paris. Ladies of the Palace begun to wear dresses and bridal gowns specially cut and made up of two pieces with form fitting top piece and balloon skirts at the back according to the vogue in Paris. Afterwards, this tradition became widespread in due course. Currently, white bridal gowns are continued to be prepared by fashion designers in different models, cloth, cut and adornments. This essay, which follows the change in Ottoman and European bridal gowns at the beginning of 1800 and 1900s, examines differences and similarities in models, clothes, other bridal materials and fashions in both cultures. The subject has been researched by reviewing the literature about the "meaning and historical development of bridal gowns", supported by the special features of those gowns from photographs of European and Ottoman bridal gowns in 18th and 19th century.

2. What is a Bridal Gown?

Bridal gown is the name of the dress worn by the bride at her wedding. [1]
Bridal gown is a design gathering all symbols developed to emphasize the importance attached to the marriage as an institution. This design has come to today without losing its symbolic value, despite having a number of changes in its form.
Marriage is a bond declaring the change of social stations of two young people to their social environment. This change is announced by a celebration called wedding. Wedding ceremony is the last point of wedding process comprised of a number of rituals and only thing that remains in the memory of attendants is the bridal gown, a symbol of the realization of dreams especially of the young bride.
Despite becoming versatile according to life styles in different cultures in history and changing fashion trends in time, bridal gown has never lost its importance. Young woman dreams of herself in a

magnificent bridal gown even before meeting a man she can marry. Wedding and wedding preparations, which is an important turning point in a young girl's life, is the most enjoyable part of the process; sweet memories are attached with this costume and the gown is preserved during one's lifetime. The tradition of placing, spreading the bridal gown on the coffin of young girls, who deceased before wearing the wedding gown of their dreams, has been going for thousands of years, graves of women buried with their bridal gowns are found in Anatolia

3. History of Bridal Gown

Any explanation about various periods in history defines wedding ceremonies as "cults". This formation laden with meaning has changed in techniques and materials, but the meaning and importance attributed to it has not changed.
It is thought that the idea of wearing a special dress for the wedding has originated in Asian societies and has spread to the world later. [2] Bridal gowns in ancient Egypt, was tiered, pleated gowns made of white linen. In Antique Greece, brides wore white dresses to express their happiness since white was the color of celebration. In ancient Rome, bridal gowns were yellow. In that period, veils were used to distinguish between married and single women. Hence brides put on a yellow veil for the first time on their wedding day, dressed in their yellow bridal gowns. In Medieval Europe, the color of the bridal gown was not important, it would be sufficient if the bridal gown new and was worn for the first time. At the two great representatives of Asian culture, China and India, it is known bridal gowns were red, long dresses.
In 16th and 17th century Europe, brides used their best looking dresses as their bridal gowns, preferring however textiles in flamboyant colors and textures. They also continued to use those gowns in their daily life after the wedding ceremony. Only noble and wealthy families had special gowns made for the wedding ceremony. Up to 19th century, brides from aristocratic families wore bridal gowns made from luxurious textiles dominated by red and silver colors.
After 19th century white colored special bridal gown passion, which became widespread in Europe, also became popular and prevalent in the world; consequently even in traditional societies, white became the color of choice for bridal gowns.

4. Head of the Bride

What has given mystery and meaning to the bridal gown for centuries is the piece of cloth on bride's head, in other words "the veil". Bridal gown and veil complete each other and form a meaningful form. This cloth covering the head, an integral part of the bridal gown has reached modern times since very early history, with an important and meaningful past.
Reliefs depicting siege of Lachish by Sennacherib in 705-608 B.C. show Jewish women wearing simple and long tunics and slightly fringed capes. Their faces and heads are not covered, but there is a band (ribbon) on their heads. However, in 3rd century A.D. Tertulian of Carthage (Christian philosopher) advices Christian women to be covered like Jewish women. Consequently, it is understood that Christian brides covered their faces with a veil when they were presented to their future husbands. Holy Bible (Old Testament- Deuteronomy XXII.5) cites rules about how women and men should be dressed. Also in antique Greece, tradition of covering head and face of Greek women in daily life dresses started when the groom took the bride to his home before the wedding ceremony**.** [3]
According to this ritual, after the groom invited the bride to his home, the bride in her white clothes and veil covering her head face would ride the carriage that would take her to the groom's house with her friends singing hymns, playing lyre accompanying the carriage. The groom will take the bride into his arms before entering the house and would leave her in front of his family waiting for the bride inside their house. After a lengthy ceremony, bride and groom go to their rooms, having the opportunity to stay together in private. The groom would only see the face of his life companion's face covered and hidden by a veil at that point in time. Hence, dressing, coiffure of the hair, adornment of the head and face would assume huge importance. First information about the cult status of adoring head and hair in Antique Greece comes from Iliad **(**See Fig. 1**)** Homer tells about the hair adornment tradition of his time by depicting dresses and adornment of Moon Goddess Selena. These explanations are the first examples of bridal gown and head adornment and dressing which symbolizes passage to womanhood from girlhood in mythology and legends

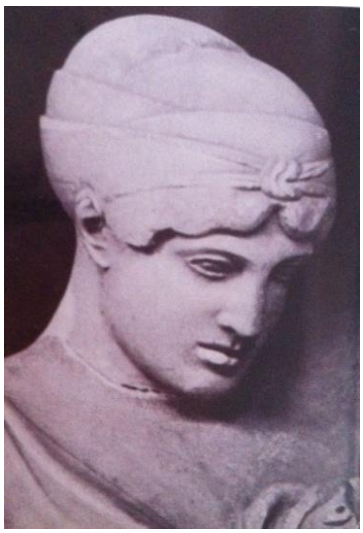

Fig.1: Detail showing the head of a young bride, (Temple of Zeus-Olympia Museum)
Source: CONTINI, M: From Ancient Egypt to the Present Day, p:29

Another example of this phenomenon in history can be found in Antique Rome. Women in Rome made adjustments in their daily dresses for marriage, which is a special occasion. The girl to be married would do her hair with a red hair net the night before the wedding. Before the wedding ceremony, she would wear a tunic wrapped with wool threads on both edges, both sides left unsown, lifted up with two knots. Then she would wear a saffron colored cape and sandals. She would also wear a metal necklace around her neck; her head will be covered with a veil coming down on her face, covering upper portion of her face (descending down to her brows). Objective of the veil was to protect the bride against evil; the veil was prepared by folding cloth six times. A circular crown sown with sweet marjoram, vervain, myrtle tree flowers, orange tree flowers, was placed on top of her head. The church made sure this simple veil became a permanent fixture and the veil became an integral part of the bridal gown (See Fig. 2)



Fig.2: Scene depicting preparation of bridal head and veil at Aldobrandi's marriage ceremony
Source: BOUCHER, F:20 000 Years of Fashion, s:123

In the East, Byzantine (East Roman) Empire was influenced by the opulence and riches of the east. Empress Theodora evoked admiration of the people during her wedding to Byzantine Emperor Justinian. The mosaics of Saint Vitale Church have kept the memory of this wedding alive for future generations. In the mosaics, Theodora wears a long, white tunic adorned with embroidered vertical lines. The piece of cloth that cascades from the shoulders called "*Maniakis*" is embroidered with golden threads adorned with valuable jewels and pearls. She wears a short sleeved caftan on top of the tunic. The caftan has a purple, jewel encrusted belt with fringes. On top of the tunic and caftan, she wears a cape embroidered with Magi figures (Three wise men that bring gifts to new born Jesus in Christianity). She wears a crown far more grandiose and glorious than of the emperor, encrusted with

jewels with pearl strands dangling from each side. She was shod with red shoes made of soft leather with rich handiwork.

5. Bridal Gown in Europe during 18th and 19th Centuries

In contemporary world, almost in every society similar importance is attributed to the bridal gown. However, its universal form and color visually was a product of Western world. This process has also led to bridal gown fashion. White has been a color which has been used in various societies since antiquity for its symbolic meaning. Before bridal gowns became white in Western world in medieval age, queens used to wear white colored dresses when the king died; therefore, they were called "White Queens". Use of white in bridal gowns became widespread in 16th century Europe. First bride in white recorded in the annals of history is Anne of Breton who married Louis XII in 1499. Anne wore black for mourning when Charles VII. King of Breton died; however, she could not change palace traditions.

Contemporary bridal gown models are all inspired by the wedding dress of Queen Victoria. When Queen Victoria was marrying Prince Albert in 1854, she wore a grandiose white satin bridal gown with 5.5 meters tail. Queen Victoria wanted to have "Vickie" lace in her bridal gown; that is why her wedding dress was made with white satin. White satin dress adorned with lace cuttings, boat neck and puff sleeves reminded gowns in fashion in France**.** (See Fig. 3)

Since the pictures of this wedding at English palace were published and seen everywhere, Victoria's gown pioneered spreading of white bridal gown fashion; hence it had become the first of contemporary bridal gown models. With the idea that white is the symbol of innocence and purity, wearing white bridal gowns has transcended fashion and has become a Western tradition.

White bridal gown passion, which started at English palace and spread to the world later, has become the vogue at Ottoman palaces at the second half of 19th century, afterwards getting popular among general public.

At the beginning of the 19th century, European bridal gowns were generally made of satin, silk satin and handmade lace. The gown was placed on the waist in a "V" form with curves coming down the waist. Later, collars going up to the neck, scoop neck or square yoke became prominent features in bridal gowns. Back portion of the skirt became longer than the front, enriching long bridal gowns. As bridal veils either crowns adorned with little pearls or wax plant flowers or head dresses made of chiffon or lace were used.

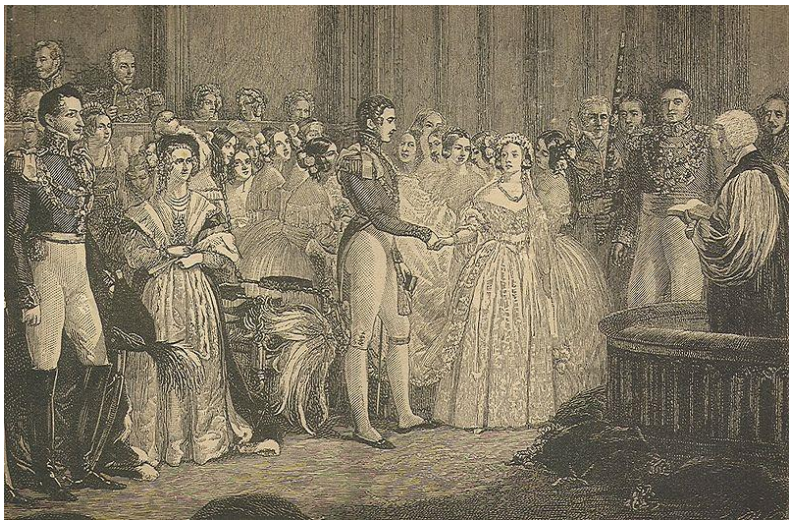

Fig.3: Queen Victoria's bridal gown adorned with laces at her wedding to Prince Albert in 1840
Source: http://tr.wikipedia.org/wiki/Dosya:VictoriaAlbertMarriageEngraving.jpg,(30.05.2014)

6. Bridal Gowns in Ottoman Era during 18th and 19th Centuries

Women's dresses and bridal gowns in Ottoman Era have developed in parallel to the life style of each social group, according to the palace, urban and rural traditions, customs, norms, rules and rituals of each strata of society. Bridal gowns are enriched by different types of dye, cloth, weaving, embroidery and model of the dress. Duration of the wedding ceremony, how many days a wedding would last depended upon the social status of the marrying couple. A different dress was worn for each day of

the wedding ceremony. The bride would have a different dress on henna night, another one for the bridal chamber; after the consummation of marriage bride would wear something called '*paçalık*' similar to a shorter version of palazzo pants.

Since Ottoman tradition frowned upon embroidered, silvery, beaded, glittery clothes; thus, young girls generally preferred plain and simple dresses. Women found the opportunity to wear fancy clothes after they were married; bridal gown as the first of these splendid dresses have always been important and also been seen as a way of underlining the difference of the bride from other women. Veil, dressing of bride's head, accessories that are integral part of the bridal gown along with the gown itself differentiates the bride from other women.
Basic dressing style of women in Ottoman Empire has been shalwar, cardigan, shirt, *entari,* (loose robe) and caftan. *Entari* worn with shalwar is the oldest example of Turkish woman's dressing. Skirts of gusseted loose robes (*peşli entari*) widens from the waist down. Especially in cities, important elements of women's dresses in daily life, loose robes (*entari*) known as three-skirts (*üç etek*) and four-skirts (*dört etek*) have frequently been used as bridal gowns. However, three-skirts or four-skirts used as bridal gowns have a higher quality of cloth, richer colors and higher quality of embroidery and handiwork differentiates bridal gown from daily wear. Shalwars and sleeveless boleros adorned with silvery threads and embroidered sashes were also used as bridal gowns in especially rural areas due to their elegant form and comfortable use. In those types of clothes and bridal gowns, undershirts made of crepe or silk clothes adorned with Turkish style handiwork (*oya*) on sleeves and around the neckline.
From 18th century onwards, in big cities in Ottoman geography, women started to use clothes imported from Europe in the making of traditional clothes. Traditional forms like three-skirts *(üç etek*) and shalwar gave way to gowns fashioned according to European styles from 19th century onwards. Form fitting bodices, puffy long sleeved blouses and ruffled long skirts have taken the place of traditional loose robes (*entari*); a phenomenon also true for bridal gowns. Various accessories like gloves, silk stockings, fans and parasols have completed the dresses. While traditionally attention was paid to making bridal gowns as simple and plain as possible before 18th century, from 19th century onwards bridal gowns made from expensive clothes were very splendid and ornate as a result of increasing interaction with the Western world. The palace has taken up red for bridal gowns since it was the color of the dynasty. Outside the palace, vivid colors like purple, blue, pink were preferred in bridal gowns besides red; however, the veil covering the bride's face has always been red regardless of the color of the bridal gown.





Fig.4: Granddaughter of Sultan Abdülhamit II in her white bridal gown
Source:Ö ÖZTUNCAY, B: "Hanedan ve Kamera" ("Dynasty and Camera") Sadberk Hanım Müzesi Sergi Kataloğu (*Sadberk Hanım Museum Exhibition Catalogue*), p.132

Turkish word for bride is "gelin", which has evolved as the semantic extension of the word "gelen", which means "the one who comes". Traditions were important in old Turkish culture. After the bride was nicely dressed, her head was covered with red tulle, the groom would take the girl from her maiden house and she would travel to the house of her husband to be on horseback. Red tulle veil symbolized virginity, purity, sexual honor and leaving paternal house. Bride's head and face would be

covered with the veil till the wedding was over and she went to her new home. After Turks left their nomadic ways and settled, this tradition was passed onto Arab society at first and then to Europe through Silk Road.
After 19th century, bridal gowns got more flamboyant and glorious as they were enriched with accessories like gloves, hand fans, bridal flowers, lace parasols etc. in Ottoman palaces. After Naime Sultan, Adile Sultan also married in white bridal gown at the palace in 1917. (See Fig. 4)
At the beginning of 1900s, like it happened in Europe, fashion of "white" in bridal gowns in Ottoman palace became the dominant color of bridal gowns in urban life as well. Bridal gowns with long tails, chiffon veils, diamond tiaras, pearl necklaces, puffy sleeves have managed to reach today with new models each year. (See Fig.5) However, general did not adapt the habit of white bridal gown at the palace so readily, traditional models and colors continued to exist till 1950s.



Fig.5: Wedding photograph of Naciye Sultan with Enver Paşa (1897-1957)
Source: ÖZTUNCAY, B: "Hanedan ve Kamera" ("Dynasty and Camera") Sadberk Hanım Müzesi Sergi Kataloğu (*Sadberk Hanım Museum Exhibition Catalogue*), p.:177

Special bridal gown and white color passion which became popular in 19th century, became the vogue all around world in time and even in traditional societies, white became the color of choice for bridal gowns. White bridal gowns have become an indispensable part of life in 20th century, still a part of our life today.

7. **Conclusion**

European fashion that has been followed in the Westernization process have also guided the changes in bridal gowns as mentioned in this article and those changes have almost been accepted in Ottoman Palace almost at the same time as in the West. Changing women dresses and bridal gowns according to the path provided by European fashion designers have influenced not only changes in Ottoman women's dresses, but also bridal gowns. White bridal gown which came out of English court as a novelty at the beginning of 19th century has been shaped with symbolic value attributed to it centuries ago and when coupled with the "veil" it has been transformed into woman's dress during wedding ceremony.
Ottoman bridal gowns, change of which we have observed since the beginning of 1800s, when analyzed with Western examples show remarkable resemblance to models, cloths, color, form and other wedding accessories to its Western counterparts. Currently "bridal gown", shaped according to a model in accordance with European fashion, is generally a white, long dress with a veil and tinsels.
Leaving Ottoman bridal gowns in red, a color which represented traditional taste, a sacred color of our culture to color white, symbol of purity and innocence is a part of the effort to Westernize, to keep in step with Western culture.
This change and transformation in women and women's dresses from the beginning of Westernization process to today is been a very important indicator of cultural change. In Ottoman society within the context of changing urban life and economic relations, concept of bridal gown has been transformed and changed like many of our other traditions. Development of technology plays an important part for

bringing light to daily life routines and traditions buried in history along with social, cultural and economic values.

Bibliographical References

[1] Hayat Mecmuası, “Hayat magazine”, No: 20, p: 37, 1972

[2] Bursa Araştırmaları Merkezi. Bursa Kent Müzesi Sergi Katalogları, *Bursalı mısın Kadifeli Gelin-Dünden Bugüne Bursa'da Gelinlik Sergi Katalogu,* 1st Edition, Bursa, November 2011. *Are you from Bursa Bride with Velvet?-Past and Present Bridal Wedding Exhibition Catalogue in Bursa.*

[3] BOUCHER, François. *20 000 Years of Fashion*, Thames and Hudson, New York, 1987

[4] CONTINI, Mila. *From Ancient Egypt to the Present Day*, James Laver, Paul Hamlyn, 2nd Edition, London, 1967

[5] ÖZTUNCAY, Bahattin: “*Hanedan ve Kamera*” *Sadberk Hanım Müzesi Sergi Kataloğu*, Istanbul, 2010. Dynasty and Camera

[6] SEVÜKTEKİN APAK, Melek; ONAT GÜNDÜZ, Filiz; ÖZTÜRK ERAY, Fatma, *Osmanlı Dönemi Kadın Giyimleri,* Türkiye İş Bankası Kültür Yayınları, Ankara, August 1997. Ottoman Women's Clothing

[7] Web: http://tr.wikipedia.org/wiki/Dosya:VictoriaAlbertMarriageEngraving.jpg, (30.05.2014)

[8] Web: http://yenisafak.com.tr/Pazar/?i=281290, (30.05i2014)

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A generative design algorithm for the architectural design

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Abstract
The intensive quarters of the new residential areas lacking in facilities and urban form on the one hand, and the urban sprawl of suburban houses and buildings on the other, do not appear to be the best solution for a balanced and (eco) sustainable development and regeneration of land.
In recently expanded areas, particularly in urban environments of small administrative dimensions, new types of housing have emerged spontaneously, reflecting people's wishes, but in a disorganised way. In most cases, these wishes are inspired by television programmes and the culture of social transformation from country living to urban working patterns.
Generally speaking, there is a consensus that development needs to limit the use of agricultural land, which is already severely affected by pollution and urban sprawl; moreover, instead of building on brownfield and disused sites, development now encroaches on greenfield sites, triggering a dangerous cycle of disorganised growth.
Therefore, we should develop a concept of building development that brings together new ways and desires of living that belong to our time, but which go hand-in-hand with appropriate and sustainable models.
Thus, the preliminary assumption, but one which is crucial, reflects the desire of populations in peripheral urban areas (not only in such areas) to enjoy the advantages of a detached property in addition to those of a city of average density. The first line of research is to ascertain how - and if - it is possible to envisage a multiplication of levels. Such multiplication would permit regeneration in a contemporary perspective of the idea that develops from Le Corbusier's immeubles-villas to present-day eco-cities: is it possible to construct a building with a garden and vegetable patch on the fourth (or even thirtieth) floor?

Keywords: generative design, algorithm, architectural design, artificial intelligence, formal ontology.

1. Intervention sites
In the River Sarno area, on the edges of the modern town of Pompei, there is some land with specific characteristics that lies near the mouth of the river, in the municipality of Castellammare di Stabia.
This site was used for industrial purposes for a long time, and the industrial buildings border on very fertile land. The buildings are either disused and deserted production sites or residual areas deriving from a process of saturation of the land, which is now almost complete.
On the site identified at the mouth of the River Sarno (a brownfield site with sub-standard and obsolete social housing (IACP – Istituto Autonomo per la Case Popolari) there are residential buildings of average housing density (4/6 floors above ground) and warehouses. The morphology of these buildings is disorganised and mostly random, thus requiring a complete redesign, above all as regards the relationship with the surrounding areas, which are mostly used for agriculture and horticulture.

2. The tools
The approach adopted is based on research aimed at creating an expert support system for the design process, in particular the need to "teach" the computer how to tackle problems of architectural and urban design.
The research, based on premises of analogic design, was developed not only by studying classic standard types of building but also by identifying typological nuclei to use in the development of tectonic and compositional models for replication in similar territorial conditions. The hypothesis is to identify sets of

relations on different scales between the constituent parts of the architectural project and to ascertain the conditions of appropriateness in the various situations of the spirit of the place.

3. Procedure: from ‘Bounding Box’ to construction project

The procedure used to develop the project consists of successive phases of rendering (algorithm), each of which applies composition principles (typological nuclei) and operating constraints (design requirements) imposed at the different levels of detail.

The first phase of the procedure aims to define the Bounding Boxes (BB), so that they are compatible with the design premises. The Bounding Box is a theoretical volume that constitutes the limit within which the compositional project can be developed.

The total dimension is the function of the typological nuclei and the design requirements, as the BB is the maximum dimension but not the total volume of the building. This means that if, for example, every floor of the building requires an equal amount of covered and terrace surface area, the dimensional limit of the BB for that floor is given by the sum of the covered surface and of the terrace, but it does not correspond to the total possible extent of the floor, which is given exclusively by the covered surface.

The BB is developed using a compositional grid deriving from the geometries of the lot and the functional and construction needs. The dimensional mesh of the grid is a major factor in influencing the variability of the results.

Our experience to date has convinced us that for regular rectangular grids the optimal range varies from 4.50 to 7.80 metres.

The dimensional mesh also has a height value (the required result is a volume) that can be constant for all the levels or differ for each one or for groups of them.

The BB is produced by the orientations of the grids and their position on the lot, and it distributes the volumes on the grids in line with the design specifications and the typological nuclei required.

The next phase in the rendering develops within the BB and consists of extracting the possible planimetric and volumetric compositions. In this phase the relations are defined that every single cell at every level must have with those on the same floor and with those immediately below and above. The relations with the vertical and horizontal connections and all the quantitative and qualitative relations must regulate the development of the building.

The procedure always needs checking in addition to retrospective action for refinement. However, the basic principle remains, so that only what really has to be constrained is constrained, so as to give space to the expressive nature of the procedure.

The basic software chosen for the realization of the procedure is McNeel’s Rhinoceros modeling with the implementation of an operational metalanguage plug-in (visual editor for scripting) called Grasshopper.

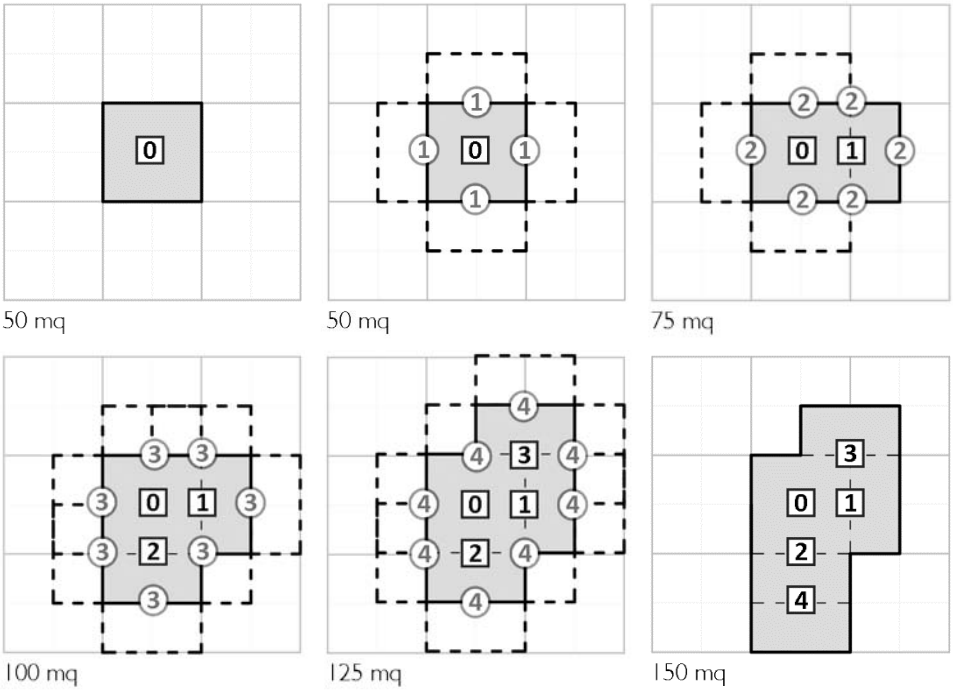


Fig. 1: Cells’ development through the slip of the growth’s points

4. Experimental projects

This work develops integrated residential, facilities and services projects capable of addressing the wishes for spatial and visual autonomy of the residents (detached house), at the same time integrated into a set of average residential density, by identifying the typological nuclei that can regulate them. The expected result is the realization of a design algorithm that even in infinite stylistic, morphological and compositional variations allows the development of projects that are appropriate and coherent with the basic premises of the work in any area with similar characteristics.

This study regards two sites: a disused industrial piece of land (building substitution) and a residual area (building completion), both of which overlook the river, and defines the planimetric and volumetric compositions of the buildings, without considering the stylistic and construction aspects.

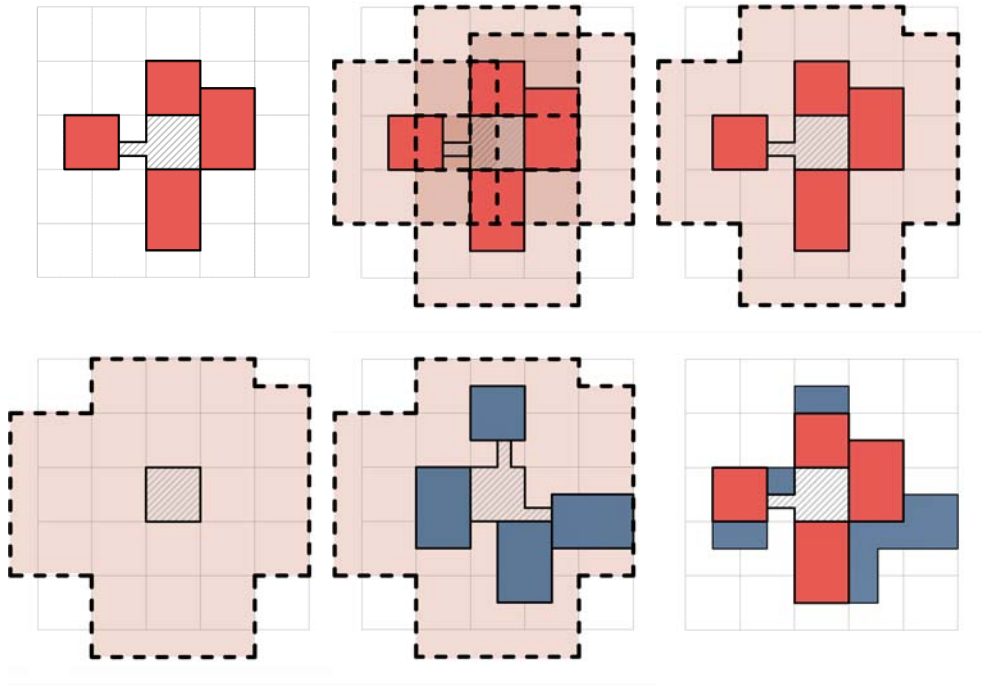


Fig. 2: The overlap of aggregations and the definition of pertaining uncovered surface:

1_first horizontal Cells' aggregation - 2_individual pertaining Cells' areas - 3_the union of the pertaining areas becomes the bounding box of the lower level - 4_second horizontal Cells' aggregation - 5_the aggregation of the lower level is accepted when the upper level reaches the percentage of pertaining uncovered surface

5. Building substitution

The project presents a volumetric study based on the multiplication of floor levels in a construction that, in this case, no longer has a tendency to low density (and is responsible to a large extent for the urban sprawl of the surrounding area) due to the very nature that the area has acquired over time, relating both to the development of the context and the industrial building that it is to replace.

Each dwelling has a large external space with a section of arable soil approximately 80 centimetres deep, which provides ample space for horticulture and floriculture. This depth of cultivation soil also provides sufficient space for planting trees (size three factor) without problems of rooting and growth.

This result is reached by adopting a duplex typology for the housing units and a variable mezzanine floor between the access levels and the internal levels of the units.

The dimensional mesh is always constant (7.2 x 7.2 x 7.2 m), assuming a mezzanine of approximately 3.60 m.

The ground floor of the building is an independent volume, which can be used for locating service industries and commercial premises along the street front line, and artisanal workshops or production units in the interior behind the front line. The particular nature of the area (common to various similar sites) in this case allows a large proportion of it to be given over once more to horticulture and floriculture (typical productions of the area) in addition to a variety of under-cover activities.

The design of the construction plan is structured around a large courtyard intended for cultivation which develops in elevation with two towers, whose compositional character is a front line on the services sides. This is a simple constraint, but one which serves to show the possibility of configuring volumes with architectural composition criteria.

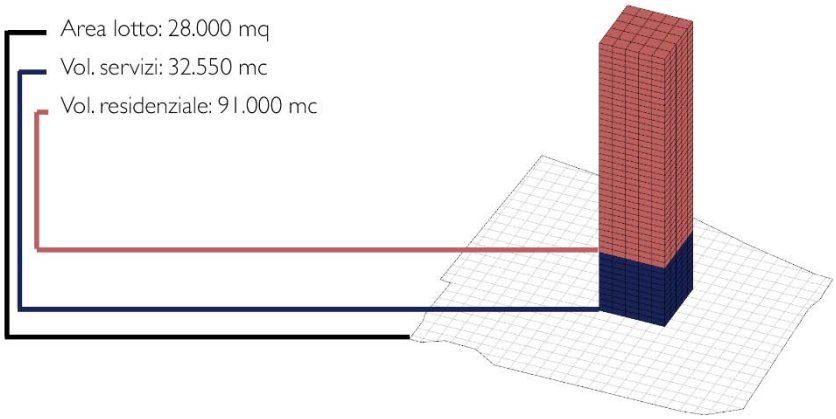


Fig. 3: Dimensions of development of Bounding-Box

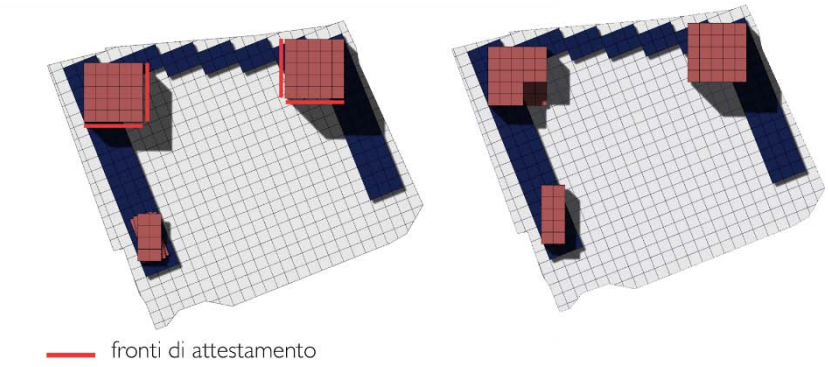


Fig. 4: Volumes' abutting faces

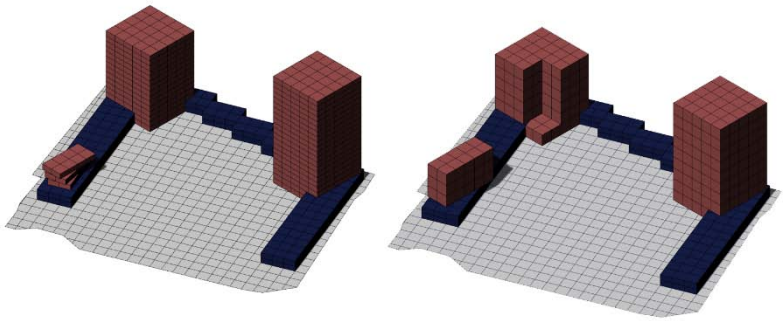


Fig. 5: Bounding-Box assumed

6. Building completion

The projects regard two residual lots on the road running along the river compatible with average density residential developments (3-5 levels above ground), which are structured so as to achieve multiplication of floors. The mesh and typology of the section are the same as the substitution intervention, but with a vertical development up to a maximum of four levels and an aggregation by blocks. The main composition constraint is the alignment of the balconies and the stair wells on one side of the building line in all the blocks, and the second by the alignment of the end points of the volumes, to form a single wall.

The aggregation of the cells in planimetric terms is of the classic type of the building line or block, but with a development of the section that reflects the main general premises (multiplication of the floors and small and very small scale production activities).

The ground floor is reserved for artisanal or service industry activities carried on by the families who live there.
It is evident that the housing units on the first level enjoy a greater area of appurtenance than those situated on the higher levels. However, this was a compositional choice intended to check the solutions that the procedure proposed, and to verify respect for the features.

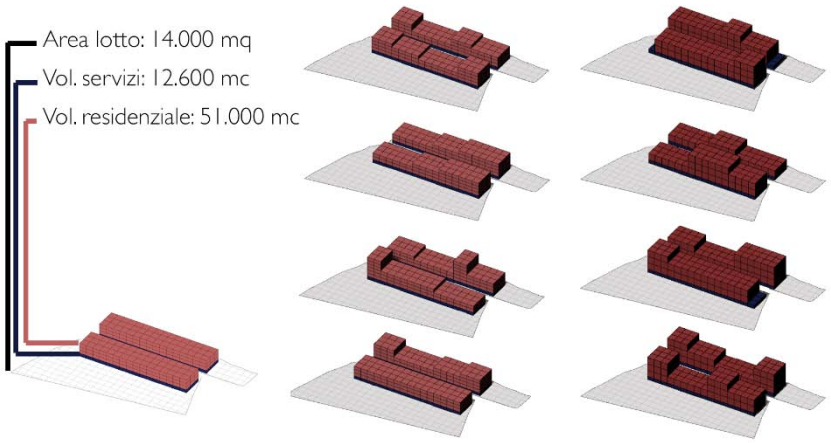


Fig. 6: Development of Bounding-Box in accordance with the fixed dimensions

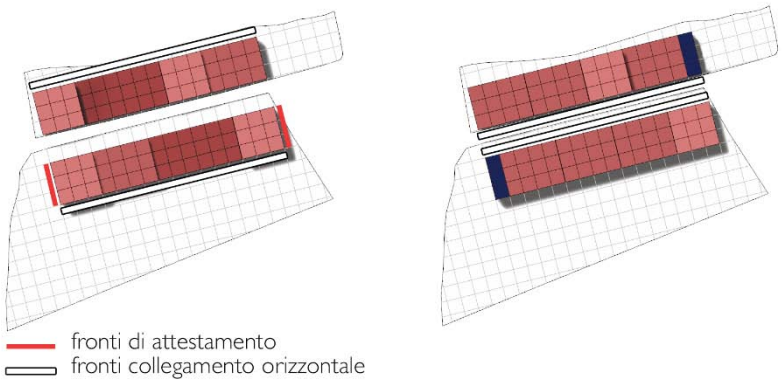


Fig. 7: Volumes and horizontal linkages' abutting faces

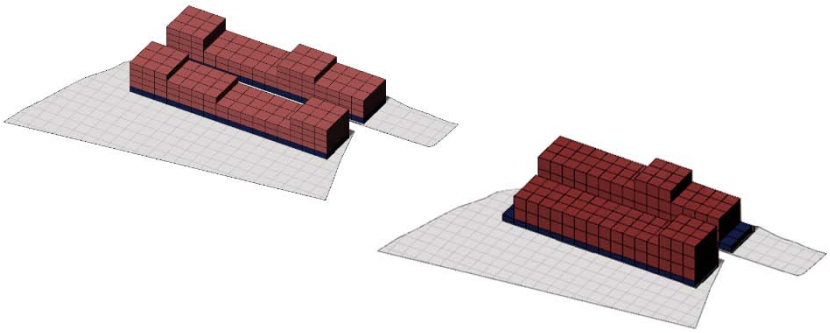


Fig. 8: Bounding-Box assumed

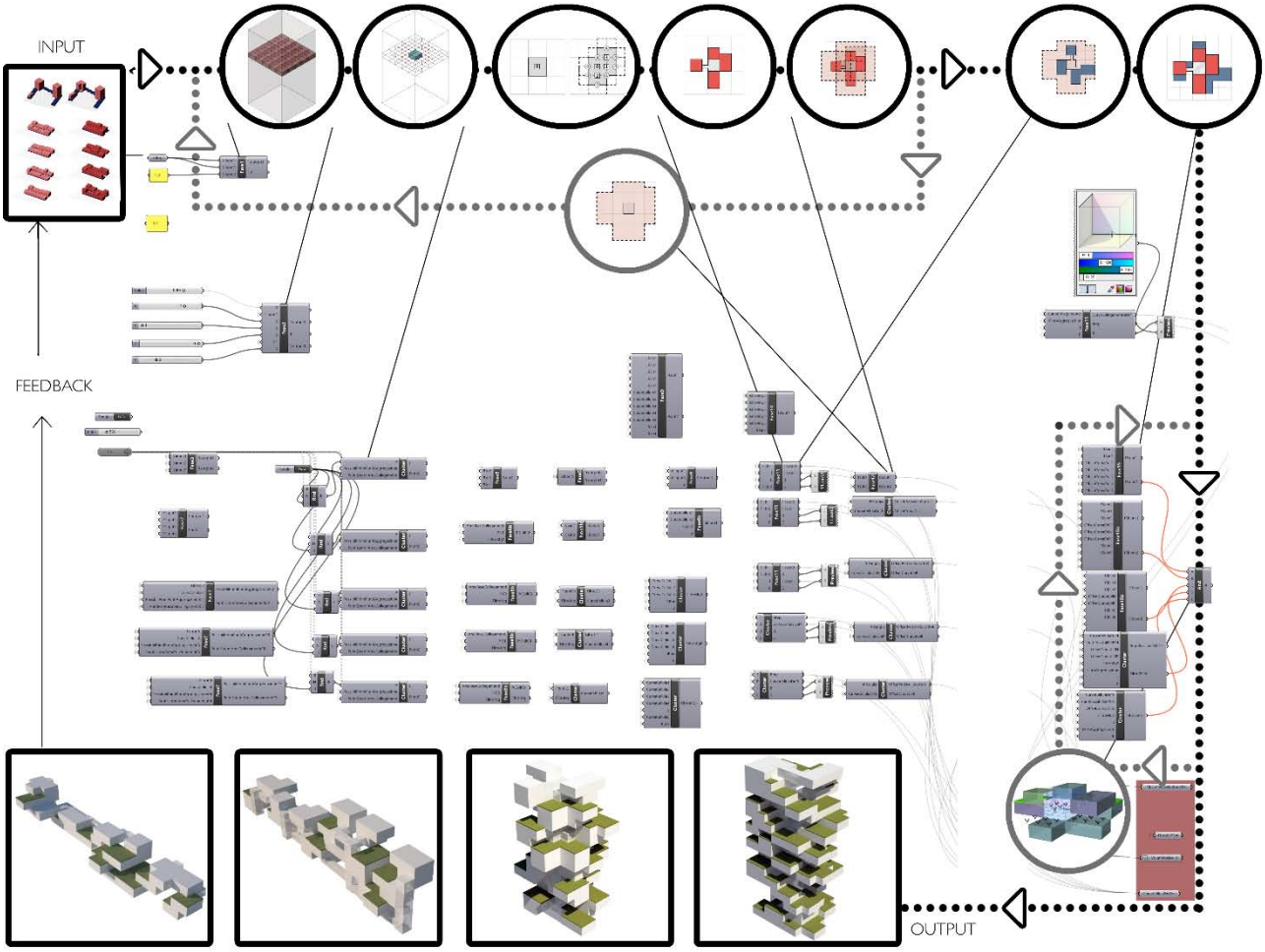
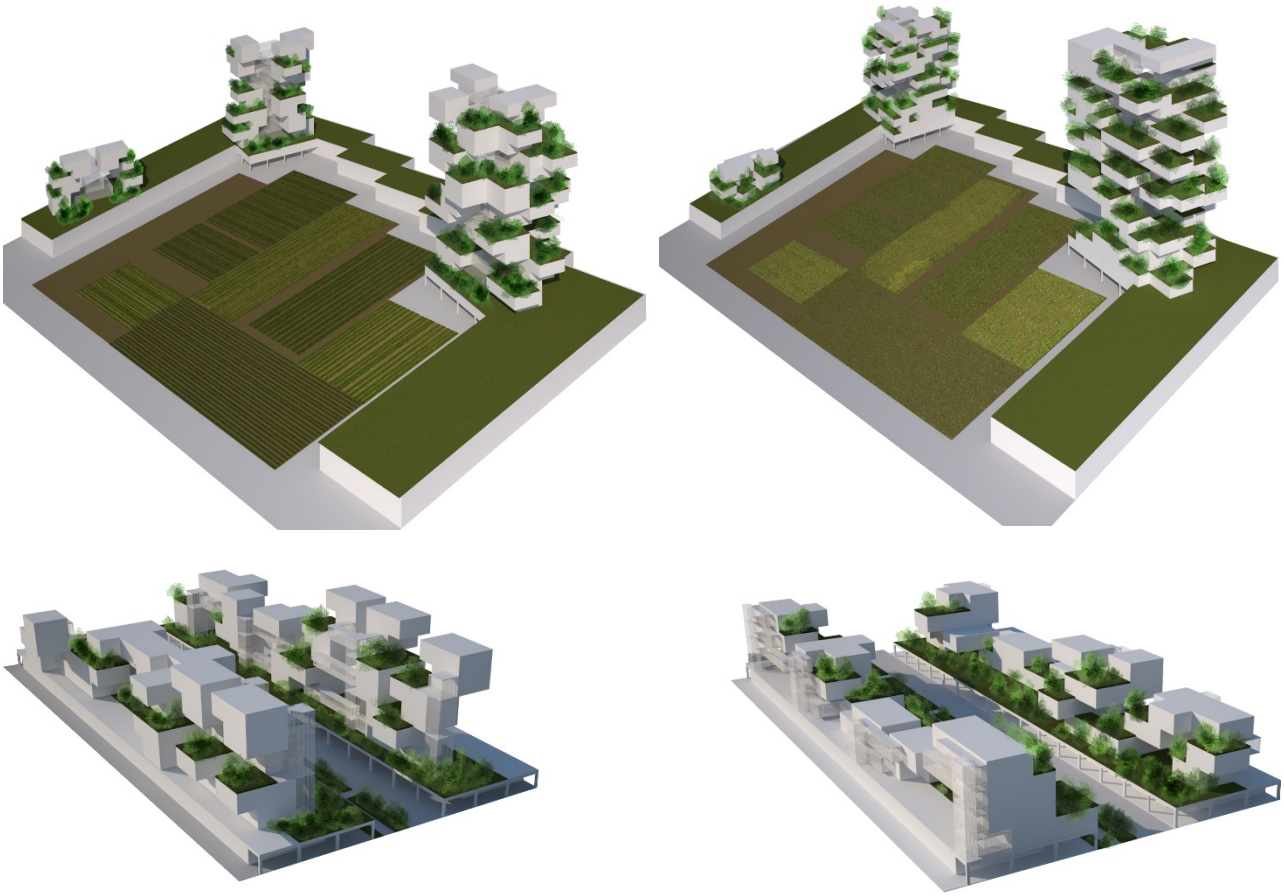


Fig. 9: Generative design algorithm



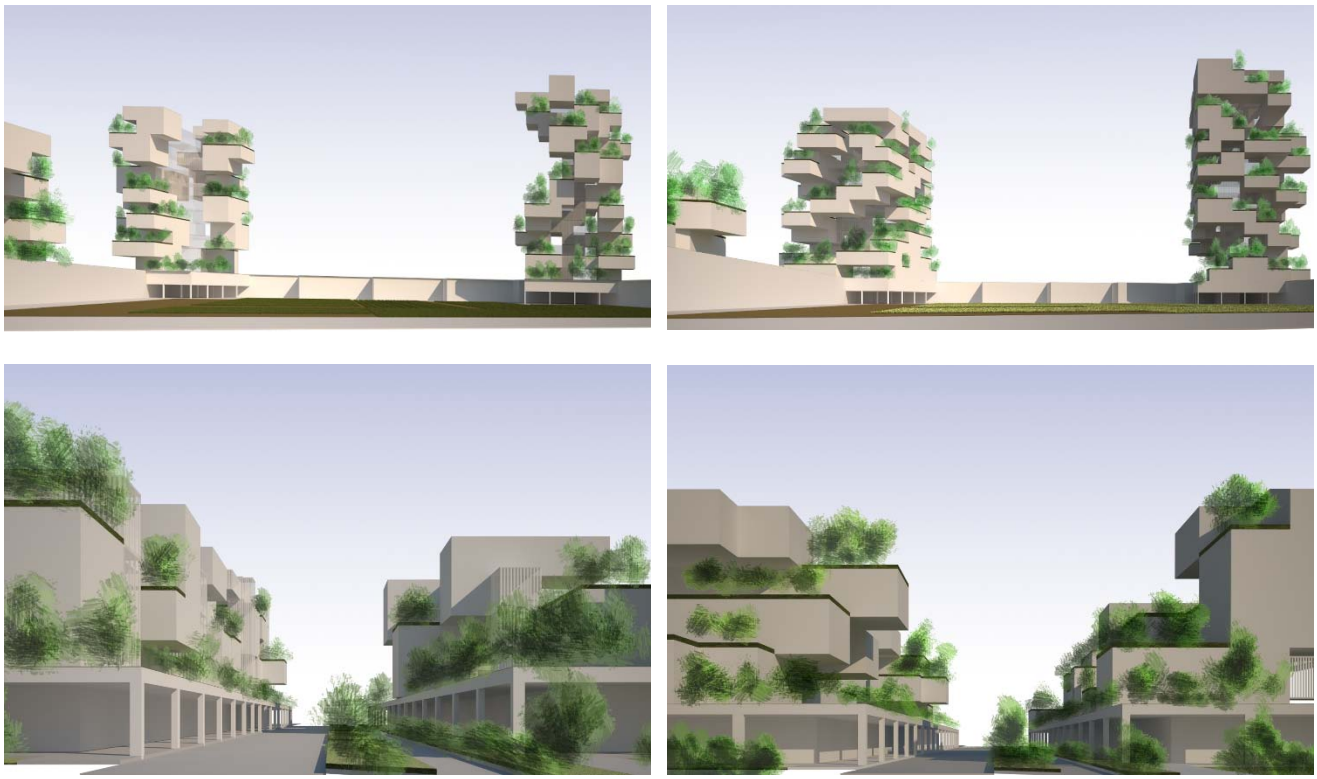


Fig. 10: Views of plan-volumetric developed by the procedure

Bibliographical References

[1] NEGROPONTE, Nicholas. *La macchina per l'architettura.* Il Saggiatore, Milan, 1972

[2] SODDU, Celestino. *Città aleatorie.* Masson, Bologna, 1989

[3] SODDU, Celestino. *In progetto ambientale di morfogenesi.* Progetto Leonardo, Bologna, 1992

[4] SODDU, Celestino. *Generative art.* Dedalo, Rome, 1998

[5] OXMAN, Rivka E. and OXMAN, Robert M.. *Refinement and adaptation in design.* Design Studies, Tel Aviv, 1991

[6] GERO, John S.. *Adaptive Systems in Design: New Analogies from Genetics and Developmental Biology. In AA.VV. Adaptive Computing in Design and Manufacturing*. Springe, Adelaide, 1998

[7] SCHMITT, Gerhard. *Information Architecture - Basi e futuro del CAAD*. Testo&Immagine, Turin, 1998

[8] UDDIN, M. Saleh. *Digital Artchitecture*. McGraw-Hill, New York, 1999

[9] PONTECORVO, Michael S.. Designing Undesigned. In AA.VV. *Generative Art*. Dedalo, Rome, 1999

[10] PONTECORVO, Michael S.. *Emergence as tool for design*. In AA.VV. *Generative Art*. Dedalo, Rome, 1999

[11] PALUMBO, Maria Luisa. *Nuovi ventri - Corpi elettronici e disordini architettonici*. Testo&Immagine, Turin, 2001

[12] SACCHI, Livio and UNALI, Maurizio. *Architettura e cultura digitale*. Skira, Milan, 2003

[13] COPPOLA, Carlo. *Attraverso l'architettura*. Alinea Editrice, Florence, 2011

[14] COPPOLA, Carlo and CALABRESE, A. and MELE, F. and SORGENTE, A. and TALAMO, O.. *Three conceptual levels for the artifacts design.* In *International Journal of Pattern Recognition and Artificial Intelligence*. World Scientific Publishing Company, Boston USA, 2008

[15] COPPOLA, Carlo and CALABRESE, A. and MASECCHIA, S. and MELE, F. and ORIGLIA, A. and SORGENTE, A. and TALAMO, O.. *A formal approach to generative design: an assistant system for the creation of artefacts model.* In AA.VV. *Second International Symposium on Brain, Vision and Artificial intelligence*, BVAI, Naples, 2007

[16] COPPOLA, Carlo. *Progettare con le ontologie*. CARRERI, E.. *Insegnare composizione architettonica - Principi e pratica quotidiana*. Edizioni Kappa, Rome, 2007

[17] COPPOLA, Carlo. *Computer e creatività per l'architettura - Intelligenza artificiale e sistemi formali*. A-Linea Editrice, Florence, 2005

[18] COPPOLA, Carlo and CALABRESE, A. and IAZZETTA, A. and MELE, F. and TALAMO, O.. *The Transformation's Control and Development*. In AA.VV. *Digital Design: The Quest for New Paradigms*. 23nd eCAADe Conference Proceedings, Lisbon, 2005

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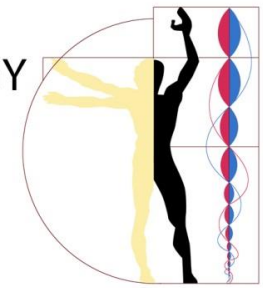

The signage and communication systems in the ancient city of Pompei

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Abstract
The identity of a cultural public place is determined by a strong combination of space, architecture and contents. The communication plan aims to create a visual link between the container and content explicating, in a linear way, the reading and the understanding of all the assets that contribute to create the identity of a specific place.
A coherent system of information and guidance signage appears to be a key component for the proper working of a path of knowledge in an archeological site.
For these reasons, I carried out an analysis of signage systems in the archeological site of Pompei which revealed that it proves to be quite diverse and not always adequate for its main purpose: to direct in a simplified way the flow of tourists and guide them in the ancient city.
We cannot say that there is no form of communication in Pompei; research has shown that most of the choices made to make it functional to the overall understanding of the site is not effective.
The signage systems of the archaeological site, concerning different enhancement projects, have been documented and analyzed in relation to the strengths and weaknesses and the potential opportunities. In this context, infact, for the archaeological site of Pompei, which attracts more than 2 million tourists a year, we cannot underestimate the need to communicate and inform adequately a vast and diverse audience.

Keywords: cultural heritage, archaeological site, cultural identity, tourism

1. Introduction

The identity of a cultural public place is determined by a strong combination of space, architecture and contents. The physical elements occupy a specific place and define identity's image and understanding.
The communication plan aims to create a strong visual link between the container and the content explicating, in a linear way, the reading and the understanding of all the assets (tangible and intangible) that contribute to create the identity of a specific place.
For these reasons, we need an interface that provides the user (visitor) with a range of information that could serve as a premise to a more detailed process of knowledge about what a cultural place might offer.
In this framework, a communicative aid can convey the cultural identity to the visitor, being a link between the spaces themselves and the visitor. The visual communication is thus a fundamental element for the understanding of the information a place can offer and a coherent signage system appears to be a key feature for the proper enjoyment of a cultural area such as i.e. and archaeological site.

2. The case study of the archaeological site of Pompei

This paper primarily focuses on the archaeological site of Pompei, the ancient city destroyed by the Vesuvius' eruption in 79 CE and preserved under thick layers of ashes and lapilli. A relevant pole of touristic attraction Pompei offers some highly valuable insights into the matter at issue here [1-7].
The work initially aimed to the recognition and analysis of different signage system that were adopted at the site in order to provide, through time, the user/visitor with an easy path of knowledge and enjoyment within the city.
The incredible well preserved ruins of the ancient city, whose remains are not always easy to understand, arouse in the average tourist a sense of awe and wonder although, at the very same time, the tourist does not have all the necessary tools for the de-codification or at least the partial understanding of what he encounters.
For this reason, in such places, a good signage system plays a key role as it uses an universal language and can easily lead the movement towards POIs (point of interest), entrances, exits, services and desired paths. This system aims to put the visitor at ease, giving him all the valuable and necessary information to organize his visit in the most independent way as possible.
The ultimate scope of an archaeological site, in its relation between the discovered contents and their display, must aim not only to the preservation, but also to the divulgation according to the different levels of use.
Pompei attracts, each year, more than 2 millions of tourists and for this reason the takers of the site would consider to adequately communicate and inform a vast and different audience. Furthermore, the tourism highly relies on the proper cultural use of a given site, and thus Pompei must attract, inform and diversify the visiting public, responding to their needs and improving their visit experience.

2.1 The signage of the archaeological site of Pompei

The study carried out at the site allowed us to identify and evaluate different levels of signage, mainly divided according three stages of information, as clearly reported by the guidelines *Linee guida per il superamento delle barriere architettoniche nei luoghi di interesse culturale* redacted by the Italian Ministry of the Cultural Heritage [8-11].
It refers to an informative, directional and identifying signage, beside the safety signs, according to the current legislation in public spaces. At Pompei, these three different levels of information already coexist, together with a fourth one, which is entirely devoted to the educational features.
It is therefore a pity that the three different levels of signage do not appear coherent because of the fact that they have been set up by different projects, chosen in the last years with the specific goal of enhancing and re-launching the site and ensuring a diversified fruition model for the users/visitors.
The user can access the archaeological site from Porta Marina, Piazza Esedra and Piazza Anfiteatro. Porta Marina is the main entrance, where the majority of the tourists converge. The reception area is organized with different facilities including the ticket booths, the information point, the bookshop and the audio-guide services. A short free guide to the site (in multiple languages) is also distributed in this area together with a paper map that helps the visitor to understand the urban layout of the ancient city, with the aid of schematized drawings of the many buildings and complexes that he might encounter during his visit. Each of these buildings can be easily identified on the map by a number, which also matches the description on the guide section. This guide and the attached map are, therefore, the only paper supports offered to a visitor at Pompei.
Information services and recommended routes (with the walking time) are also marked on the map. In addition a section of the guide is dedicated to the other nearby archaeological sites of the Vesuvius area.
Piazza Esedra and Porta Marina Inferiore with the adjacent piazza Anfiteatro are the secondary entrances to the site. In these two areas there are, respectively, an informative panel with a map of the site, short bilingual (Italian and English) texts on the history of the city, its most important monuments and some pictures and a more detailed map of the urban layout and the building locations.
From this evidence is clear that the informative signage, which has the goal of providing the tourist with the primary support to his visit, giving him simple but satisfactory tools to read the space around, is not homogeneous an coherent at all.
The last case is the one of Porta Marina, which is close to the main reception area. Here educational panels and maps (that could help the tourist understand the spatiality and complexity of the ruins) are totally missing. Thematic pathways signs are absent and there are no multimedia stations to promote the visit of the site and favour the autonomous visit of the ruins to the tourist (including the information on the other sites of the Vesuvius area).

The directional and informative signage system, however, is present and rather uniformly adopted within the site.
These aspects were sensibly implemented in 2001 within the framework of the construction of a new communicative identity for the Soprintendenza Archeologica di Pompei, as relevant parts for the visual communication within an archaeological site [12-13].
Totem poles made out of Corian (a resin-based material with high resistance, easy to clean and with a discreet aesthetic quality) represent the most evident result of this implementation.
These two-faced signs are quite narrow and long, with and elliptical cross-section and they are enriched with information and symbols, which are engraved on both the sides.
The poles have been placed at the beginning of each road and intersection and they allow the visitor to orientate within the nearby blocks with a series of information that are (from top to bottom): the name of the street/alley, the names of relevant buildings and complexes in the area (with numbers marked to refer to the map and the audio-guide symbol where available) and the next road that the visitor can walk. Directional arrows allow the visitor to easily reach the closer services as well. In the lower part of the totem-pole there is also the *logo* of the Soprintendenza and the name of the other archaeological sites of the area (all of them managed by the Soprintendenza). (Fig. 1)



Fig. 1. Front and back of a panel in *Via Marina*; it reports the buildings along the route and the directions to the contiguous destinations and services of the archaeological area.



Fig. 2. An example of identification signage system with the indication of the *Tempio di Vespasiano* (*Aedes Genii Augusti*), the number, the symbol of the audio guide and logo.

This visual identity system also includes the identification signage system (or confirmation signage system) which is achieved through the adoption of small plaques, made out of the same material and type of the self-supporting panels, which are affixed vertically on the facades of the buildings. These list the names of the buildings or houses, the corresponding map number, the symbol of the audio-guide and the logo at the bottom. (Fig. 2)

The free paper supports (map and the short guide mostly), distributed at the information point in order to assure a free and independent fruition, are also part of the new system of the visual identity at the site.
It must be said that, from a mere point of view of the communication, the signage system of directional totem poles and identification plaques is the sole coherent and homogeneous system adopted at Pompei and the only one which is still able to provide the visitor with a preliminary orientation and to increase his awareness of the surroundings. This system, however, shows some weaknesses that affect its function.
The colours used, i.e., are altered, both on the totem and on the plaques, because of the constant exposure to the weather conditions. This has caused a strong decrease of the contrast between the background and the text, which is supposed to be an essential feature for the success of a good graphic signage system. Furthermore, because of the lack of maintenance the symbols and the text are now only barely readable; stains, adhesive residues and graffiti have disturbed both the poles and the plaques.

In addition a uniform and coordinated system of explanatory panels (written in simple ways and understandable by everyone) is currently absent.
Our investigation also notices that some of the panels placed close to some buildings are no longer leasable and thus lost their original functional purpose.
Some of these are now part of the Project "*Archeologia e Natura della Baia di Napoli*" and have been placed at the *Casa di Pansa*, *Casa di Apollo*, *Casa della Nave Europa*, *Praedium di Giulia Felice* and outside the city walls south of the Amphiteatre, relatively close to *Porta Nola*.
Some of these, however, despite their bad state of preservation, give us useful information on certain aspects. Unfortunately the do not fit into an unified path of knowledge in all the accessible areas.
On the other hand, explanatory bilingual panels have been set up in the eastern part of the city, along the north-eastern stretch of the Via dell'Abbondanza. These are all part of the "*PompeiViva*" project, a program of knowledge, protection and enhancement of the ancient city of Pompei, which debuted in 2010 also with other interesting initiatives for the touristic fruition. (Fig. 3)
The panels address general topics such as the eruption of the 79 CE and the earthquake that followed, as well as specific topics on some of the buildings (like *La Casa dei Casti Amanti* and *La Casa dei Pittori a Lavoro*). Educational and Informative panels installed nearby the Termopolio of

Vetutis Placidus, in via dell'Abbondanza on the occasion of its opening to the public, are also part of the PompeiViva program. (Fig. 4)



Fig. 3. Information panels along a part of *Via dell' Abbondanza*. They are part of the program of knowledge, protection and enhancement *PompeiViva* (2010).



Fig. 4. Entrance of the private residence of *Termopolio di Lucius Vetutius Placidus* with explanatory panels that are part of the program of knowledge, protection and enhancement *PompeiViva* (2010).

This also includes a particular initiative entitled "*Friendly Pompei*" whose focus is on the construction and adaptation of an alternative touristic route purposely designed for all those visitors with a reduced mobility (disabled persons, older visitors, people with strollers, etc..). Special ramps make the path easier to walk. The departure point from the entrance in Piazza Anfiteatro guarantees the opportunity to visit at least 10 POIs which include: the necropolis of *Porta Nocera*, the *Orto dei fuggiaschi*, the vineyard of the *Casa della Nave Europa*, *Casa della Nave Europa*, *Caupona Euxinus*, the *Casa di Menandro*, *Casa dei Quattro Stili*, *Casa di Casca Longus*, the *Termopolio of Lucius Vetutius Placidus*, *Casa di Giulio Polibio*.
These visiting points are all part of a predetermined path and offer, thanks to the presence of explanatory totems written in an educational and informative way, a series of useful information, which provide a valuable support to the visit.
The *Friendly Pompei* project has created, therefore, a homogeneous informative and educative signage system, answering those primary questions that any archaeological site offers. However, considering its original purpose, the project is forcedly limited to a very small path if compared to an overall visit of the entire area.

As far as it concerns the signage within the city of Pompei the program *PompeiViva* also included the creation of a pedestrian and bike path outside the ancient walls in order to combine the visit to the archaeological site with a pleasant stroll or a bike ride.
This path, known as *Pompei bike*, is about 5 kms long and it goes from Piazza Anfiteatro to *Villa dei Misteri* through seven stages. Informative kiosks with short texts about the buildings that might be visited from that specific point after having parked the bike in special racks have been placed at each of these stages. (Fig. 5)
This type of signage is fully connected to the one of *Friendly Pompei*, creating thus an integrated network of knowledge, which is able to welcome the visitors and facilitate their visit experience.



Fig. 5. Rest area, near *Porta Vesuvio*, with information board and racks to park your bike. It is part of the path *Pompei bike*.

3. Conclusions

The analysis carried out so far on the signage systems of Pompei has showed that these are so diversified that there is no adequate and/or responsive approach to its original mission of directing the flow of tourists in the simplest way and guiding them within the city offering a general understanding of what an archaeological site could be.
It would be desirable to extend the communication along all the paths through the combined use of explanatory bilingual panels and schematic maps. These could offer, with the use of simple and clear texts, a series of information for each building: the function, the particular features, some notes on the architecture, the daily life context, etc. Other panels, in addition, may propose insights on the *discovery* and *preservation* of the buildings (techniques of excavation, the restoration works and the modern technologies applied to the archaeological research).
The analysis has also highlighted how a large part of the visitors, in effect, consults the explanatory panels in the immediate proximity of what they are observing (both within the walls and along the *Pompei bike* path). It would be thus incredibly useful to introduce fixed maps of the entire area with the classic *"you are here*" sign marked on them, in order to allow the visitor to quickly locate himself in the surrounding context and to offer him a certain *freedom of movement* among the ruins.
If strategically placed these signs can help the visitor to quickly find out his position and the direction to follow during his visit, also maximizing the use of the spaces and the services available.
In conclusion, it would be a mistake to say that there is no *communication* in Pompei*,* but it should be also noticed that most of the choices that have been made on this particular issue have somehow failed (in particular the total absence of a visual identity able to ensuring an easy communication and fruition along all the paths).
For these reasons we should aim to create an innovative network of knowledge that will be able to promote and sponsor an *enlarged* tourism not simply connected to the experience of visiting such an important archaeological site as Pompei, but also fully integrated with the surroundings, the environment, the past landscape and its modern context.

Bibliographical References

[1] PESANDO, Fabrizio, GUIDOBALDI, Maria P. *Pompei Oplontis Ercolano Stabie, Guide archeologiche Laterza*. Roma-Bari, Laterza, 2006. ISBN: 88-420-7783-6.
[2] ZANKER, Paul. Pompei. Società, immagini urbane e forme dell'abitare. Torino, Einaudi, 1993.
[3] LA ROCCA, Eugenio, DE VOS, Mariette, DE VOS Arnold. *Guida archeologica di Pompei*, 2ª Milano, Mondadori, 1994.
[4] MAIURI, Amedeo. *Pompei* in *Enciclopedia dell'Arte Antica*. Roma, Ist. dell'Enciclopedia Italiana, IV, 1965, pp. 308-356.
[5] DE VOS, Mariette, DE VOS Arnold. Pompei, Ercolano, Stabia (Guide archeologiche Laterza), Roma-Bari, Laterza 1982.
[6] FIORELLI, Giuseppe. *Descrizione di Pompei*, Napoli 1875 (ristampa a cura di PAPPALARDO Umberto, Napoli 2001).
[7] Pompei. La vita ritrovata. In COARELLI, Filippo. Udine, 2002.
[8] Ministero per i beni e le attività culturali, Direzione Generale. Linee Guida per il superamento delle barriere architettoniche nei luoghi di interesse culturale. Roma, Gangemi, 2008.
[9] http://www.beniculturali.it/mibac/multimedia/MiBAC/documents/1311244354128_plugin-LINEE_GUIDA_PER_IL_SUPERAMENTO_DELLE_BARRIERE_ARCHITETTONICHE.pdf
[10] RUSSO, Valentina. *Pompei senza barriere? Il miglioramento dell'accessibilità nelle regiones I e II di Pompei*, in PICONE, Renata. *Pompei accessibile. Per una fruizione ampliata del sito archeologico*. Roma, L'Erma di Bretshneider, 2014, pp. 259-268.
[11] PANE, Andrea, SPINOSA, Arianna, VERONESE, Luigi, FALCONE, Maria, BOREA, Serena. *L'ingresso a Pompei: l'area di Porta Marina e del Foro tra fruizione e conservazione*, in AA. VV. Attualità delle aree archeologiche: esperienze e proposte, Atti del VII Convegno Nazionale. Roma, Gangemi, 2014, pp. 299-306.
[12] GUIDA, Francesco E. *Comunicazione coordinata per i Beni Culturali: 4 Progetti italiani*, Casamicciola Terme (NA), 2003.
[13] FAGGI Olivia, *L'identità visiva della Soprintendenza Archeologica di Pompei*, aprile 2003. http://www.fizz.it/home/sites/default/files/allegati/articoli/pdf_articoli_completi/2003-faggi.pdf

HERITAGE and TECHNOLOGY
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The archeological site of Pompeii: multimedia systems' analysis.

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Abstract - ID 315

The paper gives a review of the main projects designed for promotion of Pompeii's archeological site and for the realization of App mobile and 3D models. Especially, between different projects, national and international, were chosen those with scientific purposes, promoted by public authority or institutions research, university labs and private companies. The research led to the drafting of a virtual reconstructions' catalog, available through the web, with an indication of the major points of interest, also suggested in the cultural trail advised by Sopritendenza: this buildings are visible along the main roads of the ancient city, interesting for the architecture and for the good conditions. The study also included a critical review of *mobile* applications, downloaded by users through internet, which are an alternative to the classic 'audioguida', rentable near Porta Marina. This context highlights a lack of virtual reconstructions, 'usable' and scientifically reliable, which could offer to consumer the possibility to understand, more easily, the ancient ruins preserved. Compared to the entire archaeological area, in fact, the 3D models available are still too dispersed or incomplete while the cultural trail appear not always appropriate and it isn't able to fulfill tourists' needs.

Keywords: App mobile, 3D models, cultural heritage, cultural trail

1. Introduction

3dimensional reconstructions' study of the ancient city of Pompeii, available through the web, has allowed to draw up a chart of virtual models and animations.
Regarding the extension of the archaeological area and the number of buildings, more or less preserved, many 3D reconstructions was performed for some buildings interesting for architectural features, sometimes located along the main streets of the city.
3D models are related to the archaeological site and to the tourist trails [1-2, 8-9, 22]: in fact, they become an important comunications medium, supported by scientific research, that is able to tell the story of any buildings (public, private or religious) of the ancient city of Pompeii [4-5-6].

2. App mobile

3D reconstructions, until now analyzed, usually perform, in most cases, for mobile applications while only some perform in relation to the projects promoted by private companies or university centers. The research, still in progress, gives some data on the effectiveness of some mobile applications and on the impact on the users. Currently, the applications the more downloaded by the web are:
1. Pompeii a day in the past, 2. Pompeii Touch, 3. Eros Pompeii, 4. Pompeii Maps and Walk, 5. Pompeii App, 6. Guided Tour of Pompeii, 7. Naples, Pompeii, Capri City Guides, 8. Offline Map Travel Guide Pompeii, 9. Pompeii FilmCards, 10. iPompei, 11. The Moons of Pompeii.
Users' comments refer to the application's compatibility with mobile devices and the reliability of interactive guides. Often, the difficulties encountered by tourists are the lack of interactive guides, really complete or comprehensive, and the problems related to the site of Pompeii: the size of the archaeological area, the temporary closing of buildings in restoration, the absence of touristic tabs or

information for those users who prefer a personal trail in addition to the 'traditional' tourist guides. We used some of the applications such as Pompeii one day in the past, Touch Pompei, Pompeii Maps and Walk, App Pompei, Pompeii FilmCards, iPompei and Moons of Pompeii to test the reliability of multimedia products, available online from reference's AppStore, installing them on iPhone 5 while on the Android device, Samsung Galaxy TAB 10.7, we used another application, Naples Pompeii Capri City Guides.

Currently, the most complete application mobile is 'Pompeii a day in the past' followed by 'Pompeii App' and 'Pompeii FilmCards'; they show similar features, presenting a variety of contents: audio guide, movies, interactive points, interactive map, charts with text and photo gallery, AR mode, GPS function for location in the site. The application 'Pompeii FilmCards' is interesting and includes many sections reserved for movies (about 75 minutes) and 3D videos (about 16 reproductions), created to accompany users in the archaeological area. The other applications have, however, worst contents (of lower quality), often at low cost or even free.

'Pompeii touch' has not a real textual charts: the application offers only a 'fun' virtual reconstructions of Pompeii's ruins, with no additional information while 'The Moons of Pompeii' lacks a relyable scientific content; instead, 'Pompeii maps and guides', 'Naples Pompeii Capri City Guide' and 'Pompeii Offline Map Guide' give more touristic information for the stay.

3. Cultural heritage: projects and experiences connected to Augmented Reality.

In the last few years, many enhancement's projects have promoted for the archaeological site of Pompeii, directed to the promotion of the archeological area.

The project **'Back to Pompeii'** [3], presented at the IV edition of TechnologyBIZ (November 2012), based on augmented reality's system, multi-platform, is accessible through mobile devices, web browser, PC and MAC. The design was made by Netminds (IRFO Foundation) in collaboration with a group of architects and archaeologists. AutoCAD and 3DSMax are the 3D graphics software used for the virtual models, while for the ancient settlement's reconstruction was used a system based on a procedural language such as CityEngine (ESRI). Unity 3D allowed to create the character animations. The application, which is made in order to see in real-time the virtual reconstructions of the city, is able to frame in the scene any Points of Interest (PoI) with mobile device and it has charts with video and audio; each PoI is properly marked on the archeological map. The project, created by Leonardo Lettieri, has not yet been used.

VillaDiom3Des Project [13] is coordinated by Italian and French institutes: ENS (Ecole normale supérieure) - which is also the project coordinator, the Centre Jean Bérard, the Soprintendenza for Cultural Heritage of Pompeii and Naples, Federico II University and the University of Padova. The team of researchers, led by Hélène Dessales (assistant associate ENS), foresees the conclusion of all the activities in 2017 and in the same year the presentation of research results. The work includes data acquisition with the photogrammetric surveys, the use of a drone to obtain blocks image close-range, in addition to the data acquisition obtained during the excavations. The activities are thought for the construction of a three-dimensional model of the villa, which will be entrusted with the task of disseminating some of the data collected so far.

The project for the virtual reconstruction of the **Villa dei Misteri** was sponsored by the **Cultural and Virtual Reality Laboratory - University of California Los Angeles** [18], directed by Bernard Frischer. The innovation of the project lies in the use of new display systems based on Augmented Reality and Virtual products with undisclosed large scale mode on and off line.

In 2012 an agreement was signed between the Mayor of Pompeii, Claudio D'Alessio, makers of Topcon Positioning Systems of California, the head of Italy's Topcon and the Head of the Department of Architecture, Carmine Gambardella, who provided for the creation a cultural database and a system for 3D mapping, with virtual reconstructions immersive and augmented reality in order to make available, in an innovative way, some areas of the ancient city. The collaboration with the most advanced centers of California was primarily intended to create a kind of 'technological laboratory' in Pompeii, experiencing advanced solutions for telematics and the relief applied to Cultural Heritage. The case study of the domus of Julius Polybius is very interesting and it was achieved in June 2010 for the project called 'Royal Opera IX', directed by the Institute for the Diffusion of Natural Sciences of

Naples, which has created a multi-sensory alternative and original journey. The sound installation was placed in 5 points of the house: 1) the atrium where you can listen to the sounds from the street; 2) the kitchen; 3) the impluvium that welcomes visitors; 4) the peristyle; 5) rooms in the house that tell the daily life.
The casts of some objects, found on site and put back in the house, were made by the company **Opera Laboratori Fiorentini SpA** while the whole system has been designed by the company **PFMmultimedia**. The reconstructions were, instead, developed by **Altair4 MULTIMEDIA** Rome who also created 3D models.
The **Capware digital worlds** [21] founded in 1984 by Gaetano Capasso, based in Naples, a company that took care of the virtual reconstructions sponsored by Piero Angela and those visible in the **MAV** (Virtual Archaeological Museum of Ercolano); they are famous for the collaboration with History Channel and CNN. From the company's website you can view reconstructions divided into topics: Pompeii, Herculaneum, the Gulf of Naples, the Samnites and the Middle Ages. The section 'Pompeii' is divided into focusing charts including 'la Città, la Casa del Fauno, il Lupanare, le Terme, il Criptoportico, il Loreio, la Casa del Poeta Tragico e la Fullonica', each one is accompanied by a short descriptive text and a 3D video. At the top, runs the photo gallery with the most significant frames of the movie.
In addition to this, near the archaeological ruins of Pompeii is located the **Virtual Pompeii - Center Virtual Archaeological 3Dmensionale center** promoted by **Archiland** [19] where until last year the users could continue their tour outside the archaeological area with three-dimensional movies and visiting a small Antiquarium, but now the property is closed to the public for a series of restorations.

4. The catalog

The search, through the web, allowed to collect the main virtual reconstructions created for the ancient city of Pompeii [11-12, 14, 17].
Any information is selected preferring the virtual models performed for scientific projects or promoted by universities, research's institutes and organizations. The research allowed to draw up a catalog with data sheet composed by virtual reconstructions' images; in addition topographical indications allows to locate, on the reference plan, the buildings reconstructed.
The first part of catalog includes the buildings located inside the city or near the walls; the second part consists of generic reconstruction such as Vesuvius's eruption, Pompeii's planning and those referred to half blocks outside the town (Porto, Saline, Acquedotto etc.). In particular, we point out those following studies' cases: 1. Villa di Diomede, 2. Villa dei Misteri, 3. Casa del Fauno, 4. Casa del Poeta Tragico, 5. Casa dei Vettii, 6. Casa del Criptoportico, 7. Casa di Loreio (Octavius Quartio), 8. Casa del Menandro, 9. Lupanare, 10. Tempio dorico, 11. Tempio di Apollo, 12. Tempio di Giove, 13. Tempio di Iside, 14. Tempio della Fortuna Augusta, 15. Foro Civile, 16. Basilica, 17. Terme del Foro, 18. Terme Stabiane, 19. Teatro Grande, 20. Anfiteatro, 21. Thermopolium di Vetutius Placidus, 22. Fullonica di Stephanus, 23. Panificio, 24. Insula del Centenario, 25. Eruzione del Vesuvio, 26. Urbanistica di Pompei, 27. Necropoli di Porta Ercolano e di Porta Nocera, 28. Acquedotto, 29. Ostello delle Muse a Murecine, 30. Saline, 31. Porto.
The table recaps the all virtual reconstructions, so far found, and for each one we detailed the company, the society and the mobile application connected:

Building	University/Company	Society	App Mobile
Villa di Diomede	**INRIA, IUF, CNRS, ENS, CENTRE JEAN BÉRARD, SOPRINTENDENZA ARCHEOLOGICA DI NAPOLI E POMPEI, PSI, WILLOW**	Pompeya – Pompeii Interactive Tour	
	University Of California Los Angeles (UCLA) at CVR Lab (Cultural and Virtual Reality Laboratory - director prof. Bernard Frischer)	Capware digital world Virtual Pompei – Centro	

Villa dei Misteri	Università degli Studi di Napoli Federico II – Facoltà di Architettura (arch. Raffaele Schiavullo)	Archeologico Virtuale 3Dimenensionale	Pompei Filmcards
Casa del Fauno	MAV – Museo Archeologico Virtuale di Ercolano	Capware digital world Laboratorio di Grafica virtuale di Gualtiero Roberto Carraro elaborazioni realizzate per il CD-ROM 'Pompei' della DeAgostini Virtual Pompei – Centro Archeologico Virtuale 3Dimenensionale VillageDocAndFilms	Pompei Filmcards Pompei Reconstruite Pompei Touch Pompeya – Pompeii Interactive Tour Virtual History
Casa del Poeta tragico	MAV – Museo Archeologico Virtuale di Ercolano	Virtual Pompei – Centro Archeologico Virtuale 3Dimenensionale Capware digital world	Pompei Filmcards Pompei Reconstruite
Casa dei Vettii			Pompei Reconstruite Pompeya – Pompeii Interactive Tour
Casa del Criptoportico		Capware digital world	
Casa di Loreio Tiburtino		Capware digital world	Pompei Filmcards
Casa di Giulio Polibio	Istituto per la diffusione delle Scienze Naturali – Università degli Studi di Napoli	Altair4 Multimedia – Roma PF Multimedia	
Casa del Menandro			Pompei Touch
Lupanare		Capware digital world	
Tempio dorico		Capware digital world	
Tempio di Apollo		VillageDocAndFilms	Pompei Reconstruite Pompei Filmcards Pompei Touch Pompeya – Pompeii Interactive Tour

Tempio di Giove		VillageDocAndFilms	Pompei Filmcards
Tempio di Iside			Pompei Filmcards Pompei Touch Pompeya – Pompeii Interactive Tour
Tempio della Fortuna Augusta			Pompei Reconstruite Pompeya – Pompeii Interactive Tour
Foro Civile	MAV – Museo Archeologico Virtuale di Ercolano	Virtual Pompei – Centro Archeologico Virtuale 3Dimenensionale Capware digital world	Pompei Filmcards Pompei Reconstruite Pompei Touch Pompeya – Pompeii Interactive Tour
Basilica			Pompei Reconstruite Pompei Touch Pompei Filmcards Pompeya – Pompeii Interactive Tour
Terme del Foro			Pompei Touch Pompeya – Pompeii Interactive Tour
Terme Stabiane		Capware digital world Laboratorio di Grafica virtuale di Gualtiero Roberto Carraro elaborazioni realizzate per il CD-ROM ‘Pompei’ della DeAgostini	Pompei Reconstruite Pompei Touch Virtual History
Teatro Grande		Capware digital world	Pompei Reconstruite Pompei Filmcards Pompeya – Pompeii

			Interactive Tour
Anfiteatro			Pompei Filmcards Pompei Touch Pompeya – Pompeii Interactive Tour
Thermopolium di Vetutius Placidus			Pompei Reconstruite
Fullonica di Stephanus		Capware digital world	Pompei Touch Pompeya – Pompeii Interactive Tour
Panificio			Pompei Touch
Insula del Centenario	High Tech Pompei' – Insula del Centenario e 'MUSE – PARNASO' in collaborazione con Dipartimento di Archeologia dell'Università di Bologna, il CINECA (responsabile Antonella Guidazzoli) – RVMSVSET (Research Advanced Models for Virtual Set Usage) e RAI – Studio TV1 – Milano.		



Fig. 1 - General plan of Pompeii with indication of areas rebuilt.

5. Conclusions

The investigation shows that the most interesting monuments are concentrated in the western sector of the city (Fig. 1) [10], between the Regiones VI-VIII while less attention is paid to the southern and the eastern areas (Regiones I-II).

The touristic trails, adviced by multimedia guides and by Sopritendenza or described by audioguida (passed out at Porta Marina's entrance), propose the buildings well preserved and located along the main streets of the city:

1. via Sacra/via dell'Abbondanza,
2. via del Foro,
3. via delle Terme/via della Fortuna,
4. via di Mercurio, via Consolare/via delle Tombe (da porta Ercolano verso la villa dei Misteri),
5. via Stabiana (in direzione dell'area dei Teatri)
6. via dell'Abbondanza verso l'Anfiteatro/Necropoli di Porta Nocera.

The Soprintendenza's 'audioguida' proposes 69 Points of Interest (POI), signed on the excavations' plan. Among those points there are only 28 virtual reconstructions, freely available on the web, corresponding to 40% of the buildings pointed out on the plan.

If we consider all the buildings advised in tour guidebooks [7] and not recommended in the Soprintendenza's plan the situation will change again: indeed, the Points of Interests more or less preserved and suggested are roughly 173, so comparing the number of three-dimensional models identified (about 28) to this new value system the percent of the 3D reconstructions are only 16%.

This study, still *in itinere*, allows to develop a first evaluation on the buildings' typology, until now reconstructed in each Regiones (distribution's areas) (Table 1):

Table 1

Distribution's areas	Buildings' typology	Total virtual reconstructions
Regio I	private/trade	3
Regio II	public/ private	2
Regio VI	private	3
Regio VII	public /religious/trade	8
Regio VIII	public / religious	4

Table 2

Buildings	Total 3D reconstruction
Villa di Diomede	2
Villa dei Misteri	4
Casa del Fauno	10
Casa del Poeta tragico	5
Casa dei Vettii	2
Casa del Criptoportico	1
Casa di Loreio Tiburtino	2
Casa di Giulio Polibio	1
Casa del Menandro	1
Lupanare	1
Tempio dorico	1
Tempio di Apollo	5
Tempio di Giove	2
Tempio di Iside	3
Tempio della Fortuna Augusta	2
Foro Civile	7
Basilica	5
Terme del Foro	2
Terme Stabiane	5
Teatro Grande	4
Anfiteatro	3
Thermopolium di Vetutius Placidus	1
Fullonica di Stephanus	3
Panificio	1
Insula del Centenario	1

With no doubt, this data are referred to the virtual reconstructions scientifically reliable, that are related only to the buildings lying in the city and highly recommended by the touristic trails. Buildings, located outside city's walls, such as large villas (Villa di Diomede and Villa dei Misteri) and Necropolis (Necropoli di Porta Ercolano and Porta Nocera) and some inside of Pompeii, such as the House of Criptoportico and the Insula del Centenario are not involved in this first evaluation, although the presence of virtual reconstructions, and are not included in the PoI's list (Points of Interest) of the Soprintendenza.
Finally, it comes to light a varied chart with different reconstructions' hypothesis, sometimes referred to the same building (Table 2).
The study also allowed to identify the private companies that have collaborated for the creation of virtual's models. For each companies is possible calculating the total number of reconstructions, achieved for the archaeological site of Pompeii (Table 3):

- **The Capware digital world** realized many reconstructions that is Villa dei Misteri, Casa del Fauno, Casa del Poeta tragico, Casa del Criptoportico, Casa di Loreio Tiburtino, Lupanare, Tempio dorico, Foro Civile, Terme Stabiane, Teatro Grande, Fullonica di Stephanus. This models correspond to 15.9% of virtual reconstructions of the archeological points showed on the plan of Soprintendenza.
- **The 'Virtual Pompeii - Center Virtual Archaeological 3Dimensional'** performed Villa dei Misteri, Casa del Fauno, Casa del Poeta tragico and Foro Civile (5.7% of the total reconstructions).
- **The VillageDocAndFilm**: Casa del Fauno, Tempio di Apollo and Tempio di Giove (4.3%).
- **Laboratory of Graphics Carraro** [20]**:** performed two models made, Casa del Fauno and Terme Stabiane (only 2.8%).

Table 3

Society	Total 3D reconstruction
Pompei Filmcards	15,9%
Pompei Reconstruite	13%
Pompei Touch	15,9%
Pompeya – Pompeii Interactive Tour	15,9%
Virtual History	2,8%

Fig. 5 – Outline 4.

6. Bibliographical References

[1] AA.VV. *Riscoprire Pompei. Catalogo della mostra* (Roma, 13 novembre 1993-12 febbraio 1994).
[2] B. BENEDETTI, M. GAIANI, F. REMONDINO, Modelli digitali 3D in archeologia: il caso di Pompei, Pisa 2010.
[3] LEONARDO LETTIERI, ROCCO PALADINO, ANIELLO GRECO, *Back to Pompei*, Fondazione IRFO (Istituto per la Formazione Ricerca e studi sociali – divisione ricerca Informatica Netminds).
[4] A. J. BARCELÒ, M. FORTE, D.H. SANDERS, «The diversity of archaeological virtual worlds», in *ArcheoPress*, Oxford 2000.
[5] M. FORTE, R. BELTRAMI, «A proposito di Virtual Archaeology: disordini, interazioni cognitive e virtualità'», in *Archeologia e Calcolatori*, 2000. pp. 287-288.
[6] A. PALOMBINI, «Narrazione e virtualità: possibili prospettive per la comunicazione museale», in *Digitalia* VII, n. 1, 2012, pp. 9-22.
[7] F. PESANDO, *Pompei, Ercolano, Oplontis e Stabiae*, Roma 2006.
[8] P. REILLY, «Verso una archeologia virtuale. Applicazioni Informatiche», *in Archeologia*, a cura di K. LOCKYEAR e S. RAHTZ,, British Archaeological Reports (Int. Series 565), Oxford 1990, pp. 133-139.
[9] M. R. VERDINO, *Realtà Virtuale quale metodo per la conservazione e lo studio dei Beni Architettonici e Monumentali. Proposta per un Museo Virtuale sugli Scavi di Pompei. Ricostruzione nella REG. VI di edifici in Realtà Virtuale interattiva* (Dottorato di Ricerca in

Metodi di Valutazione per la Conservazione Integrata del Patrimonio Architettonico, Urbano ed Ambientale. Coordinatore Prof. Arch. Luigi Fusco Girard, Ciclo XXIV), Napoli 2011.
[10] http://www.pompeiisites.org/allegati/Pompei_120515053335.pdf
[11] http://archeodidattica.bibienne.net/2010/06/27/pompei-3d-precursori-e-attuali/
[12] https://3dwarehouse.sketchup.com/search.html?redirect=1&tags=pompei
[13] http://www.villadiomedeproject.org
[14] http://iconem.com/
[17] http://www.raffaeleschiavullo.com/architecture/architecture.html
[18] http://www.youtube.com/watch?v=ON6AfqMFHyY
[19] http://www.virtualpompei.it/ita/video.htm
[20] http://www.carraro-lab.com/portfolio-item/pompei/
[21] http://www.capware.it/
[22] http://www.3d-coform.eu/

HERITAGE and TECHNOLOGY
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Seismic joints: architectural integration and structural safety

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Abstract
Seismic joints are used when a building is built adjacent to another, whether or not the buildings are structurally linked. A seismic joint typically creates a separation between the adjacent buildings or parts of them thus including separation of walls, floors, roof and, in case of joints within the same building, may also include separation, or accommodation to allow space for piping and other functional elements intended to cross the joint. From the structural point of view, seismic joints often result in somewhat complicated conditions. The simplest joint, separates columns placed at either side of it to provide the necessary structural support. Seismic joints or separations between buildings have been used for many years. However, over the years the required width, and subsequently the cost, of the separations has grown. Seismic joints, within a single building have been introduced by engineers in the past, either to simplify analysis or to reduce the seismic effects of building irregularities. Joints are costly and architecturally undesirable, so they should be designed to meet the requirements of architectural integration. A systemic approach to the project requires that each element of the building (and, therefore, of the envelope) should be designed in relation to the context in which it will be placed. The design of seismic joints is complex because they must ensure technological performances and includes efforts by all members of the design team.

Keywords: Seismic joints, integrated design, codes, appearance issues

1. Introduction
Pounding is the phenomenon occurring when the separation distance between two adjacent buildings is not large enough to ensure the structures relative motion during the occurrence of earthquakes (Figure 1). The structural joint, in civil engineering, is the interruption of building continuity. A structural well designed joint allows the oscillating parts to have enough space for the respective movements also in phase opposition. This separation space must be covered to ensure the building envelope uniformity, vertical and horizontal elements are available to ensure the joint cover function respectively on facades and roofs. If the two buildings belong to the same property, there is also a need to restore the horizontal connections at different levels. For the facade, if the subject joints are not properly designed, they appear as unpleasing elements as well as become points of moisture intrusion creating problems with air and thermal energy leakage. Since these elements travel along paths of least resistance, these breaches in the façade will significantly affect the building envelope performance and, inevitably, the building as a whole. Expansion joints that include structure movements are determined in accordance with seismic code by the structural engineer. Structural engineers place seismic joints in irregular shaped buildings to separate the building into two rectangular parts with no torsion seismic behavior, in these cases the installation of angular elements is required. An ambiguity in expansion joints design responsibility emerges and affects the process of how the joints are designed. Consequently, they are frequently left at the end of the design process, resulting in inadequate detailing, which causes problems during construction and too often is remedied with "bandage" type installations with an excessive use of sealant to seal these joints and tie them into the adjacent façade systems [1]. Joints within the façade are relatively small elements and account for a small percentage of the wall system and entire building envelope but special structural and architectural detailing is required to maintain the separation while, in some cases, these joints are covered creating a continuous building façade to cover. Finally, in the presence of buildings with seismic joints, a proper planning is also required for the



Fig.1 Pounding damages

technological systems. This paper focuses the attention on the seismic joints integrated design. Some codes from different countries is analyzed to compare the information relating to the minimum distance between adjacent buildings. The main issues related to technical and formal design of seismic joints is discussed.

2. Seismic joints: Code guidelines (M.Guadagnuolo)

Seismic joints are used when a building is built adjacent to another, whether or not the buildings are structurally linked. The joints are very often used in buildings having plants of irregular shape, for example as L, to separate the building into two rectangular parts with no torsional seismic behavior. However, in the same building is desirable to avoid such joints as much as possible to avoid repetition of structural components and therefore high costs [2]. If the joint cover is inserted, however, its position is usually obliged.
The minimum joints size should be closely linked to the seismic behavior of the two adjacent structures. The structure behavior depends on various factors, the site where the building is located, the type of construction and the material which it is made of. Some Codes relate to some of these aspects supplying a simplified model (Mexico, Italy). It is evident that for a correct dimensioning is required a seismic analysis of the two adjacent buildings, since the distance between adjacent structures should be such to avoid pounding phenomena and however cannot be less than the sum or a combination of the maximum displacements determined by the ultimate limit states (SLV), calculated on each construction differently increased respect to the type of analysis performed. Many of the analyzed codes provide in any case a minimum size to be respected. In Australian and New Zealander Codes, as well as in the previous Italian Code [3], the size refers only to the height of the building. In others (Chile, Greece) other alternatives are provided. When calculating the correct distance, very often, one of the two buildings is existing, so the data required for analysis are unknown. In Chile and American Codes indications about this case are given. In particular, in Chile the minimum distance of separation may be reduced by half and in the American Code the lateral deflection of an adjacent building shall be permitted to assume 0.03·H of any structure in lieu of a more detailed analysis. In Table 1, that shows the buildings separation criteria for major seismic regulation analyzed, H is the building height, R is the amplification response factor which mainly depends on structural ductility, Δ_i is the displacement calculated with the analysis method, ns is the storey number, a_g is the peak ground acceleration, S is the soil coefficient.
The European Code [4], not included in the Table 1, calls for a distance not less than the maximum horizontal displacement at the corresponding level if buildings, do not belong to the same property. When buildings belonging to the same property the distance between them has to be not less than the square-root-of-the-sum-of-the-squares (SRSS) of the maximum horizontal displacements of the two buildings or units at the corresponding level. The minimum distance can be reduced if both buildings have the same floor distances. The reduction is 0,5 in India and Mexico, 0,7 in Europe.
Figure 2 shows the minimum buildings separation depending on the total height H up to 30 m applying the equations showed in Table 1. Chilean, Mexican and Greek Codes prescribe values below 200 mm, Australian Code limit the minimum distance to building heights above 15 m. In Figure 2 have not been included lines about the American and Indian Codes as they are dependent on the structural analysis; it

Minimum buildings separation	
Australia [5]	0.01 H for H > 15 m
Chile [6]	$\frac{R \cdot \Delta_i}{3}$; >0.002 H; >1.5 cm
Greece [7]	$\sqrt{\Delta_i^2 + \Delta_j^2}$; 4 cm for $n_s \leq 3$; 8 cm for $4 < n_s < 8$; 10 cm for $n_s > 8$
India [8]	$R \cdot \left(\Delta_i^2 + \Delta_j^2\right)$
Mexico [9]	0.001 H for Zone 1; 0.003 H for Zone 2; 0.006 H for Zone 3
New Zealand [10]	0.02 H for H ≤ 15 m; 0.015 H for H ≥ 30 m; (0.02-0.005 (H-15)/15) H for 15 m < H < 30 m
Philippines [11]	$\frac{3 \cdot R \cdot \Delta_i}{8}$
Taiwan [12]	$0.6 \cdot 1.4 \cdot R \cdot \Delta_i$
Usa –FEMA [13]	$\sqrt{\Delta_i^2 + \Delta_j^2}$
Italy [14]	$\frac{H}{100} \cdot \frac{a_g \cdot S}{0.5 \cdot g}$

Table.1 Minimum buildings separation

should be noted that considering $\Delta_i = \Delta_j = 0.03 \cdot H$, as suggested by the standard American for Δ_j, the requirements of these two countries would be the most severe. The New Zealand Code is the only one in which the minimum distance, for building heights between 15 m and 30 m, does not increase linearly. The Italian Code prescribed distance, in Figure 2 has been reported for $S \cdot a_g = 1$, but depending on the site distances may be greater.

2.1 Seismic joints: Italian Code guidelines

In Italy until 2008 has been used a prescription that bound the minimum separation not to the construction site but only at the building height, this approach appeared to be not conservative. In D.M.1996 [3], in fact, is read: "two buildings cannot be built in contact, unless they are realized as a structural system safeguarding the structural integrality. The calculation of the distance between two contiguous structures would require to assess the movement of both structures, considering them in phase opposition. If it is not possible, the size of the joint must not be less than h/100 where, for joint size is meant the distance between two points facing at the same height. When the NTC2008 [14] came into force, the distance between adjacent structures, in order to avoid pounding phenomena, the distance must be calculated or as the sum of the maximum displacements determined for each construction by the SLV or by the expression given in Table1.

Figure 3 shows the minimum buildings separation depending on the building height H as referring to Italian National Code. The red line shows the distances calculated as prescribed by DM 1996 [3], while the black lines by [14]. The NTC2008 introduce the site dependence by which the distance between two adjacent buildings having the same height depends on the building place. In this figure a change in $S \cdot a_g$ between 0.2 and 1.6 is considered, but worst situations could be achieved. The graph shows that the joint size, according

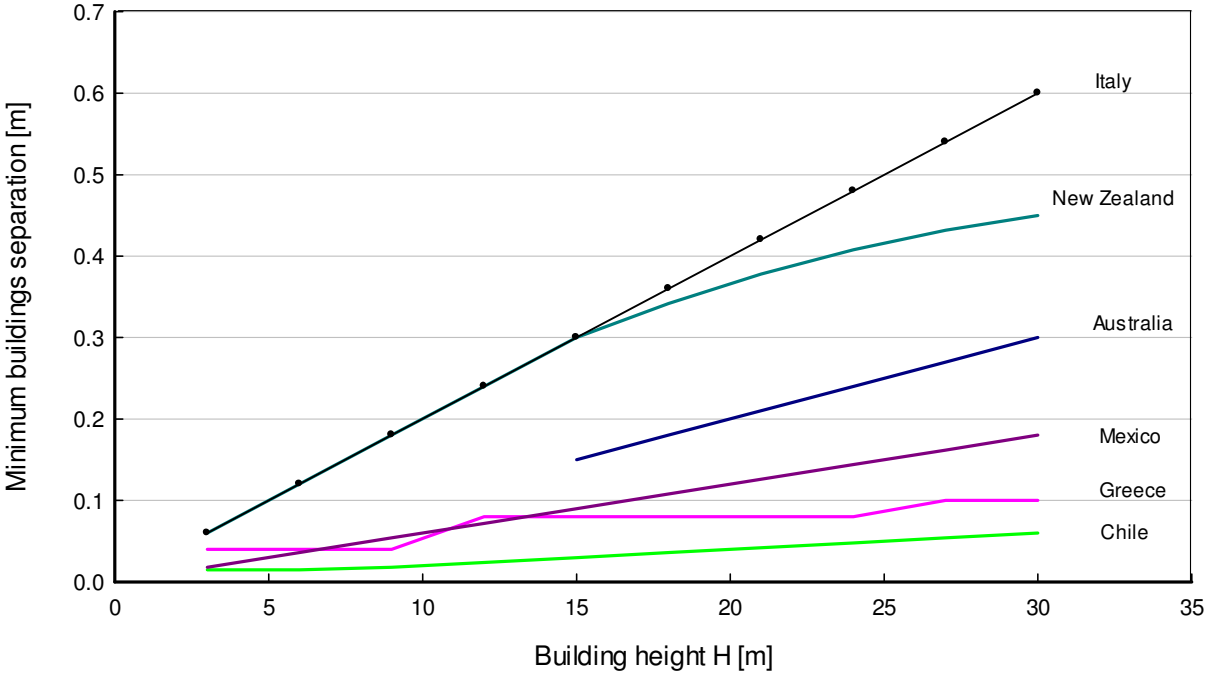

Fig.2 Minimum buildings separation

to the current Code, is mainly greater than the one provided by the old Code. In particular, if a height of 20 m is considered, the minimum distance according to D.M.1996 was 20 cm, while according to NTC2008 it can reach more than 60 cm. This significant difference has strong implications in architectural design.

3. Architectural issues: Integration and Appearance (C.Frettoloso)

A systemic approach analyses, designs and manufactures buildings as a building organism that is structured as a set of spatial elements and technical elements, both internal and external, belonging to the building, characterized by their functions and mutual relations, aimed at meeting the housing needs (UNI 10839: 1999). In analogy with the human body, this organism is divided into several subsystems: those of the structure, services and the envelope, with the latter representing the "skin" of the building. Due to its border system role, the envelope is required to carry out an articulated series of performances, from a thermo-hygrometric perspective, energetic-environmental efficiency, control of the atmospheric agents and, in general, of architectural and functional quality. The appropriate response to these requests and the durability of the performance lead to investigating and experimenting with analysis and design methods that are oriented towards managing this complexity [15].

The development of the Italian seismic Code has introduced a number of requirements that increase the degree of design complexity. In fact, the increase in the size of the joints (Figure 3), requires greater consideration of their architectural aspects.

Discontinuity and continuity, this is the paradox that can best describe and summarize the main issues related to technical and formal design of joints. A dichotomy that manifests all its criticality regarding the fulfillment of requirements for the control of the thermo-hygrometric comfort of the horizontal and vertical joints as well as those related to the architectural integration. The delicate issue of integration in the envelope (as well as in the internal environments) requires a product design that can also respond to the need of appearance.

In this sense, it is worth considering the view of Mark C. Saunders on the architectural issues and approach of some designers: The joints require a very significant design effort by the architect and, ultimately, no matter how well they are done, they are expensive and unattractive features of the building. In low to mid-rise buildings, architects will frequently ask that the joints be made the same width over the full height of the building, in order to simplify the design. This is, of course, acceptable from a structural engineering perspective, but can add to the expense of the joint because of the larger-than-needed joint covers that will be employed at the lower floors of the building [2].

A systemic approach to the project, therefore, is felt as a need. A design way which requires that each element of the building, and envelope, should be designed in relation to the context in which it will be placed. The design of seismic joints is complex because they must ensure technological performances and include efforts by all members of the design team. *Many architects think of movement joints as a necessary evil* -

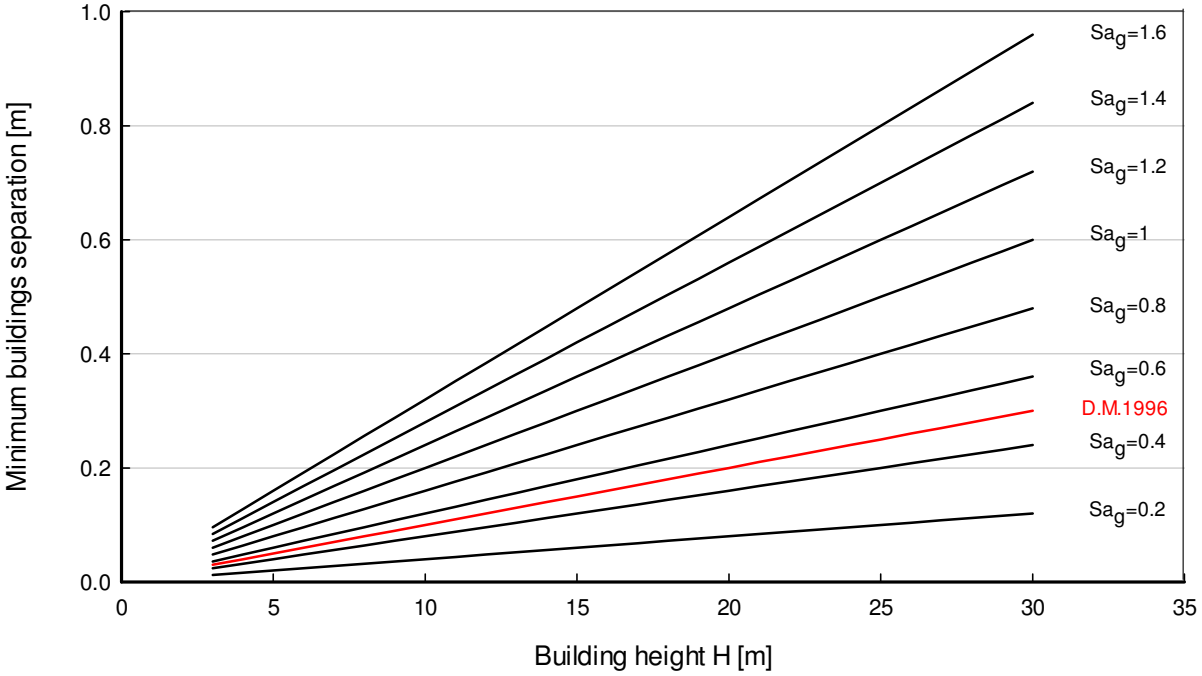

Fig.3 Minimum buildings separation according to Italian National Code

required for a proper system-performance, but detracting from the appearance of the building. Designers can do several things, though, to control the location and appearance of movement joints [16].

3.1 Product innovation in the market today

While the question of the location of seismic joints responds currently, in most cases, exclusively to the safety requirements, the appearance seems to be addressed with a partial approach. The element assigned this function is, in fact, the so-called joint cover, with several Italian and foreign brands providing solutions that can be easily adapted to different types of construction and building envelopes. The personalization of the joint cover allows the designer to evaluate the most appropriate choice in terms of protection from the elements and, in general, control of the environmental conditions of the context in which the building is in. To meet not only these needs but, also, those relating to the final appearance of the product in relation to the building system, the products on the market are often characterized by an ability to accommodate different finishes: ranging from the possibility of reducing the visible surface of the joint to the possibility to integrate it with coating systems.

A study on the characteristics of the seismic joint systems produced by different national and international brands on the market today has shown how there is an interest from companies to also highlight their formal-aesthetic quality. The aspects that are used to advertise their products relate to solutions that combine technology, functionality and aesthetic quality. A quality that translates into characteristics such as: reduction of the visible surface, dimensional control of the connecting elements (minimum size), the absence of visible joining systems, smooth surfaces , ease of assembly, use of high percentages of recycled materials (e.g., aluminum).

Regarding the opportunity to customize the system, the companies studied mainly offer products that can be adapted to different sizes (modular box profile) and connection solutions between the joints that make up the envelope. It is, therefore, an attempt to reconcile the functional application with the not yet fully completed formal-aesthetic one, with it resulting from a greater interaction between the worlds of design and production.

There are also a number of interesting solutions on the market, that can be distinguished by the possibility of a high integration within curtain wall systems. Some products work with on the aim to maximize the ability to accommodate them as final coating elements, while others are configured like common seismic devices integrated in the wall. This approach is oriented towards optimizing the relationship between performance efficiency in the presence of an earthquake and the reduction of design and expressive constraints even if the application field has limitations with respect to the types of facade construction.

4. Conclusive remarks

The paper aims to deepen the seismic joints integrated design. Some codes from different countries were analyzed to compare the information relating to the minimum distance between adjacent buildings. It is

evident that a seismic analysis of the two adjacent buildings is required to the correctly dimension the joints to avoid pounding phenomena. Unfortunately, to achieve an integrated design, an indication of the joint size is needed even before the structural analysis. Many codes, in fact, provide in any case a minimum size to be respected, which can be useful to architectural designer to reason out about the design. In Italy, with the NTC2008 come into force, this aspect can become rather complicate. In fact, the minimum separation between two adjacent buildings, being a function of the site, in most cases, is much greater than the guidelines by DM1996. This means that the joint cover size is not an insignificant extent and needs a proper architectural design. In this paper the problem of the vertical joints placed on the facade has been analyzed, other types of joints can be investigated. Proper and detailed vertical seismic joints sizing within façades is critical to achieve desired building envelope performance.
The study has pointed out the main issues related to technical and formal design of seismic joints: the delicate theme of architectural integration that requires a product design that can also respond to the need of Appearance. A survey about the products available on the market has shown how there is an interest from companies to also highlight their formal-aesthetic quality, but at the same times, a need to improve this critic performance. Building design criteria for seismic safety is a complex process, with Minjung Maing summarizing ten strategic points that start from the following consideration “by understanding the function of the joints and exercising good judgment mixed with creativity, you can make them a part of the design rather than a detraction from it” [1]. These indications are oriented towards the conception of design solutions capable of providing different responses and, therefore, higher performing envelopes, from an aesthetic point of view too. In this systemic view of design, seismic joints have an important role: the choice of material of both the device as well as the side areas, control of the thermo-hygrometric of the walls/envelope, the final design, the installation and the modelling of systems to verify and, above all, improve operation [1]. The modelling could provide valuable assistance in order to include the “design” of the joints in the facade, exploiting the pace and arrangement (vertical/horizontal) so as to compose and arrange the texture of the wall itself [16] or coating.
The problem of the seismic joints integrated design is also relevant for existing buildings, some aspects are to be further investigated.

Bibliographical References

[1] MAING, Minjung. In between: designing joints within façades. In AA.VV., *Symposium on Building Envelope Technology*. San Antonio Texas, November 2010. Web Pages Web: http://www.rci-online.org/interface/2010-BES-maing.pdfp. 73-82.

[2] SAUNDERS C. Mark. Seismic joints in steel frame building construction. In *Modern steel construction*. Chicago: Scott L. Melnick, April 2015.

[3] Ministero dei Lavori Pubblici, Norme tecniche per le costruzioni in zone sismiche, D.M. 16.01.1996, Gazzetta Ufficiale n. 29 del 5 Febbraio 1996.

[4] CEN European Committee for Standardization, Eurocode 8: Design of structures for earthquake resistance - prEN 1998-1. Final Draft, December, 2003.

[5] Standards Australia, AS1170.4 - Structural design Actions Part 4: Earthquake Actions in Australia, 2007.

[6] National Institute of Normalization, Chile, Earthquake Resistant Design of Buildings, 2011.

[7] Organization for Earthquake Resistant Planning and Protection, Ministry of Environment Planning and Public Works, Greece, Greek Code for Seismic Resistant Structures - EAK2000, 2000.

[8] Bureau of Indian Standards, IS 1893-2002 (PART 1) Indian Standard Criteria for earthquake Resistant Design of Structures, 2002.

[9] Departamento del Distorito Federal, Mexico City Building Code, 1995.

[10] Standards Association of New Zealand, General Structural Design and Design Loadings for Buildings NZS 4203:1992, 1992.

[11] Association of structural engineers of the Philippines (ASEP), National Structural Code of the Philippines, 2000.

[12] Construction and Planning Agency, Ministry of the Interior, R.O.C., Seismic Design Code for Buildings in Taiwan, 2005.

[13] Federal Emergency Management Agency, Prestandard and Commentary for the Seismic Rehabilitation of Buildings FEMA 356_38, 2000.

[14] Ministero delle Infrastrutture e dei Trasporti, Norme Tecniche per le Costruzioni, D.M. 14.01.2008, Gazzetta Ufficiale n. 29 del 4 Febbraio 2008.

[15] GRECO, Alessandro, QUAGLIARINI, Enrico (edited by). *L' involucro edilizio: una progettazione complessa* (Artec 2007). 2 Vol., Firenze: Alinea, 2007.

[16] BEALL, Christine. *Integrating movement joints into building design*. Publication #M960023: The Aberdeen Group. Masonry Construction January 1996, http://www.masonryconstruction.com

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Floor masonry beams reinforced by BFRG

Innovation on advanced composite materials for strengthening of masonry structures

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Abstract

It is well known that a suitable seismic response of masonry structures is based on the box-like behavior of buildings. Vertical and horizontal resistant elements, walls and floors, must be effectively connected to ensure a seismic behavior capable of withstanding forces from any direction. However, even when the walls are not well tied together, the presence of floor-beams prevents the walls themselves from moving one another and then the dangerous out of plane failures.
The connection between masonry walls and floors and roof can be achieved by several techniques, as masonry beams, tie-rods or external bandages, also due to the strong spreading of fiber reinforced and new materials.
The paper deals with a new technique for reinforcing the floor masonry beams, that is alternating clay blocks with layers of fiber-reinforced materials. This is a solution that well combines both the static and conservation needs, since it allows to use bio-composites based on natural fibers (basalt, hemp or flax) and grout. The masonry beams reinforced by bio-fiber reinforced grout (BFRG) is a relevant possible alternative to the traditional reinforced concrete floor beams which have produced various types of damage. The paper proposes a model for designing and comparing the floor/roof masonry beams reinforced by both several traditional materials and bio-composites.

Keywords: Masonry buildings, Earthquake, Retrofitting, Natural fibers, Flax

1. Introduction

Seismic events repeatedly highlighted vulnerability of masonry buildings. Masonry, in fact, has great resistance to loads rising compression (self-weight, dead and live loads), but low resistance against horizontal loads which induce incompatible stress states. Up to 80's several strengthening interventions were realized to improve the seismic capacity of existing buildings, but most of them proved to have the opposite effects, in addition to not being respectful of conservation. The introduction of structural elements as reinforced concrete beams (so versatile and modern as far from masonry mechanical behavior), the loss of sensibility to understand the behaviour of the original building techniques, and the lack of knowledge on old materials and techniques produced inadequate retrofitting, unable to achieve their main purpose sometimes with catastrophic consequences.
The "box behavior" is one of the bases of a suitable seismic behaviour of masonry buildings: orthogonal walls and floors must be efficiently connected each other to ensure behaviour able to resist to loads from any horizontal direction. Retrofitting is frequently focused to stiffen intermediate floors and roofs in order to supply adequate load distribution of seismic forces. This reinforcement, in addition to not always be the best solution, is often not enough if it is only to be executed. In fact, if the stiffened floors are not adequately linked to walls, the reinforcement is not able to develop its function, since masonry walls still deform independently. To achieve this outcome, floor structures can be connected to walls by means of reinforced masonry beams, through steel tie-rods or using external hoops.
This paper focuses the attention on masonry beams reinforced by natural fibers, and specifically flax, underlining pros and cons of this consolidation technique and comparing the achievable results with the ones obtained by means of more traditional techniques.

2. Floor masonry beams

Floor beams must do an important role in masonry buildings: they link together orthogonal walls, receive the horizontal loads due to earthquakes from floors and transmit them to walls, undergo thrusts from roof beams, favour the whole structure box behavior thwarting out of plane failures. Solutions by various materials are available to achieve all this needs: each solution has specific characteristics differentiating each other, whereby some static performances prevail.

Concrete beams are able to bear axial and bending forces, but are too heavy and rigid and are not capable of distributing concentrated vertical loads on the underlying masonry because of their high stiffness. Furthermore, as well as for mechanical reasons, the concrete is incompatible with much masonry also for chemical-physical reasons. Finally, the use of concrete beams in existing buildings is very harmful when the beams are at the floor level because of the weakening due to the gap to be executed.

A more compatible solution is represented by masonry beams reinforced by steel bars. In fact, in addition to slight material compatibility (but the worst presence of steel bars remains), a better adjustment to the underneath masonry is achieved because of greater flexibility. This solution differs from the concrete one in its static behavior: it usually includes the same amount of reinforcement of the concrete beams, but is built layer by layer using clay bricks or blocks. This reduces the shear resistance between layers, making the structure much more flexible. An improvement of this solution was developed replacing the steel bars with steel composite materials. Unidirectional ultra high tensile steel sheets, consisting of steel filaments braided into cords of various geometries and strength and glued on a polypropylene scrim, impregnated with epoxy resin (SRP) or with cement or hydraulic mortars (SRG) are used.

A further improvement was due to the introduction of composite materials, whose spread as reinforcement was due to their low weight, mechanical properties and availability in sheets. Among such materials, vegetable fibers are spreading more and more lately. The interest in bio-composites is growing due to good mechanical properties, recyclability opportunities and also thank to the minimum energy needed for their production, in line with recent headlines for low emission of carbon dioxide during manufacturing process. Furthermore, they are very attractive for retrofitting structures that have low or poor quality materials, which do not require fibers with high performance in terms of strength and modulus.

Bio-fibers of particular interest are flax and hemp fibers, which have molecular structure consisting of several biopolymers (lignin, crystalline cellulose, pectin..etc) and nano-structured architecture that provide excellent mechanical properties and high compatibility with masonry. The interest is also due to the possibility to use them as reinforcement in masonry beams, using resin or mortar as matrix.

3. Resisting bending moment of masonry sections reinforced by BFRG

Reinforced masonry beams can be stressed both in the vertical and in the horizontal plane: therefore, both the resisting bending moment in vertical plane and the one in the horizontal plane need to be computed for designing the floor beams. The analysis of masonry sections reinforced by bio-fibers can be simply performed under the customary basic assumptions of flexure theory: (i) the assumption of plane sections remaining plane (Bernoulli's principle); (ii) strain in masonry is the same as in reinforcing sheets at the same level, provided that the bond between fibers and masonry is sufficient to keep them acting together under the different load stages (no slip can occur between the two materials); (iii) brittle behaviour for both materials (materials are linearly elastic and do not deform plastically); (iv) materials are assumed to be isotropic and homogeneous**;** (v) tensile strength of masonry may be neglected; (vi) fiber composite does not resist to compression.

(a) Bending in vertical plane

The beam is considered to be subjected to pure bending because of vertical loads only (Figure 1a). The neutral axis y can be computed using the balance of all forces acting on the beam cross-section:

$$\frac{by^2}{2} - n_{bc}bsy + bs\sum_{i=1}^{n_{bc}} d_i + knbsy - nbs\sum_{i=j}^{n_{bc}+1} d_i = 0 \tag{1}$$

where b is the section width, j is the total number of layers of reinforcing fiber, s is the thickness of each fiber layer, n_{bc} is the number of clay blocks fully or partially compressed, k ($k=j-n_{bc}$) is the number fiber layers in tension, n is the ratio of the modulus E_b of clay blocks to the modulus E_f of the reinforcing fiber, d_i is the distance of center of each fiber layer from the upper edge of the section (numbered from the top). The neutral axis y must respect the following limits:

$$\begin{aligned} y &> (n_{bc}-1)h_b + (j-k)s \\ y &< n_{bc}h_b + (j-k)s + \frac{s}{2} \end{aligned} \tag{2}$$

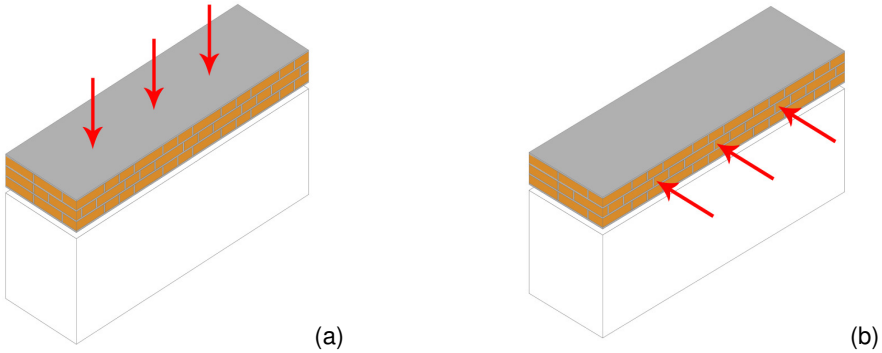

Fig. 1: Fiber-reinforced masonry beams. (a) Bending in vertical plane, (b) Bending in horizontal plane

while the stress $f_{n,inf}$ in the bottom layer of fiber must be:

$$f_{n,inf} = \frac{f_{db} n (h - s/2 - y)}{y} \leq f_{dn} \tag{3}$$

where h_b is the block height, f_{db} is the compressive design strength of blocks and f_{dn} is the tensile design strength of fiber in the stressed direction. The resisting bending moment is provided by:

$$M_R = \frac{b(y-s)^2 f_{db}}{3} + bsf_{n,inf}(d_j - y) \qquad [n_{bc}=1] \tag{4}$$

$$M_R = \frac{b(y-s)^2 f_{db}}{3} - \frac{bsf_{db}}{y-s}\sum_{i=2}^{n_{bc}}(y-d_i)^2 + bsf_{n,inf}(d_j - y) + \frac{bsf_{n,inf}}{(d_j - y)}\sum_{i=j-1}^{n_{bc}+1}(d_i - y)^2 \qquad [n_{bc}>1] \tag{5}$$

(b) Bending in horizontal plane

If the beam is loaded in the horizontal plane (Figure 1b), clay blocks and fibers are loaded differently with respect the previous case, and the neutral axis y is computed by the following equation:

$$(h - js - njs)y^2 + 2njsby - njsb^2 = 0 \tag{6}$$

The maximum tensile stress f_{inf} must be lower than:

$$f_{inf} = \frac{f_{db} n (b - y)}{y} \leq f_{dn} \tag{7}$$

and the resisting moment is provided by:

$$M_R = \frac{(h - js)y^2 f_{db}}{3} + \frac{jsf_{n,inf}(b-y)^2}{3} \tag{8}$$

4. Analysis of masonry beams differently reinforced

Several masonry beams reinforced by flax fiber are compared to corresponding masonry beams reinforced by steel bars as well as to reinforced concrete beams. Three different types of blocks are considered, as shown in Figure 2. Table 1 contains their main geometrical and mechanical characteristics. High strength flax fiber sheets (unidirectional double layer) and low strength flax fiber sheets (bidirectional balanced single layer) are considered as composite reinforcement. Table 2 synthesizes the main properties.
Figure 3 shows the resisting moments of beam cross-sections computed by Equations (4÷5) and (8), varying type and number of blocks, as well as fiber types. The beam width is assumed equal to 600 mm. It is evident how the reinforcement of double layer of unidirectional fiber (type U) provides greater resisting moment then the one obtained by layers to balanced bidirectional fiber (type B). This is more marked for flexure in vertical

	Length [mm]	Height h_b [mm]	Thickness [mm]	Hollow [%]	Vertical strength [MPa]	Horizontal strength [MPa]	E [MPa]
A	250	60	115	0	34.07	11.64	4000
B	250	60	115	30	27.38	6.69	4000
C	250	120	120	45	25.62	3.88	4000

Table 1: Properties of considered clay bricks and blocks

	Typology	Thickness [mm]	Strength [MPa]	E [MPa]
U	Unidirectional	0.27	532	43000
B	Bidirectional	0.10	459	20000

Table 2: Properties of impregnated flax fiber

planes then the one in horizontal planes. The effectiveness of reinforcement obviously depends on the thickness and mechanical properties of flax fiber which are higher for unidirectional double layer fiber sheets.
As regards the type of blocks, the resisting moment of beams made of blocks of type A and B undergone to bending in vertical planes (Figure 3a) are very close (almost overlapped) because the possible highest resistance of blocks is never achieved for equilibrium reasons among forces acting on the cross-section: this implies that the resisting moment is computed for the same stresses in blocks type A and B despite their possible strength are different.
Figure 3a also shows that, for the same beam height, the resisting moment in vertical planes is affected to a lesser extent on block type with respect to fiber type; and the influence of the type of block is greater with increasing the beam height. The influence of the type of flax fiber is decidedly more significant: for beams of height 300 mm (then of thickness equal to half of the width), the resisting moment for blocks type A is about 50% higher than that obtained using blocks of type C, for the same type of fiber. In the comparison, it must not be forgotten, however, that the use of blocks of type A and B (height 60 mm) also involves a greater number of layers of fiber compared to the use of blocks of type C (which are double height, i.e. 120 mm). For the same type of block, the use of double layer of unidirectional fiber (fiber type U) instead, results in an increase of the resisting moment of about 200% with respect to the balanced bidirectional fiber (type B).
In the case of bending in horizontal planes (Figure 3b), the difference between blocks type A, B and C is appreciated, except the overlap, totally random, of the curve relating to beams of blocks type A and fiber type B with that relating to beams of blocks type C and fiber type U. The comparison between resisting moments, if only the block type varies, shows that in this case the differences are much more evident, even for the major difference in terms of strength in the horizontal direction (transverse to the hollows) among the blocks: always for beams 300 mm high, solid bricks of type A allow a resisting moment of about 1.7 greater than that by blocks of type B and about 3.6 times greater than that provided by blocks of type C, regardless of the type of fiber. The influence of the latter is quite independent of the type of block and the use of double layer of unidirectional fiber leads to resisting moments of a little more than double those calculated using the balanced bidirectional fiber.
Figure 4 compares the resisting moment computed for masonry beams of clay bricks of type A (h_b=60 mm)

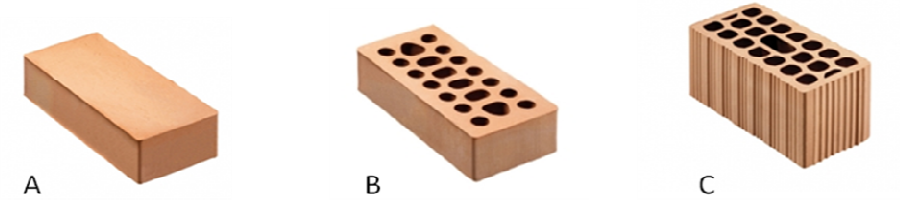

Fig. 2: Clay bricks and blocks used in analyzed masonry beams

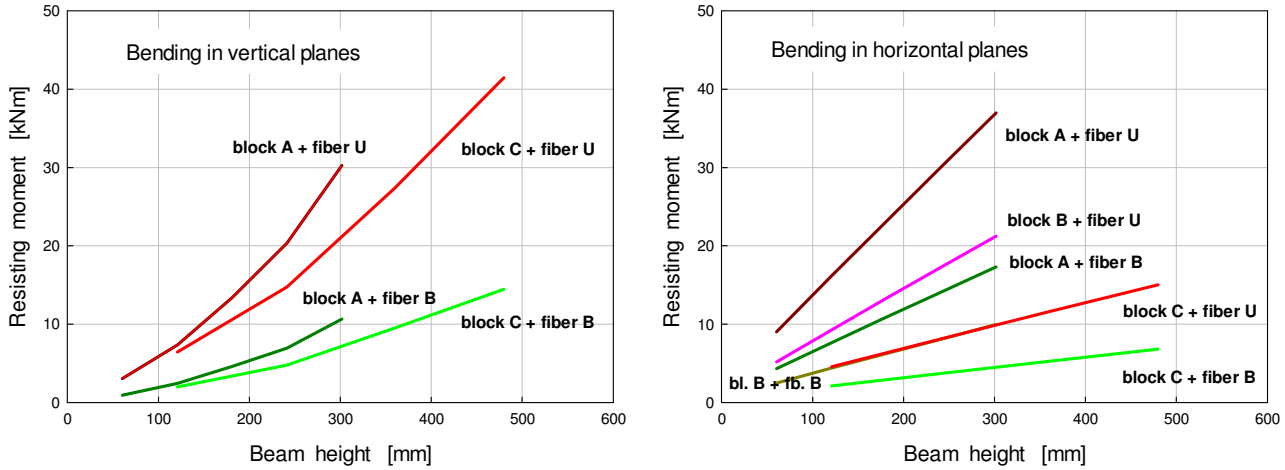

Fig. 3: Resisting moment of masonry beams reinforced by BFRG, as block and fiber types vary

reinforced by BFRG (using double layer of unidirectional fiber) with the one provided by traditional reinforced concrete floor beams, to be excluded in retrofitting of existing masonry buildings. The concrete beam is supposed to be reinforced by 3Φ16 at the top edge and 3Φ16 at the bottom edge: usual reinforcement in the crowning beams used for strengthening existing masonry buildings; this reinforcement is kept constant as the height of the beam varies. Cylindrical concrete strength of 20 MPa and steel with yielding strength of 450 MPa were assumed. The comparison is again performed for bending moments acting both in vertical planes and in horizontal planes.

The comparison of Figure 4a (flexure in vertical plane) shows that masonry beams in clay bricks reinforced by BFRG have a resisting moment of about half of that of customary r/c beams, independently of the height of the beam. The masonry beam has the same resisting moment of r/c beams, if necessary, when its height is twice that in concrete.

The resisting moment under bending in horizontal planes of BFRG masonry beams rises with increasing the beam height for the presence of an increasing number of fiber layers, while the one of r/c beams is almost constant because the reinforcement was kept constant. Figure 4b shows that the resisting moment of the masonry beams is significantly lower than that of the concrete beams, with values ranging between a quarter and half.

The results obtained, however, do not remove, indeed, that beams reinforced by flax fiber sheets develop resisting moments sufficient to make effective the crowning and the floor beam system in retrofitting of existing masonry buildings. This because the resisting moment of the reinforced concrete beams usually used is greater than that necessary, having to respect a minimum code requirement for both size and reinforcement. What's more, these resisting moments are often disproportionate and unjustified for the function to which floor beams must fulfill in masonry buildings, not to mention that r/c beams have also very

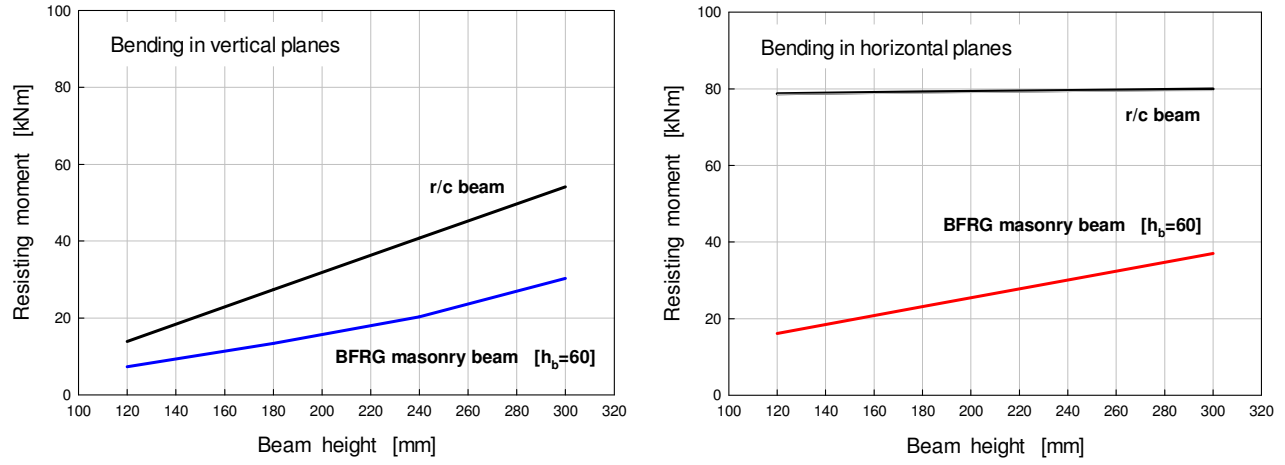

Fig. 4: Resisting moment of r/c beams and clay bricks masonry beams reinforced by BFRG

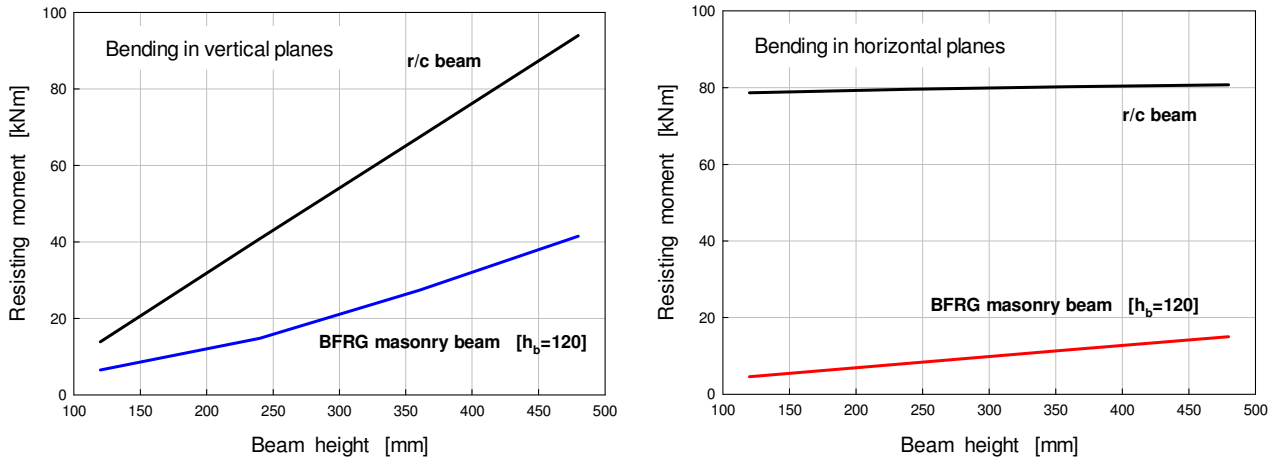

Fig. 5: Resisting moment of r/c beams and clay blocks masonry beams reinforced by BFRG

high and unacceptable stiffness as well as undesirable problems of interaction with the masonry material.
Similarly to Figure 4, Figure 5 compares the resisting moment of masonry beams made of clay blocks of type C (h_b=120 mm), reinforced by double layer of unidirectional fibers, with the one provided by reinforced concrete floor beams. In this case, the resisting moments due to bending in vertical planes ranging between 0.40 and 0.45 of that of r/c beams (Figure 5a), while those for bending in the horizontal plane are much smaller than the corresponding provided by the concrete beam (the resisting moments of the masonry beam vary between 0.05 to 0.20 of the ones of the concrete beam).

5. Conclusive remarks

Aim of this paper was to propose a simplified structural calculation model to be applied to an innovative strengthening and retrofitting intervention on existing masonry buildings. The subject was a new floor masonry beam system made of bricks/blocks reinforced by grouted vegetal fiber sheets (in this case flax). This deals with the challenge to use not more synthetic fibers but natural materials from sustainable fonts, while representing also a viable alternative to the use of reinforced concrete beams as restoration technique of masonry buildings.
The survey of damage after recent earthquakes on retrofitted masonry buildings highlighted how the common strengthening procedure based on the use of floor r/c beams, often leading to hybrid behaviors between masonry and concrete, has revealed to be not effective.
The numerical results of this paper are another small but sizeable step toward understanding and solution of this problem. The proposed calculation model seems to be a valuable tool for this purpose, showing the actual potentiality of the retrofitting method based on the use of masonry beams reinforced by BFRG, using double layer of unidirectional flax fiber or balanced bidirectional flax fiber. Obviously some features need to be further investigated.
The obtained data show that such masonry beams provide resisting moments lower than those of r/c beams, but more than enough for the expected performances of retrofitting floor beams. The introduction of these materials in structural strengthening of existing masonry buildings, in addition to satisfy the need of adequate resisting moments, provides suitable vertical deformation of beams, which better matches the movement of the below masonry walls. Also it has not to be overlooked the advantages in terms of cost and eco-compatibility/sustainability being materials from renewable sources.

Bibliographical References

[1] Andersons, J., Sparnins, E., Joffe, R. Stiffness and Stregth of Flax Fiber/Polymer Matrix Composites, Polymer Composites, vol.27, issue 2, 221-229, 2006

[2] Borri, A., Grazini, A. Il laterizio armato con FRP. Parte 1. L'edilizia, n. 128, anno XVII. Milano, 2003

[3] Borri, A., Grazini, A. Il laterizio armato con FRP. Parte 2. L'edilizia, n. 129, anno XVII. Milano, 2003

[4] Borri, A.,. Consolidamento e rinforzo delle strutture con i materiali compositi (FRP). L'edilizia, n 2, anno XVI, pp. 22 – 26, 2000

[5] Boscotrecase, L., Piccarreta, F. Edifici in muratura in zona sismica, Dario Flaccovio Editore, Palermo, 2006

[6] Bruckner, S., Allegra, G., Pegoraro, M., La Mantia, F.P. Scienza e tecnologia dei materiali polimerici, EdiSES Napoli, 2001

[7] Cangi, G., Manuale del recupero strutturale e antisismico, Dei, Roma, 2005

[8] CNR. Istruzioni per la progettazione, l'esecuzione e il controllo di interventi di consolidamento statico mediante l'utilizzo di compositi fibrorinforzati CNR-DT 200 R1/2012, Roma, 2012

[9] Consiglio Superiore dei Lavori Pubblici. Circolare 2.02.2009, n.617, Istruzioni per l'applicazione delle "Norme Tecniche per le Costruzioni" di cui al D.M. 14 gennaio 2008, Roma, 2009

[10] Dondi, M., Fabbri, B. Parametri che influenzano la resistenza meccanica dei laterizi, ANDIL assolaterizi

[11] Giuffrè, A. Letture sulla meccanica delle murature storiche, edizioni kappa, Roma, 1991

[12] Gurrieri, F. (a cura di) Manuale per la riabilitazione e la ricostruzione post-sismica degli edifici. Regione dell'Umbria, Dei, Roma, 1999

[13] Kalia, S., Kaith, B.S., Kaura, I. Pretreatments of Natural Fibers and their Application as Reinforcing Material in Polymer Composites – A Review, Polymer Engineering and Science, vol.49, issue 7, 1253-1272, 2009

[14] Lenci, S. Lezioni di meccanica strutturale, Pitagora Editrice, Bologna, 2004

[15] Marchetti, M., Cutolo, D. Tecnologie dei materiali compositi, editoriale ESA Milano, 1991

[16] Ministero delle Infrastrutture, dell'Interno e Dipartimento Protezione Civile. D.M. 14.01.2008, Nuove norme tecniche per le costruzioni, Roma, 2008

[17] Tassios, T.P. Meccanica delle murature, Editore Liguori, Napoli, 1988

[18] www.gruppostabila.it

[19] www.fidiaglobalservice.com

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The Pompeii Artifact Life History Project: Conceptual Basis, Methods and Results of First Three Seasons

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Abstract
This article provides an overview of the research goals and methods of the Pompeii Artifact Life History Project and briefly characterizes the work undertaken and results attained during the course of the project's first three study seasons, completed in June and July of 2012, 2013, and 2014. The aim of the project is to elucidate various facets of the life history of portable material culture - including manufacture, acquisition, use, maintenance, reuse, recycling, and discard - at Pompeii during the town's Roman period through the analysis of selected sets of materials recovered in past excavations. To date, the project team has initiated four different sub-projects: the study of the portable material culture from the *Villa Regina a Boscoreale*, a modest farmhouse 1.4 km northwest of Pompeii; the analysis of refuse deposited on the street to the west of the *Insula dei Amanti* and in cesspits underneath the sidewalk along the east side of this street; the analysis of refuse middens deposited against the outer face of the town wall in the *Torre VIII*/*Port di Nola* area; and the analysis of a set of *dolia* - massive storage jars – recovered in the garden/vineyard in *Regio* I, *Insula* 22. This work has provided valuable new insights into various facets of artifact life history at Pompeii.

Keywords: Pompeii, artifact life history, Roman material culture

1. Project research goals and methods

The Pompeii Artifact Life History Project (PALHIP) is an archaeological research project being undertaken with a view to elucidating the various factors that affected the life history of portable material culture (ceramic, glass, and metal vessels, bone and metal implements, worked stone objects, metal and ivory fixtures and ornaments, etc.) in and around the town of Pompeii during the ca. 160 years of its Roman period (ca. 80 BCE – 79 CE), with particular emphasis on the post-earthquake years (62-79 CE). It is being carried out by a small (ca. three- to four-person) research team from the Department of Classics/Graduate Group in Ancient History and Mediterranean Archaeology at the University of California, Berkeley under the direction of the first author and with the authorization of the Soprintendenza Speciale per i Beni Archeologici di Pompei, Ercolano, Stabia. To date, the team has completed three five- to six-week study seasons (June-July 2012, 2013, 2014) of a projected five-year research cycle. This contribution explains the project's conceptual background and methods and describes some of the results obtained.

The inspiration for PALHIP derived from a set of research questions that occurred to the first author in the course of writing a book that considered the various factors that affected the life history of Roman pottery [3] . The project's

approach is low-impact, low-cost, and straightforward, entailing the description of selected groups of artifacts excavated at and in the environs of Pompeii in the past by other projects that were recovered in contexts that promise to elucidate the various stages in artifact life history. These include manufacture, acquisition, use, curation (subsuming maintenance, repair, and storage), reuse, recycling, and both provisional (i.e., temporary) and definitive discard. The team employs what are for the most part low-tech methods - careful visual examination, supplemented in some instances with examination under ultraviolet light and/or a Dino-Lite AD413T digital microscope - to characterize the condition of each artifact. We accord particular attention to documenting various kinds of what archaeologists term use alteration, that is, changes to the artifact that are the result of its use. These include abrasion, cutting, chipping, denting, cracking, breakage, and deliberate post-manufacture modification (e.g., the removal of some part, repair by the reattaching of a part that has broken away), as well as the presence on artifact surfaces of staining, content residues, and soot.

PALHIP is a paperless project, with the team employing a MacBook Pro and third-generation iPads networked via a wireless router for all data recording and management tasks. The database software employed, FileMaker Pro 12, has a remote sharing capability that permits the team members to update our databases simultaneously while working with separate devices. For working photographs we employ our iPad-mounted cameras, while final photographs are produced using a Nikon D5100 digital SLR camera. As useful, we employ AutoCad to determine vessel capacity, displacement, and surface area from standard profile drawings utilizing a routine developed specifically for the project, and diagram the sequence of steps involved in artifact manufacture employing Harris Matrix Composer software. Beginning this year, preliminary results and other project-related information will be made available to the public through the website *Res Romanae: The University of California, Berkeley Roman Material Culture Laboratory*.

2. Overview of research accomplished to date

Each study of a distinct group of artifacts within the compass of PALHIP is referred to as a sub-project. To date, the team has completed one sub-project and has initiated another three. The subsections that follow describe each of these.

2.1 Sub-Project 1: The study of the portable artifacts from the *Villa Regina a Boscoreale*

During the period 1978-1980 the then Soprintendenza Archeologica di Napoli e Caserta undertook the excavation of the *Villa Regina a Boscoreale*, a modest farmhouse situated 1.4 km northwest of Pompeii's *Porta di Ercolano*. This work, carried out under the direction of Stefano De Caro, involved the exposure of the entire structure down to its 79 CE phase, with the recovery and documentation of all of the portable artifacts found inside it. This was followed dur-

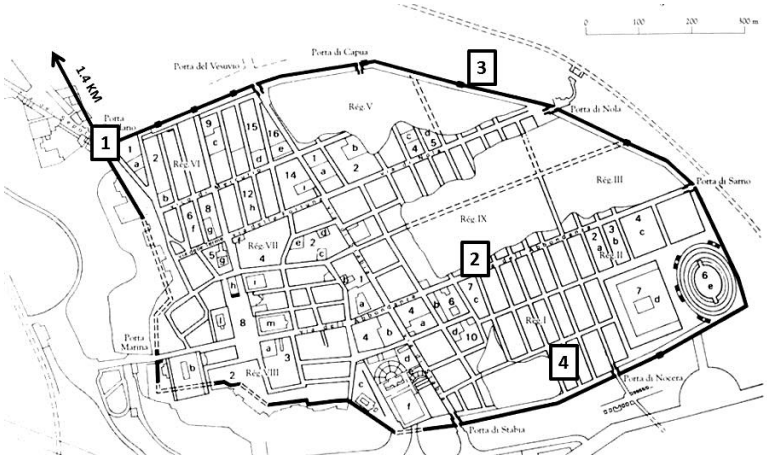

Fig. 1: Plan of Pompeii showing locations of Sub-Projects 1-4.

ing the period 1980-1983 by the excavation of the area around the villa down to the 79 CE ground surface out to a distance of between 7 and 22 m from the structure's exterior walls. The vineyards, garden, open spaces, roads, and other features exposed were subject to careful documentation and a substantial portion of the portable artifacts present on the ground surface was collected and documented. The results of this work were published by De Caro in a 1994 monograph [2] .

Some of the villa's rooms were undergoing remodeling at the time of the 79 CE eruption, while only a limited number of rooms yielded what appeared to be in-use portable artifacts. On the basis of this evidence De Caro concluded that the villa had not been restored and reoccupied as a regular residence following damage inflicted by the Earthquake of 62 CE, and that it was being used in some irregular fashion in 79 CE, perhaps as a base of operations by agricultural workers employed in the surrounding vineyards.

PALHIP chose to begin with a sub-project dedicated to the study of the portable artifacts recovered in and around the villa in use-related, provisional discard, and definitive discard contexts on account of the relatively rigorous artifact recovery protocols under which these materials had been collected and the fact that they had already been subject to regular documentation and publication, with catalog descriptions and drawings for most artifacts included in the 1994 monograph. This work occupied the team for the entire 2012 season and all but the final week of the 2013 season.

A substantial set of portable artifacts in use-related contexts was encountered in just one room, Room 12, a storeroom adjacent to the villa's main entrance. Room 2, the villa's kitchen, was filled to a considerable depth with an ash layer that contained a substantial number of portable artifacts in provisional discard. The ground surface of the vineyards, garden, and open spaces around the villa produced numerous intact and fragmentary portable artifacts in definitive discard.

The set of portable artifacts in Room 12 is of exceptional interest. This room, outfitted to serve as a storage space, appears to have been in regular use for this purpose in 79 CE, with a small hearth inserted in its southeast corner, perhaps as a consequence of the abandonment of the villa's kitchen, as evidenced by the ash layer noted above. A wooden cupboard with at least two and perhaps as many as four shelves was set against the western end of the north wall, there was a single wooden shelf attached to the wall above it, and at least one and perhaps two wooden shelves attached to the wall to the east of it. The excavators were able to reconstruct these elements through the plaster casting method and to document the items being stored inside and on top of the cupboard and on the shelves. There were, in addition, several items set upon the floor along the north wall to the east of the cupboard, and along the whole of the south wall. The set of items recovered in the room included the following: copper alloy: one pitcher, one bucket, one fragmentary lamp stand; iron: one hatchet, one bracket; glass: one bottle, one ampule, one small disk; stone: one hone; ceramic: two complete and two fragmentary lamps, two Italian *sigillata* cups, one complete and one fragmentary thin-walled ware beaker, one complete and one fragmentary jar, one bowl, one slipped bowl with an internal handle, one bottle, two pitchers, one dice cup, and one complete and one fragmentary lid all in carbonate fabrics, six cookpots, three casseroles, three jugs, one jar, one basin, one plaster-surfaced incense burner, and nine lids all in ferruginous fabrics, one Schöne 1 table *amphora*, one Schöne 6 table *amphora*, 1 Cretan 1 *amphora*, 1 flat-bottomed Dressel 2/4 *amphora* with its upper portion removed, and the base and lower wall of a *dolium* being reused as a basin.

The analysis of these items permits numerous interesting observations regarding the ways in which they were utilized. While there is not the space to develop such an analysis here, suffice it to say that collectively the items being stored in this room display a notably high degree of use alteration pointing to prolonged employment. How typical this circumstance might be of Pompeii or of the Roman world more generally is impossible to say, given the lack of similar analyses of analogous sets of items in the literature. We will here offer a brief characterization of just one of these items in order to give some idea of the kind of results obtained. The item in question is an example of a flanged casserole with a carinated wall and a flat bottom in a ferruginous fabric. It was found stored upside down on one of the shelves of the cupboard. This vessel was intact, except for a substantial portion (52 percent) of the rim/flange,



Fig. 2: Sub-Project 1: Casserole. Left: cracks on exterior. Right: residues on interior.

with the missing areas consisting of at least seven fragments. It displays patterns of exterior sooting and interior incrustation that are typical of examples of this form from the *Villa Regina*. The exterior shows heavy sooting over all surfaces, including the fracture surfaces left where the fragments of the rim/flange broke away. This indicates that this vessel was employed on multiple occasions for the heating of foodstuffs in a position elevated above the heat source, and continued to be used even after a substantial portion of the rim had been lost. On the exterior the lower wall and base display a well-developed network of cracks that in some cases propagate outward from large inclusions erupting on the surface. In some cases these cracks - the result of thermal stress and/or thermal shock - appear to pass completely through the wall, suggesting that this vessel was on the verge of catastrophic failure (i.e., breakage) when last used. The interior bears a zone of light- to dark-reddish brown incrustation on the floor that extends up onto the lower wall, apparently residue from the substances cooked in it. Above this, near the junction of the lower and upper wall, are irregular linear patches of a whitish incrustation. These are particularly notable along the lines of the cracks referred to above, and are presumably calcareous deposits left by the liquid portion of the substances cooked in the vessel, which must have contained hard water. It should be noted that the examples of the other major cooking form represented at the *Villa Regina*, the cookpot, display a completely different pattern of sooting and interior incrustation, pointing to a different method of use.

2.2 Sub-Project 2: The study of refuse deposits from the street to the west of the *Insula dei Casti Amanti*

Since 1987 the Soprintendenza Speciale per i Beni Archeologici di Pompei, Ercolano, Stabia has been excavating in the *Insula dei Casti Amanti* (*Regio* IX, *Insula* 12) under the direction of Antonio Varone. During the period 2003-2004 this work involved excavation in the area of the unnamed street that separates this block on its west from *Regio* IX, *Insula* 13 [1] . These operations saw the excavation of two test trenches that removed the refuse deposits on the 79 CE street surface. These were *Saggio* D, which was situated in the street beginning at a point ca. 2 m north of the intersection with *Via dell'Abbomdanza*, and *Saggio* C, which was situated in the street beginning at a point ca. 18 m north of this intersection. This work also involved the excavation of the contents of three septic pits situated underneath the sidewalk that ran along the eastern side of the street, designated, from south to north, *Fossa* I, II, and III. During the final week of the 2013 season the PALHIP team undertook a preliminary analysis of the refuse deposit recovered on the street surface in *Saggio* D and the fills from all three cesspits, none of which material had been examined since the time of its excavation. It was anticipated that these sets of materials would provide interesting insights into the kinds of refuse deposited on a minor side street at two different points - one close to the intersection with a major thoroughfare and one somewhat farther from this - as well as the nature and condition of the artifacts being deposited in provisional discard in domestic cesspits. Our intention was to devote a substantial portion of the 2014 season to the more detailed analysis of these materials, but, in the event, logistical difficulties precluded us undertaking this work at that time, and at present all we possess are the preliminary data collected in 2013.



Fig. 3: Sub-Project 2: Pottery fragments (some joined with tape) with red and yellow pigment on interior surface.

In order to provide some idea of these results we will provide a brief description of the refuse deposit recovered on top of the street surface in *Saggio* D. This consisted of a wide variety of materials, including fragments of pottery and vessel glass, complete and fragmentary artifacts in iron, copper alloy, and worked bone, and architectural materials, including sherds with mortared surfaces, mosaic tesserae, and fragments of stucco, marble revetment slabs, marble architectural elements, fired clay, and roof tiles, as well as animal bone and shell. There was a noteworthy number of objects in copper alloy (49, weighing 118 grams), and surprisingly few fragments of vessel glass (8, weighing 1 gram), suggesting that broken glass was assiduously recycled, whereas objects in copper alloy were not. The pottery was notably comminuted, with sets of sherds belonging to the more fragile classes (Campana B black gloss ware, Italian *sigillata*, South Gallic *sigillata*, thin-walled ware, lamps) averaging between 1 and 3.5 grams each. In some cases, several very small sherds joined, suggesting that the reduction of vessel fragments to very small pieces occurred after they had been deposited onto the street. There was a substantial presence of highly residual material (Campana A, B and C black gloss ware), and a small, but significant presence of materials dating to the final years of the life of the town (South Gallic *sigillata*, including the marbleized variety, Eastern *sigillata* B, *Firmalampen*). Also present were small fragments of several ceramic vessels that had an incrustation of red or yellow pigment on their interior surface that may have been employed in connection with the frescoing operations underway in the nearby *Casa dei Pittori al Lavoro* at the time of the 79 CE eruption.

2.3 Sub-Project 3: The study of refuse middens outside the wall in the *Torre* VIII/*Porta di Nola* area

During the period September-November 1978 a team from the Università Statale di Milano under the direction of Cristina Chiaramonte Trerè undertook the excavation of three large refuse middens that had been deposited against the outer face of the town's fortification wall in the area of *Torre* VIII. Two of these, termed *Cumulus* I and II, were deposited to either side of *Torre* VIII, while the third, termed *Culumus* III was deposited against the outer face of the wall ca. 55 m further along the curtain to the southeast in the direction of the *Porta di Nola*. The team also excavated three small test trenches against the outer face of the wall between *Torre* VIII and the *Porta di Nola*, termed *Saggio* I, II and III. One of these, *Saggio* II, located between *Cumulus* III and the *Porta di Nola*, excavated a portion of another such refuse midden. These features were presumably produced by the dumping of refuse from the tower/wall. In 1986 Laura Romanazzi and Anna Maria Volontè, who were part of the excavation team, published a study of the materials from the four middens belonging to what were at that time the better known classes of pottery, along with the small number of glass objects recovered [4] . On the basis of this work these two scholars concluded that ca. 90 percent of the materials in these deposits dated to the Julio-Claudian and early Flavian periods, and that the dumping that led to the formation of the middens may have occurred in connection with cleanup operations undertaken

following the earthquake of 62 CE. The remainder of the materials from these deposits were never studied or published.

When it proved impossible to continue the team's work with the *Insula dei Casti Amanti* materials in 2014 we shifted the focus of our attention to the study of the four *Torre* VIII/*Porta di Nola* midden deposits, anticipating that the evaluation of the materials from these features - extramural definitive discard contexts - would provide an interesting contrast with the sets of materials from the provisional and definitive discard contexts studied at the *Villa Regina* and the *Insula dei Casti Amanti*. We completed a large portion of this work during the 2014 season and plan to finish our study of these deposits in 2015.

While the complete absence of materials such as South Gallic *sigillata* and *Firmalampe*n confirm Romanazzi and Volonte's inference that the dumping operations that led to the formation of these deposits did not continue into the final years of the town's life, the robust presence of black gloss ware calls into question their assertions about the overwhelmingly imperial dating of the materials that they contain. Perhaps the most interesting result of our work was the large amount of material that we were able to document in these deposits relating to craft production. In the area of textile manufacture, we encountered no fewer than 12 pyramidal ceramics loom weights - for the most part extensively chipped - a bone spindle, a broken bone spindle whorl, and a large (at least ca. 12 cm long) copper alloy needle that had been bent and had one end of its eyelet broken off. In the area of bone working, we documented five complete or fragmentary bone rings that had been sawn from cattle long bones, presumably as a preliminary step in the manufacture of bone items of some kind. Finally, in the area of pottery production, we documented fragments from several different vessels that displayed firing defects, some substantial enough to make it clear that the vessels from which they derived were wasters - that is, vessels with manufacturing defects so substantial as to render them unusable - some indicative of irregular firing, though not extreme enough to make it clear that the vessels in question were wasters. These fragments belonged to a variety of forms and fabrics, including a lid and an *olla perforata* (flower pot) in a coarse ferruginous fabric, a thin-walled ware beaker with a vertical wall in a ferruginous fabric, and a two handled jar with a lid seating in a carbonate fabric. These materials suggests that both textile manufacturing and bone working took place at no great distance from *Torre* VIII, presumably somewhere in *Regio* IV and/or V, and, perhaps most interestingly, point to the presence of a pottery workshop somewhere in this area. PALHIP is currently collaborating with Vincenzo Morra's archaeometric research group in the Dipartimento delle Scienze della Terra at the Università di Napoli Federico Secondo in a program of compositional analysis aimed at establishing the characteristics of the three distinct fabrics represented and determining the raw materials and paste preparation practices involved in their production.



Fig. 4: Sub-Project 3: Craft production materials. Top: copper alloy needle. Bottom: bone rings.

2.4 Sub-Project 4: The study of *dolia* from *Regio* I, *Insula* 22

Beginning in 1955 and continuing into the early 1990s the then Soprintendenza Archeologica di Napoli e Caserta undertook the excavation of nearly the entire area of *Regio* I, *Insula* 22, a block located along the southern edge of the town. The northern ca. one-eighth of the block was taken up by a modest residence known as the *Casa di Stabianus*. The remainder of the block consisted of a large garden space annexed to this house, with the southern ca. two-thirds of the *insula* given over to a vineyard. The excavations uncovered a set of nine intact *dolia* (singular *dolium*) – massive jars employed for the storage of wine, olive oil, or other foodstuffs – sitting on the 79 CE ground surface in an open area between the residence and the vineyard. Also in this area was a large mound of roof tile and *dolium* fragments, and it appears that redevelopment work of some kind was being carried out in this part of the block in 79 CE. None of the *dolia* or *dolium* fragments from this area were ever studied or published.

Dolia were commonly set into the ground, with just their shoulder and rim exposed – so called *dolia defossa* – and the set of containers in *Regio* I, *Insula* 22 presented an excellent opportunity to examine both the lower and upper portions as well as the interiors of a substantial number of examples, potentially elucidating aspects of their manufacture and use. The PALHIP team accordingly arranged to carry out a study of these containers – at the upper margins of the realm of portable material culture in the Roman world – during the 2014 season. We completed the bulk of this work during this season, though plan to make some follow-up observations and analyze the containers' fabrics in 2015.

The *dolia* were all found lying on their sides. They may have been standing on their bases and been knocked over by the force of the first pyroclastic surge to reach this part of the town during the eruption of 79 CE. What they might have contained at this time – if anything – remains unknown. They consisted of six large containers grouped at the western side of the open area, and three small containers grouped in its central/eastern part. The large *dolia* were for the most part only partially excavated, rendering it impossible to obtain measurements of the overall dimensions for all but one of these. The heights of the three small *dolia* were 79, 81, and 94 cm, while that of the sole large *dolium* that could be measured was 135 cm. Preliminary calculations of the volumes of these containers made on the basis of their profile drawings yielded figures of ca. 133, 192, and 229 l for the three small *dolia* and 734 l for the large one.

Dolia were far too large to throw on a wheel, and were normally formed either by slab or coil building on a turntable. From cracks, seams, and breaks on several of the *dolia* examined it is evident that the containers in question were coil built. The potter began by forming the base from a thick disk of clay, then added a series of coils on top of this, smoothing the seams between these elements. The rim was formed by adding a coil to the outer face of the topmost coil and then molding this to shape.



Fig. 5: Sub-Project 4: *Dolium* forming. Left: seam at juncture of basal disk and first coil on exterior. Right: seam between two coils on interior near rim.



Fig. 6: Sub-Project 4: *Dolium* repair. Left: lead crack filling and tenons on large *dolium*. Right: iron crack filling and filling of cut for cross piece of staple (?) on small *dolium*.

Dolia were susceptible to cracking on account of the techniques employed for their forming combined with the notable thickness of their walls, and commonly show evidence of repair. This typically involved the filling of a crack with a lead compound of some kind (sometimes after regularizing the crack by cutting into the vessel wall) and binding the two sides together by executing a shallow double dovetail cut astride the crack and filling this with a lead compound to form a tenon. Three of the large *dolia* display repairs executed with lead. One of these simply has a crack filled with lead, lacking any tenons. The other two have both crack filling and tenons. Interestingly, one of these two also has a row of tenons that bracket an incipient crack too insubstantial to require filling. One of the small *dolia* was also repaired. In this case, an examination of the inner surface of the vessel indicates that the crack was initially filled with a lead compound, with the two sides bound together not by a tenon but rather by a staple that had its legs anchored in narrow holes drilled completely through the vessel wall to either side of the crack. On the exterior of the vessel the edge of this same crack and the cuts made to accommodate the cross pieces of the staples are notably flaky and irregular, and display what appears to be a ferruginous filling that is uneven and sloppily applied. This may perhaps represent a follow-up effort to stabilize the break. Whatever the explanation, the differences between the methods employed to repair this container and those utilized for the three large *dolia* raise interesting questions regarding the moment or moments during the life of these vessels when cracks were subject to repair (sometimes as part of the manufacturing process, when these might already be in evidence, or only after acquisition by the user?) and the identities of the craftsmen who undertook these interventions.

3. Conclusion

PALHIP has now completed three study seasons at Pompeii. Through the careful characterization of previously excavated sets of materials - some published, some partially published, some entirely unpublished - the project team has been able to collect much valuable information regarding various facets of the life history of portable material culture at Pompeii, including manufacture, use, curation, reuse, recycling, and discard. We anticipate that it will be possible to undertake additional sub-projects over the final two seasons of the planned five-year research cycle, adding to the already rich array of evidence that the PALHIP has been able to assemble, providing new insights into the lives of things in the Roman world.

Bibliographical References

[1] BERG, Ria. Saggi stratigrafici nei vicoli a est e a ovest dell'Insula dei Casti Amanti (IX, 12). Materiali e fasi. In GUZZO, Pietro Giovanni, GUIDOBALDI, Maria Paola. *Nuove ricerche archeologiche nell'area vesuviana (scavi 2003-2006). Atti del Convegno Internazionale, Roma 1-3 febbraio 2007. Studi della Soprintendenza archeologica di Pompei 25*. Rome: "L'Erma" di Bretschneider, 2008, p. 363-375.

[2] DE CARO, Stefano. *La villa rustica in Località Villa Regina a Boscoreale*. *Pubblicazioni Scientifiche del Centro di Studi della Magna Grecia dell'Università di Napoli Federico II* Terza Serie Volume I. Rome: Giorgio Bretschneider, 1994.

[3] PEÑA, J. Theodore. *Roman pottery in the archaeological record.* Cambridge: Cambridge University Press, 2007.

[4] ROMANAZZI, Laura, VOLONTÈ, Anna Maria. Gli scarichi tra Porta Nola e la Torre. In CHIARAMONTE TRERÈ, Cristina. *Nuovi contributi sulle fortificazioni pompeiane*. *Quaderni di Acme* 6. Milan: Cisalpino-Golidardica, 1986, p. 55-113.

HERITAGE and TECHNOLOGY
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The virtual representation of the past.

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Abstract
The use of new communication systems and technological instruments represent in today's world a great opportunity to gain an immediate and wider diffusion and circulation of historical knowledge. Thanks to the use of new remote sensing instruments, we are now shaping a new historical knowledge and are able to give both body and soul to buildings, structures and archeological sites that are actually partially or even totally destroyed. We are then allowed to create a very similar representation of the original model in question and a further detailed analysis will enable us to have a complete historical archive of the object or relief studied. Our analysis of the architectural building and dismantling processes that can both be human realizations or consequences of natural and military events is transformed into a complete virtual journey that overtakes the physical and temporal limits we previously held and give experts and even amateurs the chance of a rich and completely interdisciplinal interaction.

Keywords: Laser scanning 3D – Tower XI Pompeii

1. Section

There were 300,000 visitors to Chile, the same number of visitors to Catlogna and to Madrid for MAV on Tour; the digital exhibition from the Virtual Archeological Museum of Herculaneum. A further 400,000 visited the British Museum of London for the exhibition of the "Life and death in Pompeii" to admire the virtual reconstruction of the "House of the Tragic Poet". Impressively, on other side of the globe, 70,000 Korean visitors also conveyed their enthusiasm for "POMPEII: CULTURE OF THE ANCIENT ROMAN CITY", this number does not also include some other exhibitions in China and Japan. New forms of communication; created through virtual and digital technology now transgress economical limits and allow for a much wider dispense of knowledge to tourists. The use of new communication systems and technological instruments represent in today's world a great opportunity to gain an immediate and wider diffusion and circulation of historical knowledge. Google aim to complete the greatest virtual archaeological project, called Ariadne (the acronym stands for Advanced Research Infrastructure for Archaeological Dataset Networking in Europe) that will accumulate six million archeological finds in it's completion. The objective is to realize a new, more informed, knowledge of archaeology, due to the aid of the digital reconstruction of the environment. In the last few years the problem of conservation and enhancement of archaeological heritage, in Italy as well as in the rest of the world, has become an objective of great interest, owing to the development of new technologies and methodologies which allow more efficient and less intrusive interventions in the architectural and archaeological heritage to be surveyed and protected. Particularly in the field of architecture and archaeology, survey techniques based on the 3D laser scanner technology have become very popular. The development of the most widespread instrumental survey techniques (topography,

stereophotogrammetry, photographic survey aimed to digital processing up to GIS) has been considerable and has made possible both the acquiring and the processing of a large amount of data. 3D laser scanning represents one of the ultimate steps of the technological progress in the field of the morphological survey and it offers new and important opportunities.
I have decided to use the 3D laser scanner technology, and to create 3D model of the Tower XI of Pompeii. Moreover, while surveying, it was noted that 3D scanning methodology is applicable to different dimensional scales, not only to the survey of restricted archaeological remains and specific architecture but also to entire urban nuclei. Thus, the research project on Pompeii (Fig. 1) has become more and more interesting because it is now possible to create 3D models of the excavations based on laser scans, integrated with other methodologies in order to build up a digital data base which can directly accessed, consulted, integrated with the results of further research and used for conservative interventions on archaeological sites and their enhancement. This paper intends to summarize some significant results obtained during the research carried out at Pompeii on the monuments of the Tower XI.



Fig. 1: Tower XI of Pompeii.

The Vesuvius eruption in 79 A.C. buried the city of Pompeii, preserving the urban structure, as it appears nowadays, nearly unchanged, with the same architectural and urbanistic organisation preserved by the different strata of lavic materials, that petrified the city in the tragic moment of the eruption.

HISTORICAL NOTES

Walls and fortifications express the pressures at work on an area, and Pompeii is no exception. Defenses are indicators of external and internal influence, and at Pompeii there was no more influential force than Rome. In the city's history prior to the Social War, the expansion of the fortifications reflected Roman presence acting on Pompeii first as an ally, then as a threat. Both of these means of external influence resulted in the strengthening of Pompeii's fortifications, despite being opposite types of pressure. Once the Romans colonized the city in 80 BCE, the pressures became internal and the fortifications were weakened, literally and metaphorically. Pompeii was established as a walled town long before the Roman influence expanded to the area; pottery analysis indicates the first walls around the city were built in the first half of the sixth century. The first wall ran along the "tactical ridge", the lava terrace surrounding the plateau on which the city stands. Subsequent walls would more or less trace this same path, especially in the northwest and southeast corners of the city; remains of the original wall have been found at Porta Nocera, Porta Vesuvio, Porta Ercolano, and beneath the Tower of Mercury. As these remains are always associated with later defensive construction, the path of Pompeii's walls displays an exceptional degree of continuity over time. This should not be particularly surprising, as the lava escarpment surrounding the plateau provides an excellent natural defense, and an obvious border on which to set a fortification. Though the first wall was established around the same time as the town itself, and theoretically enclosed the full 160-acre area that

would be walled for the rest of the city's life, the total area was certainly not entirely urban. It has been reasonably suggested that the altstadt, the original city centre, lay in the southwest corner of the later city. If the original town kept its layout, it would explain the slightly offset street grid of this part of Pompeii, as well as the winding nature of the Via degli Augustali, the Vicolo del Lupanare, and the Via dei Teatri, which may have formed the borders of the original town. Remains of outlying buildings have been found throughout the rest of the walled area, so the original wall was certainly protecting all the town's holdings. These outlying buildings are built in a grid pattern that remain unchanging as the city develops, suggesting that the street grid of Pompeii now visible is older than those neighborhoods and buildings. Current excavation data suggests that the original wall was comprised of a single curtain two to three meters high, built in opus quadratum, out of sandstone and cruma di lava, both fairly soft materials.

In their present form, however, they are made up of tufa and limestone blocks in with chunks of lava and mortar in opus incertum. However, it is reasonable to assume that they, too, were reinforced in anticipation of the coming battle. At the same time that Pompeii's gates were restructured, a number of towers were added along the course of the wall (Fig. 2). Excavation has revealed the construction of at least 11 towers, and may suggest as many as 13. There were two main groupings of towers, four around the southeast corner near the amphitheater, and three between Porta del Vesuvio and Porta di Ercolano. These towers are constructed from limestone and lava set in mortar in opus incertum, the same material used in the reconstruction of the gates. The towers were then covered in white plaster, which was carved in relief to simulate the opus quadratum limestone blocks of the existing outer wall (Fig. 3).



Fig. 2: Placement of towers along city wall.



Fig. 3: Tower construction materials, opus incertum, plaster visible at base with relief imitating surrounding opus quadratum wall.

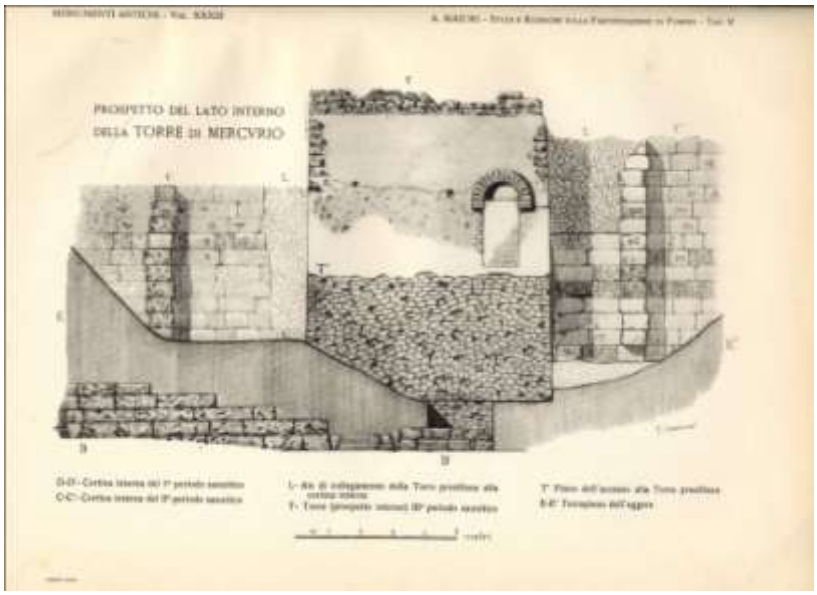

Fig. 4: Tower of Mercury, design Amedeo Maiuri.

The towers had three floors, all connected by interior stairs. The first floor was a guardroom and had a backdoor that opened onto the agger inside the city. The second floor was level with the wall walk, allowing defenders to travel from one tower to another between the two wall curtains; arrow slits were also found along this second level. The third floor had large windows from which defensive artillery might have been fired. All in all, the towers seem to have been designed not just as lookouts or bulwarks, but as an active fortification to be manned by a defending army. Pompeii's towers were not, in fact, built just before the Social War, but after it, during the Roman occupation. He cites the workmanlike construction of the towers as evidence that they were not built in a hurry as a response to danger, but were a sustained peacetime social project. The opus incertum construction of the towers would have been easier to construct than the opus quadratum of the walls, and uses local lava rather than Sarno limestone or Noceran tufa.

Archaeological sites require different scales of survey in order to discover the ancient position of the finds and, on a smaller scale, to develop territorial analyses. The 3D laser scanner allows the acquisition of 3D data without any physical contact with the surface to be surveyed; an integration between the dimensional, morphological, structural, stratigraphical and colorimetric data acquired by means of traditional survey methodologies is also possible. The purpose of this integrated methodology is to create advanced digital models to be used as databases for managing the maintenance interventions and the exploitation of the archeological heritage.
The project research concerning the Tower XI of Pompeii of started in 2014. The survey of the Tower XI of Pompeii has been carried out by means of a CAM2 Laser Scanner Focus^{3D} X 330 laser scanner technology. The laser scanner sends forth a laser beam directed to the surface to be surveyed in order to acquire all the points allowed by a selected grid: the result is a point cloud model which reproduces the morphology of the archaeological structure. Another important 3D laser scanner feature is the opportunity to acquire the reflectance data which allow the visual recognition of the different materials of the surveyed object as well as the automatic spotting of reference targets. On the basis of the results obtained from the survey and 3D modeling, a 3D model of the whole area was built up with a maximum error of 6mm. The complete 3D survey was set up in order to allow a reconstruction of the different parts of the monuments and to provide a morphological basis to be used as a reference for archaeological and historical researches, photographical data and spectrophotometric analyses. At this point the importance of creating a 3D data base in archaeological field is evident. The right structuring of 3D data bases for architectural heritage is one of the main points of the knowledge and conservation programmers on monuments. The solution proposed is a data recording at different layers, to be used for different purposes, from the management of the conservative interventions up to the exploitation by researchers, restorers, students and visitors.
For this reason it is worth pointing out again the two main aspects of this research project; the first one concerns the potentiality of a 3D model of the artistic or architectural heritage at hand; in fact, by taking into account the geometric and material properties, and by inserting them into a specific software, it is possible to perform, for example, realistic simulations of philological reconstructions or restorations and maintenance interventions. In this way the archaeologists together with the architects are able to develop interdisciplinary researches which allow a deeper knowledge of the archaeological heritage and a proper programming of maintenance interventions. The 3D model enriched by information on material data, history of the restauration, physical decay and maintenance conditions, allows a virtual check of procedures and interventions even in the time dimension. The second one, concerns the opportunity to create solid models in different dimensional scales by means of present rapid prototyping technologies. The using of solid models in the conservation of the archaeological heritage allows both the modeling of complex shapes and the simulation of restoration interventions directly on the model in order to check the results before the actual restoration. Rapid prototyping modern technologies make the "link" between digital and real data possible. Therefore these methodologies will contribute to the study, preservation and enhancement of the unique archaeological heritage in Pompeii. By exploiting the multimedia and internet resources the 3D models allow the archaeological heritage to be easily accessed by scholars and specialists of the field, as well as by a large number of art lovers.

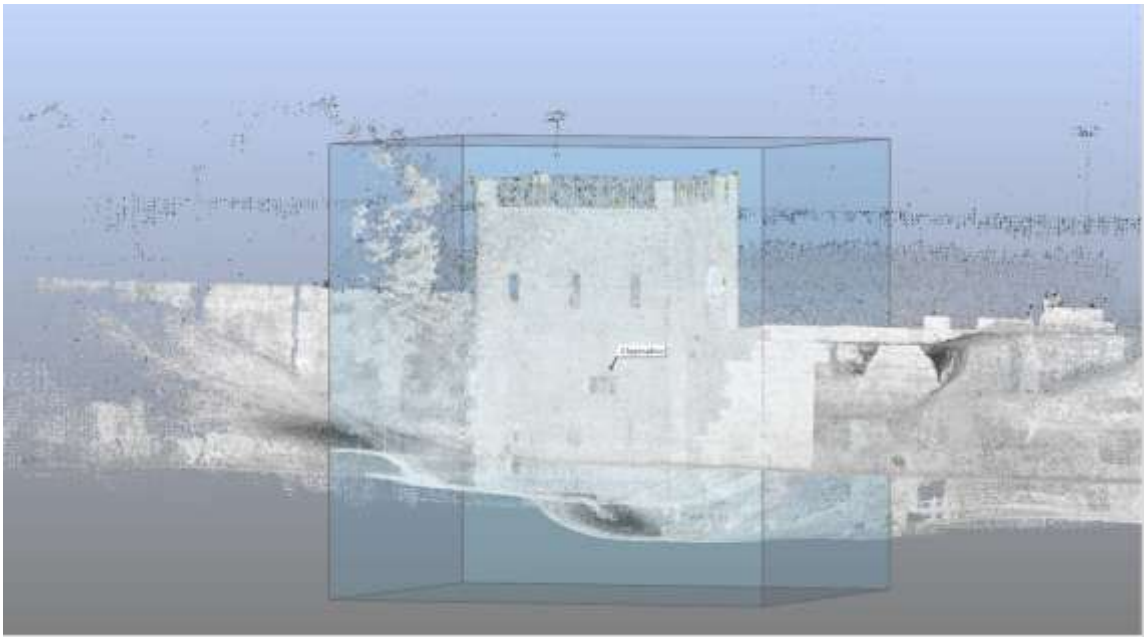

Fig. 5: Tower XI - Cloud of points.

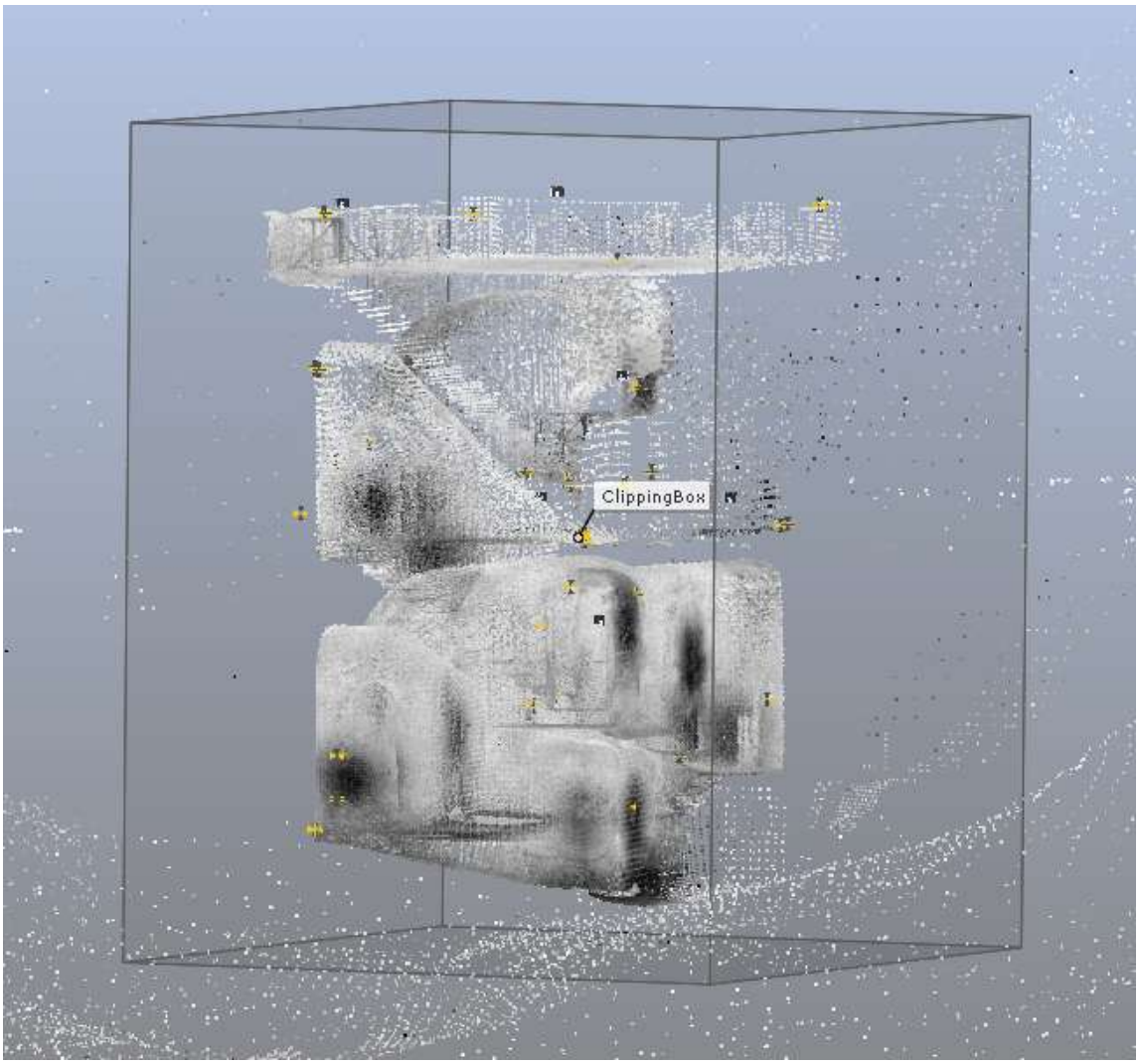

Fig. 6 Tower XI - Cloud of points.

Bibliographical References

[1] RUSSO, M. *Principali tecniche e strumenti per il rilievo tridimensionale in ambito archeologico*. 2011. Edizioni All'Insegna del Giglio. 169-198

[2] FIORANI, Donatella. *Restauro e tecnologie in architettura.* Roma, 2009. Carocci.

[3] DOCCI, Mario. *Manuale di rilevamento architettonico e urbano.* Bari.Roma. 1996. Laterza.

[4] CARBONARA, Giovanni. *Trattato di restauro architettonico.* Torino. 2008. UTET.

[5] MAIURI, Amedeo. *Studi e Ricerche sulla Fortificazione di Pompei, Vol. XXXII.* Roma. 1930. 152-163.

[6] MAIURI, Amedeo. *Pompei, XVI Edizione.* Roma. 1930.

[7] SANTORO, L. *Fortificazioni della Campania antica.* Salerno. 1979. 96-111

[8] CHIARAMONTE, Cristina. *"The Walls and Gates." The World of Pompeii*. London. Routledge. 2007. Ed. John J. Dobbins and Pedar W.Foss., 141-142-143.

[9] KAISER, Alan. *Roman Urban Street Networks*. New York. Routledge. 2011, 69

[10] BERRY, Joanne. *The Complete Pompeii*. London. Thames & Hudson. 2007, 74.

[11] RICHARDSON, *Pompeii: an Architectural History*, 48.

[12] Referring Web Pages Web: http://www.unesco.org/culture/

HERITAGE and TECHNOLOGY
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The impermanent project.
Animation and 'multiplicative persistence' in contemporary urban space

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Abstract
Several years ago, Giancarlo De Carlo, with regard to the Mars Exploration Rover space mission, wrote that "There is no 'time' on Mars and hence there is no 'history'." With a certain apprehension, he wondered how a young architect might intervene in such a situation. This reflection on the theme of time in the urban project dimension, bringing with it the mutually dependent concepts of tracing and layering, may help us find the roots of that inverse disciplinary canon that channels and drives the (often) thorny categories of the *precarious*, *temporary* and *ephemeral* in the contemporary urban landscape.
De Carlo was beginning to glimpse, following the incursion of new transformative energies laden with project opportunities, an opening to paradigms that were more oriented toward adaptability, flexibility and transformability. He envisaged the annulment of any kind of settlement framework on Mars, to be replaced by the pure and spare simplicity of a large common and shared shelter. A huge tent that would be reassuring for its intimacy and yet destabilizing given its fragile impermanence.
What are the "stabilizing elements", the persistences, in today's urban space? What is their role? The acquirement of multiple temporalities and the inclusion of a growing non-material dimension in the building of new urban scenarios, in some design methodologies being tried out in France, especially in temporary projects, confers to the concept of the 'program' and the value of the form, meanings that diverge from those typically of a recent past, in creating the contemporary urban landscape.

Keywords: weak-urbanisation, uncertainty, sensitivity, ephemeral, low-tech

1. The impermanent project
Mes sens s'ouvrent et me voici perdu en pleine fôret du monde. Henri Maldiney
The main theme of this study starts by noting a slow dissolution, beginning in previous decades in different ways and registers, of the great principles that have steered planning activity in modern times in terms of the urban project (Bonfanti, 1965). It opens up discussion on new research lines on the issue of the "uncertain border" (Viganò 2012) and the temporary or ephemeral use of urban spaces.
Our era, as Isabelle Stengers has observed, has arisen under the sign of uncertainty, which constitutes, according to physics, a *mise en écart* with respect to the deterministic laws inherited from the past and a new epistemological pathway for the future.

The chief motive and interest for the study lies in the need to once again question the different processes of transforming the contemporary city, with respect to the devices that currently regulate the organization of urban spaces and regarding the socio-cultural dynamics making up the basis of different modalities of perceiving. Perhaps never before has there been such a sensitive moment to the values of change, in which the universe of *feeling* has introduced uncertainty among the principal characteristics of transformation.
Highly interesting here is the connotation that Ilya Prigogine brings to the concept of sensitivity, understood as a feature of the systems that diverge from the thermodynamic equilibrium and thus introduce a random component. It is in this temporary instability that change is installed, a change that brings about a transformation of roles and of the significance of those involved in the process, so what was once indistinct may become visible and in which "This sensitivity, this becoming significant of what was insignificant, corresponds to a new type of uncertainty."[1]
The modern, which ushered in logical and rational functionalism, despite adopting speed and change as its epoch-making paradigms, has built its image on an "envy of the future" – a future that stands out as a new "pivotal period"[2], a horizon on which to install definitive formal and structural resolutions – rather more so than on a dialogue with impermanence, randomness, uncertainty and the temporary nature of the present.
Pinpointing the principles of urban growth today means accepting the indefinite nature of the project (already advocated by Candilis in the 60s), it means broadening the threshold of the visibility of the changes and making the process of mutation explicit.



1.2 One space, many places

According to the philosopher Mario Perniola, our society is structured on the "already felt"[3], as a response to the inherent need human beings have to recognize themselves as a “unanimous whole” (Tafuri).
Contemporary thought feeds on these “figures of the already felt", elaborated by collective feeling, producing a highly vivid imagination, which refer to a construction of the sensibility understood as a social construction site. But which “already felt figures” drive the creative processes producing today’s cities? What is the shared value becoming erected on the concepts of the 'unstable', the 'temporary', the 'ephemeral' and the 'aleatory'?
With the genre of pop culture now effectively exhausted, which led architecture back to the image, to the sign, the city is taking shape, according to Bergson’s celebrated distinction, between what is done and what

is created in permanence. It is manifested through waves of probability, micro-interventions, changing scenarios, multiple temporality and so forth.
The urban project (perhaps more specifically that of public spaces), is increasingly affected by the installation of different temporalities that denote the presence of streams and that refer to a perception of space as a complex entity.
The transition from a culture based on objects and permanence to a culture underscored by flows and instability (Buci-Glucksman 2003), has led to the set-up of counter-models of transition (Hopkins, 2010) and theories of 'urban impermanence' (Segapeli, 2014) that may today find their place in the culture of the project, highlighting the values of flexibility, reversibility and adaptability.
If the urban project has drawn culturally closer to the flow of history, it is worth noting that it is a different concept of history that we are now dealing with, an "*irréductiblement événementielle*" (Stengers 2008) history according to an approach that is ever more focusing on a visionary role of the project, as a tool for exploring methods that are no longer installed in the universe purged of models but in the rugged terrain of processes. This 'visionary role' of the project allows a profound investigation of the territory and its *milieu*; what's more, it enables different practices, alternative uses, co-existences and novel overlapping to emerge. The ephemeral thus becomes a figure of knowledge, of understanding the territory and the city.
Several years ago, Giancarlo De Carlo, with regard to the Mars Exploration Rover space mission, wrote that "There is no 'time' on Mars and hence there is no 'history'." (De Carlo, 1972) With a certain apprehension, he wondered how a young architect might intervene in such a situation. This reflection on the theme of time in the urban project dimension, bringing with it the mutually dependent concepts of tracing and layering, may help us find the roots of that inverse disciplinary canon that channels and drives the (often) thorny categories of the precarious, temporary and ephemeral in the contemporary urban landscape.
De Carlo was beginning to glimpse, following the incursion of new transformative energies laden with project opportunities, an opening to paradigms that were more oriented toward adaptability, flexibility and transformability. He envisaged the annulment of any kind of settlement framework on Mars, to be replaced by the pure and spare simplicity of a large common and shared shelter. A huge tent that would be reassuring for its intimacy and yet destabilizing given its fragile impermanence.
What are the "stabilizing elements" (Rowe, Koetter, 1978), the persistences, in today's urban space? What is their role? The acquirement of multiple temporalities and the inclusion of a growing non-material dimension in the building of new urban scenarios, in some design methodologies being tried out in France, especially in temporary projects, confers to the concept of the 'program' and the value of the form, meanings that diverge from those typically of a recent past, in creating the contemporary urban landscape.
Persistences assumed as structures of the city, have left the place to a probability of presence, a wave, an aleatory and fluctuating possibility of intervention that can leave traces and that assumes value as animation of the space, with its interruptions, its cuts and its cycles of aleatory permanence.
The urban space results therefore animated by forms of "exappropriation" (Derrida 2002), as traces of writing that establish a new topology, based on 'final instability'[4], each time the space is inhabited and refounded by a new animation.
In this scenario, we may on one hand recognize the difficulties in the loss of anchorage, recognizable forms of solid stability, while on the other the characteristics of a transitory period no longer experienced as an interval but as legitimate and intrinsic to the practice of planning the city today.
The expectation of change has taken on value today: the space is transformation and is realized through the emergence of new mutations. The period between non-use and the project may give rise to an 'experimental time', in which no claim is levied on future developments, in which the being *en suspens* allows trying out new methods, following sometimes long and non-linear processes.

1.3 The unconscious of the city and its dialogic relationship with the apparent urban layers

We often speak of the urban unconscious as a kind of metaphor of chaos. The need to reckon with the unconscious is instead a process: the unconscious is a little explored dimension since it is constantly evolving. "The unconscious also conceals psychological materials that have not yet acquired the level and dignity of the conscious: they are the seeds of content, some of which will then become conscious"[5].
The concept of space *en attente*, very often mentioned in discussion on waste lands, on abandoned lots that hence await new uses, is very close to the notion of the unconscious, in the above sense. There is not

always evidence of the conditions needed for a project to be realized or that a new scenario may be outlined. The ability to perceive the seeds of something coming to life lies within the sensitivity of the more aware architects: to the question "How did Archigram come about?" Peter Cook replied: "I think it was because London was ready for such things. This city has always been a very stimulating sort of place, boiling underneath but without really showing it on the surface."
The term latency describes this condition well: there are always layers or parts within cities to be revealed, that are awaiting the right conditions to accommodate them. The city needs to breathe chimeras and utopias to prepare for changes. The unconscious may for this reason be considered a laboratory: a place in which the dreams and visions needed to produce changes are developed.



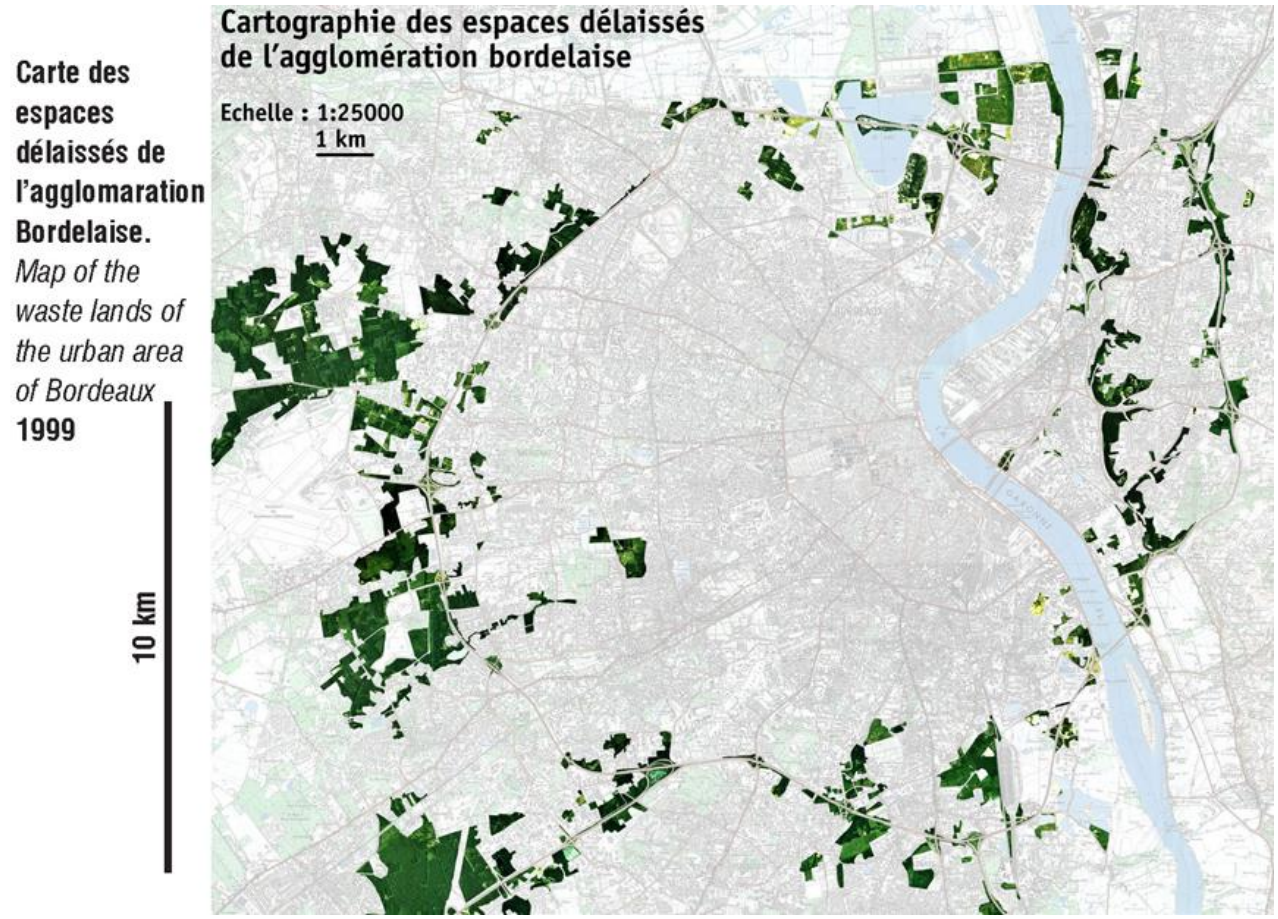
Fig. 2: Bruits du Frigo*, Le Ring,* Bordeaux 2013. Le Ring was built on the site of Le Rond-Point recreating a living spot.La Benauge is a garden city built in 1948 on the right-bank side of Bordeaux. This side has for a long time been the forgotten part of the city

2. The body, the architecture, the city. *Différence(s) et Répétion(s)* in the Bruits du Frigo project series

L'idiografia, la scrittura delle differenze, ha contribuito in modi sostanziali e non banali all'emersione della 'città contemporanea' (...) un legame solido lega la capacità di leggere le possibilità *di un* milieu *e la costruzione di scenari per il futuro delle città [6]* Paola Viganò

Emerging in the '90s in Bordeaux, from the outset the Bruits du Frigo collective has declared itself to be interdisciplinary as a matter of principle and oriented towards the latent aspects of the urban phenomenon in practice.
Linked conceptually to issues on the idea of 'adaptable' urban space (Candilis), from a topological viewpoint Bruits du Frigo's work focuses on the uncertain border that the city (re)traces in a repetitive but intermittent way among the texture of its fabric - those that over time that have been re-written, that overlap, that have been grafted on - and what in a vague and imprecise way is still designated by the term 'countryside'. Working on the frontier means asking, as Andrea Corboz has, what the chief parameters of the city are today, knowing that different and sometimes contradictory answers have followed and alternated in recent decades and that nothing definitive may now be stated.

Bruits du Frigo tackles the complex issue of the border by reaffirming the structuring force of the open space and the possibility for less deterministic planning practices, based on the idea of a permanent re-configuration of the space.
Their approach to planning envisages observing the edge [7] of the city through the physical exploration of space and begins in the context of the agglomeration of Bordeaux with "Zone Sweet Zone", a research project on the forms and dynamics of the peri-urban public space.
The planning process began with a phase of exploring the territory, and brings on the field of the "discovery" of the territory. Breaking with the dictatorship of the zenith-view paradigm of the system of interpreting the city, closing up the distance between object and observer and starting off again from the body as the foundation of both reception and understanding, appeared from the start as the main criteria of their sensitive approach, perhaps the only one able to describe and to interpret the uncertain territory of the sprawl city.
Learning to observe, to listen to sensations and emotions, integrate individual codes with the shared codes of representation, to be aware of the statute of the observer as an individual but also part of the observed surroundings, extend the perceptive process by multiplying the observation points and extracting the object from the automatism of perception (Shklovsky 1917) these are, in brief, the motives leading to the compiling of sensitive living map "Zone Sweet Zone" which retrace the city's urbain voids.



Carte des espaces délaissés de l'agglomaration Bordelaise.
Map of the waste lands of the urban area of Bordeaux
1999

The idea that the urban project may be structured around a general process that organises the interconnection of open spaces, through their necessary taxonomic distinction, already existed at the beginning of the last century. Indeed, it was present in Europe in the thinking on articulating the green spaces organized in rings around Berlin and similarly in the United States, from the mid-nineteenth century on, in the series of proposals for the Boston Public Garden. The concept of the greenway, with its great spatial versatility, has over time allowed building landscapes where the green belt appears as a method and not a formal device, assuming many different roles and sizes, from the plains of Philadelphia by Louis Kahn, to the experiments by Woods on the figure of the stem. The industrial city arose from the urban myth of growth, order and development, but contained within the seeds of a 'disurbanism' linked to the myth of a "green city": starting with the legacy of the Soviet avant-garde of the 1920s (the Trotskyist sociologist Mikhail Okhitovitch already imagined a city that was not territorially rooted), to the proposals of the disurbanists that

in the various vicissitudes of modern and contemporary city planning have split the city up into ribbons (the green city of Ginzburg and Bartch), up until the myth of anti-city of Boeri. Bruits du Frigo applies an approach that enables the project to unfold over time, following a proliferation of tactics. Beyond the objects set discretely in the space, the project implies an idea of the city that comprises the periphery as an inclusive and non-adversative phenomenon, as a consubstantial expression of the complexity of the contemporary.

The project of peri-urban refuges is part of one of the series defining the work of this collective and that set it within distinct conceptual frameworks. Their approach is typically low-tech, engaged in reclaiming abandoned urban and peri-urban land and in the use and recovery of 'poor' materials. It is a spatially flexible but socially rooted process; each refuge draws on the archetypal idea of the shelter and at the same time embraces the unforeseen of the installation *in situ*.

The founders of the collective belong to the generation following on from the "Global Tools", the current that had grounded in the culture of the project the idea of being able to tap into forms not taken up by building practices. An experimental program that particularly believed that collective creation were an essential form of cooperation for an interdisciplinary approach. "We created a cooperative, a legal instrument for this type of organization, and set up a number of work programs on the themes of the body, building, communication, survival and of theory." (Branzi 1984)



The series may be conceived as phylogenetic evolutionary processes that open up different kinds of scenarios more so than static design categories. This denotes a planning attitude that sees the ephemeral as an application method and not merely a conceptual category. It allows trying out different and alternative practices; in other words, it is a heuristic process that enables exploring possibilities of risky transformation and the insertion and superimposition of heterogeneous systems.

Sharing the stages of transforming the city and its parts makes their process of mutation a public event and envisages involving the residents who take charge of the design choices. Conviviality, adopted as the distinguishing principle of this practice, shows the need to find *ad hoc* solutions, outside preconceived strategies and schemes, and policies of governance of a common heritage as the goal of social emancipation. The city then as a site of collective construction continues to develop: new spaces of

relationship, new temporalities in flows and movements, novel uses and new practices. Sometimes temporary.



Fig. 5: Bruits du Frigo*, Randonnées Périurbaines,* Bordeaux 2015

Quotations

1. Isabelle Stengers, “Charmes et risques de la fin des certitudes”, in *Lexiques de l’incertain*, Marseille: Editions Parenthèses 2008. “*Cette sensibilité, ce devenir significatif de ce qui était insignifiant, correspond à un nouveau type d’incertitude.*”
2. Cfr. Karl Jaspers, *The Origin and Goal of History*, New Haven : Yale University Press, 1953
3. Mario Perniola, *Del sentire*, Torino: Einaudi 2002
4. Cfr. Rem Koolhaas, *Delirious New York. A retroactive Manifesto for Manhattan*, London: Academy Editions, 1978
5. Carl Gustav Jung, *Dialectique du Moi et de l’inconscient* (1933), Paris: Gallimard 1964
6. Paola Viganò, *I territori dell’urbanistica. Il progetto come produttore di conoscenza*, Roma: Officina 2010. "Idiography, the writing of difference, has contributed substantially to the emergence of the 'contemporary city' (...) a solid bond binds the ability to interpret the *possibilities* of a *milieu* and the construction of scenarios for the future of cities"
7. Cfr. Stephen Jay Gould, *La vie est belle: les surprises de l’évolution* (1989), Paris: Le Seuil, 1998

Bibliographical References

- Boeri S., *L’Anticittà*, Bari : Laterza, 2011
- Branzi A., *Modernità debole e diffusa. Il mondo del progetto all’inizio del XXI secolo*, Milano: Skira, 2006
- Buci-Glucksmann C., *Esthétique de l’éphémère*, Paris: Ecritures/Figures 2003
- Derrida J., *Traces et archive, image et art*, Paris: INA Editions 2014

- Goetz B. Madec P., Younès C., *L'Indéfinition. Architecture et philosophie*, Paris:
éditions de la Villette, 2009
- Illich Ivan, La convivialité (1973), Paris: Seuil 1973
- Sauzet M., Younès C., *Contre-architecture, l'espace réenchanté* , Paris: éd. Massin, 2008
- Segapeli S., "Pour une théorie des impermanences", *Philotope* 10, La revue du réseau scientifique thématique PhilAU, Clermont-Ferrand 2014
- Segapeli S., "Towards a theory of impermanence", *Le vie dei mercanti*, XI Forum Internazionale di Studi, Facoltà di Architettura, Seconda Università di Napoli, Morconi (Bn): La scuola di Pitagora editrice, 2013
- Segapeli S., "Artistic practices in the process of renewing the urban project concept. A case study in Sydney", In PINTO da SILVA, Madalena (coord.). 'EURAU12 Porto | Espaço Público e Cidade Contemporânea: Actas do 6º European Symposium on Research in Architecture and Urban Design'. Porto: FAUP, 2012.
- Segapeli S., "Recycling Urban Spaces. An Alternative Action Research on Sustainability and Creativity in Ivry-sur-Seine", *Le vie dei mercanti*, X Forum Internazionale di Studi, Facoltà di Architettura, Seconda Università di Napoli, Morconi (Bn): La scuola di Pitagora editrice, 2012
- Segapeli S., «Un esercizio di estetica compatibile. Il progetto 'Anticamere dello spazio pubblico' a San Paolo del Brasile», *Venustas/marché/démocratie,* Actes du congrès Eurau - 5ème édition – journées européennes de la recherche architecturale et urbaine, Edizioni , Naples: Clean, 2011
- Segapeli S., "The elastic boundary of plurality. Beyond the search of identities: creating new landscapes through arts and sensibility", *Paisajes culturales: herencia y conservación*, actes du III Colloque de l'Asociación EASLCE (Asociación europea para el estudio de la literatura, cultura y medio ambiente), Alcalá de Henares: Edition Universidad de Alcalá de Henares, 2010
- Segapeli S., «*Supernomadism*. Nuove realtà urbane tra utopia e multiculturalità : dalle TAZ (*Temporary Autonomous Zone*) alle infinite potenzialità dello spazio aereo», *Hi Art*, revue de la Formation Artistique et Musicale, «Intercultura», n. 2, janvier-juin 2009, pp. 40-45
- Segapeli S., "I padiglioni tra architettura e arte. Le alterazioni urbane di Dan Graham", *Voyantes* n. 2 Quaderno delle Attività degli studi e delle ricerche del D.A.R.P. , Cahier des activités des études et des recherche du DARP- Département d'Analyse Représentation et Projet dans les aires Méditerranéennes, Syracuse: Lombardi editore, 2009
- Segapeli S., *Arte Società Banlieue*. *Verso un'interdisciplinarità del progetto*, Roma: Officina Edizioni, 2008
- Segapeli S., « Gli elementi del paesaggio iper-urbano. Nuovi assetti formali. Una riflessione interdisciplinare sul concetto di spazio », (english text: Elements of the hyper urban landscape. New formal structures. An interdisciplinary reflection on the concept of space), Giacinto Taibi (sous la direction de), *Le ragioni del progetto*, Catane: LetteraVentidue, 2008, pp. 111-155.
- Segapeli S., « Habiter/transformer les paysages ordinaires », 4º Congreso Europeo sobre Investigación Arquitectónica y Urbana EURAU'08, *Paisaje Cultural*, Madrid: Universidad Politécnica de Madrid, 2007
- Segapeli S., "Habiter les territoires périurbains", in Michel Lussault, Thierry Paquot et Chris
Younès (dir.), *Habiter, le propre de l'humain*, Paris: Editions La Découverte, 2007, pp. 229-238
http://www.cairn.info/publications-de-Segapeli-Silvana--47780.htm
-Younès C., Goetz B., « Mille milieux », *Le Portique* [En ligne], URL : http://leportique.revues.org/index2471.html
- Viganò P., *I territori dell'urbanistica. Il progetto come produttore di conoscenza*, Roma: Officina Edizioni 2010

HERITAGE and TECHNOLOGY
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Heritage - Religious buildings in the routes of restoration: the case of the church of St. Gennaro at the elm

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Abstract
The church of “St. Gennaro at the Elm” is located in the heart of the historical center of Naples.
The date of its construction is uncertain, estimated by some experts to be around the 4th century and by others to be even before the year 680.
In the early 17th century, the church was assigned to the “Congregation of Seventy-two Priests”. According to the historian Strazzullo, restoration works performed in those years altered its original decorative aspect. Furthermore, following further restoration work, the outer facade of the church was changed.
Up until the early years of the 20st century, the interior was seriously impaired in its decorative features, due to neglect and especially as a result of restoration works, some of which had debatable results.
In 2008, the Commission for the Architectural and Landscape Heritage of Naples approved the restoration works proposed by the “Giambattista Vico Foundation” about its interior parts. The restoration works of the exterior facades took place from 2011 to 2012.
The project described in this article has developed from a survey phase aimed at the diagnosis of the pathologies, to the establishment of criteria and intervention methods, in accordance with principles of restoration.
This study will describe the stages of the survey and subsequent processing of restoration up to showing the results of the intervention performed.

Keywords: Heritage – Restoration – Enhance - Naples – Architecture

1. Introduction
The heart of the historic center of Naples is characterized by stately mansions with majestic monumental staircases, located within narrow alleys and imposing churches that bear witness of the architectural taste of the period when they were built, and other smaller churches, chapels and monasteries that are quite hidden by the city’s stalls, amongst the voices and scooters driving through the crowd.
This is integral part of the city, the most shy and hidden cultural heritage, the pictorial view of the neighborhoods of which it be-comes the symbol and historical witness.
Walking among the cribs, at the end of St. Gregorio Armeno’s street, towards Spaccanapoli, one finds himself in a small square, marked by the facades of two adjoining churches, St. Gennaro at the Elm and St. Biagio, that appear almost anonymous, nestled as they are in a patchwork of buildings which have engulfed their sides, swallowing up the perception of the sacred sites.
Nevertheless, as told by the headstone placed on the facade of St. Biagio’s church, *"Here, at the house of St. Gennaro, martyr and patron saint, in the Square of the Elms, stood the Augustalis Church which became deaconship abbey parish, the hermit St. Gregorio and the doctor St. Biagio are still worshipped, and here, where the Marigliano’s house, built in the fifteenth century, gave prestige and decorum to the renewal of our art, the art of the booksellers, whose son was Gian Battista Vico, Neapolitan glory, had its origin".*



Fig. 1: The facades of St. Gennaro and St. Biagio churches

2. Historical notes

The churches are located in the heart of the historic center of Naples.



Fig. 2: The urban plan of the historic center of Naples

St. Gennaro's church, known as "At the Elm", for the tree that supposedly once stood in front of it and was used, according to the legend, for the game of "greasy pole", was originally dedicated to St. Gennaro *ad Diaconiam*, since it was one of those churches, deaconries precisely, which until the third and fourth century, bishops assigned to deacons to distribute alms to poor, orphans and widows. St. Gennaro At the Elm *"was one of the most important among the seven Neapolitan deaconries".* [1]

The date of construction of the building is still uncertain, estimated by some researchers to be around the 4th century, under the reign of Constantine, and by others to be even before the year 680, probably built for the bishop of Naples Sant'Agnello.
We need to look for descriptions dating back to the 7th century to obtain informations about the Church with its paleo Christian basilica plan: *"it was the first basilica built in the city in honour of St. Gennaro, after the one built near the catacombs outside the walls"* [2].
In the eighth century, Armenian nuns, fleeing from the persecution of the iconoclasts in the East, took refuge in the church, and preserved the relics of St. Gregory and the skull of Saint Biagio until the adjacent church of St. Biagio Major was built, and the relics were moved there.
In the early seventeenth century, the church was given to the "Congregation of Seventy-two priests". The restoration work carried out in those years are described by the historian Franco Strazzullo: *"The pious congregation believed they were making a good service to the ancient church promoting the restoration according to the then modern taste (baroque), but it was a ruin".* [2]
According to Strazzullo's description, the restoration profoundly modified the original decorative aspect which could be recognized up to then, introducing decorations and mouldings, polychromatic altars and balustrades, and even whitening the two porphyry columns of the cathedral presbytery, that Don Lorenzo Loreto describes as *"Two beautiful red ancient marble columns, supporting candelabra, with five gilded copper cornucopia above each column".* The beautiful fluted columns were smoothed, probably due to excessive deterioration. The priests finally replaced the portrait of St. Gennaro, which was placed on the main altar, with that of St. Michael, the patron of their congregation.
Following a further restoration, the outer facade of the church was changed: *"outside St. Gennaro at the Elm, a miserable neoclassical plaster facade is evidence of a restoration made in the early twentieth century."* [1]

3. The Church Plan

The church is spread over an area of about 22 meters in length and 12 meters in width. Despite its small size and strong alterations, made in the eighteenth century, it preserves the original structure of a basilica with three naves.
The church entrance is from St. Gregorio Armeno's street; this entrance was originally preceded by a small square and a few steps; however, following the restoration completed in the early twentieth century, the facade of the building was extended and aligned with the street, by means of two rooms that englobed the steps in a small vestibule between the facade and the church.

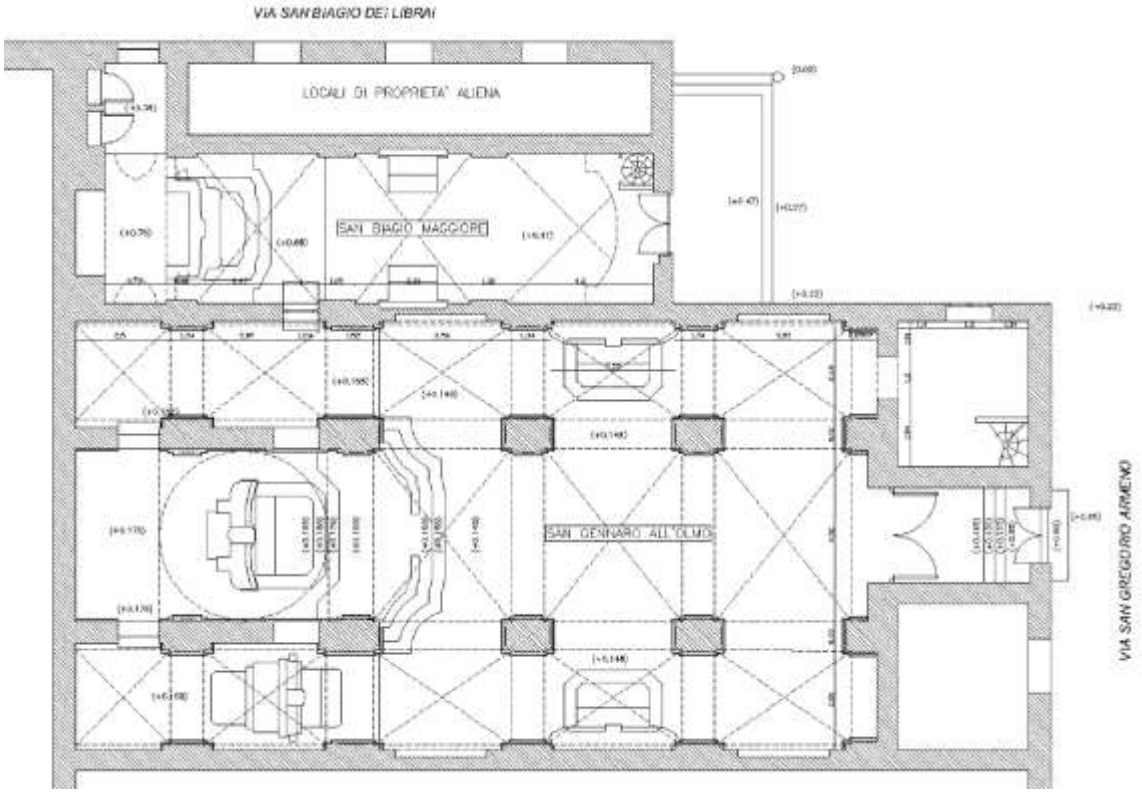

Fig. 3: The plan of the churches

The rooms on the sides of the vestibule, both of square shape, remain separated from the main structure of the church. The first, especially, on the left side, is also extraneous to the function of the monumental construction where it is located: in fact it has a shop with access from the street; the second, on the right of the hall, is occupied by a vestry from which, through a spiral staircase, one can access a small bathroom downstairs and a roof terrace upstairs.

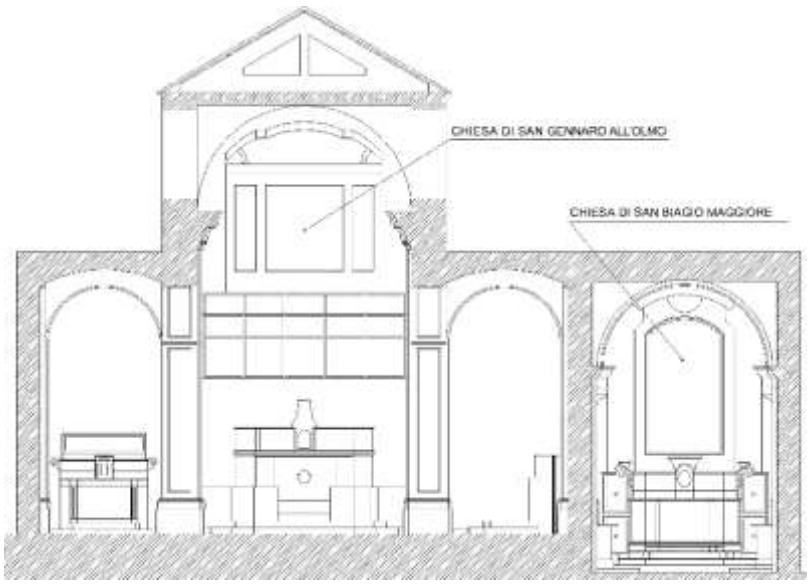

Fig. 4: The section of the churches

The interior of the church is described in its original layout by Carlo Celano: *"Three aisles, of Gothic structure, with two columns near the main altar of about 18 spans each"*. [3]
The three aisles are defined by two rows of five columns each. On the bottom of the central nave there is the main altar, raised a few steps and bounded by a low marble balustrade. Behind it there is the back-altar.
"Inside, the nave floor rises significantly in the direction of the high altar; this suggests that, in the past, the church would have had a crypt; or at least that the inclination of the floor is the result of adapting to the Roman structures beneath it".[1]
The two aisles contain, at the second span, some smaller wall altars. At the fourth span, in the left aisle, there is a further altar while, in the right aisle, a small opening guarantees the passage to the church of St. Biagio Major.

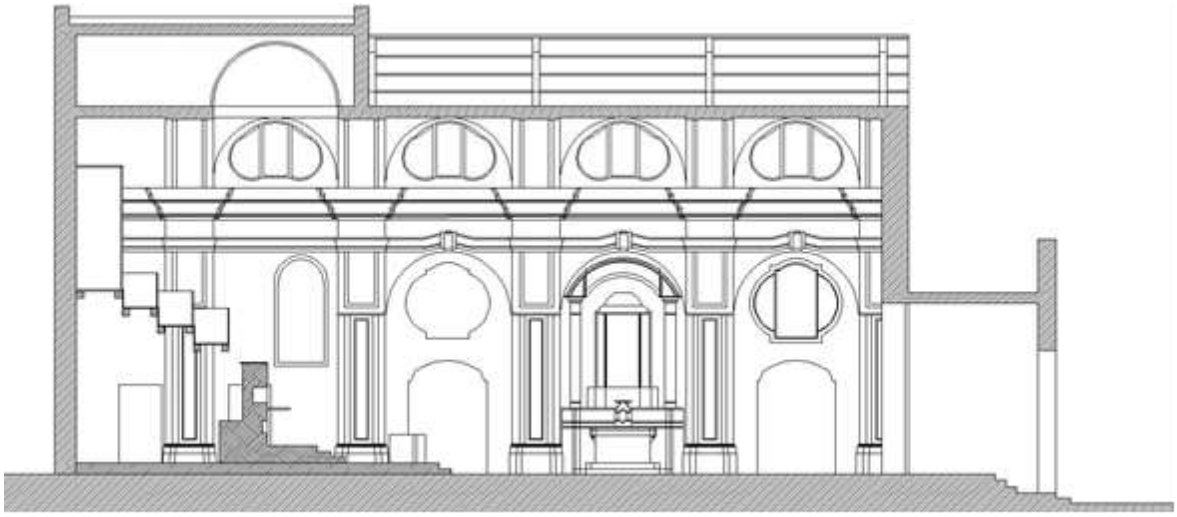

Fig. 4: The section of St. Gennaro At the Elm

Natural lighting is through baroque windows through which the central nave, higher than the two lateral, overlooks outside. The high window aligned with the original entrance to the basilica overlooking St. Gregorio Armeno Street is larger than the others. Inside the sacristy there is an opening which overlooks the open space of the elm: this much simpler and linear.
Among the windows with Baroque lines that can be seen in the first and third span of the aisles, however, only the first among those overlooking the open space of the elm is a true window while the other, blind, are depicted using the technique called *trompe l'oeil*.
The main structure of the church consists of a perimeter wall made with Neapolitan yellow tuff, while the three naves are marked by two rows of five columns, in tuff too, with rectangular section resting on a base about 80cm high. The base section of the building rests on elements in porphyry still clearly visible today.
This *"suggests that the construction is resting directly on existing walls. This hypothesis is very reasonable considering that, since the times of ancient Rome, this area was the "forum" of the city. It is also possible that inside the columns there are porphyry components, which were once building blocks and then, in some restoration, have been incorporated in columns".*[4]



Fig. 5: Window depicted with the *trompe l'oeil* technique – Detail of the base of the church in porphyry

Semi-columns protrude from the perimeter wall and, along with the columns of the central nave, support the vaults covering the different spans of the church.
In particular, the aisles are covered by cap vaults, although the decorative intrados would indicate that they are cross vaults. The coverage of the central nave, is composed by cross vaults in three of its four spans: only at the main altar stands a "fake vault" so called so called because it is made with woven canes suspended to the main structure.
The back-altar is characterized by wooden choir stands behind the high altar, supported by wooden beams with square section resting on the walls of the last span.
The covering of the central nave is completed by a texture of wooden trusses supporting the pitched roof with tiles, while at the extrados of the two aisles the structure of the terraces consists of flat coverage that overlooks the open space of the elm with a piperno stone balustrade, which presumably is contemporary to the edification of St. Biagio Major church.
The structure of the dome of the apse, made of wood and canes, as well as paving and plasterwork of all interior surfaces, were badly damaged until to the restoration carried out in 2008.

The restoration project [5]
The interior of the church, until the early years of the twenty-first century, was in a state of neglect, severely compromised in its architectonic aspect and even more in the decorative one. This was not only due to the lack of treatment and to the signs of time, but especially due to restoration interventions made during the past, some of which in fact, as historically documented, had questionable results. Other more recent interventions, on the contrary, were made according to the rules of reversibility, recognisability and minimum intervention typical of modern restoration.
In 2008, the Commission for the Architectural and Landscape Heritage of Naples approved the restoration works proposed by the "Giambattista Vico Foundation", holder of a loan agreement signed with the Curia for the property in 2005, which concerned the interior parts of the Church.

The restoration works of the exterior facades began in 2011, according to the project designed by the Achitect Mariarosaria Villani, financed by POR FESR Campania 2007-2013 Asse I - Specific Objective 1d - Operative Objective 1.9.
The works were awarded to the Company Triad s.r.l., a company belonging to the Piloda group, who had already performed the restoration work inside the church, and were completed in July 2012.



Fig. 6: The central nave before and after the restoration works

The project developed from a city planning study, followed by a very comprehensive investigative phase (about geometry, historical research, architectural aspects and study of materials) aimed at the correct diagnosis of the pathologies. This has allowed the determination of the criteria and methods of intervention, according to the principles of restoration.

4.1 The existing planning instruments

The Variation to the Urban Development Plan of the City of Naples identifies the Church as a “Special building unit of pre-nineteenth-century with original or restructuring unitary structure”: the construction unit characterized by the presence of a unitary space predominant over any associated ancillary rooms, and therefore characterized by the centrality of its space and by a vestibule unique or predominant over other ancillary rooms. Therefore, despite changes made in time, it is possible recognize plan and elevation elements of pre-nineteenth century types. The special pre-nineteenth century units featuring these characteristics include mostly churches in autonomous site or consisting of autonomous space into the broader monumental contexts.
The physical changes allowed for these building units include restoration and enhancement of environmental aspects and architectural elements and restoration of the altered elements, in particular one can identify interventions of restoration of exterior and interior facades through the conservation of existing openings in number and shape, size and position if they correspond to the distribution logic of the original structure, or arise by the transformations consolidated over time; the modification of openings is allowed if aimed at the re-establishment of the previous system, if it is identifiable, in order to reconfigure the facades, but this is possible only in a single operation on the whole construction unit. It being understood that changes and

restorations of openings are allowed only if either surveys on plasterworks or an exhaustive historical documentation show the presence of pre-existing structures in line with the overall system unit building.

4.2 Analysis of the degradation

The description given in the documents of the restoration project reveals that the lack of regular maintenance on the facade of the church had contributed to the progressive deterioration of the external plaster and stone elements. Moreover, a fire near the main facade of the church of St. Biagio of the Booksellers had greatly altered the appearance of the facade.

Many plaster elements were swollen and detached from the support and, in some spots, complete detachment, with consequent fall of masonry, has been detected. Similarly, along the base of the side facade, numerous detachments of pieces of piperno stone had been found, exposing the masonry yellow tuff underneath.

Therefore, the proposed interventions for the maintenance of the facade belong to the sphere of operations strictly necessary to prevent the perpetration of degradation, in accordance with the assumption that each addition or change would introduce new elements foreign to the nature of the structure, form and function of the building and of the artefacts it contains.

4.3 Restoration works

According to the rules of the restoration, the conservation work followed these criteria:

- "Minimal intervention" in order not to compromise the documentary value of the building; thus invasive operations about removal and reintegration have been excluded;
- Physical and chemical compatibility of the materials;
- Reversibility.

The proposed interventions were grouped by type of material and component element, and for each of them the type of alteration and the nature of the phenomenon of deterioration, the operations required for cleaning, for the consolidation and protection have been analysed in detail.

Plasterworks: the plasterworks of the church presented different decay phenomena related to the making of crusting of superficial deposits, the breakup, the presence of stains and in some areas the lack of plaster.

The crusting was presumably produced by the action of atmospheric agents and by the accumulation of moisture which had created a tough layer of variable thickness and different colour than the underlying surface. In order to eliminate this pathology, the cleaning of the surface was carried out, using softening substances and atomised water, supplied at low pressure, and removing residues with a natural bristle brush. Subsequently, steps were taken in order to carry out a consolidation of the plaster surfaces by impregnation with consolidator liquid applied with a brush or with syringes applying a slight pressure to facilitate the absorption of the material. Finally, the surface has been protected by remaking of the layer of painting with products based on natural dyes (whitewashing lime).

Furthermore, plasters of the church were affected by other superficial deposits of extraneous materials of various types, similar to dust, soil and droppings, characterized by variable thickness and poor grip to the underlying surface. These elements have been removed by cleaning with natural bristle brushes and subsequent treatment of the surfaces with breathable and waterproof products.

To restore the parts of plaster affected by the phenomenon of splitting, which had produced the detachment of granules, especially on the decorative elements, cleaning of surfaces has been carried out with the use of natural bristle brushes and low pressure water. Later, the consolidation of the plaster has been realised using consolidator liquid, once again applied by brush with the purpose of reconfiguring the adhesion of the detached plaster to the support. Finally a layer of protection has been created by painting with products based on natural dyes.

The phenomenon of the spots, which was visible due the casual and local colouring of the surface, was removed by cleaning the surfaces with softening substances and natural bristle brush, which was followed by protection with painting based on natural dyes.

For those surfaces affected by the phenomenon of absence, that is the fall and loss of parts of plaster, cleaning of the surfaces was carried out to remove the plaster at immediate risk of detachment, and degraded mortar between the joints of the masonry has been applied. Later it was a new plaster was made with products compatible with the original support, and finally the surface was protected with paint made with natural dyes.



Fig. 7: The consolidation and painting of plasters

Stonework: even in correspondence of the piperno stones, the presence of crusts was detected, removed through the cleaning with emollients and atomized water applied with natural bristle brushes. Finally, protective breathable and waterproof treatments were applied.
Furthermore, the formation of a film on the piperno stones has observed, which consists in an alteration strictly limited to natural modifications of the material surface perceivable as a change in the original colour of the material. This phenomenon has been removed by cleaning the surface with natural bristle brush and by treatment with protective breathable and water repellent products.
Finally, it was observed that at the base of the facades, some stones were damaged or completely absent and therefore they have been substituted with other piperno stones with the same shape and size.



Fig. 8: Stonework before and after restoration

Woodwork: the wooden elements have undergone a natural photochromic alteration which has been eliminated by sanding and brushing of the superficial part and subsequent treatment with protective products. The protection of the surface was completed by painting the elements.
Iron: the most recurrent pathology for iron elements is oxidation, which consists of partial corrosion with formation of a layer of rust due to the direct action of the oxygen and carbon dioxide. This phenomenon, caused by the lack of maintenance of the elements, has been removed by sanding and manual brushing and subsequent protective treatment by the application of anti-rust paints and flaxseed oils.
The missing iron elements were integrated with new elements of the same shape and size.

4. Conclusions

The restoration work was completed in 2012 and the facade of St. Gennaro at the elm returned to characterize the "square" playing again the role of opening element for the curtain of St. Gregorio Armeno.

The Church has been functionalised again with cultural activities promoted by the Foundation Gian Battista Vico, which still take place in the church and that make it an active part of the life of the neighbourhood and the city.



Fig. 9: The square after restoration works

Bibliographical References

[1] ROBERTO Pane. *"The convent of St. Gregorio Armeno in Naples"*. (Il monastero napoletano di San Gregorio Armeno). Napoli: L'arte tipografica, 1957

[2] FRANCO Strazzullo. *"The ancient street of St. Gregorio Armeno"*. (L'antica strada di San Gregorio Armeno). Napoli: L'arte tipografica, 1995, ISBN: 88-6419-065-1

[3] CARLO Celano. *"News of beauty ancient and curious of the city of Naples"*. (Notizie del bello, dell'antico e del curioso della città di Napoli). Napoli: a spese di Salvatore Palermo, 1792, ISBN-10: 1271911043

[4] MARINA Fumo. *"St. Gennaro and St. Biagio: Churches, patron saints, Booksellers, pastors and other curiosities"*. (San Gennaro e San Biagio: Chiese, Santi patroni , Librai, pastori ed altre curiosità). Napoli: Editore Cerbone, 2002

[5] Acts technical by the project signed by Arch. Mariarosaria Villani commissioned by the Foundation Giambattista Vico and kindly made available to the author, with permission of the President prof. Vincenzo Pepe

[6] ROBERTO Pane. *"The ancient center of Naples"*. (Il Centro antico di Napoli). Napoli: Edizioni scientifiche italiane, 1970

[7] ITALO Ferraro. *"Naples. The atlas of the historical City"*. (Napoli. Atlante della città storica). Napoli: Clean, 2002, ISNB: 88-8497-082-2

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Relation between sustainable economic growth and Safety, security in Albania and the region

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Abstract
Safety and Security issues are related directly to the sustainable development of the economy. This means that any action carried by the law enforcement to disrupt the illegality in a specific country is destined to fail in the long term if it is not accompanied by a robust policy of economic growth. In Albania this last months the police undertook two main and successful operations against the cultivation of cannabis. The cultivation of cannabis is one of the illicit activities, which were broadly spread in the country, but not only. The amounts of seized cannabis are estimated to be at around 6.4 billion Euros in these last seven months. We do not want to analyze the reason of how it was possible or why it was realized in the past. Our aim is to provide a sustainable solution after this illegal business is not more present in Albania. Consequences are inevitably related to the safety and security of people. People who were used to exercise this activity will seek other illicit forms to reach the same level. The impossibility to do this will became a serious problem when it comes to the safety and security in the long term.
The idea is that of an exit strategy and policy to convert the culture of people and to give the opportunity to people to enter into legality.
This is possible by undertaking a common action as a community with the assistance of our partners, especially of the EU.
And, this common action should affect the entire region, which is at east at the same level of illicit activity as Albania used to be till last year and this is confirmed by the reports of the European agencies such as Europol.

Keywords: Safety, security, exit-strategy, cooperation

1. *Introduction*
Till some months ago, Albania was considered as a country of origin and transit of cannabis sativa. This phenomenon was widely spread in all the country. The authorities, during these last years have tried to stop the phenomenon with some results and this is shown in all the reports of the European agencies such as Europol and in the reports where Albania is monitored by the European Union. Albania got the candidate status last June, 2014 and this is obviously an achievement recognized by the European Union. Albania has shown its commitment in the fight against narcotic trafficking. It is obvious, that the phenomenon of cannabis sativa cultivations affected in the past an entire chain of the Albanian economy. By the results of the quantity sized and the results showed by the project of airborne control of Guardia di Finanza and Second University of Naples/Benecon SCaRL in Albania during these last three years, it is clear that a large part of money in circulation is due to this illicit activity. In this regard, *some statistical data will give the state of play from the Police point of view in the last three years*:

Type	2012	2013	%
Heroine	87 Kg 719.9 gr	47 kg 325 gr	-46
Cocaine	4 kg 61 gr	16 kg 104.6 gr	+296.5
Marijuana	21138 kg 231.4 gr	20672 kg 916.9 gr	-2.2

Data obtained in the annual Albanian State Police report 2014

So, regarding the quantities of narcotics seized, there was an increase in quantity: Cocaine (+296.5%) and reduction of the amount Heroin (- 46%) and marijuana.

Figures regarding the criminality related to the phenomenon were as follows: There were hit 43 criminal groups involved in trafficking and distribution of narcotics with 196 persons prosecuted. In 2012, 50 criminal groups were hit with 233 persons prosecuted. There were performed 50 operations by applying special investigation techniques. While, during 2012 there were realized 50 of such operations. There were carried out 54 operations using various forms of international cooperation (43 with Italy, 5 with Germany, 2 with Greece, 1 with Kosovo, 1 with France, 1 with Belgium, 1 with the Czech Republic) where in Albania there were arrested 77 persons. Meanwhile i*n 2012 there were carried out 54 international operations with 76 persons prosecuted in our country.*

When it comes to the fight against cultivation in narcotics in 2013, a total of 2124 police officers and 271 police vehicles of Police Directorates of the Police in Districts, Police Commissariat, Rapid Intervention Forces of Shkodra, Tirana, Fier, and also a special aircraft aviation unit of the Italian Guardia di Finanza and the Second University of Naples/Benecon SCaRL, two helicopters of Special Unit "RENEA " as well as two helicopters along with a tank that supplies the Army Air Force were engaged in police operations nationwide.

In the above mentioned special mission of Guardia di Finanza and Second University of Naples/Benecon SCaRL, there have been conducted 44 flight missions, out of these, 19 flight missions with the use of state police helicopter, 25 flight missions with aircraft of Guardia di Finanza and it was monitored an area of 3618 km2. In 2013, in all over the country there are identified 229 offenses of cultivation of narcotic plants and there were disposed 98,491 plants, for which there were prepared 229 referrals for prosecution, 77 cases were detected, 89 offenders, of these there were arrested in flagrante delicto 52 authors, 16 authors at large and 21 authors wanted.

Cases of identification of narcotic plants cultivation divided per district, as follows:

District	No. of cases	Detected	%	No of Plants	Perpetrators	Arrested/detained	Free situation	Wanted
Berat	6	5	100	511	7	1	2	4
Dibër	6	4	60	830	5	4		1
Durrës	37	13	31	13277	15	4	3	8
Elbasan	5	4	40	295	2	2		
Fier	17	15	94	3705	17	10	5	2
Gjirokaster	8	1	12	1197	1			1
Korçë	4	4	100	421	4	4		
Kukës	7	1	14	5541	1	1		
Lezhë	8	3	28	2995	6	6		
Shkodër	54	17	34.5	51250	19	15	2	2
Tiranë	10	7	100	5642	11	5	3	3
Vlorë	67	3	60	12827	1		1	
TOTAL	**229**	**77**	**36**	**98.491**	**89**	**52**	**16**	**21**

2. *The Italian Mission and project*

We would like to draw your attention to better understand what about the Italian project related to identification of cannabis sativa plantations by means of high and advanced technology used by Guardia di Finanza and Second University of Naples/Benecon SCaRL. The project is composed by two teams one of pilots of Guardia di Finanza and the other of researchers of the Second University of Naples/Benecon SCaRL. The scope of the mission is to identify narcotic plants by using an airplane which is equipped with 2 sensors (hyper spectral and thermic) and a video camera with a very high resolution. By means of these advanced technology they acquire data while the airplane flight the territory. These data are then processed by the experts and the final product is the identification of narcotic plants planted and gowned. Here below the data acquired in three years mission.

According the data furnished by the Airborne Remote Sensing Missions: chronological table

YEAR	**2012**	**2013**	**2014**
PERIOD	JUNE	JUNE and JULY	JUNE to SEPTEMBER
FLIGHT MISSIONS	12	25	39
OVERFLOWN AND SCANNED AREA	990 Square Km	3618 Square Km	4313 Square Km
ALBANIAN SCANNED SURFACE PERCENTAGE	3,5 %	12,5 %	15,08 %
NUMBER OF SUSPECTED CANNABIS PLANTATIONS REPORTED	61 + Lazarat	304 + Lazarat	815 + Lazarat[2]
SURFACE OF SUSPECTED CANNABIS PLANTATIONS REPORTED	0,02Square Km + 0,385Square Km (Lazarat)[1]	0,045 Square Km + 3,19 Square Km (Lazarat)	0,162 Square Km + Lazarat[2]
HYPERSPECTRAL COLLECTED DATA	325 GigaByte	497 Giga Byte	892 Giga Byte
TRUECOLOR IMAGES COLLECTED DATA	675 GigaByte	680 Giga Byte	792 Giga Byte

[1] In 2012, the collected data on the Municipality of Lazarat were broken during the flight for scattering reflection problems.

[2] At the end of the two flight-missions, carried on June 7th and 22th 2014, it was not possible to estimate the suspected cannabis plantation areas in the Municipality of Lazarat, due to after the massive armed intervention of the Albanian State Police (after June 12th 2014).

It is worth mentioning that the abovementioned data are not comparable analytically, because they refer to Albanian areas geographically close, but not perfectly overlapping; and then the total amount of scanned Albanian surface was different year by year.

At the end of the mission 2014 (September) from data published by the State Police of Albania it was mentioned that 815 plantations of cannabis sativa were signalized by the Italian mission. Out of these 815 plantations the State Police intervened in 798 plantations and 770 of them resulted positive with a trustworthiness of airborne procedures that reaches 96.5%. The total of eradicated narcotic plants was 46.607.

The main areas where cannabis sativa were planted and cultivated were as follows:

- Vlora District: Communes of Vllahinë Haderaj, Rexhepaj, Armen, Karbunarë, Treblovë, Kotë, Brataj, Mazhar.

- Shkodër district: Areas of Vaut i Dejës, Gurit të Zi , Shllak,Vig Mnelë, Malësi e Madhe, Kastrat, Shkrel, Shosh, Shalë, Sermë.
- Durrës district: Communes of Nikël, Cudhi, Barkanesh, Fush-Krujë, Kodër –Thumanë, Bruz –Zall.
- Gjirokastër district: Commune of Lazarat, Areas of Bashkisë Tepelenë, Communes of Qendër, Krahës, fshat Memaliaj, Qesarat.
- Tiranë district : Areas of Zall- Herrit, Radhesh, Qinam, Pinar, Areas of Dajti, village of Darshen, Commune of Shëngjergj.

Areas involved shows that the whole territory was involved in cannabis cultivation. The quantities seized and eradicated showed that the business involved was enormous. Only in Lazarat area there were eradicated 133567 narcotic plants, it was seized 71 ton and 87 kg marijuana, 5 kg heroine, 53735 kg narcotic substance ready to be distributed (in so called chocolate form), 4395 kg seed of cannabis sativa, 16.8 kg oil of hashish, 5 labs of narcotic plants elaboration, 2 incubators, arms and ammunitions in a considerable quantity and as a result there were arrested 51 persons.
If calculated in Euro value, the quantity of narcotic plants eradicated and the quantity of narcotics seized only in Lazarat Commune during this police operation it results that, 133567 narcotic plants products approximately 130 tons of finished product, which together with 71 tons seized arrive at approximately 200 tons of product. If this quantity of product had been arrived in the European market with an average price of 5 euro per grams, the total amount should have been 1 billion of Euros.
Additionally, the same intervention it was carried out in the Communes of Pult, Shosh, Shale and Temal" in Shkodra district, where 313 plantations were identified and consequently 136468 narcotic plants were eradicated and seized 15.924 kg of marijuana.

3. *The Albanian project*

Having in mind that the fight against cannabis cultivation is continued and an enormous effort, it is not thinkable to monitor the territory by means of protocols like the one we have with Italy. Police itself alone cannot monitor all the territory, especially that part of territory out skirts of the cities and villages. A considerable part of territory is not easily accessible due to the mountain formations. Nowadays by using advanced technology it is possible for the perpetrators to cultivate narcotic plants even in winter time.In addition, considering that the economic effort to be afforded is huge and the problem cannot be solved by using foreign missions. The main problem to be solved in Albania, after the police interventions is how to manage safe and security of people. It is well known that in other countries or regions where these types of police interventions has occurred, after a first period of tranquility, the number of criminal offences involving people from areas affected has increased considerably. The government has to offer alternative solutions to people. Areas involved in the past with narcotic cultivation will suffer economic crises. Safety and security will be affected if the government do not apply any exit strategy or other policies.In cooperation with the experts of Guardia di Finanza, Second University of Naples/Benecon SCaRL we launch our project of setting up a permanent multidisciplinary team in Albania aiming at an holistic solution of narcotic cultivation, offering solutions by means of an exit strategy. Albania has to increase its own capacities. Our project is to set up a multidisciplinary team initially composed by experts from Guardia di Finanza, Second University of Naples/Benecon SCaRL and experts from the Albanian party (Albanian State Police, University of Tirana and other ministries involved in this process) and in a second moment composed by only Albanians. This project will aim at the surveillance of the Albanian territory regarding the plantations of cannabis sativa but, not only. This project will deal with a number of issues which will give solutions in the fields of: Agriculture by offering solutions in what planting in the ground (the most suitable plants to be planted) in a determinate area; Safety and Security, by controlling the whole territory by mapping it and in this regard having under control the illegal constructions and identification of the perpetrators; Environment, by controlling the pollution and monitoring the air; Culture, by controlling the archeological sites and other fields such as monitoring of the maritime space.



The Italian Ambassador Mr. M. Gaiani and the Minister of Interior Affairs of Albania Mr. S. Tahiri and some members of the Italian Multidisciplinary Team by Guardia di Finanza and Second University of Naples/Benecon SCaRL.

4. *Considerations and conclusions*

After the main police operations, in Lazarat and Dukagjin, which resulted in the complete destruction of all plantations cultivated, it is compulsory to offer some alternative when it comes to the economic situation of people.

The great result of these operations was the fact that no one was injured. In these operations, at the very beginning, police was obliged to use arms because some groups of individuals tried to resist.

These police interventions showed that the phenomenon of cannabis cultivation is widely spread in all the territory. The Modus Operandi of cultivation was the same in all the territory. People invested a lot of money in this illegal activity which resulted in a continued growth of this phenomenon. With the exception of Lazarat area, where people used to plant also in their own yards, the rest of people used to plant cannabis in forests, in mountains, and state areas. In this regard it resulted very difficult to identify the perpetrators. It is worth mentioning that all the areas affected by this phenomenon have a very good economic growth. The houses evidenced this and the cars used by people in these areas. A lot of people were involved in this activity. Because of the long period of persistence of the phenomenon there is a problem in the culture acquired. Many people look at this like the end of their occupation. It has to be taken into account that these areas do not offer many economic alternatives to the people who live there. The terrain is poor and the villages have not a good access. The main activities are related to animal farming, cattle and goats.

This shows that so much have been done by the Albanian authorities to combat narcotic trafficking. The economic effort is enormous taking into account the Albanian context.

On the other hand, the demand in the market (European) is still high. Albania is not the only country, which faces this phenomenon. For sure is the only one, which has opened his doors in order to measure this phenomenon. Cannabis cultivation is a phenomenon, which affects all the countries. The cooperation with Italy in identifying the cannabis plantations in Albania is the first of its type. We think that this is a good example of combating effectively this phenomenon, but what to do then? The main questions remain: Is Albania the only country, which used to cultivate narcotic plants? What about the other countries in the region? Why this phenomenon is widely spread? After the Albanian intervention, is the European market suffering problems of marijuana absence?

Indeed there is an economic point of view. The income derived by this activity is huge, so it works in poor areas, where people have no other possibility. A solution can be our project of the multidisciplinary long-term

team with the assistance of EU. This project will build capacities in Albania and consequently in the entire region. This project will offer a model to be followed in order to be cost effective.

References

[1] Albanian State Police report after Lazarat and Dukagjin Interventions September 2014

[2] Ministry of Interior Affairs, Press conference, Tirana International 24 september 2014.

[3] Albanian State Police annual reports 2012, 2013.

[4] Guardia di Finanza reports, September 2014

[5] Gambardella, C., Argenziano, P., Avella, A., Bastoni, S., Casbarra, G., Tessitore, F. (2013). Hyperspectral and thermal airborne surveying for the characterization and the monitoring of natural and anthropized environment. In Gambardella, C., *Heritage Architecture Landesign focus on Conservation Regeneration Innovation*, *11th International Study Forum Le Vie dei Mercanti*, La Scuola di Pitagora Editrice, Napoli.

[6] Gambardella, C., Pisacane, P., Argenziano, P., Avella, A., Bastoni, S., Casbarra, G. (2014). Technical and scientific protocol for the multitemporal airborne surveying. In Gambardella, C., *Best practice in Heritage Conservation Management from the World to Pompeii*, *12th International Study Forum Le Vie dei Mercanti*, La Scuola di Pitagora Editrice, Napoli.

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From Pompeii in Nola: the restoration of Mediterranean habitat. The De Nola of Ambrogio Leone

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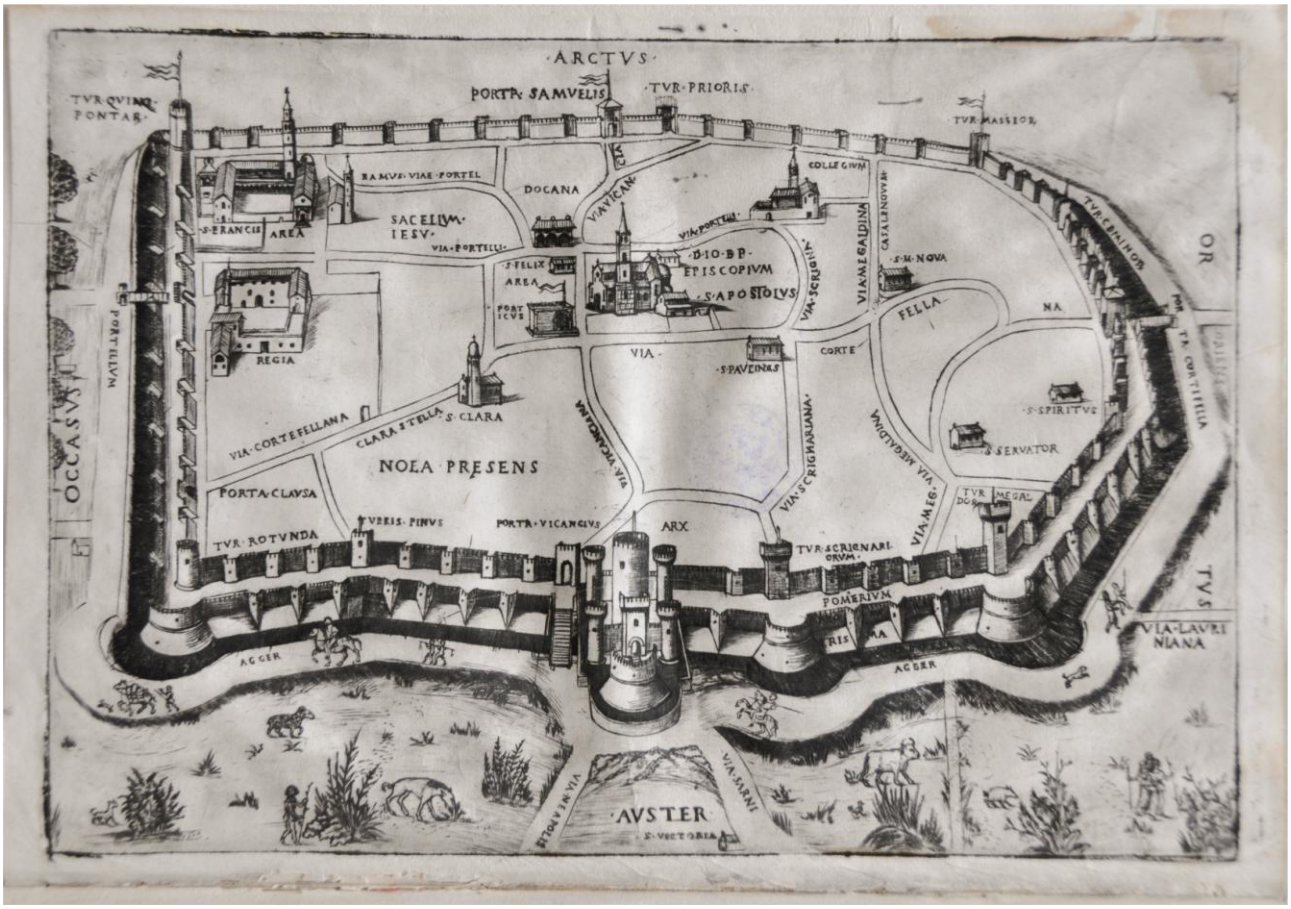
Abstract
In 1514 Ambrogio Leone publishes the *De Nola*, a fundamental work to reconstruct the dynamics of the Renaissance in the Kingdom of Naples.
Defined by author «Opusculum distinctum, plenum, clarum, doctum, pulcrum, verum, grave, varium et utile», the text contains an interesting and little-known description of the 'Nolan home' in the XV chapter of II book.
The "figura aedium praesentis urbis" demonstrates humanist's will to present the residential typology of his hometown as heir to that of Pompeii and, therefore, of the classical world.
The same terminology used to describe the various parts responds to a project, evident in the course of treatment and probably the result of the cultural context in which Leone works: in the cultured climate of humanistic Padua of the early sixteenth century, and even more, in the cultural milieu of Manutius, the first to publish many of the Greek works until then ignored, the intellectual tends to present his country as an image and prototype a yearned past.
Among the features emerge the ergonomic use of resources and the attention to the technical data, which place the *De Nola* in the wake of Vitruvius and Alberti.

Keywords: ancient building techniques; tipological home; building's restoration and conservation

Ambrogio Leone's description of a house in Nola, in *De Nola ,* published in Venice in 1514, offers an interesting opportunity to reflect on the traditional building techniques which were present in Campania. It also confirms the ancient type of residence of Roman influence which was widespread in Mediterranean countries and which was well recorded by the *domus* of ancient Pompeii. Ambrogio Leone from Nola, friend and correspondent of Erasmus of Rotterdam and professor of medicine in Padua, is especially interesting because of his attention to detail when writing about the city, for which he provides a street map. In fact, he not only represents the streets but also the most important monuments and the defensive city walls and towers.

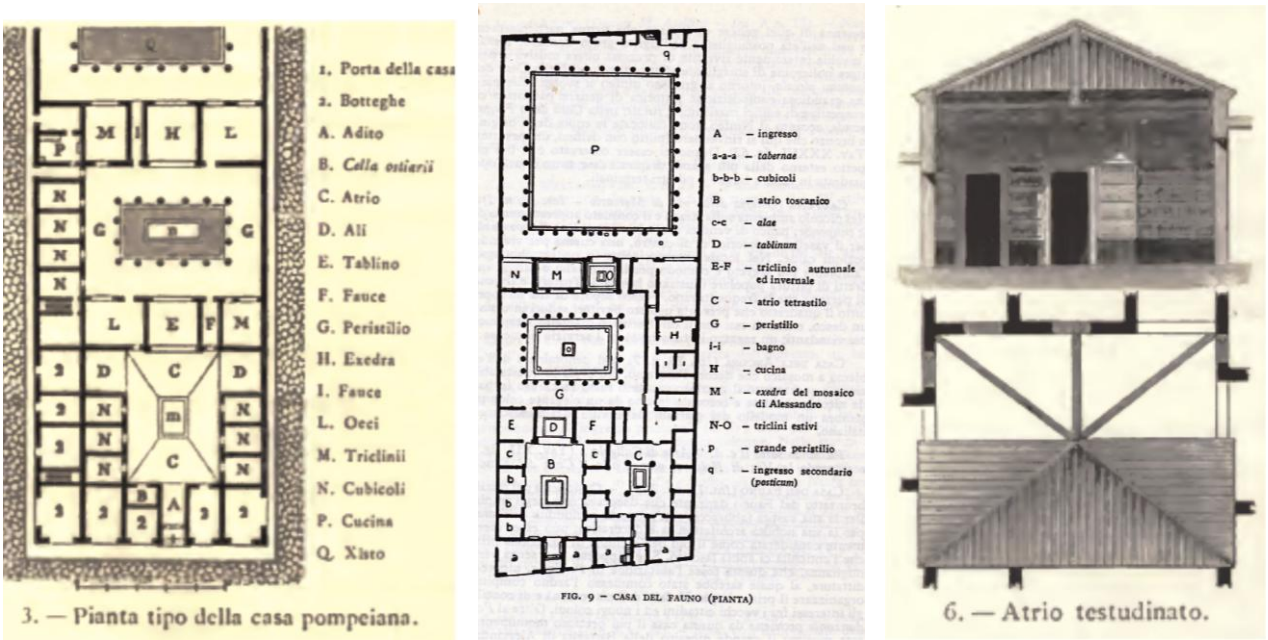

Nola, medieval window



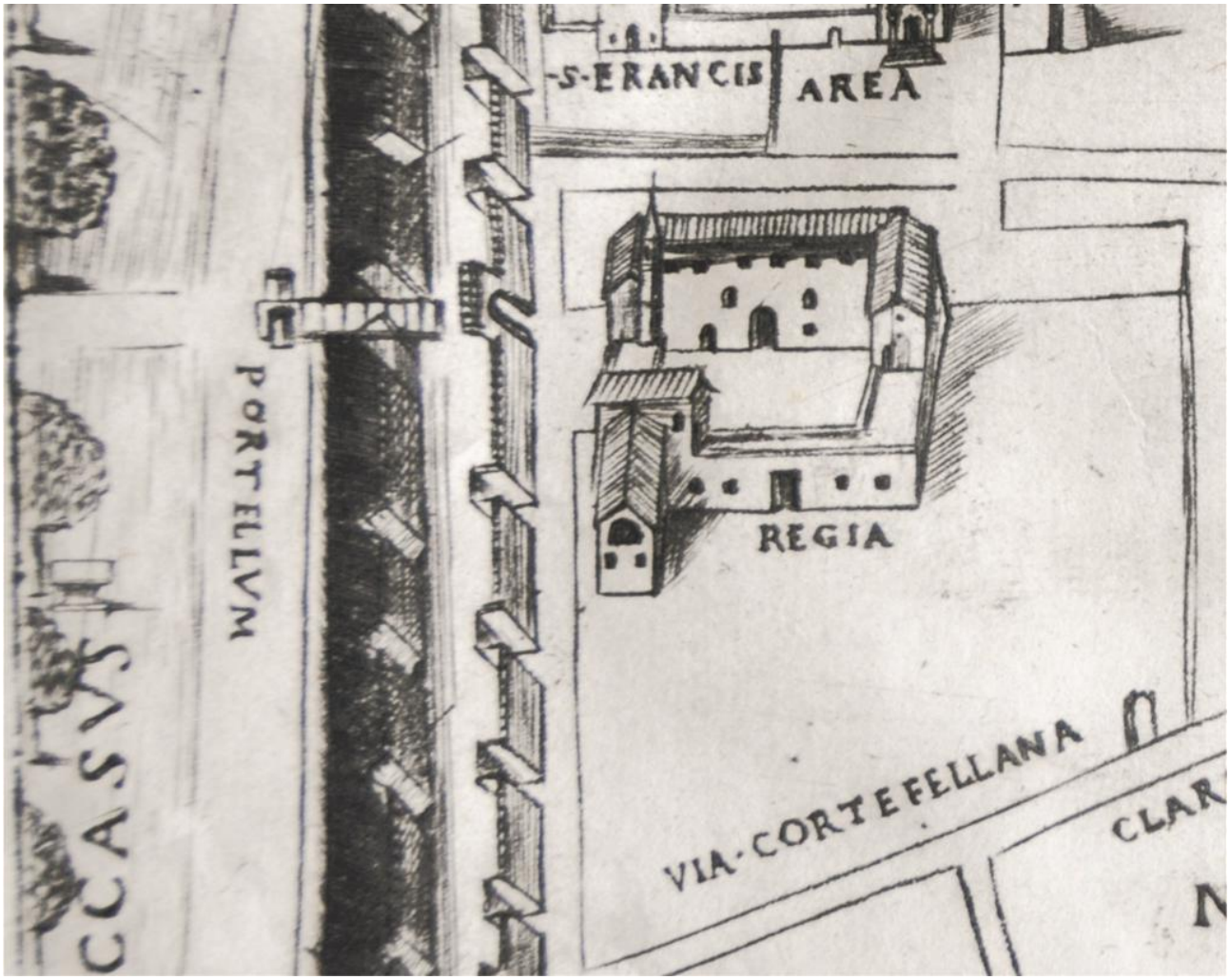
A. Leone, city plan Nola (1514)

«The structure was either square or, more commonly, longer rather than wider. Most of the houses had a courtyard, very few didn't. The houses with a courtyard usually occupied only one side of it, sometimes two or three, and very rarely all four sides»[1].

Ambrogio summarizes the most significant aspect of the urban residence, that is to say the interesting comparison which archeologists made in the XIX century during excavation of the ancient city of Pompeii. Giuseppe Fiorelli describes the so-called *House of the Tragic Poet* «On the right hand side of the road, after the Arch of Caligula, the *House of the Tragic Poet* can be seen. The entrance to this noble habitat, whose.



Pompeii archaeological site, plants "domus", by Solari-Leone 1878 and Maiuri 1977, and 'Atrio testudinato'

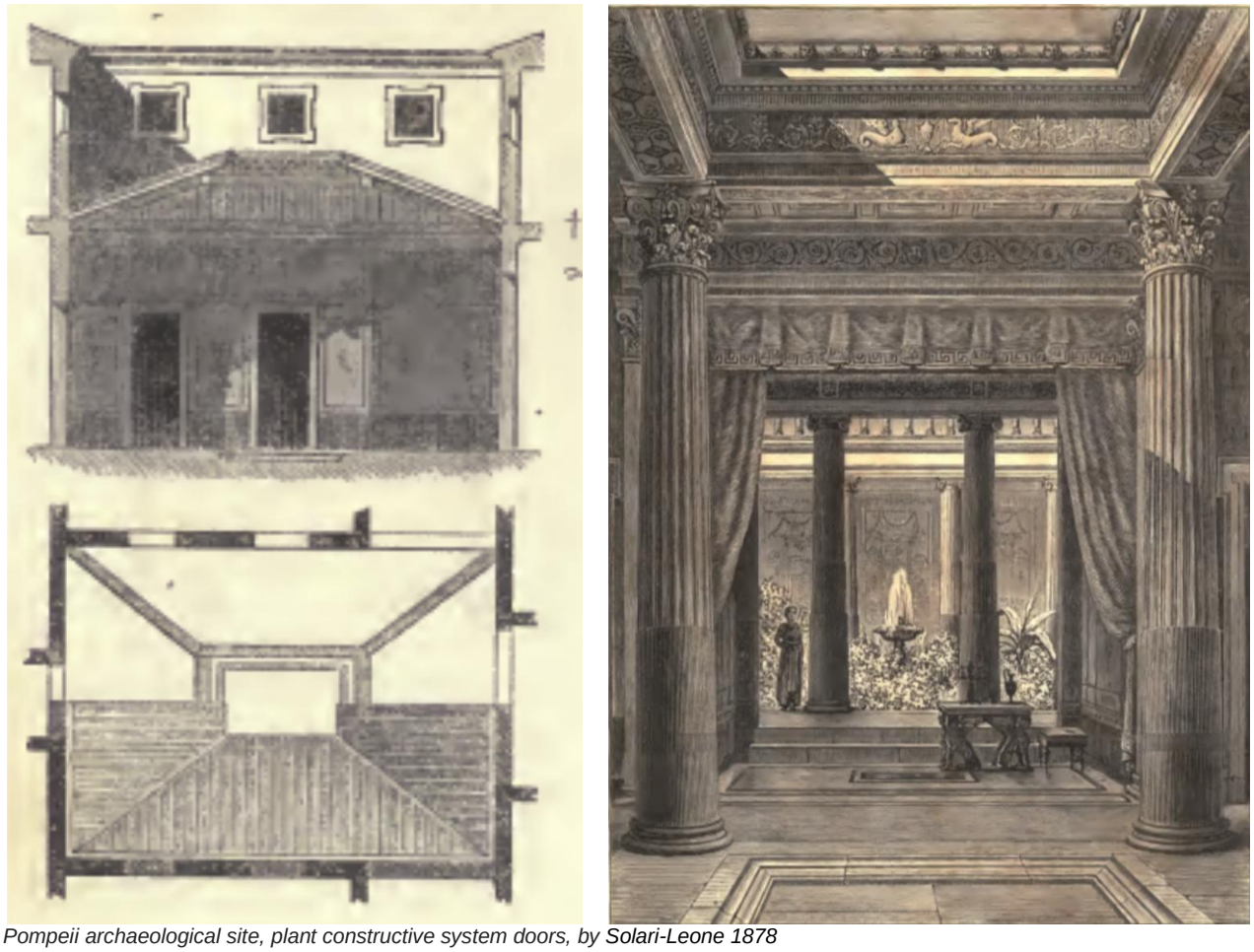


A. Leone, city plan Nola (1514), detail

owner remains unknown, was at n.5 and had the mosaic of a chained howling dog with the words CAVE CANEM, (Beware the dog) in the entrance hall. In the *atrium*, which can be considered of Tuscan architecture because it is without columns, two splendid paintings can be found. The paintings, together with the mosaic and other items are kept in the museum in Naples. Only a small section of the painting remains in

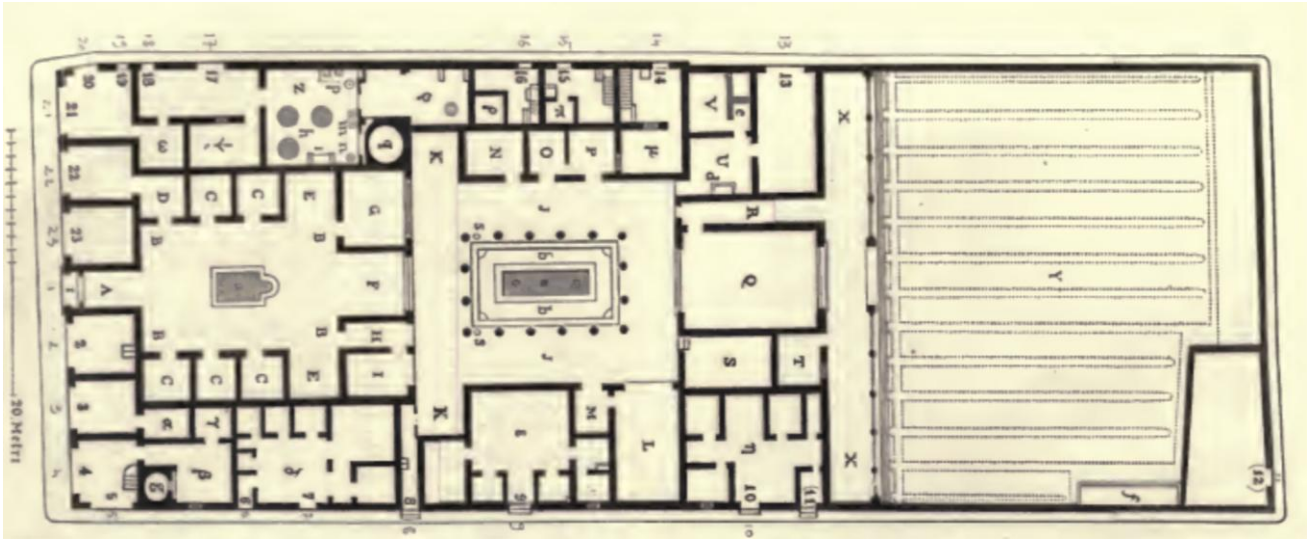


A. Leone, city plan Nola (1514), detail



Pompeii archaeological site, plant constructive system doors, by Solari-Leone 1878

its original place. This small section shows Neptune (Poseidon) after kidnapping Amymone. He is sitting on a sea-horse among the waves, lead by a Triton and accompanied by a cupid who is carrying his trident. There are two rooms to the left of the atrium with a ladder to the upper rooms and a picture of Apollo and Daphne. On the upper part of the wall there is a decorative frieze showing Amazon battles, Venus of Pompeii, and two cupids. The *tablinum* (reception room), opposite the entrance, leads to the garden where a niche to the Lares can be found. The walls of the dining room (*triclinium*) opposite are decorated with solitary figures and three paintings which represent Venus and the cupids, Ariadne abandoned by Theseus, and a scene from the myth of Diana»[2]



Pompeii archaeological site, plant constructive system doors, by Solari-Leone 1878



Nola, traditional wood system structural with concrete 'battuto di lapillo'

As regards Pompeii, other authors point out the architectural differences between the ancient written theories and the actual buildings. «Before the discovery of Pompeii and Ercolano, the only description of a Roman house was that of the architect Vitruvius and other ancient authors, who passed on architectural rules and theories. Without any designs or pictures, modern scholars could only guess at the final result»[3].



Nola, traditional wood system structural with concrete 'battuto di lapillo'



Nola, a traditional wooden floor

Ambrogio Leone compares the residence in Nola to that of Pompeii. «The parts of the house which are kept apart are: the entrance hall, the basement (*cellaro*), the stable, the dining room, the bedroom, the upper portico, the library, the pantry, the "*nave"*, the dove tower, the courtyard and the garden. The entrance hall is on ground level and it is where guests are welcomed. It usually continues as far as the courtyard because there is more light and it's easier to introduce utensils»[4].

The new details that the archeologists brought to light are particularly interesting because they show how much space was available for carrying out daily activities. «We have imagined an average size house plan with the basic rooms of a typical Pompeian house. The entrance was at the front of the house where there were rooms which could be used as shops»[5]. Some of them were used to trade the owner's own crops while others were rented out to shopkeepers. More detail is given to certain parts of the house which were discovered during excavation. «Most of the rooms were covered by a wooden ceiling or by a vault made of volcanic stone or broken canes which formed the framework; they often used caned vaults with a low curve. These vaults were then plastered and painted. The walls were decorated with landscapes, familiar or mythological scenes, nymphs, satyrs and imaginary animals. Occasionally the wall decorations represented what the room was used for. The floors were mostly "*signina"*, mosaic or simple cement»[6]. Ambrogio Leone reminds us how habits and customs have changed over XV centuries for people living in cities. In fact he confirms that in a town like Nola, which is an episcopal town, business activity is kept separate from residential areas to guarantee moral behaviour.



Nola, medieval portals

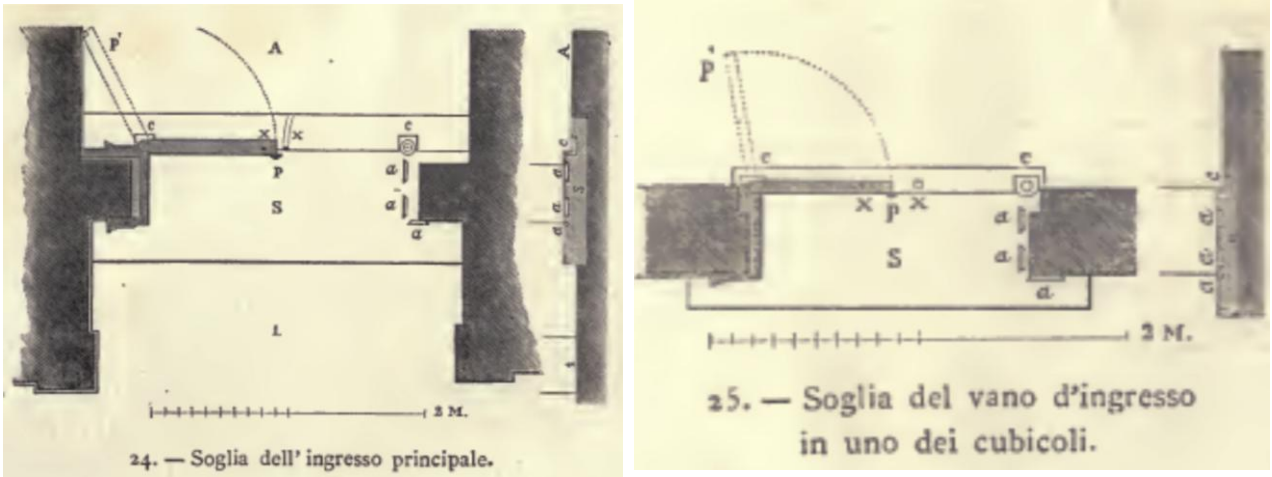


Nola, constructive system for ancient doors

«There are about 700 houses in the city of Nola, all of which are separate from the shops for the sake of decency. They say that it isn't right for women and young girls to live in a place where men trade. For this reason shops and all trade activity is in the centre of the city around the "*portico"*, the market and the forum. The residential area occupies the rest of the city near the basilica»[7]. New professions emerged in the late Middle Ages which were related to military or religious matters.

Thanks to archeological excavations a transformation can be seen in the houses in Campania which combined different aspects of ancient residences. «The houses in Pompeii are made up of two main parts. The first is for public use and business; the "*portico"*, the atrium and its smaller adjacent rooms, the tablinum, the entrance. The second part is for the family ; the peristilyum (garden), the triclinium (dining room), the oecus (study), the esedra (niche with fountain) and the "*xisto"*. This kind of layout can be seen in *fig.4* where three small houses formed an *insulae*. It comes from a street plan of the ancient city of Rome drawn up at the time of Septimius Severus and is now kept in the Museo Capitolino»[8].

The type of dwelling which emerges from Leone's description seems to be inspired by the kind of residence which was also used for work and trade. «The building where the dyers worked was called *Fullonica* and so *Plinio I tintori(Pliny the dyers).* The *Fullonica* of Pompeii was discovered not far from the *Baths;* A medium sized square with porticoes and respective rooms on three sides. In the courtyard some of the tools can still be found : the fountain, basins,"*i possi"*, and the oven. Column ruins can also be found in the courtyard and this leads us to believe that there was an upper level of rooms (...). There they found soap, an enclosure for lime, a caldarium, and sticks. Surprisingly, a jar of oil was also found containing olives still with the stems»[9].



Pompeii archaeological site, plant constructive system doors, by Solari-Leone 1878



Nola, constructive system for closing ancient doors

The type of house which Ambrogio describes is very similar to that of the residence / dying house in Pompeii with a transformation in size of the single rooms. «The stable is often closer to the entrance than the cellar because the entrance and street are too noisy for the *cellaio.* The lower rooms are more often covered by chestnut beams rather than vaults. The stable has no floor but the *cellaio* does and depending on the size of the barrel there is also a paved hole. The courtyard is nearby with the parapet (covering) for the well. The well doesn't collect rainwater, instead it descends to water level under the ground. Behind the courtyard there is a small wall separating it from the gardens and sometimes part of the house can be found there. An oven and wash house were often built on this ground level and it was called the "*cantaro dei panni".*
From the entrance and courtyard there are steps to the first floor, which is known as the loft (*solaio*)»[10]. Today in a similar sort of house we would say downstairs for daytime use and upstairs for night time use.
Ancient Roman building techniques can still be found in the different types of atrium which are larger and without a roof. They can be considered the first examples of modern day "*soppenni"* and Leone called them "*nave*".
«The "atrium testudinatum" was the centre of the Pompeian house. Two or three cubicles could be found on one or two sides and small windows let the light in. It wasn't covered by a vault as people had previously thought, but by a roof with four layers called the pavilion. Fig.6 shows an *atrium* which is very similar to the plan, where half the roof is projected. Later, atriums were built with an opening in the roof to allow sunlight to enter»[11].
The larger entrance hall, which was probably to give carts and animals access to the street, gave another layout to the space which archeologists referred to as "adito". It was protected by a door which can still be found in Campania today, with a locking system "a bilico". «In fig.24 we can see the layout of the entrance, drawn to the scale of *0m,02* per metre.
On the right side there are the joints *a* with the antepagment and the hinge cavity. On the left side we can imagine the *antepagment* and one single shutter: on the left side of the shutter a "regolo p. replum" was placed along the full length to hide the gap when the two sides were closed. On each door there was a stake "pessulus" which was inserted into a small hole in the doorway. Traces of the scrapes made by the stake on the right side of the doorway can still be seen. When the two sides were closed, the holes for the stakes corresponded to the size of the wood and so we can suppose that the stakes were used to close the door»[12].



Nola, constructive system for ancient doors

Ambrogio Leone's house in Nola is therefore witness to the Roman dwelling of ancient Pompeii in the Mediterraneanarea.





Nola, constructive system for ancient doors (old church St. Francis)



Pompeii archaeological site, decorations from Villa of the Mysteries

Bibliographical References

Some of the contributions on the subject are:[1] CARILLO Saverio, *Alcune osservazioni sulla pianta della città allegata al* De Nola *di Ambrogio Leone*, in TOSCANO Tobia R. (a cura), *Nola e il suo territorio dalla fine del Medio Evo al XVII secolo. Momenti di storia culturale e artistica*, Nola 1996, pp. 25-43; [2] CARILLO Saverio, *Conservazione e valorizzazione dell'architettura tardomedioevale in Terra di Lavoro*, in GAMBARDELLA Alfonso (a cura di), *Ager Campanus ricerche di architettura*, Edizioni Scientifiche Italiane, Napoli 2002, pp. 559-576 (ISBN 88-495-0390-3); [3] CARILLO Saverio, *Un documento capuano e l'industria edilizia quattrocentesca di Terra di Lavoro. Privilegi, ruoli e maestranze: appunti per una storia del cantiere*, *in "Capys", XXXVI, Capua 2003 pp. 27-46* (ISSN 1121-788X)*;* [4] CARILLO Saverio, *Fonti iconografiche per l'edilizia quattrocentesca di Terra di Lavoro*, in FIENGO Giuseppe, GUERRIERO Luigi (a cura di), *Atlante delle tecniche costruttive tradizionali. Lo stato dell'arte, i protocolli della ricerca. L'indagine documentaria*, "Atti del I e II Seminario Nazionale", Arte Tipografica editrice, Napoli 2003, pp. 210-215, (ISBN 88-87375-40-2); [5] CARILLO Saverio, *Nevile Reid e il restauro di villa Rufolo. Sistemi costruttivi, industria edilizia amalfitana e cronologia delle strutture,* in FIENGO Giuseppe (a cura di) *La Costa di Amalfi nel secolo XIX*, "Atti del Convegno di Studi" (Amalfi, 22-23 giugno 2001), Centro di Cultura e Storia Amalfitana, Amalfi 2005, pp. 195-256 (ISBN 88-88283-33-1); [6] FIENGO Giuseppe, CARILLO Saverio, *Il mancato restauro cinquecentesco del palazzo Rufolo a Ravello*, in SETTE Maria P., CAPERNA Maurizio, DOCCI Marina, TURCO Maria G. (a cura di), *Saggi in onore di Gaetano Miarelli Mariani*, Sapienza-Università di Roma, "Quaderni dell'Istituto di Storia dell'Architettura", Dipartimento di Storia dell'Architettura, Restauro e Conservazione dei Beni Architettonici, n. s. fascc. 44-50 (2004-2007), Bonsignori Editore, Roma 2007, pp. 387-398 (ISBN 978-88-7597-401-5); [7] FIENGO Giuseppe, CARILLO Saverio, *La villa-palazzo dei Rufolo e l'architettura della costa di Amalfi nella testimonianza di Giovanni Battista Bolvito*, (con G. Fiengo) in CANTONE Gaetana, MARCUCCI Laura, MANZO Elena (a cura di), *Architettura nella storia.* Scritti in onore di Alfonso Gambardella, Skira, Milano 2007, vol. I, pp. 24-38; Tav. II-II; p. 537 (ISBN-13: 9788876248504 ISBN: 8876248501); [8] CARILLO Saverio, FIENGO, Giuseppe *Villa Rufolo a Ravello. La maison mauresque. L'organismo medievale, le trasformazioni moderne, i restauri contemporanei*, Paparo edizioni, Napoli 2008 (ISBN 978-88-87111-68-2); [9] CARILLO Saverio, *Contributo allo studio delle pavimentazioni tradizionali campane, in* FIENGO Giuseppe, GUERRIERO Luigi (a cura di), *Atlante delle tecniche costruttiva tradizionali, Napoli, Terra di Lavoro (XVI-XIX), t. II, Infissi, ferramenta, pavimenti*, Arte Tipografica Editrice, Napoli 2008, pp. 718-782 (ISBN 978-88-6419-007-5).

Notes

[1]LEONE Ambrogio, *Nola*, (trad. a cura di RUGGIERO Andrea), Istituto Grafico Editoriale Italiano, Napoli 1997, p. 381
[2]FIORELLI Giuseppe, *Guida di Pompei*, Roma, Tipografia Elzeviriana, 1877, pp. 24-25
[3]SOLARI Giuseppe, LEONE Eugenio, *Le rovine di Pompei. Parte seconda*, Stabil. Tipog. del comm. G. De Angelis e Figlio, Napoli 1878, p. 5
[4] LEONE Ambrogio, *Nola*, cit, p. 381
[5] SOLARI Giuseppe, LEONE Eugenio, *Le rovine…*, cit p. 8
[6] SOLARI Giuseppe, LEONE Eugenio, op. cit, p. 7
[7] LEONE Ambrogio, *Nola*, cit. p. 391
[8] SOLARI Giuseppe, LEONE Eugenio, *Le rovine..*, cit. pp. 8-9
[9] DE CESARE Francesco, *Le più belle ruine di Pompei, descritte, disegnate e misurate*, Napoli 1845, p. 44
[10] LEONE Ambrogio, *Nola*, cit, p. 385
[11] SOLARI Giuseppe, LEONE Eugenio, *Le rovine..*, cit p. 14
[12] SOLARI Giuseppe, LEONE Eugenio, op. cit., p. 31

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The non-finiteness heritage. A project strategy

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Abstract
The non-finiteness appears as a big emergency in Italian and European contemporary landscape.
A landscape representing its belonging to the crisis time: incomplete constructive frames, concrete enclosures defining agricultural fields, fragmented urban parts with no roads and equipment in which we can find different non-finiteness conditions. The non-finiteness therefore emerges as a strongly recurring state concerning the non-completion of architectural artefacts and consequently of entire urban parts. This issue (as highlighted by Grima in his research presented at last Venice Biennale) is not about the re-use and the abandonment [1-2] but It regards the forms of interruption in formation processes of buildings and city, before they could reach a "functionalization".
From these landscape conditions, this contribution wants to show the analysis and design modes adopted by our research team. Modes that allow a classification of different non-finiteness conditions (defining precise parameters encoding degrees and canons of the phenomenon).
Design hypotheses - regarding the sectors of didactic and research – assume as goal the reaching of a finiteness and completion state taking into account a peculiarity: the context is partially conditioned by existing framework. The staging of the time-lag between the foundation moment of the first building and the design of its completion becomes therefore a significant opportunity in expressive and linguistic terms, as well as a real opportunity for measuring the effectuality of contemporary project.

Keywords: Non-finiteness, Composition/Construction, Unity



Fig. 1: Non-finiteness landscape in Naples metropolitan area

1. Non-finiteness: context

The sequence of fragmented buildings - constructive frames, platforms, high concrete enclosures, incomplete artefacts partially used - defines the urban image according to criteria to be decoded. This set characterized by incompleteness and by the non-functionality generates an iconography of the non-finiteness[1] which constitutes the most powerful representation of some parts of contemporary urban landscape. The reasons of this non-finiteness condition must certainly be included in economic issues in reference with the international situation marked by the collapse of real estate values and by contraction of housing demand. But in some particular cases - such as Italian cases – the non-finiteness condition seems even to affect a progressive constructive practice [3]. It may be considered as a result of a particular culture that has assumed "the principle of temporariness" [4] permeating all dimensions of existence and, among these, its physical scene. So phenomena that, from scientific perspective, can be considered as diseases, assume a "natural" condition in the real social context.

From a social perspective, the coexistence and the perception of all physical signs remaining in their precarious attribute for years or decades are not surprising: iron bars, fences, scaffolds in memory of a stopped construction, but especially pillars waiting for the structural re-union, solitary platforms with the signs of absent pillars' positions, roofs or coverings rising above frame without walls and thus without an interior space to protect. These sets of elements, with different possible configurations in their incompleteness, can be defined as "proto-architectural" elements and they represent the most appropriate simulacra of precariousness age.

In its being so expressive of our time, in its being so present in territories we cross, the non-finiteness architecture emerges therefore as a deeply actual theme deeply taking almost an emergency character [5]. With respect to this issue the project as a discipline must poses itself precise questions about reasons and intervention modes. Our research identified interpretative and operational experimental forms for this phenomenon. Respect to this point, we should clarify that, in order to outline a possible and effective solution of the problem, the project must also assume a strategic nature relating, among other things, contributions from different disciplines[2] (structural engineering, urban planning, administrative law, real estate evaluation). We must say that the strategy does not solve the design issue and that it must be anticipated by an orientation involving broader issues of architectural composition. In fact, even on the basis represented by themes emerged in other disciplines, we have tried to point out a compositional premise for the design action. It puts into play specific arguments as the non-finiteness and, consequently, poses a question about the idea of finiteness (and unity) that we can refer today. This aspect was central for the understanding of the ways in which the invasive condition of non-finiteness, to be considered as a constructive interruption and as a temporal disjunction, could reach its proper expression manifesting itself in corrections – today non-totalizing – of the project.

The necessity of this intervention is due to two fundamental issues not merely about the aesthetics of contemporary landscape. The first node is about the safety of the territory and the consolidation of its urban arrangement. The non-finiteness includes geographical weak areas recently formed with strongly labile urban structures standing as terminal flaps of urban centres. These areas, in spite of everything, constitute the life context for a lot of people. A context marked by the absence of secondary urbanization equipment, infrastructures and a non-sufficient network system. Here the presence of incomplete artefacts raises questions about the static and environmental safety.

The second node is about the issue of "land consumption" (land use). The sum of non-finiteness volumes - the data are reported in following lines - makes us reflect on the actual size of the phenomenon. The large amount of incomplete and non-functioning artefacts (corresponding on average one part per thousand of the total land surface) certainly represent a design opportunity to give a "first life" to these "proto-architecture" according to a precise orientation. It goes in the direction of the urban improvement and it does not accommodate private housing initiative that nowadays does not correspond to the real market. Our address, tending to balance critical issues we can find in these exclusively residential areas, seeks to bridge the gap with the normal standards of public facilities and social housing.

2. The study of the phenomenon: census of the non-finiteness

The knowledge of the architectural non-finiteness was undertaken through an analytical activity tending to define a quantitative and qualitative survey of a narrow geographical ambit. This process allowed to recognize the different non-finiteness manifestations and it, contemporaneously, was an operational opportunity to identify alternative critical reading criteria.

The analysis of non-finiteness as phenomenon is about an area with twentyseven[3] municipalities actually involved in urban dynamics of the great Neapolitan pole [6-7]. Twenty-four of them[4] are contained in Napoli metropolitan area's boundaries recently established[5]. The geographical scope covers the northern neapolitan area; it is defined by Domitian Coast on the west and by municipalities of Acerra and Casalnuovo

on the east side, it assumes a part of the Aversa conurbation as northern limit and the administrative limits of Naples on south.
The study area has a total population of 962,000 inhabitants and an area of 335 km2. The survey[6] identified 818 NF cases related to different conditions: enclosure, platform, platform with pillars, frame, partially closed frame, incomplete building. The overall data providing the non-finiteness size in this area are related to the occupied (and consumed) surface (SNF) corresponding to 273,488 m2 and to the total volume (VNF) corresponding to 2,027,294 m3. These data reveal the phenomenon incidence especially if we convert them into comparison indexes relating the non-finiteness amount with demographic and geographical size of the scope:

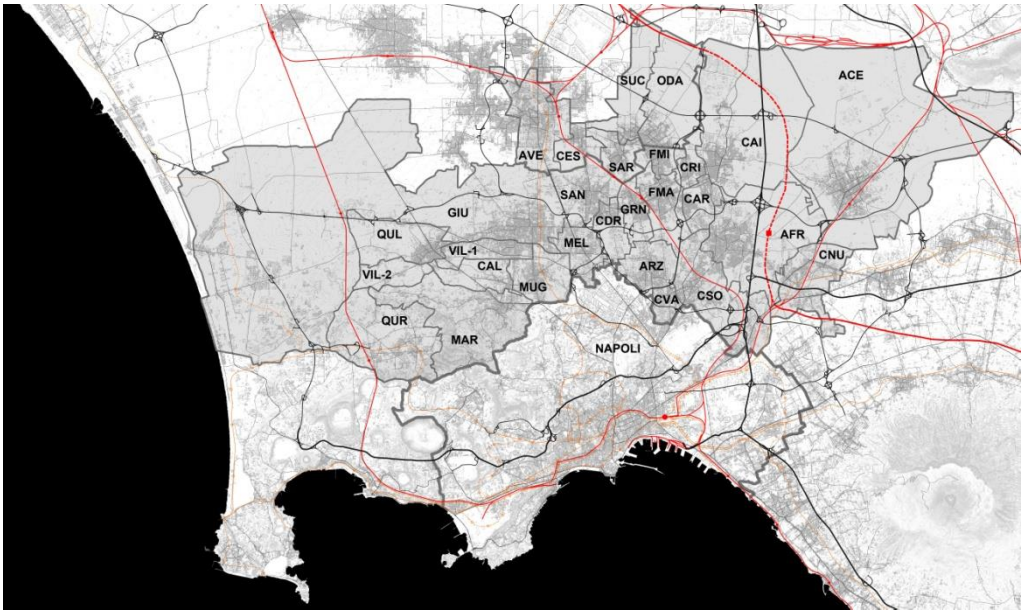


Fig. 2: Study area: northern metropolitan area. Acerra (ACE), Afragola (AFR), Arzano (ARZ), Aversa (AVE), Caivano (CVA), Calvizzano (CAL), Cardito (CAR), Casalnuovo di Napoli (CNU), Casandrino (CDR), Casavatore (CVA), Casoria (CSO), Cesa (CES), Crispano (CRI), Frattamaggiore (FMA), Frattaminore (FMI), Giugliano in Campania (GIU), Grumo Nevano (GRN), Marano di Napoli (MAR), Melito di Napoli (MEL), Mugnano di Napoli (MUG), Orta di Atella (ODA), Qualiano (QUL), Quarto (QUR), Sant'Antimo (SAN), Sant'Arpino (SAR), Succivo (SUC), Villaricca (VIL).

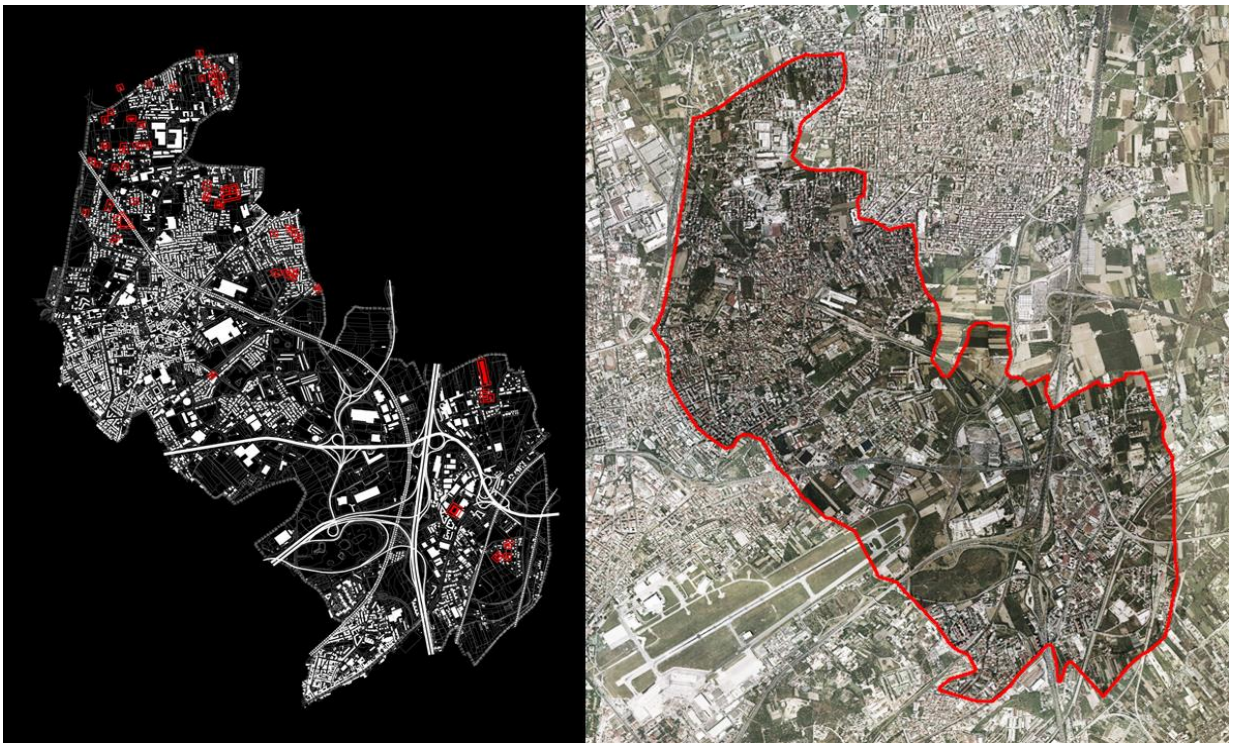


Fig. 3: Casoria - Non-finiteness cases in Casoria (in red, left), aerial view (right)

a-Cases frequency

Density of NF cases per 1000 pop. (NNF/1000 pop.) is the ratio/distribution between the number of NF cases of NF and population (assuming one thousand inhabitants as unit) and it has an average of 0.98 cases per 1000 inhabitants. The survey on individual municipalities shows that there are relevant peaks as in the case of Casandrino where the value is 3.64 NF/1000 ab.

Density of NF cases per km2 (NNF/km2) is the ratio between the number of NF cases and the surface extension (where we assume the km2 as unit) and it has an average of 4.64 cases per km2. The survey on individual municipalities shows that the upper limit is represented by the City of Sant'Antimo where we have 15.93 NNF/km2.

b-Impact on surface:

The NF surface density per 100 ab. (SNF/100 inhab.) is the ratio between the soil occupation generated by non-finite building (in m2) and the population (assuming 100 inhabitants as unit). The overall datum shows an average surface incidence of NF corresponding to 28,16 m2 occupied every 100 inhabitants. In survey on individual municipalities the upper bound is represented by Melito di Napoli with a value of 85.59 m2 /100 ab.

NF surface density per km2 (SNF/Km2) is the ratio between soil occupation generated by produced by non-finite buildings (expressed in m2) and the surface extension (assuming 1 km2 as unit). The overall datum shows an average surface incidence of NF corresponding to 1402.18 m2 occupied every km2. In survey on individual municipalities the upper bound is represented by Melito di Napoli with a value of 8536.22 m2/km2.

Comuni			Dati Generali			Censimento del Non Finito Architettonico			Dati di confronto					
Nome	Codice	Prov	Superficie ST	Abitanti	Densità residenziale	Casi del Non Finito Architettonico	Volume del Non Finito Architettonico	Superficie occupata (coperta) dal Non Finito Architettonico	Densità superficiale del Non Finito ogni 100 abitanti	Densità superficiale del Non Finito per unità di superficie o Indice di copertura del Non Finito	Densità volumetrica del Non Finito ogni 100 abitanti	Densità volumetrica del Non Finito per unità di superficie	Densità di casi di Non Finito per 1000 abitante	Densità di casi di Non Finito per unità di superficie
			km2	ab	ab/km2	Nnf n	Vnf m3	Snf m2	Snf / 100 ab m2 / 100 ab	Snf / ST m2 / km2	Vnf / 100 ab m3 / 100 ab	Vnf / ST m3 / km2	Nnf / 1000 ab n / 1000 ab	Nnf / ST n / km2
ACERRA	**ACE**	NA	54,71	59567	1088,78	24	32018,4	5305	8,91	96,97	53,75	585,24	0,40	0,44
AFRAGOLA	**AFR**	NA	17,91	65522	3658,4	32	66857,5	27106	41,37	1513,46	102,04	3732,97	0,49	1,79
ARZANO	**ARZ**	NA	4,71	34903	7410,7	13	13776	2318	6,64	492,14	39,47	2924,84	0,37	2,76
AVERSA	**AVE**	CE	8,85	52813	5967,57	16	61533	4178	7,91	472,09	116,51	6952,88	0,30	1,81
CAIVANO	**CAI**	NA	27,22	38238	1404,78	8	20643	2637	6,90	96,88	53,99	758,38	0,21	0,29
CALVIZZANO	**CAL**	NA	4,01	12737	3176,31	18	10089	2030	15,94	506,23	79,21	2515,96	1,41	4,49
CARDITO	**CAR**	NA	3,21	21302	6636,14	15	32055	4308	20,22	1342,06	150,48	9985,98	0,70	4,67
CASALNUOVO DI NAPOLI	**CNU**	NA	7,83	49904	6373,44	31	93825	14233	28,52	1817,75	188,01	11982,76	0,62	3,96
CASANDRINO	**CDR**	NA	3,19	13179	4131,35	48	40404	5236	39,73	1641,38	306,58	12665,83	3,64	15,05
CASAVATORE	**CVA**	NA	1,53	18710	12228,76	4	24867	1069	5,71	698,69	132,91	16252,94	0,21	2,61
CASORIA	**CSO**	NA	12,13	79542	6557,46	63	206404	19993	25,14	1648,23	259,49	17015,99	0,79	5,19
CESA	**CES**	CE	2,74	8241	3007,66	11	29019	3549	43,07	1295,26	352,13	10590,88	1,33	4,01
CRISPANO	**CRI**	NA	2,22	12585	5668,92	10	19170	2388	18,97	1075,68	152,32	8635,14	0,79	4,50
FRATTAMAGGIORE	**FMA**	NA	5,37	30108	5606,7	36	80058	9371	31,12	1745,07	265,90	14908,38	1,20	6,70
FRATTAMINORE	**FMI**	NA	2,05	16067	7837,56	33	54636	6970	43,38	3400,00	340,05	26651,71	2,05	16,10
GIUGLIANO IN CAMPANIA	**GIU**	NA	94,62	120194	1270,28	168	432222	57659	47,97	609,37	359,60	4567,98	1,40	1,78
GRUMO NEVANO	**GRN**	NA	2,88	18269	6343,4	24	26675	5230	28,63	1815,97	146,01	9262,15	1,31	8,33
MARANO DI NAPOLI	**MAR**	NA	15,64	59457	3801,6	14	57194	4625	7,78	295,72	96,19	3656,91	0,24	0,90
MELITO DI NAPOLI	**MEL**	NA	3,81	37997	9972,97	28	233655	32523	85,59	8536,22	614,93	61326,77	0,74	7,35
MUGNANO DI NAPOLI	**MUG**	NA	5,25	34537	6578,48	5	17814	2774	8,03	528,38	51,58	3393,14	0,14	0,95
ORTA DI ATELLA	**ODA**	CE	10,83	25713	2374,24	29	137967	12346	48,01	1139,98	536,57	12739,34	1,13	2,68
QUALIANO	**QUL**	NA	7,43	25313	3406,86	15	40206	5415	21,39	728,80	158,84	5411,31	0,59	2,02
QUARTO	**QUR**	NA	14,16	40387	2852,19	25	62643	7428	18,39	524,58	155,11	4423,94	0,62	1,77
SANT'ANTIMO	**SAN**	NA	5,9	34061	5773,05	94	135414	21929	64,38	3716,78	397,56	22951,53	2,76	15,93
SANT'ARPINO	**SAR**	CE	3,2	14267	4458,44	8	11892	1668	11,69	521,25	83,35	3716,25	0,56	2,50
SUCCIVO	**SUC**	CE	7,21	8040	1115,12	9	40783	4216	52,44	584,74	507,25	5656,45	1,12	1,25
VILLARICCA	**VIL**	NA	6,88	31005	4506,54	37	45474	6984	22,53	1015,12	146,67	6609,59	1,19	5,38
VALORI MEDI						**30,30**	**75084,96**	**10129,19**	**28,16**	**1402,18**	**216,54**	**10736,12**	**0,98**	**4,64**
TOTALI			**335,49**	**962658**		**818**	**2027293,9**	**273488**						

Fig. 4: Impact of Non-finiteness: cases frequency, impact on surface, volumetric amount

c-Volumetric amount

NF volumetric density per 100 pop. (VNF/100pop.) is the ratio between non-finiteness overall volume (expressed in m3) and the population (assuming 100 inhabitants as unit). The overall datum shows an average volumetric incidence of NF corresponding to 216.54 m3 of non-finite volume every 100 inhabitants. In survey on individual municipalities the upper bound is represented by Melito di Napoli with a value of 614.93m3/100pop.

NF volumetric density per km2 (SNF/Km2) is the ratio between non-finiteness overall volume (expressed in m3) and the surface extension (assuming 1km2 as unit). The overall datum shows an average volumetric incidence of NF corresponding to 10736.12m3 of non-finite volume every km2. In survey on individual municipalities the upper bound is represented by Melito di Napoli with a value of 61326.77 m3/km2.

These data stand as a demonstration of the non-finiteness impact on real urban context.

According to an approximation, defining however an immediate perception of the phenomenon, we can elaborate rapid deductions on the basis represented by the described data. In study area we can find a NF case every thousand inhabitants (280 m2 of surface occupied by non-finite buildings and 2160 m3 of non-finite volume) and there are 4.6 NF cases in each km2 (1400 m2 of surface occupied by non-finite buildings and 10700m3 of non-finite volume). Considering specific values for individual municipalities to check the geographical distribution of the phenomenon, we notice some inter-municipal concentrations of non-finiteness. The first one is the Giugliano concentration (in which we include the triad Melito-Sant'Antimo-Casandrino) where, more than the value of non-finiteness surface density per inhabitant (59 m2/100ab.), we can notice the impact on the land represented by the ratio between non-finiteness surface density and territorial surface. In this ambit there are 3625 m2 occupied by non-finite buildings per km2. Similar values are detectable in the second concentration: the Atella conurbation (Municipalities of Cesa, Orta di Atella, Succivo, Frattaminore). The reasons of these data can be found in the intensive activity of real estate and construction companies in the decade 2000/2010. They provided low-cost accommodations in comparison with houses values in big city on the basis of a longer distance from the centre of Naples than other places of the same conurbation.

3. Grades and canon of non-finiteness

The non-finiteness as phenomenon shows a remarkable variety of configurations and different "weights" in function of the interrupted constructive phase. The phenomenon's complexity derives from its different manifestations: for example we can find simple concrete enclosures, pillars system waiting of the horizontal deck or constructive frames with no closures. To describe and record this variety, research defined these different conditions of non-finiteness we called *Non Finiteness classes or grades.* These categories stand as tools for a more exhausting classification and then for a more articulated comprehension of the phenomenon.

Grades of Non-Finiteness (GNF) are progressive and they regard the presence of architectural elements (enclosure, platform, pillars, decks/floors, roofs, "closing" walls "). In following list we describe the different classes.*GNF1 / Enclosure* - There is the enclosure delimiting the lot only. It represents the preparatory action of the construction. It is a very common condition.

GNF2 / Platform - There is a horizontal plane corresponding to the basement (where present) covering or to the ground floor or the mezzanine deck. This platform, as element, determines soil sealing, the "land consumption" for building in shapes and sizes dictated by the element itself.

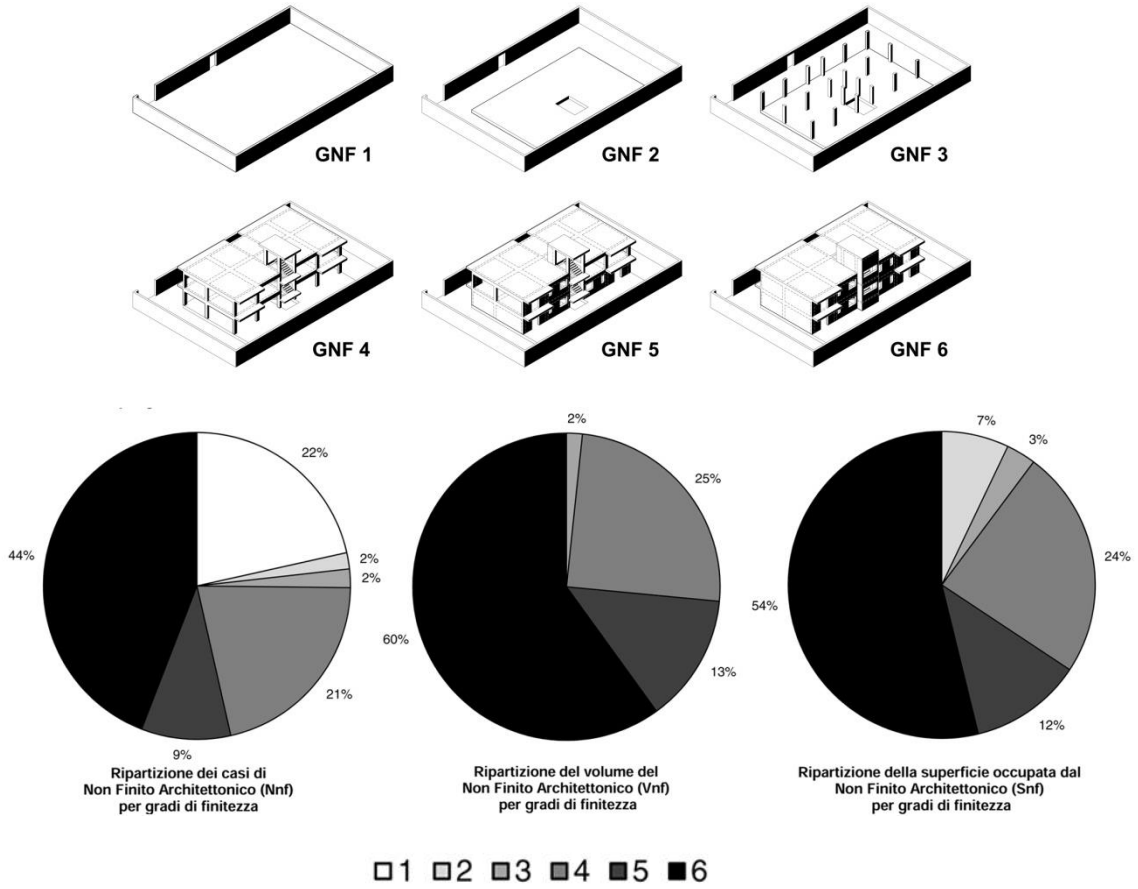
GNF3 / Platform with pillars - There is the platform, considered as the establishing slab of the artefact, there are also vertical structures (pillars or structural walls) realized for the entire floor height or partially. There are no covering horizontal planes. It is a very rare condition.

GNF4 / Frame - There is an artefact made up of pillars and decks. We can call it frame when we at least have two decks: the ground floor (or the mezzanine) and the first floor that sometimes can stand as covering. The upper deck construction determines de facto the non-finite volume on the basis of the covering's height in confrontation with the ground level. This configuration is very common.

GNF5 / Partially closed frame - In addition to the frame, as described in the previous lines, there are external walls, "closures", closing partially the artefact. In this configuration we can find, for the first time, non-structural elements.

GNF6 / Incomplete building - It is a completely closed artefact (with or without plaster) through external walls, "closures", but with no - partly or completely - of finishes (windows, railings, walls, paving, coatings...).

The cognitive basis determined by the "Non-Finiteness Survey" (quantitative and qualitative census with photos showing artefacts status) allowed a first consideration. The analysis is useful for attempting to decode the ways unifying different non-finiteness cases. The issue concerns the existence of a *constructive canon of Non-Finiteness* which, being systematically applied, defines the recurring iconographical substance.



Figg. 5-6: Non Finiteness grades (GNF): elements; Impact of GNF in the study area

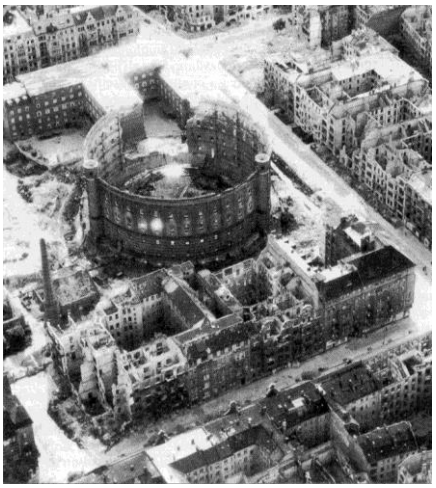
This canon is formed by two elements: the enclosure and the constructive frame.
(a) The enclosure assumes in Ager Campanus different consistencies but the rudimentary reinforced concrete wall three meters high prevails. So enclosure normally defines the property limit expressing the deep need to give a definitive and irreversible nature to this right, a right to be protected. We see this way that the idea of precarious right match an extraordinary will of finiteness, demonstrating an inverse proportion between the right's stability and the physical consistency of the lot's limits, in accordance with a rule you can find in different geographical contexts. The construction of the enclosure runs out the will of finiteness that will not find other expressions in architectural construction.
(b) The structural frame is normally oversized. Consisting of pillars with excessive sections (typically, base: 30 cm, depth: 50-60 cm) and short distances (3-4 m), the frame alludes to hypothetical building heights and to un-existing stresses. The oversizing reveals the aspiration for growth, for further surfaces, producing the indefinite character that is typical of the non-finiteness.
The oversizing as theme is manifested with a great power: through the interrupted frames dotting the landscape, it reveals the gnashing between the "Tuscan"[7] proportions of the pillar and the thin floors constituting low buildings; or inside a house, when appears the contradiction between the abundant structural measures and the modest internal space.
The oversizing's expressive strength allow us to say that this rudeness and "Tuscanity", in its lack of grace, in the gap between what it is and what it must support, defines an architectural order corresponding to the contemporary indeterminateness and non-finiteness.

4. Conditions of project on non-finiteness

The conditions of the architectural non-finiteness dramatically influence the project conditions [8]. In fact, the dominance of structural elements tends to define a significant correspondence between structural framework and pre-existence. In other words, the incomplete building reality frequently coincides with its structural reality and this correspondence induces, in a specific design process on non-finiteness, to attribute the "documental value of pre-existence" to the constructive frame (or to isolated structural elements or to elements organized in series) .
Ultimately, the project on non-finiteness – wondering about modes to regulate ratio between pre-existence and new parts - cannot exist without a compositional reasoning focused on dialectic ways between structural framework and figural system (iconographical order, character). In fact they basically seem to identify

themselves with the terms ("what's pre-exist", "what's new") of this ratio. So this discourse tends to give larger meanings and roles to osteological elements, to planimetric figurations and to architectural diaphragm and it involves, in general, the relationship between discontinuity of structural grid and continuity of composition mass.
As mentioned in the general introduction to this contribution, the clarification of this relationship is vital from the point of view of non-finite building - to lead to finiteness - character. In fact, this character must manifest the temporal disjunction between two phases: the project and the execution. It should make the interruption







Figg. 7-8-9: Housing and office building in Via Broletto, Milano, archh. L.Figini e G. Pollini, 1947/1948 (above); Landscape of ruins near Viktoria-Luise Platz, Berlin, in 1946 (below, left); Non-finiteness building in Giugliano in Campania (Naples), 2014 (below, right).

expressive because the absence of temporal and physical unity is the main feature of architectural non-finiteness.
So, the composition work on disjunction can have - if properly set up - great wealth and fertility starting from the recognition of diversity due to incompleteness of which Francesco Venezia recognizes a "strong aesthetical value" [9].
In this sense, some works by second Italian Rationalism, the post-war experience by Gardella, Figini and Pollini, Albini, seems to put into play useful issues for the project on non-finiteness. In particular, experimentations on double façades and tridimensional fronts [10]. The double register loggia / mixtilinear wall we can find in main facade of the famous "house in the park" by Gardella [11], the disturbing coexistence between extroverted structural grid with a ordering character and the deliberately imperfect and domestic richness of the inner diaphragm in the via Broletto tower by Figini and Pollini [12], the dissonant misalignments between structural partitions and openings in via Circo building (by the same two Milanese architects), demonstrate attention to relationships, not always compatible, between different worlds: the regularity of city and the "freedom of housing" [13], the structural rationality and facades variety, apparently hiding more general oppositional categories as abstraction/matter or history/nature.
Acknowledging the difficulty to understand these terms in a single speech we can find ways, rather than forms, for a project on incomplete artefacts that cannot tend to a falsifying architectural unity.

Design applications for non-finiteness "first life"

The transformation of incomplete artefacts aimed to a first functionalization - a real "first life" for the building – choses architectural themes coming from urban criticalities emerged in the analysis of planning parameters. In general, these critical aspects are about the lack of community facilities and social housing and they derive from the strong non-finite buildings diffusion in low-structured places with an almost complete absence of services. In particular, elaborations configures education buildings through public/private partnership operations assuring the economic feasibility.

The design applications are interventions on non-finite artefacts situated in study-area, the northern Neapolitan conurbation. They face five different situations:

Giugliano-Varcaturo (a series of three small closed frames plus three platforms with pillars, GNF6 GNF3), Giugliano-Auchan (a big industrial frame, GNF4), Giugliano-Casacelle (a four levels closed frame, GNF6), Orta di Atella (a six levels closed frames with a linear development, GNF6), Casoria (three separate frames in the same urban fabric GNF4 and GNF6).

The required adaptation for the functionalization of non-finite artefacts is based on the minimum intervention criterion (but also, if necessary, it provides new integrative volumes) in accordance with the new use characteristics (distributive, lighting, structural conditions and technological plants). The artefact adaptation evidently implies - even in GNF6 cases characterized by an extended completeness – certain important operations mainly depending on three aspects: architectural morphology, lot occupation modes and structural system. These three conditions of the existing artefact may have different configurations and difficulties /resistances to the mutation.

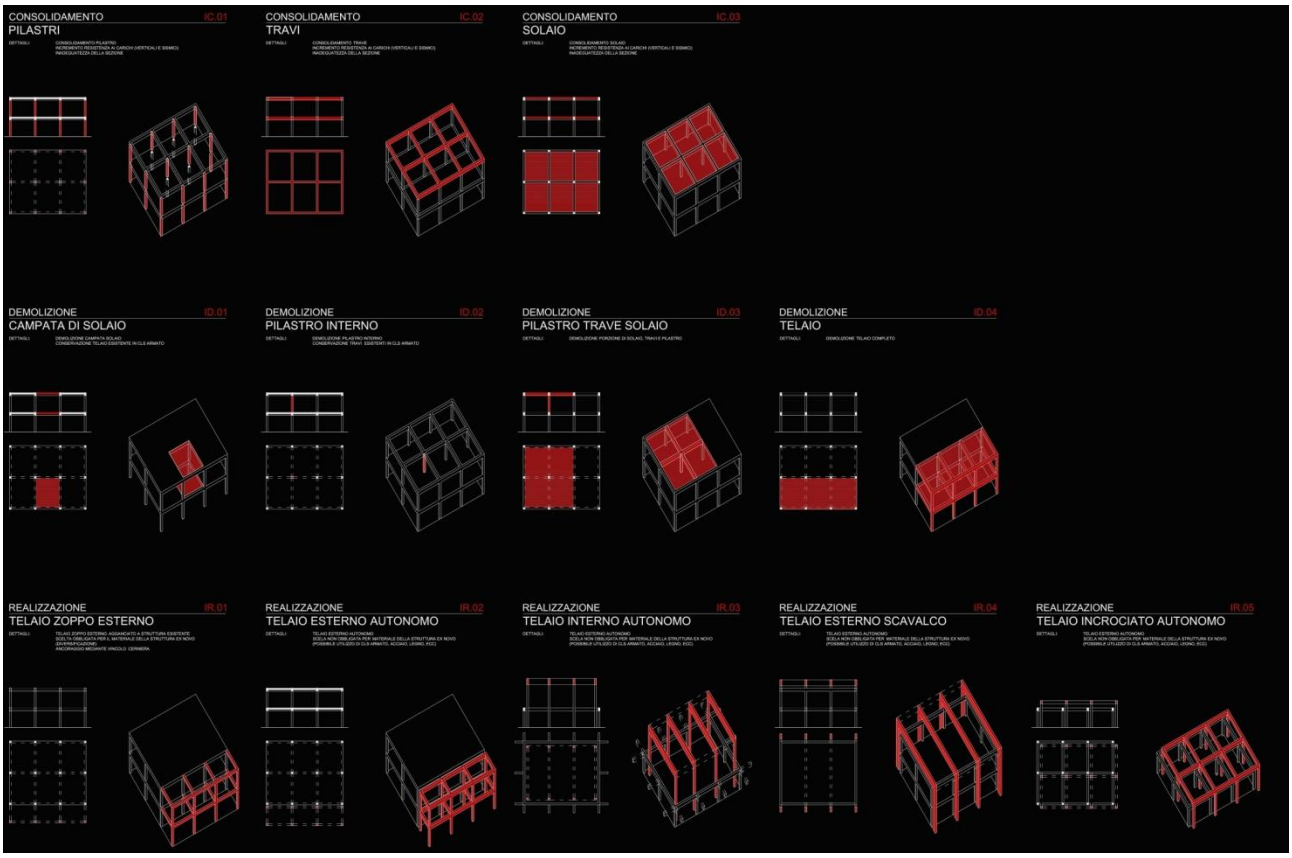
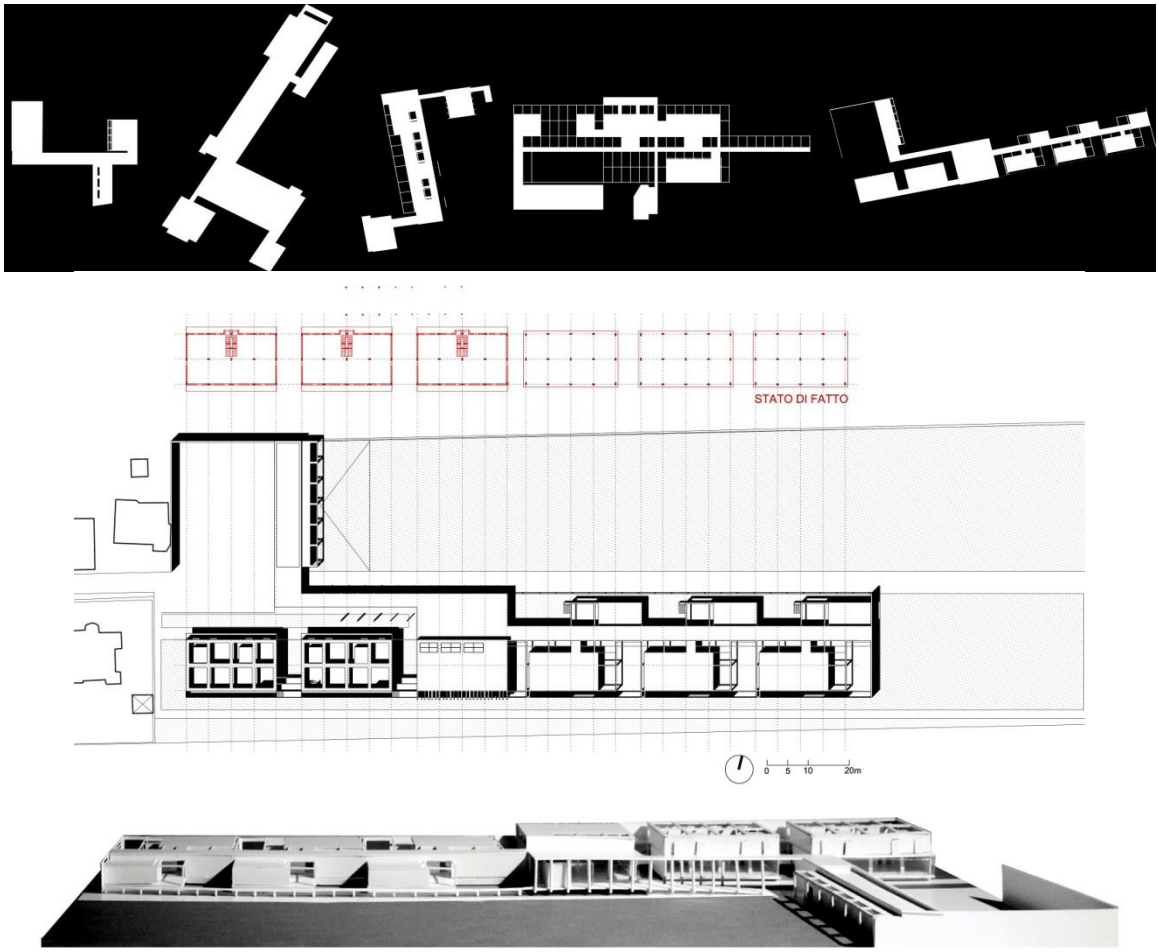


Fig. 10: Non Finiteness Project: structural operations

Adopted design criteria are the following ones:

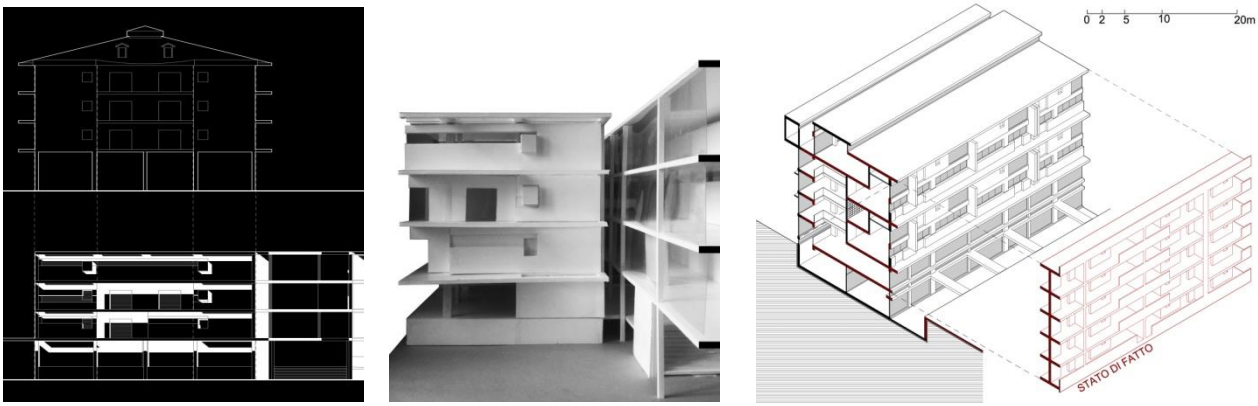
A - *Operations addressed to volumetric integration*: definition of articulated architectural unit with strong articulation and recognisability of pre-existing and new volumes.

- In cases of medium-large artefacts or small-medium artefacts organized in series, if we only find structural frames (GDF3 or GDF4), we can operate on planimetric figurations in order to integrate or replace volumes. In this case, pre-existing structural frame - standing as a discontinuous three-dimensional system - acts as an ordering element in compositional regulation.
- In cases of isolated small-medium or distant artefacts (within 100 m, inserted in urban fabrics or in extensive situations), we can introduce additional elements tending to define a distribution unit and they may assume linear (galleries) or slab shapes (fig. 11-12).



Figg. 11-12: Five project solutions; Project for a school in Giugliano in Campania (Team: De Chiara N., Giannelli, Lombardi)

B – *Operations on facades*: façade figuration tends to manifest the pre-existing/new dialectic and it focuses, whenever possible, on structural outpouching.
- For total or partial closing of pre-existing openings in external walls, the closing elements are placed on different vertical planes or they adopt different finishes.
- For new openings, we will adopt an autonomous formal repertoire, different than the existing one, determining eventual "formal-linguistic" conflicts.
- In case of protruding decks (balconies, terraces, ...), they preferably will be maintained trying to build horizontal systems standing as architectural ordering elements and as protective elements (sunscreens) at the same time (fig. 13-14-15).



Figg. 13-14-15: Facade composition for a junior high school in Giugliano in Campania, drawing and model (Team: Crispino, De Chiara A., Giliberti; project of a high school in Orta di Atella, section/façade (Team: Barra, Castaldo, Fioretti).

C - *Operations on internal architectural space*: definition of non-ordinary internal spaces corresponding to collective uses and matching the functional (structural adaptation/distribution) and habitability needs.
- Partial or total demolition of decks (only for secondary structures) maintaining the main beam-pillars grid in order to define double or triple height spaces (for atria or special halls) or to reach adequate heights for habitability.
- Definition (or re-definition) of internal walls respecting, if it is possible, the structural geometries (fig. 16).

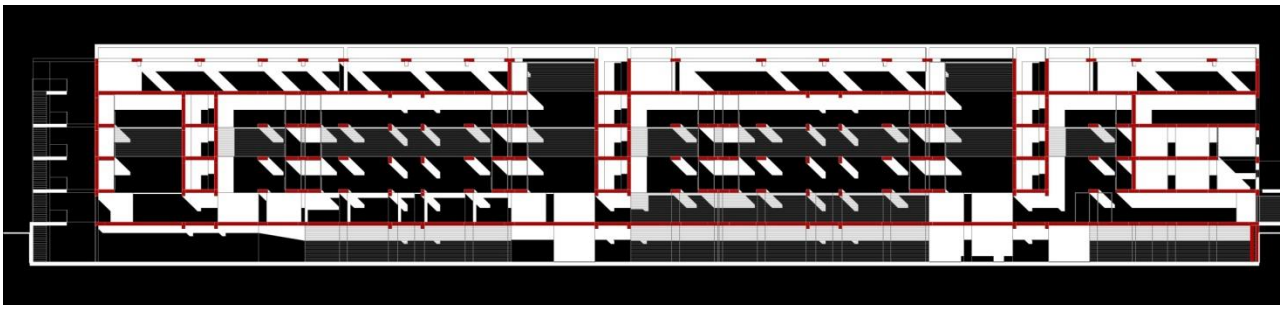


Fig. 16: Internal space, project of a high school in Orta di Atella, section (Team: Barra, Castaldo, Fioretti).

Bibliographical References

[1] CIORRA G., MARINI S., *Re-cycle. Strategie per la casa, la città e il pianeta*, Milano: Electa, 2012.
[2] MARRAS, G., *Iconismo e forma limite. Il riciclo come ipotesi di ricerca per l'architettura,* in FA Magazine nov. 2013, p. 17-21.
[3] COSTANZO, F., *Il progetto della residenza nei* Campi Architettonici. In Bellomo M. *et al. Proceedings of the Congress "Abitare il nuovo/abitare di nuovo ai tempi della crisi".* Napoli: Clean, 2012, p. 784-794.
[4] AA. VV. (1999), *La città eccentrica.* Roma: La nuova arnica.
[5] MOLINARI, L., *Second life*. In *Domus*, n. 654/2012.
[6] BISOGNI, S., RENNA, A., *Il disegno della città.* Napoli, 1974.
[7] MANZO, C.A ET. AL., *Recinti metropolitani. La costruzione della pianura campana*, Roma, Kappa, 2012.
[8] COSTANZO, F., *Specific finiteness character of Napoli Nord or about the voluntary instability.* In AA.VV., *Proceedings of the Congress EURAU 2014 - Istanbul "Composite cities"*. Istanbul: Istanbul Technical University press, 2014, p. 096:001-016.
[9] VENEZIA, F., BASSO, O., *Non finito in architettura*, Venezia: IUAV, 2007.
[10] DAL FABBRO, A., *Separare-unire: la facciata come architettura*. In Semerani, L., *La casa. Forme e ragioni dell'abitare*. Milano: Skira, 2008.
[11] GUIDARINI, S., *Ignazio Gardella nell'architettura italiana. Opere 1929-1999*, Milano: Skira, 2002.
[12] GREGOTTI, V., MARZARI, G., *Figini e Pollini. Opera completa*, Milano: Electa, 1996.
[13] MONESTIROLI A., *Ignazio Gardella*, Milano, Electa, 2009.

[1] The iconography is a "set of motives and criteria distinguishing and framing the urban image from the cultural point of view." See definition of "iconography" provided by the dictionary Devoto-Oli.
[2] Non-finiteness reaserch focused on neapolitan area is done by Research Unity of the Department of Architecture and Industrial Design "L. Vanvitelli" - Second University of Naples during 2014/15. L'U.d.R is composed by proff. Francesco Costanzo (Scientific coordinator, Architecture and Urban Design), Giuseppe Faella and M. Teresa Guadagnuolo (Construction), Claudia De Biase (City Planning), Marco Calabrò (Administrative Law), Fabiana Forte (Economic Evaluation) and by Gaspare Oliva, Giuseppe Di Caterino, Mariangela Villalunga (design and city planning research materials).
[3] Municipalities list: Acerra (ACE), Afragola (AFR), Arzano (ARZ), Aversa (AVE), Caivano (CVA), Calvizzano (CAL), Cardito (CAR), Casalnuovo di Napoli (CNU), Casandrino (CDR), Casavatore (CVA), Casoria (CSO), Cesa (CES), Crispano (CRI), Frattamaggiore (FMA), Frattaminore (FMI), Giugliano in Campania (GIU), Grumo Nevano (GRN), Marano di Napoli (MAR), Melito di Napoli (MEL), Mugnano di Napoli (MUG), Orta di Atella (ODA), Qualiano (QUL), Quarto (QUR), Sant'Antimo (SAN), Sant'Arpino (SAR), Succivo (SUC), Villaricca (VIL).
[4] Aversa, Cesa, Orta di Atella are included in Province of Caserta and they are not part of Napoli metropolitan area.
[5] According to the law L.142/90 about organization of metropolitan cities. Napoli metropolitan city corresponds to administrative limits of Province of Napoli.
[6] Survey work has been organized by arch. Gaspare Oliva with the relevant contribution of students that have participated in Design Laboratory 3A of the CdS Architecture in Department of Architecture and Industrial Design "L. Vanvitelli" in Academic Year 2014/2015 between November 2014 and March 2015
[7] In the first volume of the Four Books of Architecture, Palladio describes the Tuscan order, referring to Vitruvius, as the most straightforward and simple among architectural orders, which corresponds to a robust and heavy character.

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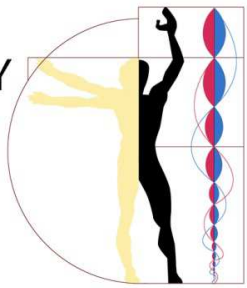

From Borbonic Royal Gunpowder to mouth of the river Sarno: a redevelopment project architectural and landscape

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Abstract
The thesis that we develop in this research is that the Sarno River Park is intended as infrastructure that can promote the development of tourism in the Sarno Valley through the study of some topics of architectural value and landscape. The project reinterprets the sites of reclamation Bourbon from Scafati at the mouth of the Canal of Sarno bringing in the domain of architecture issues airworthiness and the hydraulic system of the river turning operations for flood defense, naturalization and the reconstruction of the embankments , the new harbors, bridges, vegetation, bulkheads, etc ... in form factors of the landscape. There are three nodes where the project aims to recover the identity of places:
1- the large enclosure of the former Powder factory Bourbon that is transformed into a center of culture and applied research into the more generic of a museum environment;
2- recovery dell'aree near the new bridge that includes the remains of industrial archeology of the Mill De Rosa and Bath navigation;
3- restoring the mouth of the Sarno with the recovery of the first metallurgical plant and the design of the new marina.
The general theme and the nodes are intertwined and mutually reinforcing in the ability to have a way of water as a natural infrastructure and a core of tourist activities and accommodation that make the navigability of the river a necessary condition.

Keywords: River Park, Landscape, Infrastructure, Architectur

1. Research terms

For a long time, with the research unit of the Department of Architecture and Industrial Design coordinated by Prof. C.A. Manzo, we are working on projects to upgrade the complex landscape and architectural system of Sarno Valley and in particular the areas near town of Sarno between Pompeii and Scafati.

In 2008, with the workshop "Crossing Pompeii" curated by Emanuele Carreri, we identified four sensitive areas in the peripheral fringes of Pompeii with the aim of overcoming the various fractures caused by metropolitan infrastructures construction; in the National Research Prin 2009 "From the urbanized countryside to the city in extension: composition rules for architecture of territory and minor centres" we analyzed some issues about urban composition for 'studying patterns for countryside urbanization responding in a sustainable and progressive to residential, productive and landscape needs of peri-urban areas'.

Based on these considerations, we proposed structural and identity reconnection of territories crossed by Sarno river through a large-scale project. Using the river as a territorial hinge, we proposed an urban

expansion hypothesis for the valley small towns concentrated on transversal strings crossing the river and some punctual hypotheses in close relationship with the water system.

This research, under the theme 'Urban Ecotourism for the fruition of cultural heritage in Campania', extends, revises and deepens these previous studies. The theoretical hypothesis is that the Sarno River Park stands as a historical infrastructure with a light character, made up of vegetable and built parts over time. This unitary system composed of nodes can be described through a series of transversal urban sections determinating its variable shape and the size. The research subjects have two objectives that redesign the urban principles and strategies.

The first goal is to bring issues connected with hydraulic re-organization of Sarno river and Bottaro canal in the domain of architecture proposing a new landscape form through pre-disposition of an archive made up of sensitive points of water infrastructure and elements allowing navigability: dockings, crossings, bridges, banks, bulkheads; the reshaping, naturalization and the reconstruction of embankments sections; operations for floods defense, the lamination basins.

The second goal is the recovery of river architectures as internal elements of the River Park with territorial functions. This theme overlaps the issue of the park as a tourist attraction, of abandoned valuable productive volumes as industrial archaeology and environmental and landscape revitalization of natural elements: the construction of the second mouth and the recovery of the 'Stagnone'; the recovery of existing industrial volumes for cultural activities; the recovery of the Darsena al ponte nuovo; the rehabilitation of former Borbonic Powder factory as ' environment museum '; the recovery of mills island in central Scafati; the recovery of Realvalle abbey as Sarno valley historical museum; the new arrangement of Paleolithic archaeological site in Longola.



Fig. 1: Drawing the identification of new strategic locations on the river Sarno

2. Constraints, realism of the issues and methodological approach

Our hypothesis is inspired by the real trasnformation needs of interested municipalities and provinces and assumes directives contained in two projects by Autorità di Bacino: the Great Sarno River Project (2009) which provides the hydraulic arrangement of the entire basin with some restoration works addressed to the removal of polluted sediments; the Coastal Conservation Plan (2011) which provides for the river navigability.

There are some strategic/territorial aspects of the first project that we use for our study such as: hydraulic and environmental redevelopment of Sarno rivers lower course with the realization of the Second Mouth trough re-functionalization of Bottaro and Conte Sarno canals, and the regeneration of coastal ambit; a laminations basins system for the upstream retaining of floods volumes; the regeneration of river environment in order to reconstruct the edges continuity and the cross-connections.

The 'Big Project' directly participates in acting objectives of the current Area Vasta planning represented by "Regional Development Plan". It falls, in part, in the perimeters of the Regional Park of the Sarno River Basin, safeguarding areas of "Rete Natura 2000". Equally, research takes into account the delimitation of the River Park, the flood risk areas, the Vesuvius Emergency Plan red ares in synergy with the two Territorial Plans for Provincial Coordination of Naples and Salerno.



Fig. 2: Inserting urban identification of new strategic locations on the river Sarno

3. Urban Transformations between Scafati and the Sarno mouth

In connection with the framework of the Campus Project we examine three steps from Bourbon rectification intervention of Sarno riverbed and the attempt to use it as a waterway to the realization, at the present day, of the complex infrastructure network. Using paintings, engravings, documents and historical maps (the latter archive IGM), we outlined urban transformations of Sarno's trait running from Scafati to the coast.

The first time is fixed in the map 'Castellammare e dintorni - Foglio 1' by IGM in 1818. We can read the Conte di Sarno and Bottaro canals and the old route of the Sarno river with the Scafati Mills, the Bottaro Mills and the Persica Mills and Bridge and the mouth describing a long loop with a parallel arrangement in confrontation with the coast, called 'Stagnone'.The Canal of Conte di Sarno was built in the sixteenth century by Tuttavilla Counts under management of Domenico Fontana to bring water to their mills in Torre Annunziata. The construction of this waterway allowed the discovery of the Pompeii ruins during the works to overcome the hill of ancient city. The canal probably followed the route of the Paleolithic river defining the

southeast side of old Pompeii promontory on whose banks the port stood. After the devastating eruption of 74 d.c., lava changed the topography of the valley by moving on south, in the current position, the riverbed.The construction of the Bottaro Canal is around 1620 when the Celano Counts, Scafati vassals, built, on the Torre Annunziata limit, their factories causing the raising of the water level and the swamping of the countryside near the mouth. In 1850 Ferdinand II of Bourbon, in conjunction with the construction of the Royal Powder factory of Scafati, made the adjustment of the River Sarno reclaiming the mouth and regulating the use of water to activate the mills and factories machinery in the whole valley.

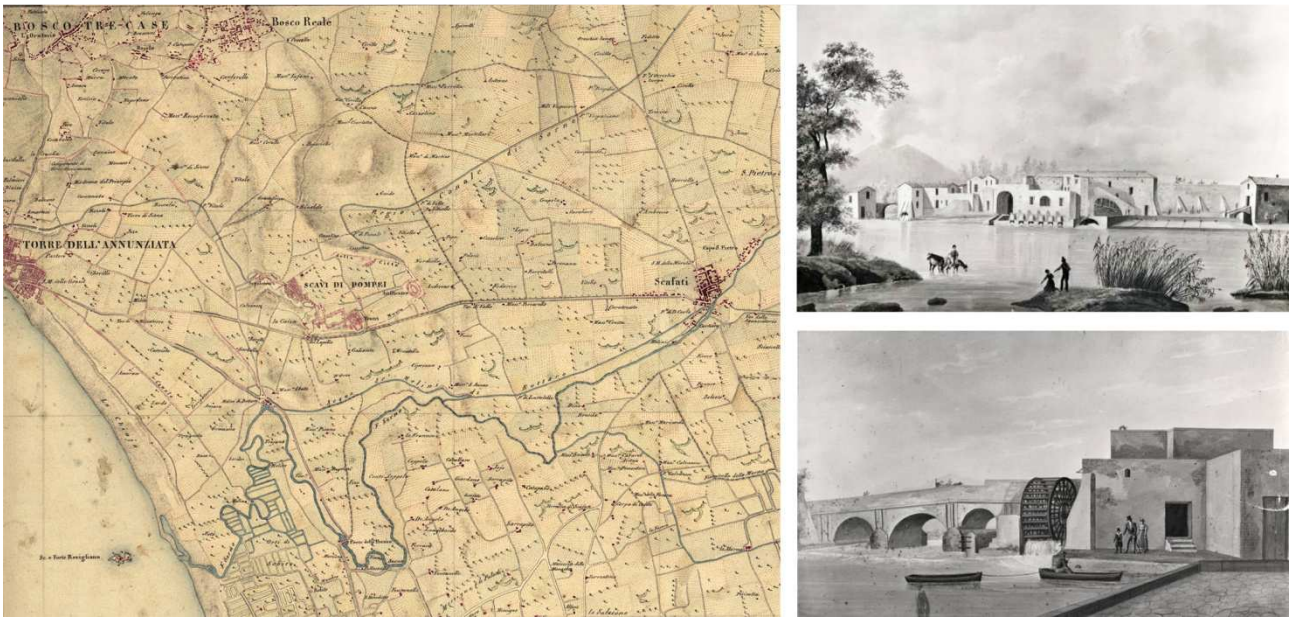

Fig. 3: IGM map in 1818 and two drawings anonymous 800: Mills Bottaro (above) and the Persian Bridge (below) traceable in the plan

This decisive transformation can be seen in the Map Igm 1909 where all works of Bourbon rectification are completed. Of Pompeii by Bartolo Longo are evident the Sanctuary and the Hospice while the railroad already defines a first urban cut in the valley. In this map we want to highlight the transformation of the three strategic nodes we want to investigate for the redevelopment of the Sarno river park:

1- at the mouth, on the northern side we identify the 'Stagnone' site, the retro-dune water system harmonized with the old Sarno mouth that today is a natural reserve site; while, on the southern site there's the Cattori factory courtyard building;
2- the New Bridge junction, the Navigation basin and De Rosa Mill define the point in which the rectification canal divides itself in three under a three arches bridge. On the first side the mill's hydraulic load used to pass, in the middle there was the river prosecution and on the other side there were a access canal for the navigation basin;
3- the old Bourbon Gunpowder Factory, already become Real Institute of Tobacco, preserves almost intact the historic arrangement: the built core on the roadside of the great elongated courtyard with the north – south arrangement and the walled enclosure between Bottaro canal and Sarno river.

In an zenith aerial photo (archive Igm, 1956) and in two contemporary photos we can read the successive transformations. We notice some significant changes in all the three study areas: at the mouth there are more industrial buildings both on the Torre Annunziata side than on the Castellammare side; near New Bridge we can almost see the De Rosa Mill, but it is abandoned; Institute of Experimental Tobacco uses the space on the East side, toward the street, to expand its volumes closing the connection north – south.

The recent upheavals have hidden the historical traces of this area and river's corrective works acted by Bourbons. Since sixties, the residential plans and a reckless industrial policy have transformed the Sarno Valley into a melting pot composed by widespread 'micro city' pieces and 'metropolitan enclosures'. The

landscape creeps between pieces of ancient and contemporary city. Overlapping levels we can identify a new study-entity I call ' landscape city '.



Fig. 4: IGM map in 1909 and two images: the New Bridge (above) and the design of the tank Navigation (below)

4. Redevelopment hypothesis for Bourbon Powder Factory

In 1851, by order of Ferdinand II of Bourbon, they dig the foundations of the large building for production of the best military gunpowder in the entire Kingdom of the Two Sicilies. The Bourbon Powder Factory, strategically located near Pompei, between the Sarno River and the Bottaro canal, is an large enclosure (200 x 700 meters) with a huge open area that once was destined to the powders experiments, then to the testing of tobacco and today is used for agro-food experimentations. In 1862, after several vicissitudes related to explosion danger, this artifact was turned into the Royal Institute of Experimental Tobacco to contribute to national production and reduce the heavy trade deficit in this market.

In the 60s, the state property established a research center to replace the Experimental Institute through determined demolition action of the old buildings and successive construction of office buildings, quarters and an auditorium. Today is the Environment Experimental Center is in dismission. Between 2000 and 2010 the City of Scafati recovers Nineteenth Century buildings trhough a project by the Superintendence for Architectural Heritage and Landscape of Salerno and Avellino. The Cultural Centre is composed of a main building on three levels organizing a courtyard with a small pavilion, the small church and the semicircular access to the gardens.

In 2010 the entire system is granted a free loan to the City of Scafati through an agreement between the Ministry of Heritage and Culture, the State Property Agency of Naples, the Ministry of Agriculture, the Council for Research and Experimentation in Agriculture, the city of Pompeii and the Municipality of Scafati. The pact defined the strategic direction and coordinated the actions in order to enhance the site. As a result of this document a Feasibility Study was carried out. It was addressed to the optimization and enhancement of the overall building through the realization of a culture and applied research center, accommodation and wellness facilities, trade and advanced services pole.



Fig. 5: Design and reconstruction of the former Powder factory Bourbon recent transformation

The restoration project identifies and reconnects some free areas on a river transversal axis. The draft plan is organized through few actions: it delimits the roadsides with new vegetation (green wedges), it introduces a system of special housing for students, researchers and young couples; it reorganize the activities of the Environment Research Centre; it proposes new green areas reconnecting Sarno River Park.

The project uses ‘elongated arms’ as infrastructural connective element and as compositional ploy to allow the direct relation of the new building with the Northern urban fabric and the suburbs and agricultural fringes on South. They allow to overcome the railway and highway infrastructural systems and connect the volumes separated by water canals. Architectures, suggesting this theme, are taken from long corridors that Francesco Venezia uses in the redevelopment project for San Leucio in Caserta and frome the suspended aqueduct that Alvaro Siza used as infrastructure for linking and balancing the design blocks in Malagueira (Evora). The elongated arms draw a lecorbuserian radent grafting, to the north, in a new civic center and in the former Bourbon barracks, standing as extension of the existing cultural center, and on the southern side they cross the Sarno River, connecting the environment research center with the crafts pole. This system becomes the base of the new Art Academy, replacing one of the existing volues and posing a synergy with the cultural center and with the environment research center.

The project also includes the redrawing of empty space as a fenced park for agricultural experimentation. The design involves the following operations:

- Recovery of Bourbon tracks and canals recovering existing volumes

- Elimination of industrial warehouses on the southern side

- Recovery of tobacco drying house as exhibition space

- The design of a small houses neighborhood for CRA researchers and the artists attending the art academy.

The design of green and open spaces, maintaining a larger area to dedicate to experimental agricultural activities and to the conservation of the plane trees monumental central axis, is linked to the possibility of bringing water inside the enclosure standing as memory of Bourbon canals, as lamination basin and water garden at same time.

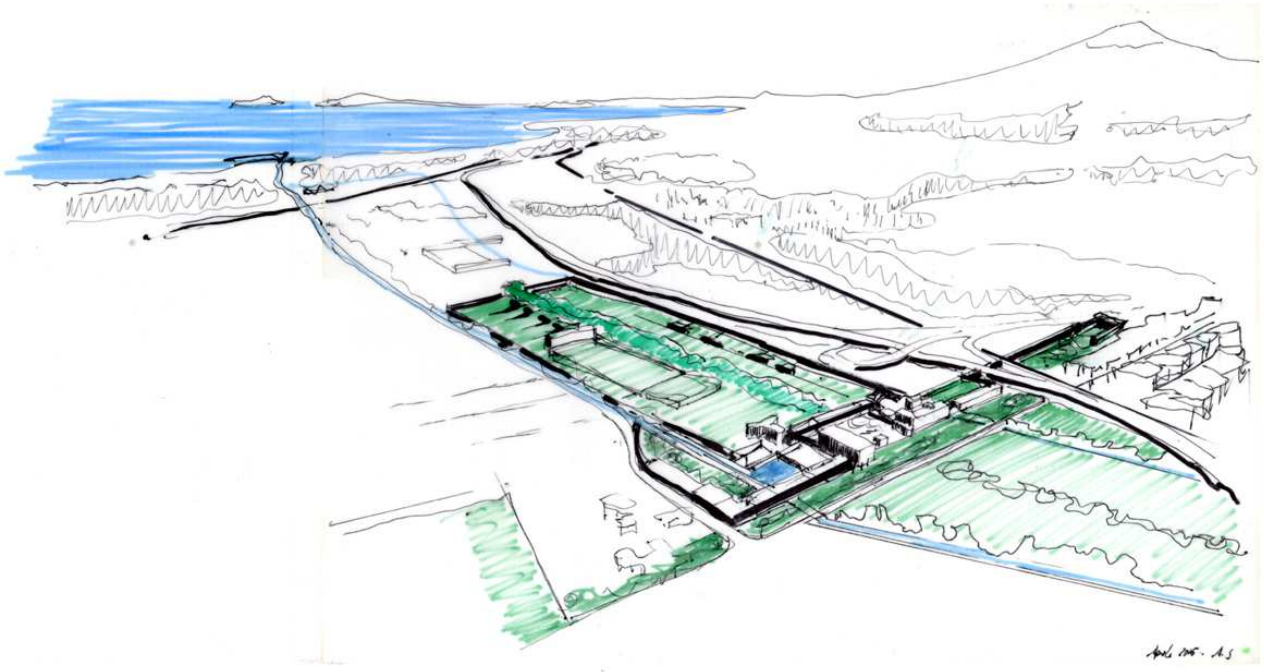

Fig. 6: Study sketches vision northwest

Bibliographical References

[1] ARIS, Carlos Martìs. *La cèntina e l'arco.* 1ª ed. Christian Marinotti, Milano, 2007. Translation of original book title 'La cimbra y el arco'. 6
[2] MANZO, Carlo Alessandro. Natura e valore nel progetto architettonico. In MACAIONE, Ina (edited by). *Città – Natura, allegato a Siti 04 .* City: Matera, 2005, p. 54.
[3] MANZO, Carlo Alessandro (a cura di). Sistemi agrourbani. In Gangemi Editori, Roma 2014
[4] LANGELLA, Aniello. *Il polverificio Borbonica.* In http://www.vesuvioweb.com/it/2013/06/il-polverificio-di-scafati-di-aniello-langella/
[5] PESCE, Angelo. *Il Polverificio borbonico di Scafati e la rettifica del basso corso del Sarno.* Ed. Giglio, Pompei 1996.
[6] VITALE Maria Grazia. *Studio di Fattibilità tecnica per il recupero e la trasformazione dell'area del Polverificio Borbonico di Scafati (SA). In http://ambientesa.beniculturali.it/BAP/?q=iniziative&tipo=Studi%20ricerche%20e%20progetti&ID=133*
[7] STRABONE, Geografia V, 4. 246-247 - Traduz. tratta da Centonze, G. "Stabiana. Castellammare di Stabia e dintorni nella storia, nella letteratura, nell'arte", Bardi Editore, Roma 2005
[8] AA. VV. 'Il progetto della seconda foce del fiume Sarno', Quaderni AdB Collana di Studi, Documentazione e Ricerca Autorità di Bacino del Sarno. 2/2007
[9] AA.VV. 'La navigabilità del fiume Sarno', Quaderni AdB Collana di Studi, Documentazione e Ricerca Autorità di Bacino del Sarno. 2/2008
[10] AMAROTTA, A.R., "Il Sarno e il mito della navigabilità", in Atti dell'Accademia Pontaniana, Nuova serie, vol. XX, Napoli 1971
[11] MAIURI, Amedeo, 'Passeggiate Campane', ed. Sansoni, Firenze 1957

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The rebirth of the water in Rome. Aqueducts and fountains

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From the era of imperial splendor, Rome remained in the fifth century AD without that great heritage of water that had characterized for many centuries its power, until it was resumed in the fifteenth century the Virgin water and then the other waters. Barbarian hordes, vandalism and neglect of later centuries destroyed a great heritage of engineering and technology, forcing the citizenship of Rome to drink the water of the river Tiber, preferable to polluted sources for the state of neglect of the ducts.
The first signs of a revival of the waters were already evident in the fifteenth century, intensified further in the following centuries. A series of repairs and new interventions of high technology and engineering wanted by the Popes brought back in Rome the ancient and copious flow of water to meet the needs of the population and helping to promote numerous projects and exhibitions monumental fountains that transformed the city's image.
The contribution is to analyze and document the value of water related to engineering and architecture, through some examples, as part of the rich cultural heritage of the city of Rome, highlighting what once represented and what today is for the protection and enhancement aware of historic urban landscape.

Keywords: roman aqueducts and waters, architecture, town, territory, documentation

1. The first aqueducts in Rome and the damage in the Middle Ages

"*The ancient element has always been of prime necessity everywhere; but especially in populated places and by far in populous and large cities, for the uses of life of men and beasts; and arts and opificj of every kind; and again for public ornament, which cheers and animates the inhabitant, and the passenger,*" wrote Carlo Fea about the water in 1832. However, as early as 15 BC Vitruvius in Book VIII of text *de Architectura* declared the great benefit that gives the water not only for drinking but also for the endless uses that allows. In the various chapters of the book are highlighted the properties and characteristics of the water in general and some in particular, the diversity of their use and the way to level them and transport them. Much importance was, in fact, for the Romans the water, which was used in addition to the common uses for the sacrifices and religious practices such as "lustratio", an ancient purification ceremony performed by washing with water. Very common in ancient Rome was the construction of the baths served by fresh water, warm and hot (*frigidarium, tepidarium and calidarium*) and numerous public and private fountains were used for both hygienic and for ornamental purposes.
In ancient times the Romans used to take water from the river and from urban sources and wells, whose purity and potability was guaranteed by the state, while the acquarioli carried to water in the town. Among the most important urban sources, remember: *Lupercale*, on the Palatine Hill, the source of *Giuturna* in the Roman Forum, the source *Tulliana*, water Lautula near the Basilica Emilia, the source *Apollinare*, the source *Scauriana* on the slopes of the Aventino, the water of *Mercury* and the source of *Camene* on the slopes of Celio [1].
Increasing over time the need for water with a growing development of the town, was designed and built the first aqueduct by the censor Appius Claudius the Blind that in 441 BC led to Rome the first water that was called Appia whose sources were located at the quarries of Rustica.
Forty years later, using the springs in the valley of the Aniene at Vicovaro, the censor Curio Dentato built the aqueduct *Aniene Old* finished by Furio Flacco. Later, in 144. C., the aqueduct Marcio was built by the magistrate Marcio Re with sources in the upper valley of the Aniene and in 125 a. C. from the springs in the valley Precious was captured water for the aqueduct *Tepula* built by the censors Cervilio Sepione and Cassio Longinio.
With the Emperor Augusto started the first restorations of these large hydraulic structures that characterized the urban landscape of ancient Rome becoming icon of the town preserved to this day. Agrippa was in charge of the restoration and built in Rome two new waters: *Julia* in 33 a. C. with sources at Grottaferrata

and *Virgo* in the 19 a. C. with sources in Salone, which were added to water Alsietina built by Augustus to power in Trastevere a great Naumachia, taking water from the lake Alsietino in Bracciano, today called Martignano [4].
Under Emperor Caligula in 38 BC. were built aqueducts: *Claudio* with sources between Agosta and Arsoli, in the valley of the Aniene and *Aniene Nuovo* with sources at Subiaco completed both in 52 d. C. by the Emperor Claudio. The waters *Traiana* were then constructed by Emperor Traiano in 109 AD with sources located near Lake Bracciano and the waters *Alessandrina* built by Alessandro Severo in 226 d. C., with sources in the estate of Colonna, south of the old main Via Prenestina. (fig. 1). With Alessandro Severo was built the water *Crabra* from Frascati.
To the Aqueducts was linked the wealth of the town, not only because of the magnitude of these imposing buildings but mostly because they were linked to the presence of water in the town that came from outside the walls, entering in Rome in a copious. Moreover, they have been an important instrument of control and propaganda, occupying an important place in Roman politics.
During the period of the republic were the censors, the finance ministers and public works, to administer the aqueducts and the waters that were owned by the town, while in the imperial era, with Augustus were the *curatores aquarium*, appointed by the Senate, which were provided to that task. The aqueducts built by the Romans were generally "free surface" masonry; few were, in fact, those built with underground development. Moreover, to overcome very deep valleys and steep slopes the Roman engineers preferred to conduct the water channel on the high arches instead of using the siphons-reverse that were uneconomic compared to the cost of a channel suspended on arches [8]. Based, in fact, on the principle of communicating vessels, the system made use of lead pipes very thick and thus also very expensive to withstand high pressures.
The average gradient of a water did not exceed 2%. Each individual part of the path was lower than the previous one, and a little higher than the next. For this reason it was necessary that the sources were placed in the hill at a height greater than that of the town of Rome.
The pipes of aqueducts were generally carried out as well as in lead also in terracotta, stone or in some cases also in bronze. The water distribution system was characterized by the presence of the *castellum* from which the water was distributed to a group of users. It was a building block and closed in some cases even with the residence of the castellan [3].
For specific structural and functional features, for the complexity of the design and construction, the aqueducts have represented, more than any other type of monument, the *romanitas* par excellence in which the triade vituviana: the *utilitas, firmitas* and *venustas* found the its highest expression. The arches, while

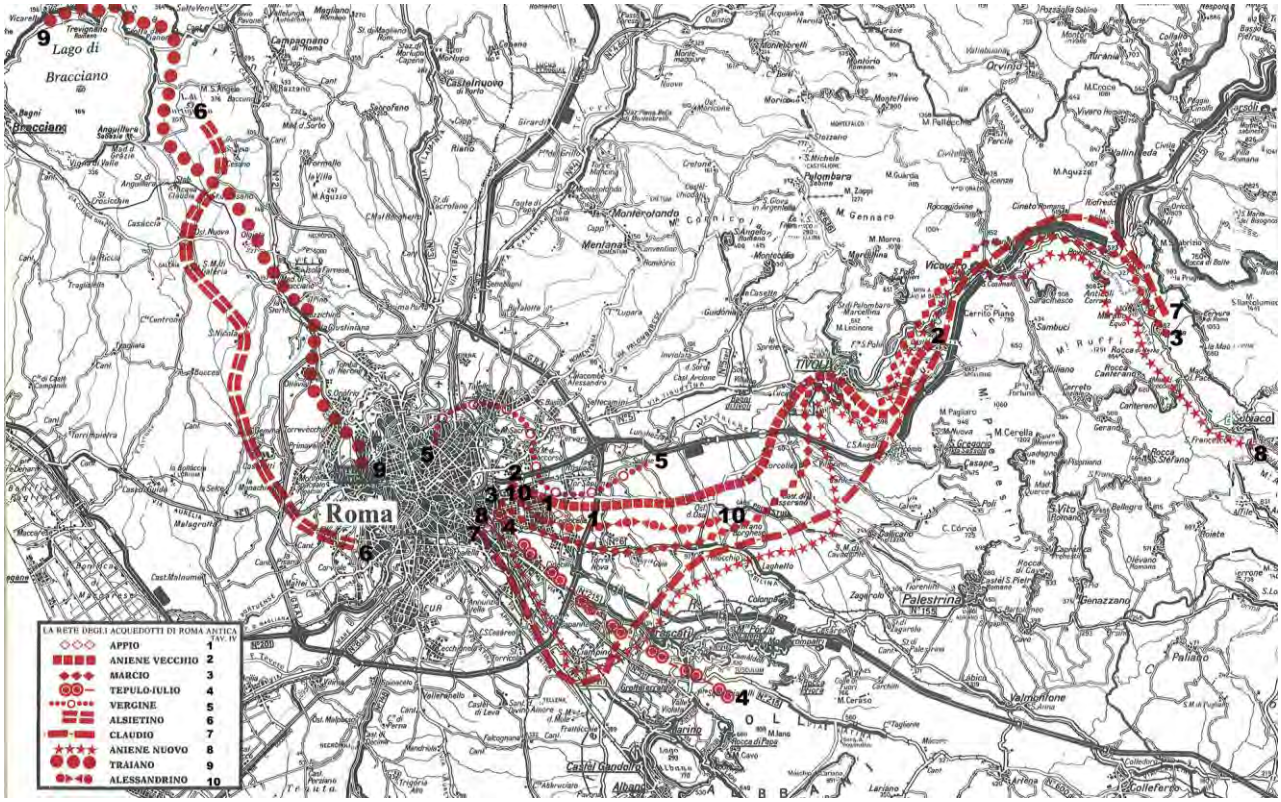

Fig. 1: Plan of the area around the town of Rome, were numbered the paths of the ancient aqueducts (image from: Panimolle, 1984 Tab. IV) [5].

representing, however, the most monumental part, were the weakest point of the aqueducts because they could easily be destroyed, as well as in fact happened during the barbarian invasions when many theories of arches were demolished in order to leave the population without water Rome thus forced to leave the town because unable to drink. Other pipelines were put out of use, having been walled up by the Romans because they represented easy access routes to the town for the invaders [7].
Many scholars agree in tracing the decline of Rome in 537, when King Goto Vitige, with the aim of winning more quickly the town, decided to demolish the aqueducts outside the walls of the urban area. From this date begins the rapid decline of the town. Lacking the most important subject and vital, the water, the architectural heritage linked to it, constituted of nymphs, fountains-exhibitions, naval battles, spas and public baths, troughs, went quickly into disrepair and Rome from about a million and a half population was reduced to 500 units.
Were also serious damage suffered by aqueducts after natural disasters due to earthquakes and flood of the Tiber. In the fifth century, the population of Rome was forced to drink water from the River Tiber to not use the sources survivors remained polluted for the state of neglect of the ducts. Many were the commercial and productive activities that developed along the banks of the river using its waters, through the construction, for example, of the mills. For about eight centuries the town remained without this great wealth that had characterized his power, until it was re-connected water Vergine and reactivated the other aqueducts. Concerned about the hygienic conditions besetting the town of Rome, the Popes began as early as the tenth century a repair of water facilities to provide for emergency water, but subsequent looting by the Lombards first (753) and later by Frederick Barbarossa (1167) destroyed their attempts at restructuring.

1.2 The Acquarenari

In the centuries of decline the population of Rome abandoned the old quarters located in the hills, descending to the Tiber and into the low-lying areas of the town, settling in the district Campo Marzio, where in a state of decay were the imperial forums, baths, temples, statues and numerous fountains. In this period the water, coming from distant sources or taken from the river Tiber, was transported to Rome with barrels.
Workers in this service were the porters (facchini) called *Acquarenari* to indicate the operation of purification of the water arenosa of the Tiber. Protected by St. Andrew the Acquarenari, until the fifteenth century they met in the church which was later demolished by Pope Sixtus IV to build Santa Maria della Pace also called Santa Maria de Acquarenariis, in memory of the ancient religious building.
The Acquarenari would pick the water at the Piazza del Popolo and Ponte Molle. Purified by special tanks until the layer of marl had not deposited in the fund, the water, considered very good and drunk even after the restructuring of the aqueducts, was collected in barrels that were loaded on donkeys for transportation in the town. [2].
The lack of water meant a great loss for the Romans also cultural. Numerous religious services were no longer practiced with the loss of the worship of the deity linked to water, personified by Fons, the son of Giano and Giuturna, and in certain circumstances also by the same Giunone. To the water gods, the Romans erected a temple on the Palatine and in the Campus Martius. Moreover, ancient legends attributed

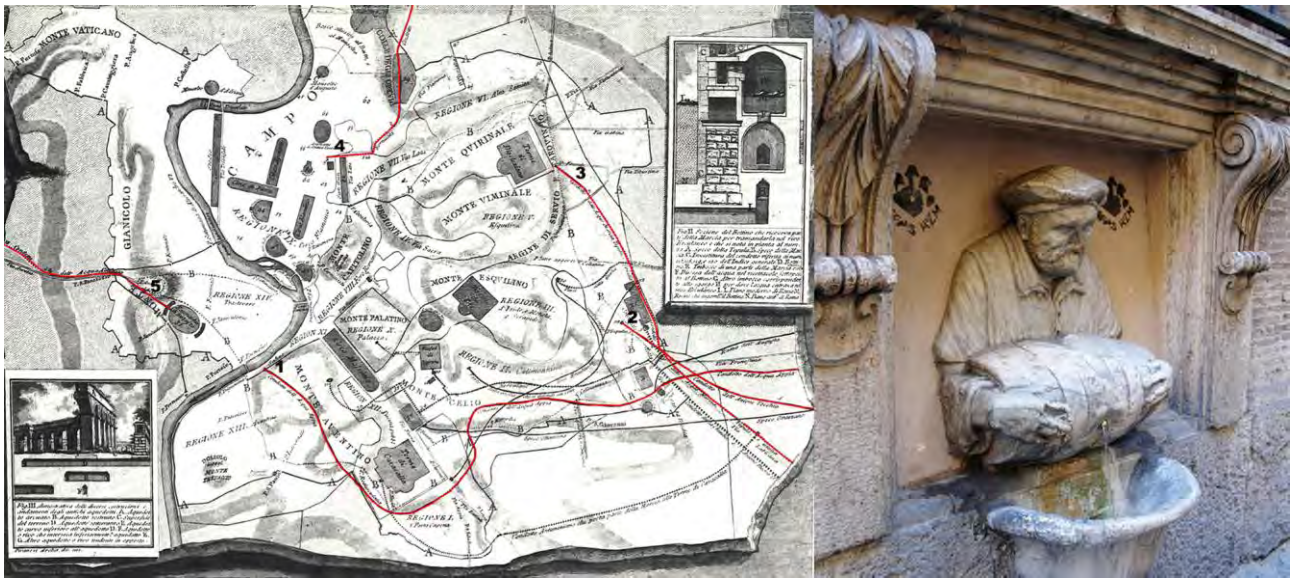

Fig. 2: On the left, GB Piranesi, Aqueducts of Rome, 1756 (extract). Were highlighted paths of the main ducts. To the right, the Fountain of the Facchino, in Via Lata.

to water miraculous powers and virtues. Remember that the water, spilled suddenly from the ground where the temple was located Ianus Geminus, prevented the Sabines to surprise the Latins on the Campidoglio. After centuries of deprivation, the water return to Rome with the restoration of the aqueducts was welcomed as a rebirth of the town (fig. 2).

2. The aqueducts of the popes and the rebirth of the water in Rome

Already in the fifteenth century appeared the first restorations of the water which intensified further in the sixteenth century. In this period a number of repairs by the Popes brought in Rome a quantity of water sufficient to meet the needs of the population, marking the rebirth of the town. With the return of the water, Rome was enriched also exhibitions of monumental fountains, expression of the patronage of the popes.

2.1 The Acqua Vergine and the first repairs

The first aqueduct to be activated by the popes, after the vandalic destructions of the Barbarians, was one of the Aqua Virgo which suffered less damage other aqueducts for the fact that over a distance of 21 km only two were designed opened with short stretches of arches. The water Virgin was born from the estate of the Salon at 24 m. above sea level, became property of the Chapter of Santa Maria Maggiore in the Middle Ages and located 10 kilometers from the door on the way Collatina Maggiore (between the Tiburtina and Prenestina).

The aqueduct arrived to town following a path very large, it was not the shortest. After five kilometers from Salone, in fact, come to ditch of the Marranella, the aqueduct instead of continuing down the hill town, diverted the path to the north and with a wide arc across the Tiburtina, the Nomentana and the Salaria. Headed towards the Parioli, near the nymphaeum of Villa Giulia, (where there is access to the water, but you do not know the exact location), crossed the hill Pinciano, under Villa Medici (in the park where there are two accesses aqueduct, one of which is made with a spiral staircase) to arrive to the present via Due Maceli, which through a series of arches, went through the current via Nazareno, where is still preserved the end part of the arc of Claudio (fig. 3).

The aqueduct proceed towards the present Piazza di Trevi to overcome with arches the actual Via del Corso to the height of the building Sciarra thus concluding its path in via del Seminario, with a large fountain called the show because it marked the manifestation of the water in the city, to spread, then, through a castellum for the many monuments created by Agrippa, as it has been described by Frontino [9]. According to the testimony of Procopius also the aqueduct Virgin was interrupted by Vitige, according to other authors, however, the aqueduct diminished only its flow, to be restored by Adrian I during his reign (772-795) together with the aqueducts Marcia and Traiano. According to what is written in the itinerary of *Einsiedeln*, famouse guide Rome dated to the time of Hadrian and Charlemagne, the aqueduct Virgin was interrupted at via del Corso near the palace Sciarra. It was Pope Adrian that interested to build the then small Trevi fountain, erected behind the arches.

There were numerous inspections carried out at the time to ensure that no offense was taken by private individuals. To check any abuse of acquaroli, a gate surrounded the fountain and on the left side was then made also beveratoio for animals. Although never been interrupted, the flow of water Virgin greatly diminished despite the interventions of the Camera Capitolina and Apostolic and were abandoned the true sources reactivated after entering veins of lower quality and scope as those of Bocca di Leone (D'Onofrio, p. 46). An interest in the revival of the water Virgin was Nicolò V, who in 1453 resumed the work of the restoration of Pope Adrian I of the 786, making restructure pipelines of ancient work of Agrippa near the urban area to distribute water in the different points of the town.



Fig. 3: Acqua Virgo. On the left, the fountain of Bocca di Leone, along the via Collatina. To the right, the remains of the Arch Claudio visible from via Nazareno.

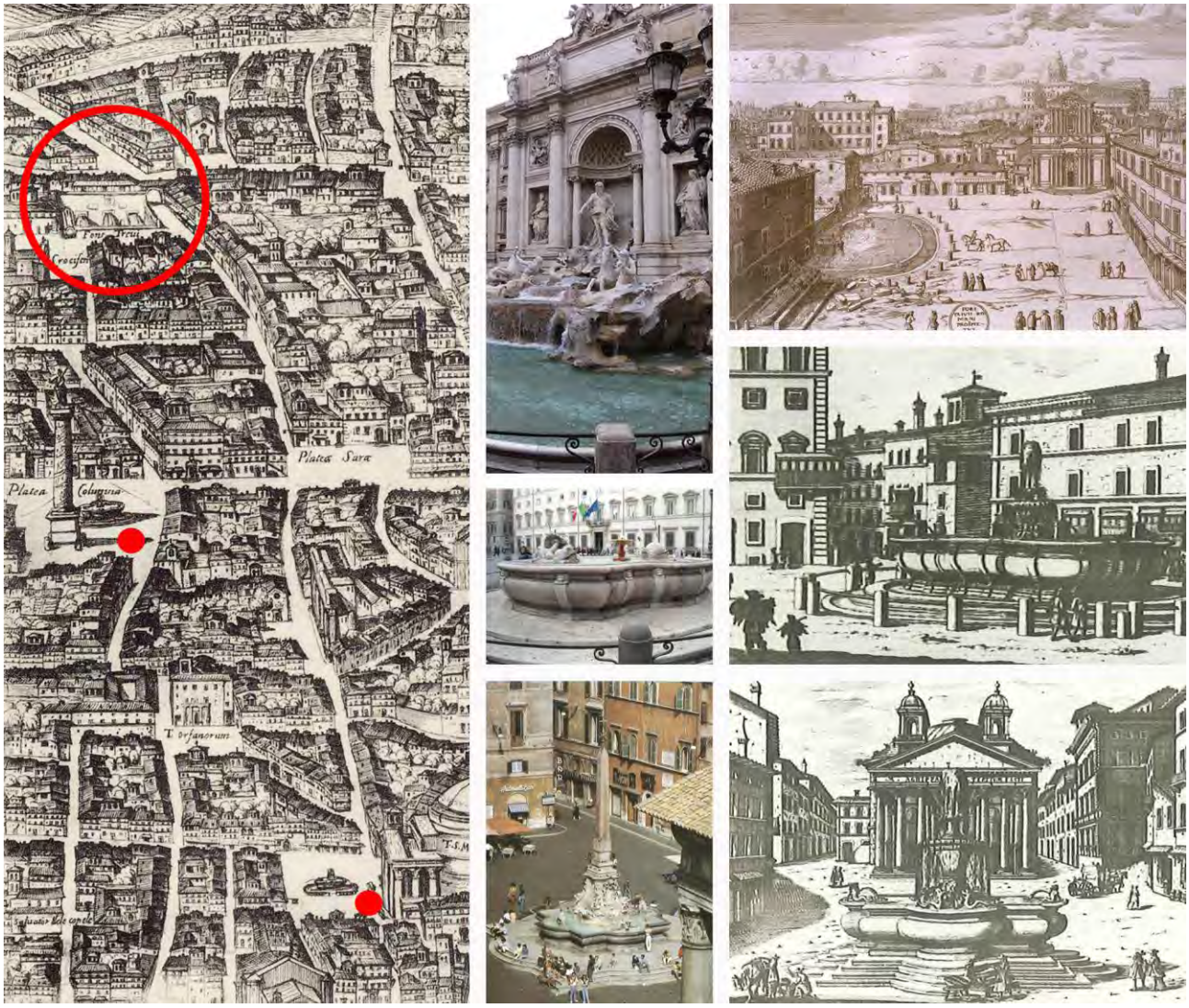

Fig. 4: Acqua Virgo. On the left, Map of Rome A. Tempesta (extract), 1593, in which are highlighted the fountains of Trevi, Piazza Colonna and the Pantheon. At the center, images of the fountains of Trevi, Piazza Colonna and the Pantheon. To the right, the Trevi fountain in a drawing of the Cruyl of 1662 depicting the project of Bernini, following an engraving of Falda 1665 Fountain in Piazza della Colonna in its original [6] and a view of Vergelli fountain in Piazza del Pantheon built by G. Della Porta in 1575 and subsequently amended [6].

The first exhibition Virgo aqueduct was built around 1456 near Piazza di Trevi, near the church of S. Maria in Trivio, in Piazza dei Crociferi [2]. It consisted of a rectangular pool fed by three streams of water coming from three mouths, the middle one with mask in relief, designed by Leon Battista Alberti, surmounted by a stone bearing the coats of arms of Nicolò V and the Senate (Mastrigli, 1928, p. 29 II vol.). The fountain, the subject of studies and projects throughout the seventeenth century including one commissioned by Pope Urbano VIII Barberini to Gian Lorenzo Bernini, who designed a large semicircular basin as reported in an engraving of Lievin Cruyl of 1667, only in 1732 will be built on designed by Nicola Salvi in the rich forms that have been preserved until today. Also in the fifteenth century by Nicolò V was opened another fountain near the church of the Santissimi Apostoli before the house Muti Papazzurri, now building Balestra, currently located within one of the two courtyards of the building to the left of the church of the Santissimi Apostoli. In the same period in 1490 was erected in Piazza San Pietro the fountain started by Innocenzo VIII and finished by Alessandro VI, located off center to the right (looking at the basilica), fed with water Alsietino which also served the hill Vaticano and the Gianicolo, channeled into old pipelines. Another fountain erected in 1450 by Nicolò V, and still present after several restorations and reconstructions, was the one in Santa Maria in Trastevere, whose supply came also from the remains of the aqueduct Alsietino

In the sixteenth century began the papal reconstructions that returned to the city of Rome much of its ancient water resources. Virgo aqueduct repairs were carried out by Paolo V (1566-1572) who became interested in restoring the ancient sources of Salone and rehabilitate the area near the Pincio, entrusting the work to Luca Peto, Giacomo della Porta, and Bartholomew Gritti. So that will not be repeated abuses and disasters of the

past in 1570 the Pope entrusted the custody, administration and distribution of Virgo to a Commission composed of three Cardinals, from Conservatives of Rome, by the Heads Rioni, from the masters of the streets the city, by the Priors and parliamentarians to the fountains. A first program for the construction of new public fountains was established by a resolution on November 4, 1570, when they were chosen few points most important and also the most populated area in the north-west of the city to serve with the new pipelines in addition to those restored. The first of the fountains was made the fountain of Trullo, built in Piazza del Popolo by Giacomo della Porta and then moved first in Piazza San Pietro in Montorio and after Piazza Nicosia, where it's now [11]. Not all fountains set by the program were built; between those realized you remember over the fountain in Piazza del Popolo, one in Piazza Colonna, the two in Piazza Navona, Piazza della Rotonda in front of the Pantheon, Piazza San Marco is now Piazza Venezia (later removed and transported to the Pincio), in Campo dei Fiori (the terrine, moved in 1924 to the streets of the New Church) and in the square Giudia now piazza Cinque Scole. According to a subsequent resolution of the Commission of 20 December 1570, it was decided to continue the Virgo aqueduct to Piazza Mattei, in which open source. The commission determined that the waters of the fountain could be at the service of the Mattei family provided this eseguisse at his expense the paving of the square and tasked with maintenance of the fountain. To Taddeo Landini it was entrusted with the construction of the fountain called the Tartarughe [2]. It was Gregory XIII, successor of Pope Paolo V, who, to distribute water in most parts of the district of Campo Marzio, from the tub at the foot of the hill of San Sebastianello derived three pipelines, passers-by of the Trinity, the actual via dei Condotti, the middle one was built in travertine and side terracotta. In this way the water channeled into a new booty (castellum secondary) located in Piazza Caetani, the current Largo Goldoni, to be distributed to private households in the plain of Campo Marzio. The main pipeline passing under the Pincio carried water in Piazza di Trevi. Under Pope Leone III the three conductor of Gregory XIII were replaced by a single pipe lead. Other lead pipes that go the first pipeline were created in the lower part of Via Condotti and doing all head in the barrel of the Caetani (fig. 4).

2.2 The Acqua Felice

During the pontificate of Pope Gregory XIII (1572-1585) the inhabitants of Trastevere still using the water of the Tevere, purified in tanks by the Benedettini of San Calisto and by the Carmelitani Scalzi di Santa Maria della Scala. The Acqua Vergine, in fact, fed the plain of Campo Marzio, leaving yet discovered the area of Trastevere and, for reasons related to the particular configuration of the soil, the area of packages: the Quirinale, the Viminale, the Esquilino and the Campidoglio. With the target of bringing water to the Quirinale hill, where there was the residence of the popes, and the surrounding hills of Rome, Pope Gregorio XIII decided to reactivate the old aqueduct Alessandrino which used sources of Pantano Borghese at Colonna. On the death of Pope Boncompagni, work will proceed with Pope Sisto V, Felice Peretti, from which the aqueduct was named. The Acqua Felice, completed in 1585 under the direction of Matteo Bartolino first and then by Domenico Fontana, the main implementer of projects of Pope Sisto V, developed along a route of 37 km, including 28 underground and 8 above ground at the end of which was built the great exhibition of Mosè in Piazza San Bernardo, built on the designs of Domenico Fontana. From the beginning of its restructuring the aqueduct, which also fueled the grandiose villa on the Viminale: Villa Montalto destroyed, it was subject to constant maintenance [3] which provided quarterly checks to pipelines and fountains that served. Moreover, by special decree in 1580 it was decided the protection and preservation of its assets and factories built along the path of the hydraulic system.

The sources of the Acqua Felice found in Pantano at Montecomprati-Colonna, a short distance from the railway station Pantano Borghese vicinale Rome-Fiuggi. The source was lower in altitude 69 m. above sea level, while the highest was at an altitude of 208 meters. The aqueduct, a single cave, followed an underground route to Roma Vecchia achieved while Roma was developing on arches using the piers of the ancient aqueduct Marcio. From Roma Termini you enter in lead pipes to arrive under Piazza Cinquecento and Piazza delle Terme coming in the main castle next to the fountain of Mosè from which it begins the distribution to private users and to public fountains.



Fig. 5: Acqua Felice. On the left, Porta Furba and some arches of the aqueduct. On the right wall fountain of 1733 near Porta Furba.

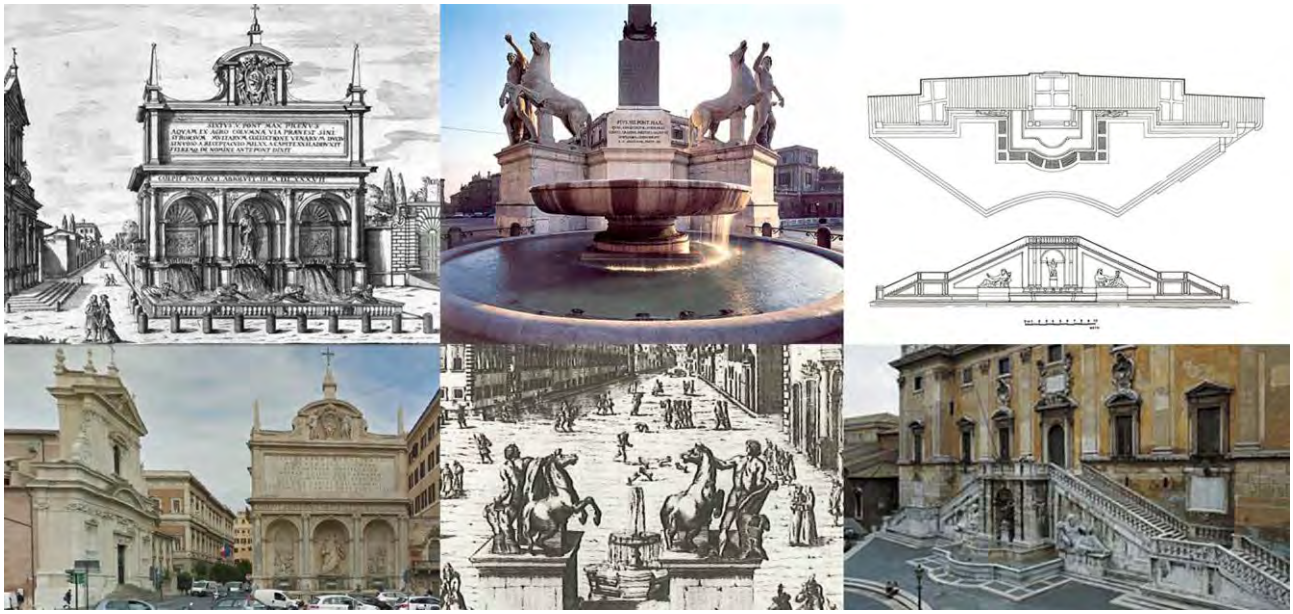

Fig. 6: Acqua Felice. To the left, the show-fountain of Moses in an etching of GT Vergelli, PP Girelli, 1680-90 and a current photo. At the center, the Fountain in Piazza del Quirinale in a current photo and a view of Tiburzio Vergelli, 1693 [6]. To the right, the Fountain of the New Palace to the Capitol in the drawings of relief [10] and a current photo.

Other important castles were built at Porta Maggiore and Porta San Lorenzo. During a meeting of the 1587 Council of the municipality capitolino [6] were chosen places in the city to serve and decorate with public fountains. Not all were built and some were added later, among which the fountain in Piazza Madonna dei Monti; in Campo Vaccino (located in the Roman Foro, whose basin was used later in the fountain in Piazza del Quirinale); under the Campidoglio, at the foot of the capitolina cordonata of Michelangelo, where then were placed two Egyptian lions; in piazza Campidoglio, the center of the scale of the Palazzo Senatorio; in the courtyard of the Palazzo Nuovo, the seat of the Musei Capitolini; in piazza Aracaeli; in piazza Campitelli; in the disappearance Piazza Montanara once located between the Campidoglio and the theater Marcello (now the fountain is located in Piazzetta San Simeone). This municipal program was implemented through the activities of Giacomo della Porta that, as official architect of the town, realized several fountains in Rome. The Apostolic Camera was interested instead of the construction of the fountain in piazza Quirinale, then subsequently dismantled, performed by Domenico Fontana who was also interested in the arrangement of the square and the restoration of the group of the two Dioscuri. Other fountains were built by individuals in return for use of the Acqua Felice as in the case of the family Mattei who was committed to the construction of the Four Fountains in the intersection between the ancient Via Pia (now Via del Quirinale-via XX Settembre) and via Felice (now Via Sistina) (figg. 5, 6).

2.3 The Acqua Paola

With Paolo V, in 1608, was activated the Acqua Traiana to serve the neighborhoods on the right of the Tevere. The Pope bought by Virgilio Orsini, Duke of Bracciano the group of sources that already fed the aqueduct. Reusing the old aqueducts, the waters in part were for both the Vatican and private citizens. Over the centuries, other waters were entered to the Acqua Paola that increased thus its scope. In 1646 Pope Innocenzo X fueled the aqueduct with other sources of the territory of Anguillara. Clement X taken water from Lake Bracciano and in 1829 Pope Leo XII taken the waters of nearby Lake Martignano. At the conclusion of the new aqueduct Pope Paul V built by Giovanni Fontana and Carlo Maderno the show-fountain of S. Pietro in Montorio on the Janiculum that later in 1698 with Alexandro VIII was enriched with a large bath that brought a new attitude to the square front of it. With the water Paola were also fueled the two fountains of St. Peter. Numerous sources were located close to Lake Bracciano and were connected to it with tunnels that exceeded hilly terrain of about 480 m above sea level. The waters of the lake were taken with the construction of the Castle Vici located near the bank and having three openings; the sockets, instead, were consisted of small galleries. The waters of the lake came in to the water through a building called "Botte di Unione" from which it begun the aqueduct Paul, who is therefore composed of two arms: one with the Trajan source near to the train station of Manzania, line Rome- Viterbo and with a length of 24.5 kilometers with an additional 7.8 km of tunnels; the second is Paul starting from Botte di Unione and with a length of 32.10 kilometers. The aqueduct is almost all underground except some sections, including that of about 400 meters at the bridge said the channel Arcacci for crossing the valley of Cesano (fig. 7).



Fig. 7: Acqua Paola. On the left, ground projection of the shadow of a stretch of which are still visible in the theories of arches in the estate dell'Olgiata in Cesano (Google Earth). Right, arches of the track still visible in Via Casale San Pio.

Before the Porta S. Pancrazio at the church of the Madonna del Riposo, the aqueduct branches off the arm that serves the Vaticano and the two fountains of Piazza San Pietro. The aqueduct continues by via Casale di San Pio V, via Aurelia antica, villa Doria Pamphili and ends in the Gianicolo to m. 69 above the sea level.
Given the lacustrine origin, the Acqua Paola was never distributed in Rome as drinking water but only in the service of the fountains for industrial uses and for washing, starting by the five castles located after the exhibition of the Gianicolo.
As with the aqueducts Virgo and Felice, immediately after the activation of the Acqua Paola was executed a plan of urban distribution of water through a Bolla published on 13 November 1612 in which Pope Paolo V exposing his intentions to build new branches for both serve those regions which had not yet served by the water but also to realize new fountains with the purpose of beautifying the town. New pipelines were built to bring water to the Gianicolo, the Vatican, Trastevere but also to bring the water beyond the bridges and Sisto dei Quattro Capi (Ponte Fabricio) arriving on the Campidoglio and other places of the town through the creation of Castels.
Among the fountains made, you remember the show-fountain on the Gianicolo and the fountains in: piazza Santa Maria in Trastevere, piazza Trilussa (a Ponte Sisto), piazza Benedetto Cairoli, via Giulia (the fountain of the Mascherone), piazza Capodiferro, piazza Farnese, piazza Santa Maria Maggiore (fig. 8).



Fig. 8: Acqua Paola. Above, the show-fountain at the Gianicolo in a current view and in an engraving of Gottafavi, 1837. Below, the wall fountain in piazza Trilussa, ponte Sisto in a relief drawing [11], in a current photo and an etching by Giuseppe Vasi, 1759.

2.4 The Acqua Pia Antica Marcia

In 1865 to a design by Luigi Canina and then after his death thanks to the architect Nicola Moraldi, was designed the restoration and reuse of the ancient aqueduct Marcio. The implementation was carried out by a company that obtained the concession by Pope Pio IX, who called the aqueduct Acqua Pia Antica Marcia. So it was brought back in the town the ancient Acqua Marcia with a path ending in the show- fountain of the Naiadi in piazza della Repubblica. At first the water was placed in the current via Luigi Einauidi, where later it was put the monument to the fallen of Dogali.



Fig. 9: Acqua Marcia. Remains of arches visible in Aqueduct Park in via Tuscolana.

The springs are located at different altitudes between 321 and 327 m above sea level, are located in the valley the Aniene between Roviano Agosta and Marano and are the same sources from which water took the ancient aqueduct Marcia Augusta. The plant is distinguished into two parts: from the sources to Tivoli, in which it is free hair, from Tivoli to Rome is penstock. Some stretches of the aqueduct Marcio are still visible in the Park of the Aqueducts in viaTuscolana and some arches of the alley of Porta Furba in the ground of the Bank of Italy. In the Aniene Valley and up to Capannelle, the structure is almost completely underground except for crossing ditches. From Capannelle to the arcs of the acqueduct Marcio are overlapped those of the ancient aqueducts Tepula and Julia. Also visible is the section of spechi at Porta Maggiore and Porta Tiburtina (figg. 9, 10).



Fig. 10: Acqua Pia Antica Marcia. Naiadi fountain in an antique photo (left) [6] and a current photo (right).

3. Conclusions

Considering the town an artifact of architecture that has a strong complexity as it includes a number of elements visible and not that are relate to each other, the documentation of signs, recognized as characteristic features of an urban environment, promotes knowledge of places and also returns the logic of the facts of settlement, so it can be a tool to investigate and read a town or a part of it, its transformations and evolutions that has suffered in the course of its history. The water in the town of Roma has left a mark even when there was no more, its presence and absence has influenced the course of its history and the history of its inhabitants. The value that the water has had and has for this town we perceive through the town, not only watching but also listening to the flow of water that falls from the jets or by the architecture of the majestic shows that with their magnificence welcome in town a water coming from afar. All fountains, small and large, mural or round, have enriched the town featuring urban spaces, each with its history that

reflects the history of a people. The ancient Roman aqueducts and Renaissance were the result of a technological innovation that led to new living conditions. Just think of the miles of pipes that have been made, to the mountains and to the hills that have been drilled, the valleys that have been exceeded. It's necessary and important to protect and preserve this immense heritage linked to water to enhance awareness of the historic urban landscape that a town like Rome offers [12].

Bibliographical References

[1] FEA, Carlo, *Storia delle acque antiche sorgenti in Roma e modo di ristabilirle. Dei condotti antico moderni, delle acque Vergine, Felice, Paola e loro autori*, Roma: Stamperia della R.C.A., 1832.

[2] MASTRIGLI, Federico, *Acque acquedotti e fontane di Roma*, voll. I e II; Roma: Ed. Enzo Pinci, 1928.

[3] CORSETTI, Giampelino, *Acquedotti di Roma: dai tempi classici al giorno d'oggi*, Roma: Fratelli Palombi, 1937.

[4] LANCIANI, Rodolfo, *Le acque e gli acquedotti di Roma antica*, Roma: Coi Tipi del Salviucci, 1881. Ristampa anastatica, Roma: Quasar, 1975.

[5] PANIMOLLE, Giuseppe, *Gli acquedotti di Roma antica*, vol. I e II, Roma: Abete, 1984.

[6] D'ONOFRIO, Cesare, *Le fontane di Roma*, Roma: Romana Società Editrice, 3a Edizione, 1986.

[7] BRIZZI, Bruno, *Le fontane di Roma*, Roma: Editore Carlo Colombo,1988.

[8] Comune di Roma - Assessorato alla cultura, *Il sistema degli antichi acquedotti romani*, Fratelli Palombi Editori,1995.

[9] FRONTINO, Sesto Giulio, *Gli acquedotti di Roma. Introduzione, traduzione e note a cura di Francesco Galli*, Lecce: Argo, 1997.

[10] SOLETTI, Adriana, *Chiare, fresche, dolci pietre. Il rilievo delle fontane murali romane*, Roma. Dizioni Kappa, 1997.

[11] MARTONE, Maria, L'acqua e i beni culturali. La fontana in piazza Nicosia a Roma. In: *Revisiones del futuro, previsones del pasado. V Congreso Internacional de Expresión Gráfica en Ingeniería, Arquitectura Y Áreas Afines. X Congreso Nacional de Profesores de Expresión Gráfica en Ingeniería y Arquitectura, Y Áreas afines Egrafia, Rosario 1-3 ottobre 2014*, coordinado por Salvatore Barba, Rosario: CUES (editorial) y FLASHBAY (edición digital) para EGraFIA. 1a ed., 2014, p. 664-669.

[12] This paper represents a deepening of the Sapienza University Research entitled: "The value of water in the heritage of cultural heritage through the reading of some episodes architectural, urban and territorial" of which the author is responsible.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Knowledge in Apollonia.
The Medieval Monastery and the territory.

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Abstract
The route of the research is aimed at understanding the medieval monastery in the archaeological site of Apollonia with search of operations to investigative character, to which are added references to the religious theme that, in relation to archeology, displaying the beauty of composition and structure of coenobitic architecture in the territory. They are readings of structures and archaeological works that refer to the territory; they are analyzes that are fertile knowledge suitable to be perceived, represented and documented in the main dimensions through the existence of points in time and spatial continuity in the experience of the archaeological site of Apollonia.
The knowledge of the archaeological site and monastic Apollonia consisted of the reading of the territory, given to the understanding of all the complex issues that contribute to determining the shape, not only as the outward appearance, but also as the bearer of intangible assets, related to the history, culture and traditions that over the centuries have impressed their signs to the environment, starting a knowledge of the territory, so to speak genomics. The ultimate goal of this research is to promote the development of the region through the protection and enhancement of natural and cultural resources present, in order to combine the improvement of the environment with economic growth resulting from the development of tourism activities, productive and cultural, in terms of sustainability.

Keywords: Design, Albania, Apollonia, Medieval Monastery

1. The monastic complex and the research methodology.
Knowing a monastic site in an archaeological complex and its territory means to review the history of its inhabitants and its urban fabric or acquire social structures and archaeological sites of the past and present and also more attention to what is preserved heritage from protect current and future as a powerful sign of the cultural and social well-being. Capture information and understand the value of human heritage, urban and monumental, it means to own the image of the city and its historical identity. For acquisitions can be referred to mediation between moments correlated in the language of living such as the categories of space, time, and ethics of the people - share expressions of nature and landscape is understood as a value generator, passing from ethics to aesthetics or the beautiful real.
The landscape thus seen as a tangible manifestation of the environment and spatial reality, can be interpreted with the noble sense of sight that can be directed to the perception not only of form but with other studies, including the color of building materials, light as a result of climatic changes. The interpretations are of monastic sites and archaeological works that refer to the territory; are analyzes that are prolific of adequate knowledge to be perceived, represented and documented in the main dimensions through the existence of points in time and the continuity monastic - archaeological experience territorial site of Apollonia.
The research is based on the belief that any action for the protection and valorisation of the sites can not be separated from a preliminary activity of multidimensional knowledge based on discretization and extent of the heritage. The tools of knowledge that we have broaden the traditional concepts of geometry and measurement, enabling a multidimensional representation, in which each component, material and immaterial, between the parties, to return the territory as a dynamic entity in constant evolution.

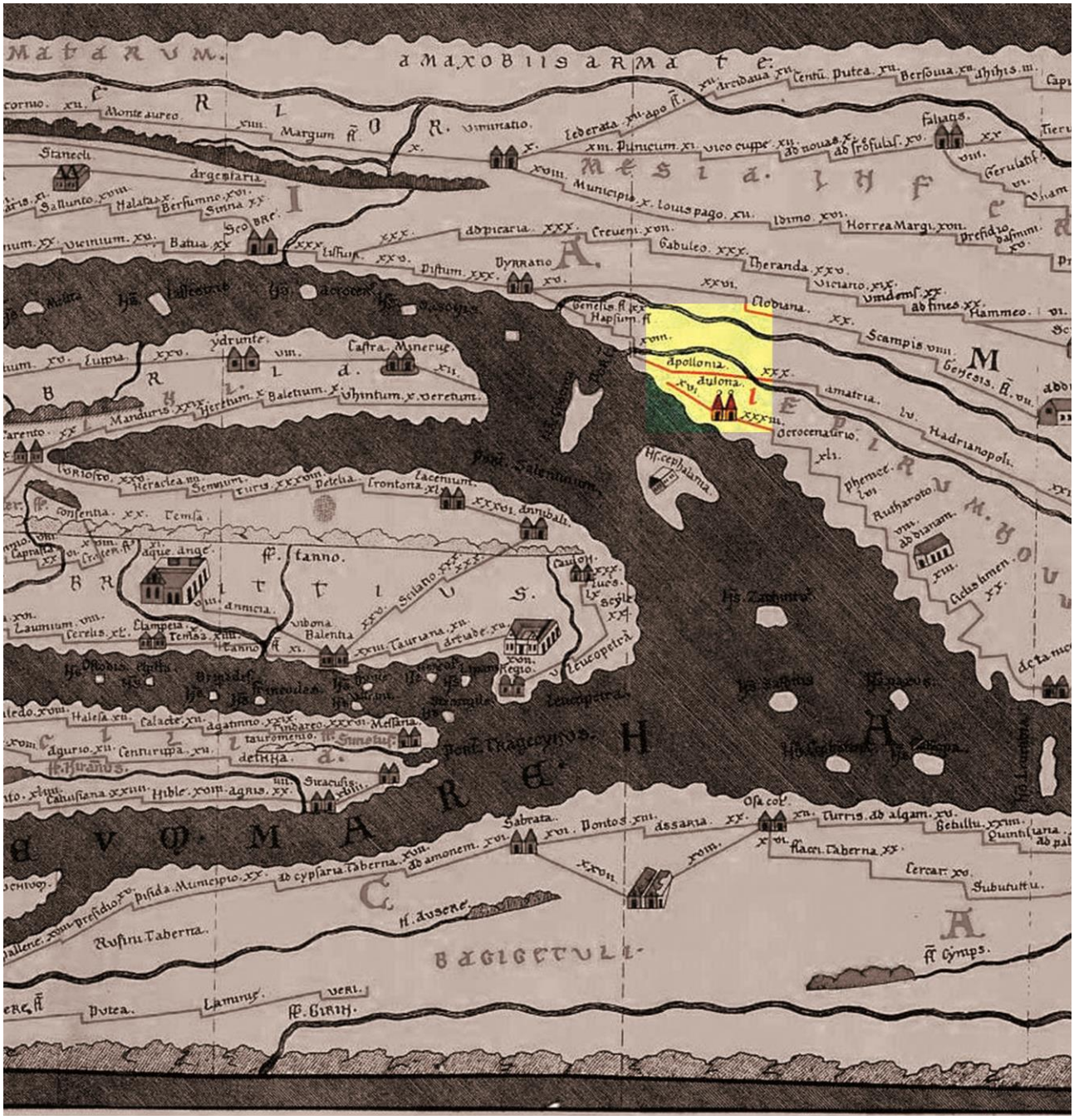

Fig. 1: Table Peutingeriana: identification of the site of Apollonia.

The methodological system is gave from the sum of the individual monothematic knowledge, but from a full knowledge, in which data is qualitatively and quantitatively itself, integrating the complex knowledge of that and only that point. Each point is described by a variety of information from the studies conducted in most disciplines, that analyze the characteristics and intangible assets ecogeometric triggering an approach that allows, therefore, to “measure the complexity”, to recognize the basic characteristics of local identity, by reading the signs. It is therefore the most effective means not only to analyze a territory, but also to program the management by defining a hierarchy of interventions for development. The application of the method ecogeometric has allowed for the integration of knowledge and multidisciplinary expertise, identified as essential prerequisite for the Government of the modification.



Fig. 2: Apollonia, Albania, the relief of the Medieval Monastery, plant 00.

The knowledge of the monastic site of Apollonia consisted of the reading of the territory, given to the understanding of all the complex aspects that contribute to determining the form, not only as the external appearance, but also as the bearer of intangible assets, related to the history, the culture and the traditions that over the centuries have impressed their signs to the environment, starting a knowledge of the territory, so to speak genomics. Integrating knowledge and technologies, has as its the motor of innovation in the cycle of protection and valorisation of the regenerative cultural, environmental, and industrial landscapes, the ambitious goal of defining operational protocols for analysis and knowledge, and then the design and sustainable land management, which can be used as models exported to other contexts.



Fig. 3: Apollonia, Albania, the Medieval Monastery, entrance to the religious complex.

The final objective of this research is to promote the development of the region through the protection and valorisation of natural and cultural resources present, in order to combine the improvement of the environment with economic growth resulting from the development of tourism activities, production and cultural, in terms of sustainability.



Fig. 4: Apollonia, Albania, the Medieval Monastery, the old convent now home to the museum.

2. The monastic complex and the archaeological site of Apollonia.

The archaeological park of Apollonia is located 12 km west of Fier, near the village of Pojan. The ancient city is located at the foot of a lonely hill in front of the lagoon between the mouth of the river to Vjosa and Seman. The archaeological site covers an area of 137 hectares, where reminiscences of civilization illirie, greek, Roman, Byzantine, Ottoman, Fascist, Communist to testify today the story. Apollonia was founded in 588 from Corinthian colonies from Corfu.

It became one of the most important colonies and ports of the Adriatic coast, where the trade to and from the hinterland of Albania, Macedonia, Italy and Greece was going to the city to intensify and grow and be embellished. Developed schools, the arts, architecture and philosophy, in the fifth century BC. Apollonia was a city - state and minted its own silver coin expanded throughout the Balkans. In 299 AC the city came under Roman rule that connect making it a focal point of trade along the eastern Adriatic coast. Caesar in 48 a. C, chasing Pompey and his troops settled in Durres, camped in Apollonia.



Fig. 5: Apollonia, Albania, the Medieval Monastery, the ancient refectory.

The support given to Caesar during the war against Pompey earned in Apollonia the status of free city guaranteeing a prosperous future. In the third century d. C, a strong earthquake caused extensive damage to the city was changed the course of the Vjosa river, making it unnavigable, the port, now abandoned, gave rise to a marshy area, consequently as malaria. These social and economic consequences Apollonia conducted to a progressive decline and abandonment. In the first half of the thirteenth century, when the city was already abandoned and destiny reduced to a small community, a group of Orthodox Christians built a monastery and church of Santa Maria. For the building of the monastery they were used stones and settler of the city and it is believed that the monastery of the Virgin stands on the ruins of the temple of Apollo.



Fig. 6: Apollonia, Albania, the Medieval Monastery, the bell tower built on the ruins of a defensive tower.

3. The monastic complex and religious structures.

In the southeastern part of the old town center of Apollonia is located the monastery of the Dormition of the Virgin Mary that, after the Second World War, is now a museum. The monastery, also known as the Monastery of the Panaghia, stands with a quadrilateral shape, the configuration of which is irregular due to the use of part of the old city walls. Even the bell tower, built after the First World War, stands on the foundations of the medieval defense tower.

The proportion available for hermitage, amended several times and completed only recently, is divided into two parts with two floors, located on the northern and western part of the monastic complex and at right angles, which open onto a courtyard with galleries with arches and external staircases. In the west wing is the refectory: an environment shaped rectangular niches on the east and west sides and an apse in the south wall.



Fig. 7: Apollonia, Albania, the medieval monastery, the katholikón

The frescoes, of great importance, are dated between 1315 and 1320 it represent the oldest evidence received of fresco decoration of a refectory in Byzantine art.
At the center of the courtyard is the il katholikón: a religious building a cross with a dome which has at the bottom a thorough reuse of blocks from the ancient theater of Apollonia; the top of the structure, with a dome supported by a drum and barrel vaults, is made of plastered brick. The west wall, connecting the property to a local central square, consists of a gallery with arches, columns and pillars alternating; south and north entrances are equipped with porches, the north side is a chapel. Decoration are preserved fragments of frescoes in the narthex, as well as important sculptural pieces such as capitals with zoomorphic and anthropomorphic.



Fig. 8: Apollonia, Albania, the medieval monastery, the porch with columns and pillars

Bibliographical References

[1] DUCELLIER A., 1965, Observations sur quelques monuments de l'Albanie
[2] GAMBARDELLA C., (2001), Ecogeometria in Venafro. Identità e trasparenze, Napoli
[3] GAMBARDELLA C., (2003), Le Vie dei Mulini. Territorio e impresa, Napoli
[4] GAMBARDELLA C., (2009), Atlante del Cilento, ESI, Napoli
[5] GAMBARDELLA C., (2012), Atlante di Pompei, Napoli
[6] GIORDANO P., (2012), Il disegno dell'architettura costiera, La scuola di Pitagora editrice
[7] GIORDANO P., CORNIELLO L., (2014), Atlante Grafico e Teorico Amalfitano. La conoscenza e la modificazione del paesaggio costiero, La scuola di Pitagora editrice
[8] KAHN A., 1961, Apollonia, City of Statues, Archaeology
[9] KARAISKAJ G., (1981), Prese mije vjet fortifikime ne Shqiperi, Tirana
[10] MALIQARI A., (2013), Management Plan Historic Center and Buffer Zone of Berat, PEGI, Tirana

[11] MEINEKE A., 1849, Stephani Byzantini Ethnicorum quae supersunt, Berlin
[13] MEKSI A., 1971, Arkitektura dhe datami i kishës së manastirit të Apollonisë
[14] MEKSI A., 1971, Monumentet
[15] MEKSI A., 1974, Dy ndërtime të tipit trekonkësh
[16] MEKSI A., 1976, Mbi disa probleme të kishës së manastirit të Apollonisë
[17] NALLBANI H., 1976, Të dhëna të reja rreth pikturës së kishës së manastirit të Apollonisë
[18] PUZANOVA V., 1961, Manastiri Shën-Mëria e Apollonisë në Pojan, Buletin i Universitetit Shtetëror të Tiranës, Seria Shkencat Shoqërore

HERITAGE and TECHNOLOGY
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Mario Botta, the man's house in the New Stone Age

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Abstract
The architectural work of Mario Botta, reinterpreted through a perspective of continuity between past and present, describes a route project that has helped to change the idea of architecture in the eighties of the last century. The analysis of the first phase project of the Swiss master reveals, as well as a rooting characters identity of the traditional territory of Ticino, a great capacity for innovation in relation to the type, morphology and the contemporary language of architecture. The large number of single-family homes designed by Mario Botta in the first twenty years of his professional life well represent the architectural issues at the base of a research characterized by novelty able to rise to the construction of the house of the man in the role of symbolic metaphor not only in relation to architecture domestic but also in respect of subsequent experiments the urban scale and the territorial.

Keywords: Mario Botta, project of the Swiss, Ticino

1. The man's house in the New Stone Age
A seemingly traditional building, made of stone blocks mounted by uncertain, on a hill below the severe bulk of the parish of Genestrerio: this is the first work by Mario Botta, a parish house, built between 1961 and 1963 in small village located south of Mendrisio. The compact volumetric importance of building block, capable of dealing with the texture of the stone above the southern facade of the church, while denouncing a desire for continuity with the local building tradition expresses, through the long horizontal cuts of ribbon windows, a clear trend towards the figurative architecture of the Modern Movement. A combination that, by relating the typological and morphological tradition of the aesthetic language of the Modern, pushes the first work by Mario Botta to a totally contemporary architectural definition already emerged, however, in the works before the so-called school of Ticino and the “neo-razionalist” Italian, Milan school, so called “Trend”. A movement that developed in the sixties of the last century largely due to theoretical and design of Italian architects like Aldo Rossi, Carlo Aymonino, Giorgio Grassi and Ticino architects as Luigi Snozzi, Aurelio Galfetti, Livio Vacchini, Tita Carloni. Such cultural affiliation would not, however, produce the next acceleration style of Mario Botta, towards his colleagues Ticino and Milan, if there had been a strong intellectual curiosity against a great master of overseas or passion towards work of Louis Kahn. Unlike language, favored by the other members of the “Trend” of the Italian and Ticino, the dense materiality of architecture and the refined linguistic symbolism of American master will remain etched in the subsequent works of Mario Botta as a clear character of belonging not to the language of a teacher but to an idea of architecture, exalted above all in the last works of Luis Kahn, that is a matter of substance rather than appearance. Idea of architecture, capable of dealing with a symbolic dimension of the building obtained through a design research, is not based on a geometric rationalism but also on a formal fluidity that can be generated, either from a perception deterministic or a poetic vision of characteristics identity of their environmental realities in which to place objects unique architectural and never repetitive. The substantial number of single-family homes, designed by Mario Botta, in the first twenty years of his professional life well represent the architectural at the base of a research strongly characterized by new typological, formal and linguistic able to be given the status of the construction of the house of man to the role of symbolic metaphor not only domestic but also in relation to architecture against subsequent experiments the urban and the territorial scale. The project cycle that analyzes is included in the time period that starts with the design of the parochial house of Genestrerio built in 1963 and comes to the construction, in 1983, the house of Morbio Superiore.



Fig. 1: Mario Botta, House of Genestrerio, 1961/1963.

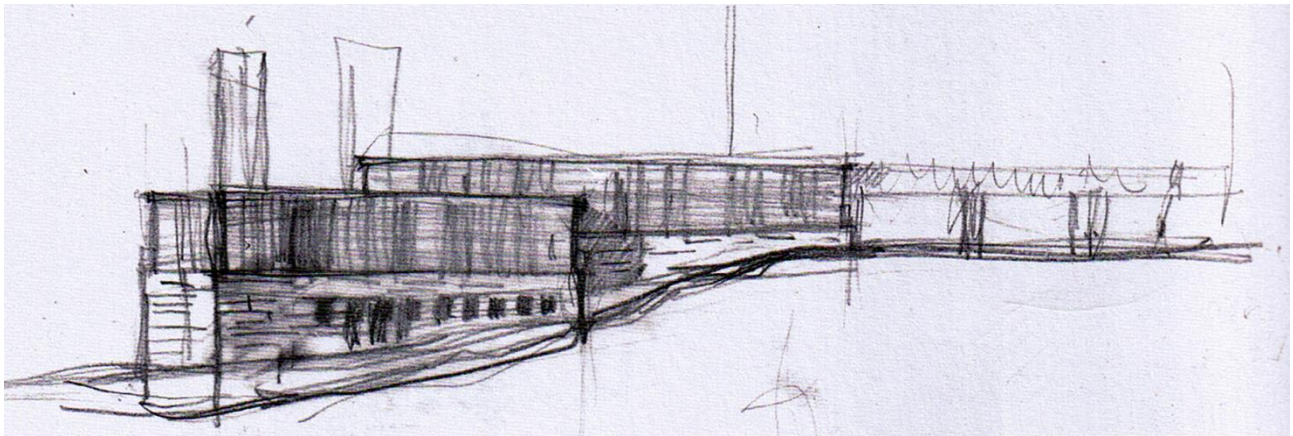

Fig. 2: Mario Botta, House of Genestrerio, 1961/1963.

Between these two works Mario Botta designs, in two decades and in tight succession, the house of Stabio (1965-67), one of Cadenazzo (1970-1971), the lake house of Riva San Vitale (1971-1973) The house Ligornetto (1975-76), the house of Pregassona (1979-1980), the house of Massagno (1979-1981), the house in Viganello (1980-1981) and the house made cylindrical in Stabio in the biennium 1980-1981. Although the research work of Mario Botta on the house has gone over the two decades said the research will dwell on

the first project period as it is characterized by a research on the architectural form capable of expressing archetypes building characterized by pure geometric configurations essential yet complex as the exercises of the second project twenty years or what the house of Breganzona of 1984 (a sort of large insect architectural) comes through the expressionism of the house of Daro (1989-1992), until the “splinter architectural” represented by detached house of Bernareggio in 2001.

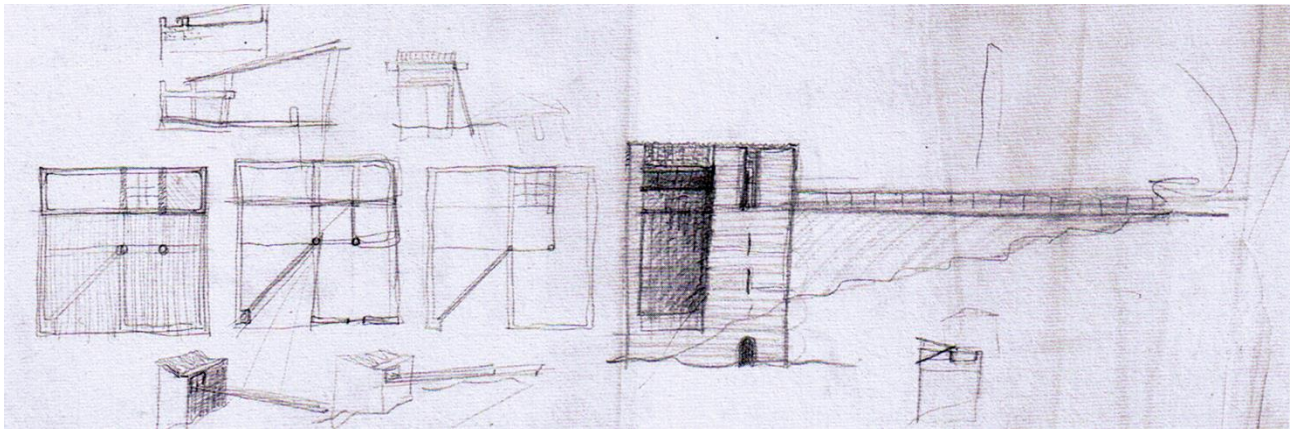

Fig. 3: Mario Botta, House of Riva San Vitale, 1972/1973.

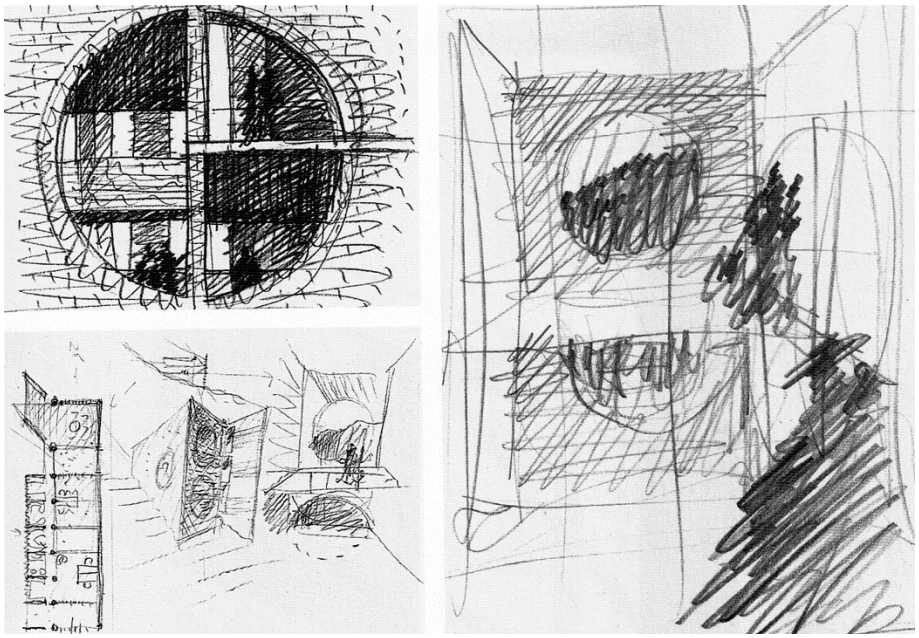

Fig. 4: Mario Botta, House of Cadenazzo, 1970-1971.

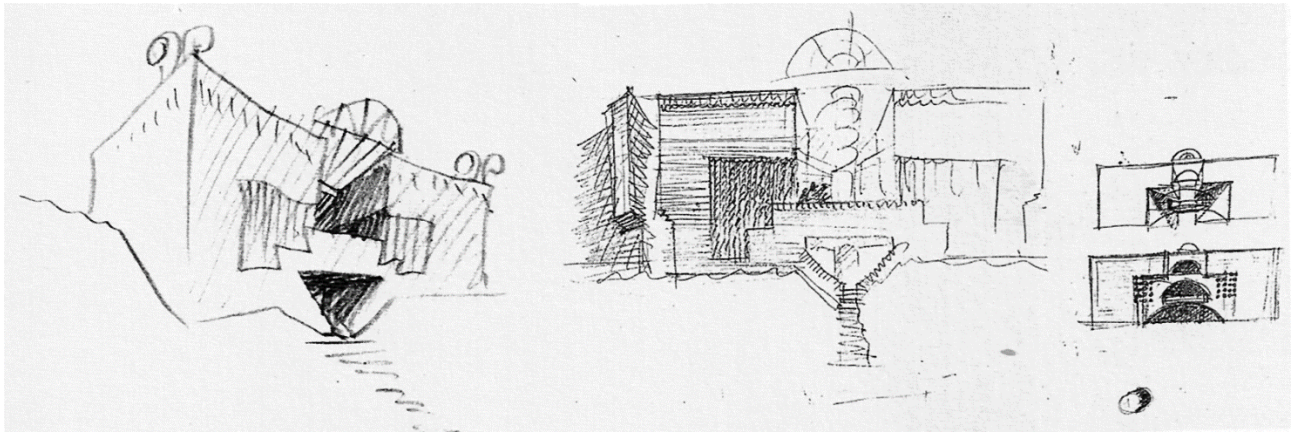

Fig. 5: Mario Botta, House of Viganello, 1980-1981.

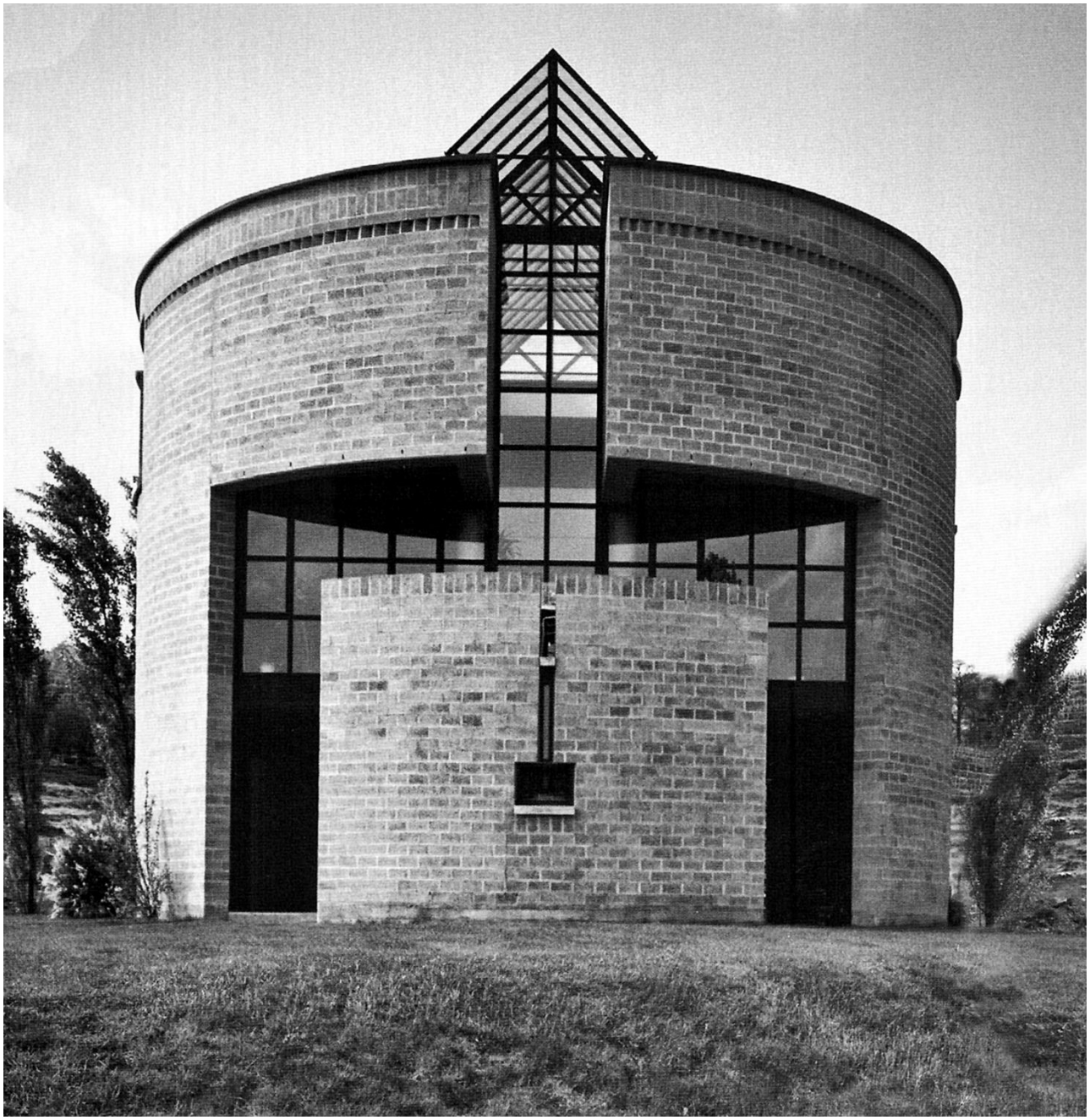

Fig. 6: Mario Botta, House of Stabio, 1980/1981.

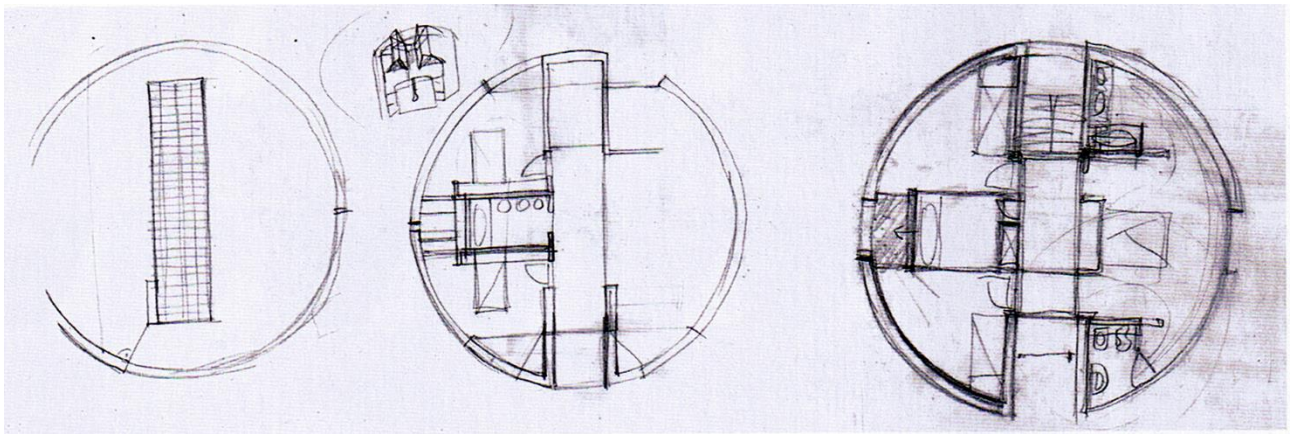

Fig. 7: Mario Botta, House of Stabio, 1980/1981.

Single family homes, where we see not only a complex sophistication of the joints and volumetric space of the buildings but also and above all a clear hybridization of types and shapes which mark a decisive design evolution than the previous twenty-year cycle. A cycle, the latter, which can be defined as “the Stone Age” of Mario Botta or the double meaning signifier is the first phase, almost legendary by now, the project work of the master of Ticino and is the use of a material poor, the concrete block of expanded clay, which to reproduce the appearance of the lost paradise of architecture metaphorically identified by Ludovico Quaroni use of stone in the construction of the architecture of the past. The contemporaneity of the work of Mario Botta is expressed also in the use of simple materials such as Bloc hired and dignified like a real stone. The external walls of the first single-family houses of Mario Botta infact appear the same way as domestic small medieval fortresses and the complex and different modes of implementation of the wall and both the unusual shape of its openings (ribbon, diamond, circular, slit, to lodge, in rectangles tapered from bottom to top, trapeze overturned). The only exception to this strong reminder of the past is represented by the design of the first house built by Mario Botta, after the construction of the parochial house of Genestrerio, or the Le Corbusier House in Stabio 1965. This building made of reinforced concrete is a real tribute to the activity of the master side of the Alps with which very young, he worked shortly before his death - which occurred in the summer of 1965 - the design of the hospital in Venice in the study organized by Le Corbusier in the “Scuola di San Marco”. Writes Giuseppe Mazzariol, “[...] This house of Stabio is, after two years, the testimony of an authentic experience of life and culture; the sign of a profound spiritual memory, which for a young architect could not otherwise express the architectural reality; a simple flower on the plain of the Mendrisiotto, whom the great and superb Le Corbusier was greeted with a smile and moved quickly broadside of questions, all of tone on the legitimacy of the homage.” An architectural flower that will not be able to carry the reproductive spores of Modern in an area, or the Ticino, more willing to accept the design experiments of the “Trend” that emphasized, in those years, on its autonomy architecture and on the need to return to articulate it as a speech in terms of types and rules, the purpose of obtaining a logical combination of its elements; socio-cultural importance of urban structures that already exist and function performed by the monuments to represent and symbolize the continuity in time of public institutions; on the heritage of the past works, considered as a ful legacy that can be constantly resorting to a reinterpretation analog compared to this. Projects of single-family homes of Mario Botta, despite their small size scale, aspire to be, architecturally, the conditions and critical theorists of “Trend” proposing in Ticino territory as small monuments urban and suburban strongly characterized, first, by a new and logical combination between the parts and the whole; also the ability to evoke continuity rather than a break with the past and, finally, a clear allusion analog with the works of the past. A past that is not simplistically through the uninhibited use of signs and styles recovered from language historical classic - so fashionable in the so called era of postmodernism - but in relation to an in depth analysis of the essential contents of ancient architecture: an analysis that, going back “the origins of the work of Kahn, could only refer to the context Italianate, to say Roman, from which Kahn had been inspired after 1951”. The research of architectural form in absolute Luis Kahn was in the first instance “a spiritual act, almost mystical; not by chance that his most successful works are places of worship or symbolic. By competing directly with the past, he served at the same time as support and as a boost to the new, Kahn anticipated one of the central problems of the architecture of the following decades and prepared the ground between their different personalities like Aldo Rossi, James Stirling and Mario Botta.” The house opens to Cadenazzo, formally and linguistically, the season symbolic architecture of Mario Botta: a three-storey building set on the northern slopes of the hills of Monte Ceneri characterized by a simple rectangular volume in cement bricks left exposed. A compact architectural object in which stand out, on the southern front and on the northern, large circular openings shielding the backwaters lodges. A translucent wall in glass cement characterizes the west elevation contributing, with these openings, to dematerialize the monolithic overall volume. If the house of Cadenazzo is a kind of parallelepiped lying on the hillside of the Monte Ceneri subsequent work of Mario Botta, which is the single family home built on the shores of Lake Lugano, precisely in Riva San Vitale, on the contrary, it rises from the dense vegetation of Monte San Giorgio, through an architectural structure tower: a compact brick architecture of concrete and expanded clay characterized by openings in the form of vertical rectangular slots related to large square or rectangular openings. The tower building, almost place a guard tower with respect to the underlying lake, is still behind the slopes of Monte San Giorgio through a metal walkway that serves as a space serving aimed to connect the house with the rear access road to the site of membership. The return on the plains of the third work of Mario Botta first residential occurs across a work that, beyond the rational definition-morphological type of the article, is characterized by the first stylistic exercise obtained on prospects through the adoption of concrete bricks and expanded clay different color: appeals of three alternating rows of gray brick and yellow mounted after a work almost mimic the Romanesque walls of which is rich in Ticino. The subsequent work of Mario Botta, as the home of Ligornetto or house of Pregassona, represents the first example of a complex type that is produced by interlocking of a cylindrical and containing the staircase in a plant roughly square in shape: a volumetric that produces, on the opposite side to the stairwell, a gash glass on the main elevation protected, above, by a sloping roof gable made of iron and glass.

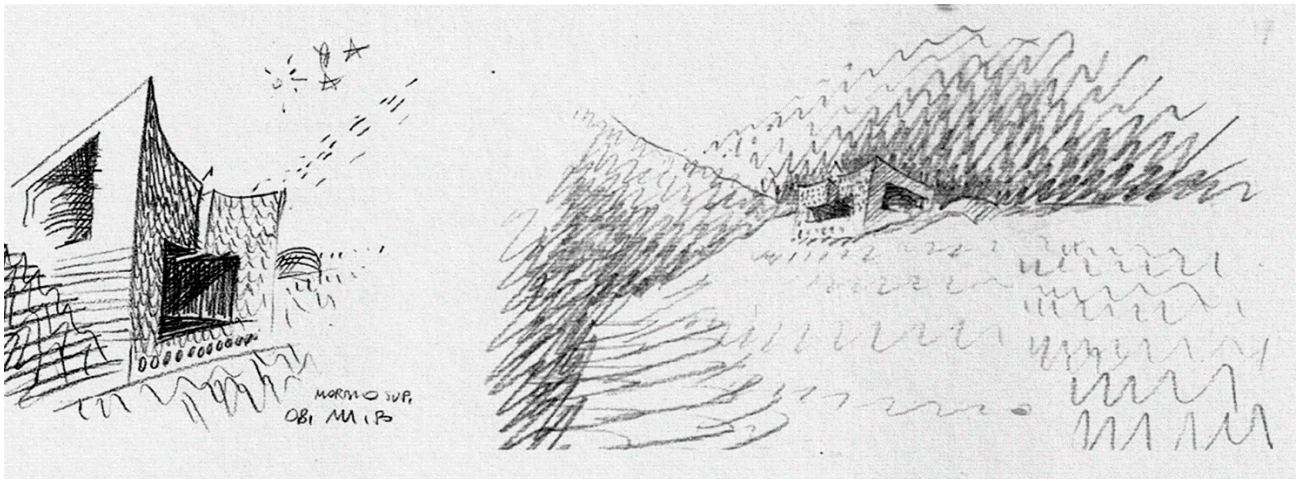

Fig. 8: Mario Botta, House of Morbio Superiore, 1982/1983.

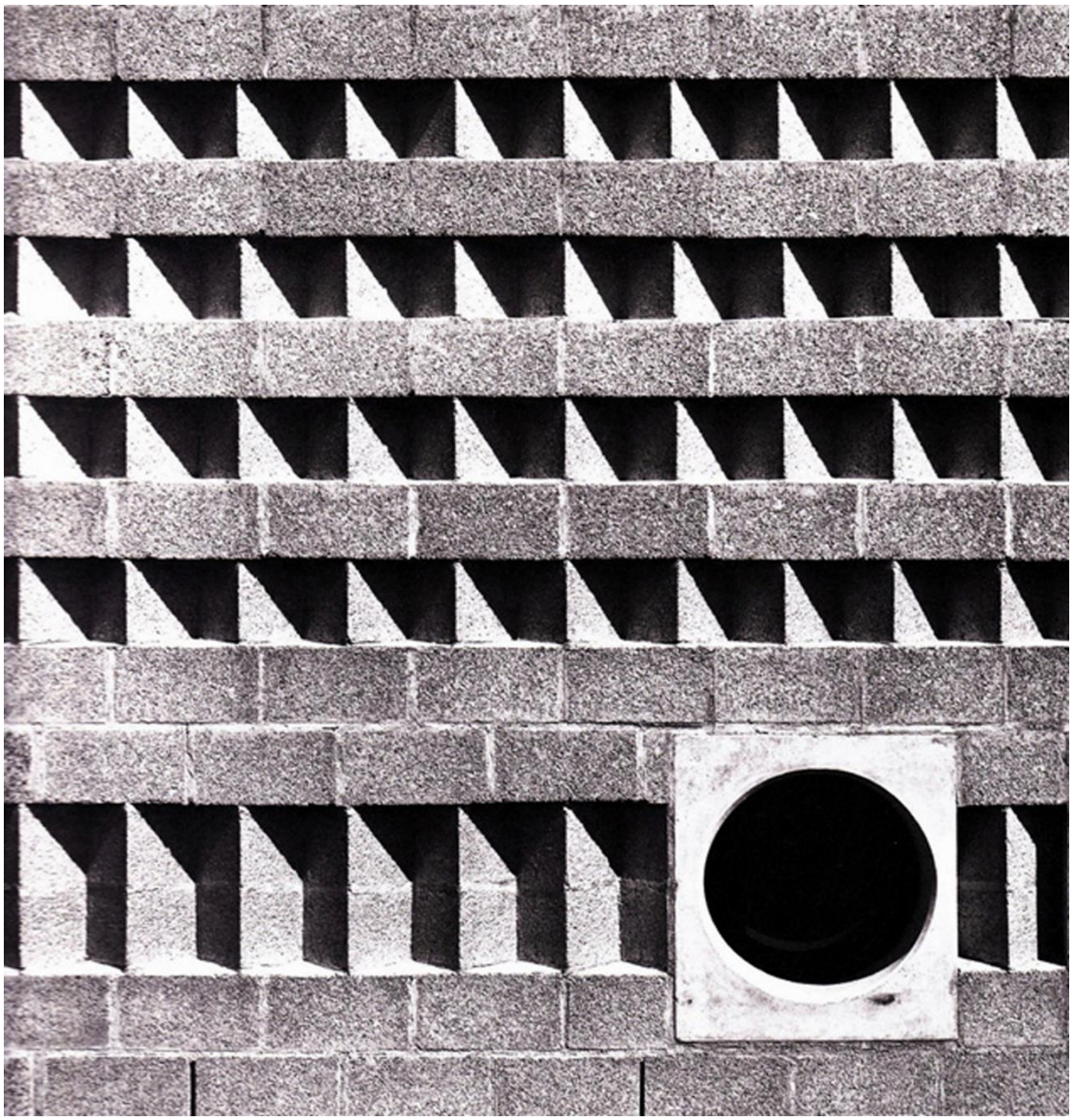

Fig. 9: Mario Botta, House of Morbio Superiore, 1982/1983.

The house of Pregassona is the experimental design of Mario Botta, consisting of a virtuous and unpublished work on configurations formal architecture based on the permeation of volumes and spaces as well as on a fine job of typological definition of the plants planimetric clearly of Enlightenment. A kind of symbolism planimetric able to reverberate even in exterior elevations of residential architecture thus defining a new schedule of residential archetypes for human life. An evolutionary process that is condensed in the house of Massagno where type, language and form leading to a work with strong symbolic characters all coagulated around the big open eye on the southern front of the residential building. An eye intelligent, that is equipped with movable eyelids materialize from two large windows concealed, if necessary translate into the wall flanking the large circular opening disclosing of the rural landscape. The new research project initiated by Mario Botta at the beginning of the second decade of his work is affirmed through the two single-family homes of Viganello and Stabio, both made in the period between 1980 and 1981: two buildings heavily characterized by pure forms - a cuboid and a cylinder - enriched with insights and typological language capable of anticipating the future virtuoso design of the long career of Mario Botta. A virtuosity that will explode in all its poetic and formal fluidity in the house of Morbio Superiore or in the architecture which marks the end of the first twenty years of design master Ticino through a mature work that can act as a conceptual hinge of the next research work and not only at the experimental scale residential but also that of the urban and territorial scale. The house of Morbio Superiore seems to encompass all the different architectural features that have marked the fortunes design of Mario Botta in his first twenty years of activity: first, from the point of view through a typological guessed interpenetration of architectural linear and point can to disengage the best interior spaces of the building, protecting, at the same time the dignity of the whole composition; also from the morphological point of view by virtue of a remarkable capacity for articulation against both the primary volume and secondary volume is trapped in the first space with great skill and sensitivity; Finally, from the linguistic point of view, through the brilliant infrastructure of the wall marked, on the main façade, a weaving of concrete blocks and expanded clay alternating with courses of Assizes Assizes courses straight to places to 45 th on the first colored silver. A plot wall that resembles both the “Palazzo Diamanti” in Ferrara and is the masonry of the church of Jesus in Naples. Not only. If the appearance typological, morphological and linguistic the upper house of Morbio represent, as a whole, a summary of the previous work of Mario Botta should be noted that the solid concave facade of the main prospect leaves open the question of the size of the intervention or landscaping: the concave wall is a kind of architectural radar capable of taking the signs of his being in that place, in that way, the local context outside or, conversely, is the landscape outside to push the main facade of the house up to bend it and to retreat before the forces of nature? Perhaps, ultimately, it could be only a brilliant compromise capable of neutralizing, harmoniously, the perpetual battle between nature and artifice.



Fig. 10: Napoli, Church of Gesù, 1601.

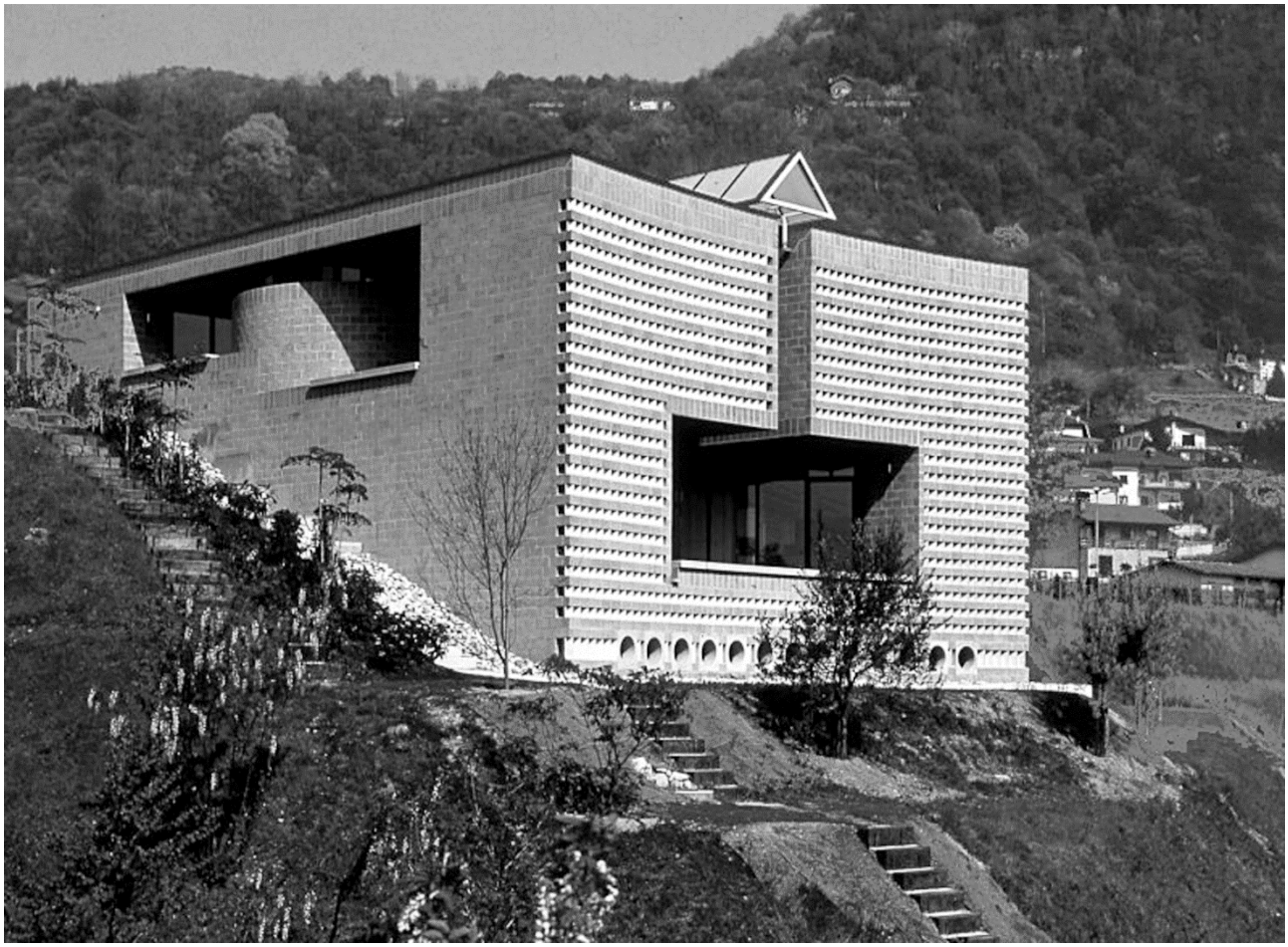

Fig. 11: Mario Botta, House of Morbio Superiore, 1982/1983.

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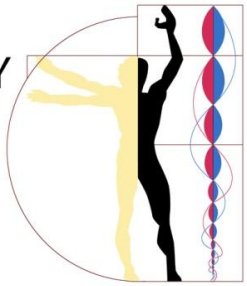

Museum Quarter as the “core of urban balance” in the post-industrial city

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Annotation

The paper offers a study on the phenomenon of the absence of historically and mentally expressed center in the city that was artificially assembled at different city planning stages from three self-sufficient and autonomous territorial units – districts. It focuses on the city of Togliatti located in the Volga Region of Russia, which can serve as a case study for many Russian cities built in the period of the country’s active industrial development over the last half century.

Togliatti is a unique territorial phenomenon, which has not obtained the recognition and status of a full-fledged city until now. And that is in spite of all kinds of possible top-notch epithets: city-experiment, city-laboratory, and city-utopia. "Despite the fact that Togliatti sprang up from nothing, this city belongs to the Soviet tradition – the tradition to build new cities" [1, P.7].

The paradoxical and contradictory nature of the object of the research creates a complicated precedent for reconciliation of "pure" design ambitions with post-project reality, but it already occurs in the mode of a running socio-cultural "disaster". Having several stages of birth in its arsenal: from a fortress city "Stavropol (the city of the Holy Cross)" (in the 1830s) to the status of the largest mono-functional city (in the 1960s), Togliatti fails to work out a cultural genome of the continuity of generations, traditions, memory, and a special local urban lifestyle. It fails to bridge the existing gap between the city’s provincial origin, which remained literally under water after flooding and the power plant construction, and the latest period of the actively developing "working" city. It fails to show "genius loci" that would consolidate the urban community, identify the territory and its inhabitants, make the city’s unique public spaces once again available and open to collective communication.

The creation of the “core of urban balance” in a post-industrial city is a complex, provocative, and to a certain extent, a futuristic project. In our case, we are talking about the project partnership "Museum Quarter Togliatti (MQT)", which is a conceptual idea of "a city within a city" that can be projected in time and space on the "zeroed out time axis" of almost a three-hundred-year history of Stavropol-Togliatti.

According to the authors of the project, the central recreational axis in the so-called “old town” is one of these key places. It divides the town’s “physical body” into two balanced parts and directly connects the present with the “lost past”. A vast wasteland in the center on the urban-natural border provides benefits for the game with the "pure idea" and the freedom of its materialization on a large scale similar to all urban initiatives that have been so far implemented in this area.

Keywords: post-industrial city, the Museum Quarter, project partnership, pre- and postproject reality, urban planning policy, public spaces, the “core of urban balance”

1. The post-project reality of the post-industrial city

1.1 Ideal – global. Geometry of life

A social experiment is characteristic of the nature of Togliatti, which is one of Russia's largest industrial centers (the population of more than 700 thousand people) that does not server as the center of a region. The mission of the project is to start the internal cultural intervention aimed at establishing of an image multifunctional territorial complex – The Museum Quarter Togliatti (MQT). It started in early 2014 at the initiative of the Board of Trustees of Togliatti Local History Museum, Togliatti Art Museum and the Social Policy Committee of the Duma of Togliatti. The initiative received support of the regional government, municipality, experts, and various local communities, developers, and city dwellers. "The social demand that has been made represents an attempt to understand and describe the basic need for infrastructure and image capabilities of the territory as the city center, the efficiency of its social and communicative connections and its investment attractiveness" [16, P.10].

The model of open design based on the interdisciplinary dialogue is not a usual practice of working with the territory in Togliatti. This project is an attempt to combine two vectors: the need for self-identification of citizens on the basis of collective memory and the value of the place and the general planning system, which is, by its nature, virtually unchanged and routine and not capable of being relevant and flexible. The homogeneity of the provincial urban environment, its amorphism, monotony and "coldness" influence depressingly on those who have to spend their lives there. Moreover, it paradoxically narrows the horizon for design solutions and its transformation. Scenarios of "revitalization" the cities and their centers as the most important components of communication are often reduced to borrowing patterns or to simple commercialization. Extinction of urban centers, "emptiness" of urban life, low-density cultural atmosphere do not allow to accumulate positive energy and make life in this city and in this environment in particular conscious and full of value.

Togliatti is one of the largest industrial centers of Russia that has been through several stages of birth, and nowadays it is a vivid example of a city with lost balance. It is, first and foremost, the matter of a unique phenomenon of huge voids in the center of each of the three districts of the city: Autozavodsky, Central and Komsomolsky, and unfinished project ideas that remained in the images and drawings. The districts gradually grew up in different periods of the city formation according to a clear spatial planning logic and their functional purpose. According to the authors' idea, each district had a recreational artery that went through the territory and literally divided it into conditional spaces: the space for work and routine and the public spaces designed to release the free energy of the city dwellers and enabled them to get the feeling of community. [11, 12]

Following the set geometry of the districts structural frame, the giant walking areas naturally went into parks and squares. The linear centers created an illusion of scale and infinite perspective. Togliatti is beautiful in its geometric purity and frequently discomfortable during direct immersion in the physical space, which is also true regarding other "utopia cities", where the creators' "perfect" plan is most favorably perceived from a bird's-eye view. [10]

All the three districts are based on a unique quarter grid: from almost a kilometer-long "Roman" in case of Avtozavodsky District (the 1960s–1970s) and construction of micro-districts with high-rise buildings; a three-beam giant wedge, Stalin and Khrushchev period development in the Central District (the 1950s–1960s) to a mixed structure of Komsomolsky District. The latter is the only district of the city that has direct access to the water and a complicated landscape. The historical part of Togliatti–Stavropol (founded in 1737) is under water and, therefore, is practically excluded from the visual and physical memory of the city. There is a forest area between the cities-districts, which borders the water area. However, there is no feeling of a city at the water. The "body" of the city as well as its history does not have consistent and natural development, and therefore it does not only fail to concentrate the common energy, but also to create a single platform of self-identification.

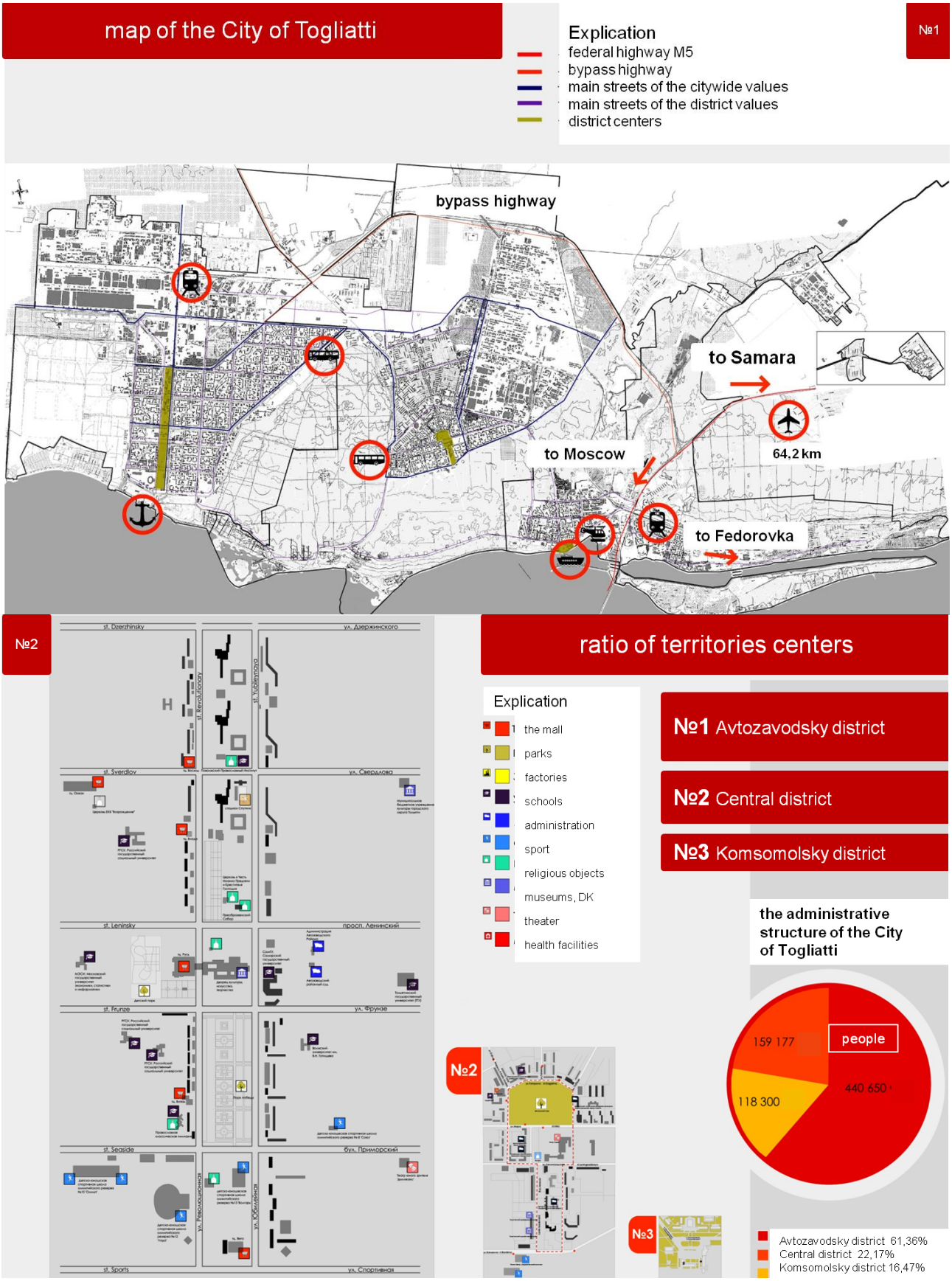

Fig. 1: Map of the City of Togliatti (project session “Territory of Trust”, 3rd International forum “City of the Future. Togliatti`14”, 2014). [18]
Fig. 2: Ratio of territories centers (project session “Territory of Trust”, 3rd International forum “City of the Future. Togliatti`14”, 2014). [18]

A special feature of development of the territory is in the fact that it is a "new city" in the next wave of massive construction. The nature of the citizens: "newcomers", as indigenous “stavropolchane” (derived from the first name of the settlement – "Stavropol") constitute a small part of the city population. There is no sense of the city as a whole. All these aspects weaken the collective attraction and do not allow to shape an overall picture of urban life.

Endless disputes about what the city center is and whether it can be fixed in such a contradictory and artificially assembled framework are being held. Taking into consideration this complicated set of problems, we decided to offer our solution that can reconcile what is irreconcilable and create a model for a dialogue about fixing the city center, first of all, in the minds of the urban community and in the place where it continues to link invisibly our past-present-future. "Creating of "a city within a city" under the "cap" of a kind of the museum futurism capable of holding nearly three century long time, which is not felt but lived through in this area of historical turbulence..." [16, P.10].

1.2 Initial situation and proposed boundaries of the potential MQT:

- the place of the transport, logistic and urban planning connection of all the three districts: Komsomolsky, Central and Avtozavodsky in the recreational area located between two parallels: Mira and Banykina streets;
- the reference point that is the place where the three planning framework rays of the Central District come together within the boundaries of Central Park (Karl Marx, Lenina and Pobeda streets);
- the linear center that intersects the Togliatti House of Culture square with the adjacent building of the Togliatti Duma and the building of Togliatti House of Culture;
- the recreation area within the boundaries of Lenin boulevard with the adjacent residential quarters and the municipal facilities located within this area (College of Music, the Central Library, the Central District Administration, Local History Museum and Art Museum), as well as commercial facilities (business center "Forum", Volga Art Gallery of Contemporary Realism, etc.);
- the territory of JSC "TogliattiStroyZakazchik", Tennis Center, Aqua Park, congress and forum center that is currently under construction (the site of Banykina str.);
- continuation of the linear center through the forest area with access to the borders of the flooded Stavropol and resources of the "sea aquatory" [14, P.18].

Specific character of Togliatti cultural and museum environment is most visible at this site of the Central District: the most important museums of the city – Local History and Art Museums are not located in separate buildings with developed infrastructure and their own adjacent territory, but they occupy the entire first floor of a 9-storey residential building. One of the largest libraries of the city has to put up with the same fate, as it is located in a neighboring twin-looking building.

The vast recreation area in front of the museums and other "anchor" residents indicated above is empty during the whole year, except for rare events held by the museums several times a year. The Local History Museum decided to step out of its walls onto this gigantic glade sixteen years ago to test a new format of communication with the city and citizens – Museum Picnic. The project nature of this event had a special language: actualization of historical memory topics, possibilities and prospects of the city, territory and communities by means of contemporary art, media, actionism, performance, and interactive practices. Local and national identity became the main leitmotif of this dialogue and its quality. The Picnic Glade started gathering thousands of citizens a year and became a real "magnet of attraction" for representatives of creative industries and traditional crafts, and the Museum Picnic became one of the city's major events.

However, the enthusiasm of the organizers began to run low over time, the funding did not become steady, and the glade began to shrink gradually due to active residential and commercial development. Nowadays, there is an urgent need to change the format of work with the territory and citizens and to launch designing not only of communication as an event, but also of the communication environment as a unique public infrastructure. To fill the literal "void" not only with new meanings, but also with real atmosphere of the "life" of the city cultural environment.

This is how the idea to create Museum Quarter as the "core of urban balance" in this territory appeared. The territory that was peacefully "captured" by the museums in the past can be revitalized as a continuous public space – the mental city center, where the park, the square and the free recreation area will become united and indivisible in the minds of the city dwellers. The place of consolidation and self-identification. The place where the city and nature, memory and contemporaneity, an experiment and the rhythm of everyday life, a new type of communication and cultural provocation meet.





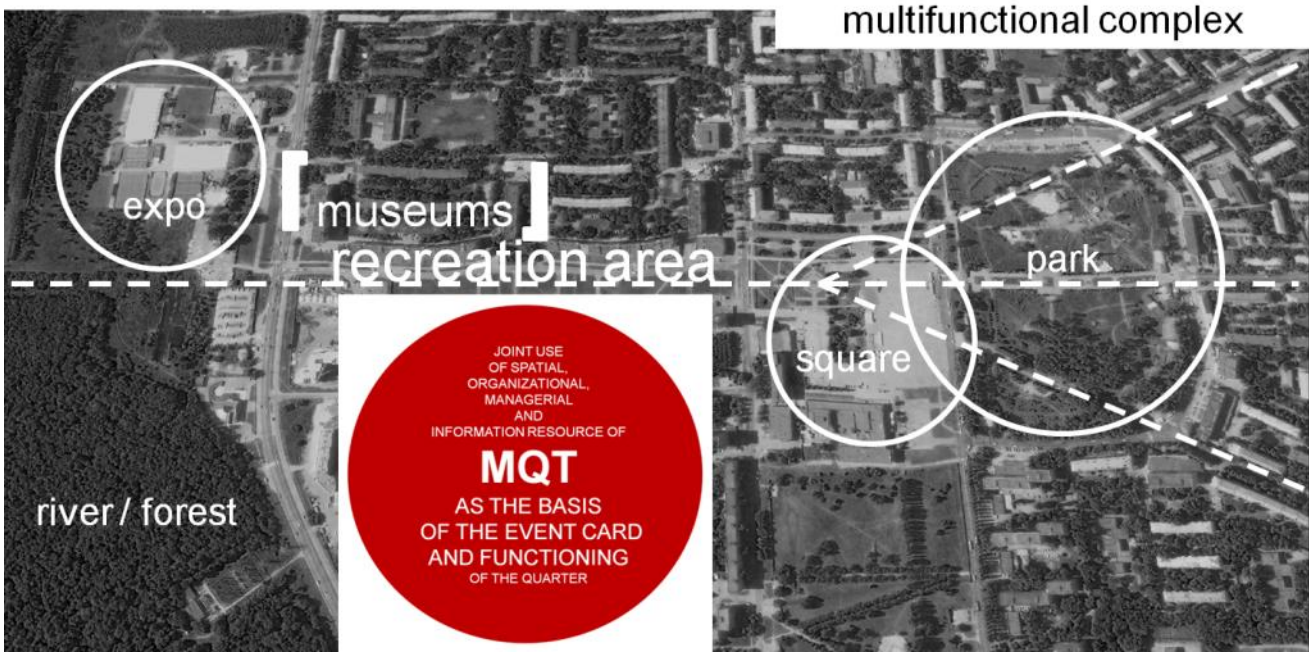

Fig. 3: Photo of potential territory of Museum Quarter (recreation area). [8]
Fig. 4: Interactive map of Museum Quarter (project seminar held within the framework of Museum Picnic cultural event, Togliatti Local History Museum, Togliatti, May 2014). [8]
Fig. 5: Recreation areas and public spaces. [8]

The organizational stage of the project is aimed at identifying:

1. the customer of the project is represented by a public-private partnership where the regional government and the municipality act as general developers and long-term partners;
2. the operator is Project Partnership "Museum Quarter Togliatti";
3. the contractor that is chosen on the basis of open competitions: architectural and spatial for the concept of the territory renovation, branding and promotion of MQT.

The establishment of the multifunctional complex will create an environment for interaction, a common interest and genuine urban consolidation [13, P.5]. This is due to the need for:

1. formation of the expressed city center, its "mental core", relevant, first of all, to the citizens and capable of attracting potential investors and tourists;
2. creation of a unique public space as a cultural, intellectual and communicative center of the city with diverse activities, developed commercial infrastructure and qualitative transformation of the surrounding territory.

Availability of the vacant territory and "anchor" residents represented by a network of municipal and other objects of public and commercial importance.

The project potentially has opportunities for:

1. recognition of the status of a "place of interest" for this area because of its cultural and historical, socio-economic and tourist significance; its inclusion into the strategic plan for the region development;

2. renovation of public spaces of the Central District that were sequentially connected in the original urban development concept as the city center: the park, the square, the recreation area: complex improvement of the territory, creation of cultural, recreational and park areas (improved walking and cycling area for different groups of the city population, including people with limited mobility, recreation places, small multifunctional architectural forms (sculptures, seating space, lighting, urban "art furniture"), a landscaped park (with a vernissage and fountains); a mobile stage and exposition platforms and modules, art-attractions, conceptual navigation, energy efficient lighting system, multi-level ramps, etc.);
3. "…use of joint spatial, organizational, managerial and information resource as the basis for the event map of the Museum Quarter and its functioning" [13, P.5]: a) creation of the social and cultural facilities network of a new type (Cineplex theaters, a network of galleries and museums that immerses visitors into the atmosphere of the city's three-century history, creative co-working centers, craft shops, small souvenir production studios; b) organization of various seasonal cultural and socially significant events, including the traditional Museum Picnic in a non-stop mode; c) creation of a network of educational, multimedia and communication platforms to meet the needs and expectations of different groups of the population and family leisure activities;
4. development of residential complexes and neighborhood territories within the orbit of "quarters" and their complex improvement: quality "enhancement" of surroundings, yards, entrances and facades of residential buildings, playgrounds, parking places taking into consideration the place status and reflecting cultural and historical specificity of the Museum Quarter;
5. attracting socially-oriented business to the territory, which will facilitate the realization of a service network and opportunities for the development of small and medium-sized businesses, including the creative ones: bookshops, shops, restaurants, art cafes, open terraces, etc.;
6. access to the territory where Stavropol was flooded (a continuous infrastructure trajectory through the forest to the Volga River that is capable of taking its rightful place in the historical heritage of the region and becoming a full-fledged part of the circular tourist route: the ecological route through the forest, including a funicular line, an outdoor museum (the flooded area of Stavropol); a quay and water routes linking other important historical and natural sites of the region);
7. involvement into the event map of the region.

The initiators of the project carried out a series of events at various venues in the city in 2014 to promote the idea of creating the Museum Quarter, to popularize the values of cultural consensus as an important tool of communication between different "players": from citizens to business, authorities and professional community. Several project sessions became an important starting point for the formation of a conceptual platform of the Quarter and the project partnership establishment.

The first strategic session was held in January at a special open meeting of the Board of Trustees of Togliatti Local History Museum. It brought together representatives of Togliatti Art Museum (a partner of the project), Regional and City Duma, Economic Development Agency of Togliatti, charitable foundations (*Togliatti Foundation* and *Spiritual Heritage Foundation*), Foundation for the local community development *People of Action*, the leading local companies (*TogliattiStroyZakazchik*, *Fabrika Kachestva*), and banks (*ElBank*, *Mosoblbank* branch) [13, P.5].

The second important step was taken in May at the 16th Annual Cultural Event "Museum Picnic". A project session held at Togliatti Local History Museum (Director Natalia Lankova), which is one of the main ideologist of the project, attracted over 80 participants from various fields: business, urban planning, architecture, design, culture, education, sociology, journalism, tourism, state and municipal administration. The session participants worked in three interdisciplinary teams: *Community* (moderator: Svetlana Chaparina, Deputy Executive Director for Development of *Togliatti Foundation*); *Space* (moderator: Natalia Makarenko, Chief Architect of the architectural bureau *BONA*, Chairman of Togliatti Branch of the Union of Architects of Russia); *Business* (moderator: Yuri Pechkin, a representative the Foundation for the local community development *People of Action*). The moderators of the session were Elena Shlienkova, a member of the Board of Trustees of Togliatti Local History Museum, the head of the Project Partnership Museum Quarter Togliatti, Peter Shcherbanos, Creative Director of *Be!Five Brand Studio* and Natalia Avgust, a design researcher, an expert in the field of service design of *Be!Five Brand Studio* [16, P.10].

Sociology Department of Togliatti State University carried out a survey about the role of the specific area in the life of the city and the Central District, as well as the Museum Quarter cultural phenomenon. Methods of design thinking and in-depth interviews provided the session participants with a shocking ground for reflection: almost none of respondents had qualitative and diverse experience close to the specifics of

cultural or "museum quarter" in the territory of the city. Local experts (a developer, a professor, an IT specialist, etc.) who we interviewed, also expressed doubts about the viability of such projects in Togliatti and similar post-industrial cities.

The public debates were continued at two major areas: the 3rd Specialized Forum *Development. Building. Resource Efficiency* (September 2014) – a thematic session *Social Demand and Territory Development. Museum Quarter as a Model of Project Partnership* [17] and at the 3rd International Forum *The City of the Future. Togliatti 2014* (December) – a thematic session *Economy of Urban Spaces* and a project session *Territory of Trust (*moderators: Elena Shlienkova, the head of the Project Partnership *Museum Quarter Togliatti*, Jakub Sztur and Alexander Haerter, founders of *SzturHärterArchitekten GmbH*, Maria Stepanova, a graduate student of Samara State University of Architecture and Civil Engineering [18].

A series of interrelated problems was identified at different platforms. They involve not only the issues of urban planning and the development of appropriate regulations, but also the need for an interdisciplinary discourse in cultural coordinates of urban communities that were formed in the era of lost reference points and the search for common values.

1.3 Graphics of the general plan. Mental code

Before the development of a conceptual model of the city "mental code" and the search for its "core of balance," we decided to fix prime causes of differences in its value characteristics perception of different generations of citizens, various focuses and possible principles of renovation of the landmarks. We faced the special character of urban planning policy in different periods of development of the "new" land and strategic objectives of the political "center", but not at the local but at the national scale. These objectives did not always allow to keep up the logic of development of the territory by adding "new" functions and its natural diversification. In some cases, they had to zero out the existing advantages and to stake on new opportunities and new perspectives. However, these decisions did not always consider the formation of cities' cultural codes, comfortable and humane environment, opportunities for self-development and diversification.

Ambitious projects and conquests have always been a special quality of the major powers. Only large-scale ideas capable of competing with no less ambitious undertakings of the competitors in the world arena allowed to implement unique complex models of territorial and political management. However, "... excessively ambitious plans come into confrontation with reality and bear the imprint of alienness to the chosen place even today" [1, P. 7].

It is becoming increasingly difficult to overcome such "alienness" in the perception of our own history as a continuous chain of events, phenomena and facts. The paradoxical nature of memory "gaps", the inorganicity and artificiality of the city "physicality", which is expressed in monotonous homogeneous buildings, the timeless and faceless beyond culture objects, which are difficult to identify, create a strange feeling of impersonality and emptiness while reviewing the "live" points on the map of the country. According to the Doctor of the History of Architecture Fabien Bellat, who carried out one of the recent studies on the formation of the city: "Responding to the challenge of the rapid industrialization of the country, the authorities had to build many new cities at the turning point of the 1920s and 1930s. It is quite natural that in the 1950s Togliatti used the achievements of Stalin's period architecture. However, the second wave of economic development in the mid-1960s introduced some changes into this "dealing the cards". The development of Togliatti in many ways occurred in the period that followed the radical turn in the improvement of Soviet urban planning, which was trying to correspond the foreign (American and European) achievements, including the city of Brasilia and new cities in France, for example Creteil" [1, P. 8].

If we do a retrospective of the names involved in the historical "flashes" and experiments on the territory of modern Togliatti, we will be able to see an amazing picture of the change of political preferences and urban development models. We will see a kind of a cultural palimpsest from different and sometimes tragic decisions, brilliant or failure project ideas, styles and aesthetic views:

Empress Anna Ioanovna – signing a letter of credence for the foundation of the fortress city Stavropol-on-Volga (1737);

Vasily Tatishchev – the founder of historical science in Russia, a geographer, the author of the first Russian encyclopedic dictionary, a statesman who began his career under Peter the Great and contributed to the birth of a number of "new towns" (besides Stavropol), which are still significant and influential on the map of our country, such as Yekaterinburg, Perm (1723), etc.;

Empress Catherine II – the signing of the Decree on the establishment of the city of regional subordination (1768);

Pietro Antonio Trezzini – a Swiss architect, the author of the first church in Stavropol (1757);

Nikolay Razin – the author of the design and the chief engineer of Kuibyshev (Zhigulevskaya) hydro power plant construction (1950-1957; 1958 – "Grand Prix" of the Brussels World's Fair), the plant that led to the actual destruction of the city of Stavropol as a result of the dam construction and the creation of a huge artificial sea (650 sq. km);

Leonid Polyakov – an architect who worked in the neo-academic style of the Stalin's period, the author of unrealized architectural concept and décor of the Kuibyshev dam structures (the chief architect of the Hydroproject Institute (1950-1957);

Mikhail Sorokin - one of the original developers of the general plan for construction of the "new town" of Stavropol (1953, Kuibyshev hydroelectric complex) that combined the specific character of functional ensembles with the hierarchy, canons and paraphrases based on the "garden city" model and the principle of low-rise buildings construction (the Central District), as well as formal monumentality of duplicates. "Semi-open squares, residential quarters that are especially notable for their separate buildings located at the corners, the basic facilities that are used as a fermata regarding to the city, wide streets that branch out as in Versailles, playgrounds on avenue, visual surprises that result from the displacement of the axes" [1, P. 54];

Yuri Kilovatov – the author of the Central District of Stavropol project (1952, the concept of a three-beam framework of Stalin, Lenin and Khimiki streets, the park and the square continued Mikhail Sorokin's original idea of a linear recreation). He participated in the creation of the general plan of Leningrad, development projects of Minsk, Petropavlovsk-Kamchatsky, Magnitogorsk, Krasnoyarsk, Vologda, Vladivostok, etc.;

Vittorio Bonadè Bottino – a consultant for architectural and technical construction of the new Soviet factory – AvtoVAZ in the 1960th (the author of the prototype plant in Mirafiori), a leading specialist of Fiat company, the head of construction of all plants in Italy until 1960 [1, P. 74-75];

Michael Melamed - Project Manager of AvtoVAZ plant as an industrial complex (1966);

Boris Rubanenko – an engineer and an architect, the author of the general plan of the "new city" Togliatti (1967) – "the city-etalon of the national urban development", which competed in scale with projects of Le Corbusier, Lucio Costa, Oscar Niemeyer. 1963 – the Director of the Central Institute for Experimental Design of Housing, the author of the general plan of Naberezhnye Chelny city. The following approaches were applied for the first time in the urban planning concept of Togliatti: the principle of microdistricts; roundabouts; the use of forest land as a public park that links the city districts by its transport artery and do not interfere with their original appearance; a clear logic of functionalism and constructivism in the organization of open urban spaces with extensive recreational axles; territorial division of the objects into residential areas and facilities; wide highways that allow for exponentially increasing individual mobility in the "automobile capital", etc. Special attention is given to the city center that is located on one of the general axes of the city-district (Avtozavodsky District of Togliatti) and reflects the concept of Roman forums, esplanades, towers, and the Egyptian pyramids in the design idea of this ensemble. Architectural eclecticism and syncretism simultaneously, a scope and futurism, which absorbed various styles, aesthetic preferences, cultural codes. However, the fixed idea of a "game with scale" remains unchanged in every meaning on the vast plain. The experimental nature of the city-factory (the automotive plant) was reflected in the specifics of city life and personality of Avtograd residents. The initial draft of the general plan was not completed due to the change of the political paradigm of Russia in the 1980s.

Yuri Bocharov – one of the authors of general plans of "new cities" – Togliatti and Naberezhnye Chelny, Doctor of Architecture, Professor, member of the Russian Academy of Architecture and Construction Sciences, the Russian Academy of Art Criticism, the Ukrainian Academy of Architecture (Kiev); a corresponding member of the International Academy of Architecture of Eastern Countries (Baku), an adviser of Socioeconomic Foundation (USA, New York), a member of the International Council of Town Planning Review (United Kingdom, Liverpool), etc. He participated in the technical-economic justification of the general plan of Kiev, residential buildings in Moscow, Novokuznetsk, Temirtau, settlements, microdistricts, public and residential buildings in the Kuzbass region, the Volga region, the Crimea, Kazakhstan, the Urals (40 completed projects).

Taking into account the transformations that have made their impact in shaping the face of the "new city", or rather several models – the Central and Komsomolsky districts, the town of Zhigulevsk in the 1950s – Avtozavodsky District in the 1960s, we get an unstable platform of the urban tissue integration. Utopian ideas ranging from the "fortress city" and "garden city" to the "city-factory" do not allow up to now to identify Togliatti as an organic structure with a special status of the city that is penetrated with three hundred years of history.

We have suddenly faced the phenomenon in which "the very definition of reality says: *it is what can be equivalently reproduced.* Such a definition appeared simultaneously with science that postulates the fact that any process can be accurately reproduced in the given conditions, and with the industrial rationality, postulates a universal system of equivalences (classical representation is not an equivalence, but a transcription, interpretation, commentary). As a result of the reproductive process, it turns out that reality is not simply something that can be reproduces, but *it is something that always has already been reproduced*. Hyperreality." [2, P.151] Endless reproduction of what has already been seen, worked out, reflected, but what is not capable of self-development and qualitative change.

Perhaps the vast "voids-wastelands" in the center of each district of Togliatti, which remain unfilled, ineffective, and uninhabited, create a strange precedent of a "pure" field with a virtual potential. The potential that was originally embedded in the city planning concept but still remains unrealized. Thus, it is not surprising that the public function embedded in the "core" frameworks – in the reference axes of the recreational areas, looked most attractive and understandable in the past, which was probably due to its utopian logic and political ambitiousness. Nowadays, this type of planning does not correspond to the demands and expectations of the citizens. It is sometimes difficult to match the scale of time, therefore, hyperreality wins. "Self-reflection is all sorts of effects of the object doubling and splitting in one of its parts. Such multiplication of the object passes itself for a deep view, even for a critical meta-language, and it was probably true in the time of a reflective structure of the sign within the framework of the dialectic of the mirror. Nowadays, this infinite refraction of the object turns out to be nothing more than another type of seriation: the reality is no longer reflected in it, but involutively curls up to complete exhaustion" [2, P.150].

So where do we find strengths and meanings for revival?

2. The search for coordinates in space and time

Thus, the search for the "core of urban balance" of Togliatti has not been stopping for over three decades. The dispute about its physical location currently remains open. There are two options: either each city district region gets its rightful center, or the center of the Central District should fix the natural coordinate axis.

We will present several project ideas that so far have not been implemented, but they allowed us to understand the rightness of our approach: there is a need for the city center. All three projects were developed at different times by practically the same team of architects, who make up the architectural elite of the city where there is surprisingly still no architectural school. "New city" has invariably had an industrial status that, on one hand, does not give it the depth, nor the power to form its own intellectual elite, and the experimental spirit, on the other hand, which is possible only in a situation of a strong political will to carry out large projects and major investments in order to implement Great ideas.

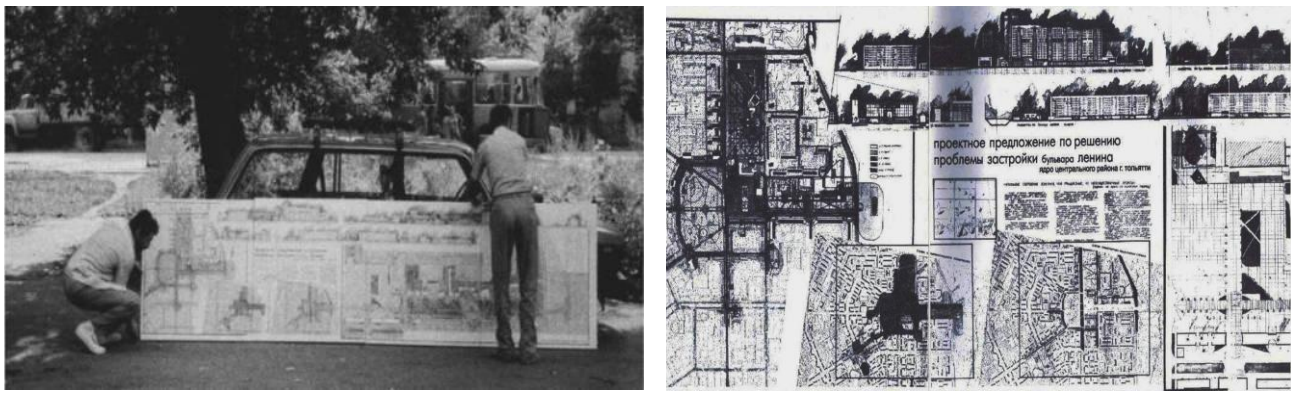

Fig. 6: Central Square of the city: **Lenin boulevard** (a competition concept, archives of Togliatti Organization of Russian Union of Architects. The square as the key element of the city planning structure of the city center. Group of authors: Vladimir Gurevich, Sergey Martynov, Andrey Medvedkov, Sergey Taldyking, Togliatti, 1986. [4]

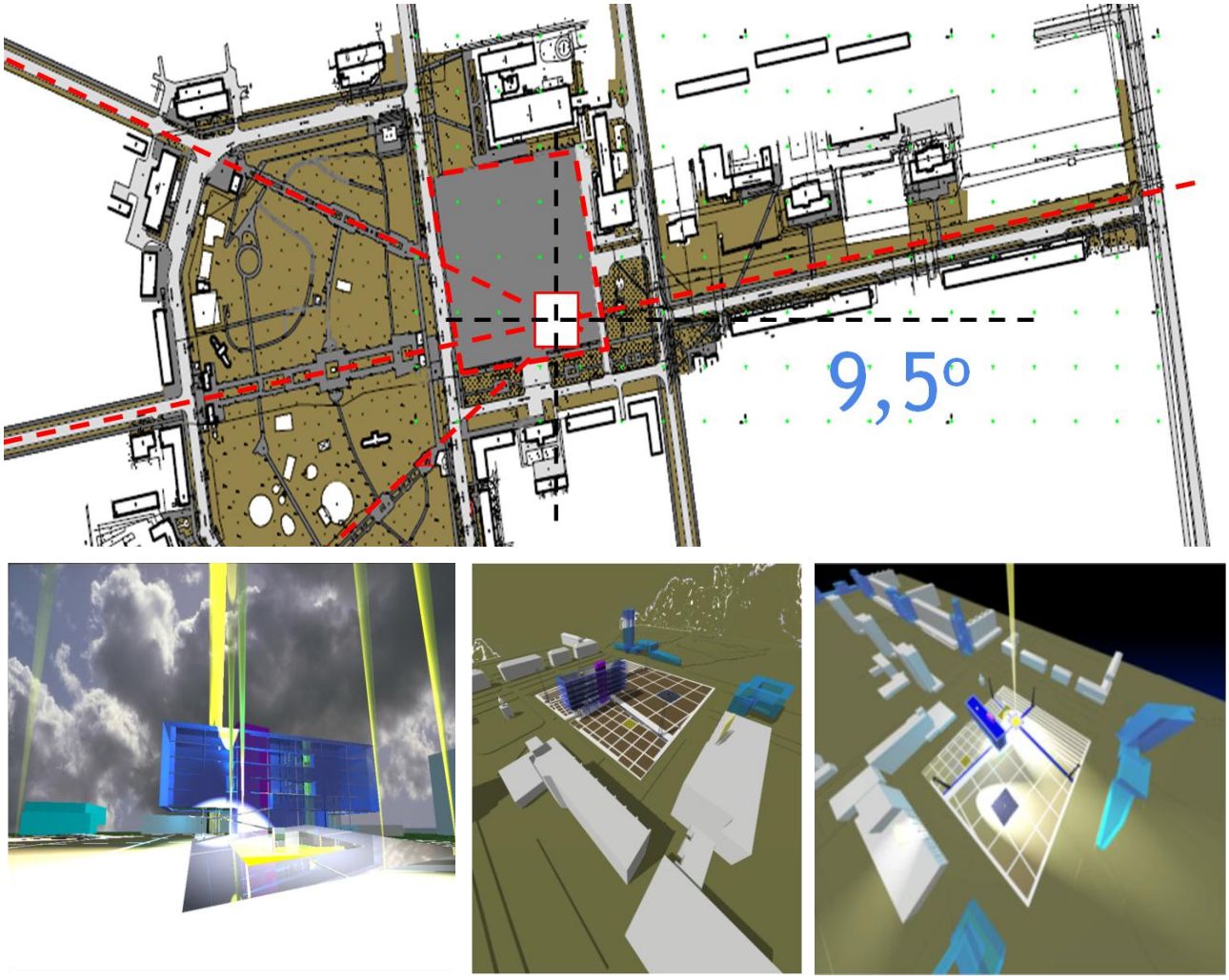

Fig.7: Central Square of the city: **Space and time – Azimut 9.5^0** (a project concept, archives of Togliatti Organization of Russian Union of Architects. Group of authors: Vadim Artamonov, Vladimir Gurevich, Viktor Zubkov, Valery Lopatin, Sergey Martynov, Natalia Makarenko, Andrey Medvedkov, Valery Mukhin, Vladimir Rogozhkin; students of Samara State University of Architecture and Civil Engineering: Nikolay Alekseev, Rimma Galiakbirova, Polina Karpeeva, Natalia Kasjankova, Taras Makarenko, Yulia Poljakova, Andrey Yashnev, Togliatti, 2000. [5]

The shape of the space is a square that is oriented to the cardinal directions. The exact direction to the north is offset from the main vector of the planning axis by 9.5^0 – this offset goes throughout the city's life and fate. The crossing of the main content axes of the square reveals the historical meaning based on – "the city of the Cross" – Stavropol. The third spatial coordinate – a light laser beam directed into space – is the starting point of a new direction, a new order, a new azimuth of life. The stone in honor of the builders of the city is the beginning of beginnings, a new starting point of the city's life with regard to the world Space and time. Now it is a monument to all creative undertakings, whether they are the construction of the city, creating a new way of thinking and relating it to the world, cosmic scale, to the World coordinate system. The square as a space and the stone as a coordinate of memory – fix the essence of the space and time concept. In their search for the "spirit of the place", the authors were able to read what the square kept. The legend created it new meaning.

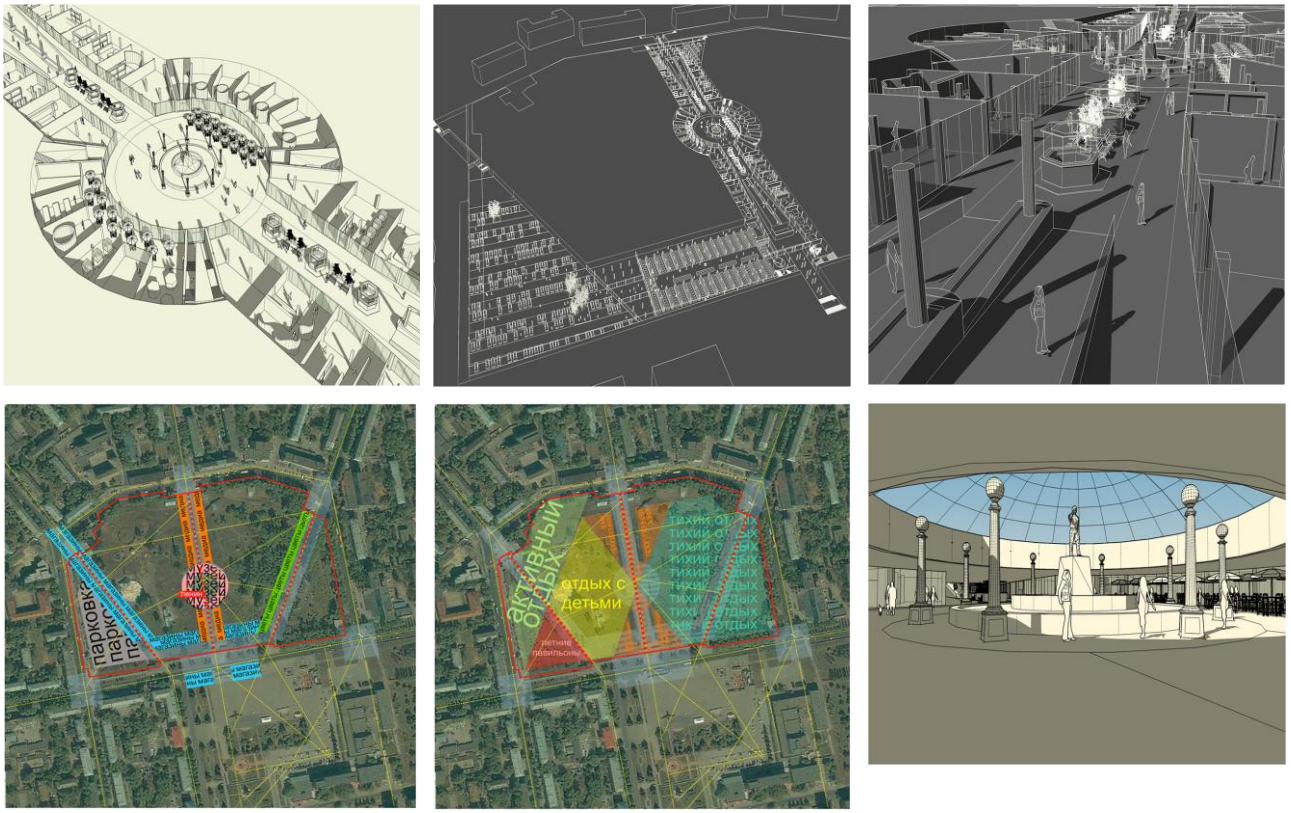

Fig. 8: Central Park: **Integration in favor of the landscape** (a competition concept, Togliatti Organization of Russian Union of Architects). Group of authors: Nikolay Alekseev, Natalia Makarenko, Taras Makarenko, Togliatti, 2009. [6]

Integration in favor of the landscape: the spaces for commercial use are located at the underground level, which allows to maintain a natural component of the park and all the organic connections with the context. The underground level is designed to accommodate commercial facilities and a car park – in those places where there is no landscaping (or the trees have no value). The objects adjacent to the park: residential quarters, Cultural and entertaining center Cosmos that is under construction, and Central square are connected by communicating underground space and pedestrian crossings through the streets with heavy traffic.

Unlike their predecessors who sought to offer the area revitalization model, the authors of the city center project, which is based on the idea of the Museum Quarter Togliatti, try to put into practice the principles of an open participatory design. The search for "the mental identity" or for the "core of urban balance" can not be concentrated in a narrow professional circle. It requires the widest coverage of various focuses of perception, assessments, and probably sometimes conflicting opinions about what the city and its center are. We offer a "new vector" of development for this unique area – the creation of the Museum Quarter. Despite the fact that this is possibly "A strange statement at first sight. Togliatti? The city with torn-off roots", the face of a universal expression". And it is not a city at all, it is a place of temporary residence, not burdened by culture and not seeking high meanings... The city, where the museums are located in "apartments" of a faceless line of high-rise buildings, and do not have illusions regarding improvement of their "communal apartment" status. The Museum Quarter without the historical background, the museum tradition, collections that make you travel halfway around the world to look at a masterpiece without taking your eyes off it and feel jealous of yourself and this opportunity to witness the "sacral" thing? The lack of tangled streets that touched the past, leaving scars, hollows and the time, which is invisible to the eye but instinctively felt. The lack of squares and palaces, where parades, coronations and executions were held, with stone sculptures that imprinted a triumph and blood... Nothing... Is it an absolutely inappropriate attempt to museumificate "emptiness"? To hoist a slogan that calls for nothing and leads to nowhere?" [13, P.5]

Conclusion

An attempt to create a scenario model of the evolution of the indissoluble space of "residing" and "experiencing" the city in post industrial time continuum has recently become an obsessive urbanistic idea of some architectural and environmental schools. The ideas that have often a speculative nature or declare fast temporary effect of acupuncture impacts on environmental and emotional background of the object.

To what extent can the external interventions become systemic and deep? To what extent can they root themselves in the mind of citizens and qualitatively keep self-development and sustainability of the local framework? Could a behavioral model be purposefully set for all the stakeholders of the process: from the local communities and citizens to the companies and organizations that do business in the area? What managerial and project platform will win? There are no universal solutions. [9]

As Nassim Nicholas Taleb emphasizes in his essay "On the secrets of sustainability" [3, P.90-91]: "When it comes to the probability, first of all – a low probability, the substitution of one direction for another is dangerous. ...on the example of the insolubility theorem and the problem of relating to oneself, we do not observe probability distributions in real life. We observe the events. ...we do not know the statistical parameters – up until the time an event occurred. If we take a number of observations, a multitude of statistical distributions can correspond to the same results, but each of them can be extrapolated in a different way beyond that set of factors from which it was derived. This problem of reconstruction is getting the more acute, the bigger number of theories and distributions can be adjusted to one or another set of data – especially when there are non-linear effects or uneconomic distribution. The whole families of parametric models explode under the influence of nonlinearity".

A provocative nature of the project idea is in the attempt to transform the negative "rhesus factor" of Togliatti cultural phenomenological space, on the positive "normal" city, that follows natural laws of life, the city in its primordial sense: the unity of vital energies of social, cultural and economic character. Nowadays, this "unity" is based on an artificial attraction and territorial "grounding" of the three almost independently existing areas of districts-cities, which make up the city, with their unique planning, rhythmic and mental character. A complex view on the nature of "forces of balance" and the search for sustainable "core" – the center – will allow to keep the sounding of so-called "nervus trigeminus" of the city in the neighborhood of dissimilar.

In our case, reconstruction of a model of historical and genetic code succession is based on a conscious city planning “utopia” of the most “soviet” city. It is a “futuristic museumification” of meanings in the open space of the experiment on the specific territory, which is obviously not predisposed to it in the first trivial approach, but which is potentially ready for new constructs of interaction.

Nowadays, there is a number of managerial models launched in 2014 that will facilitate the project development:

creation of a municipal and interagency working group that involves the Deputy Mayor for Social Affairs, the departments of culture, urban planning activity, economic development, urban economy, management of municipal property, management of international and inter-regional relations, as well as the initiators of the project: the Commission on Togliatti Local History Museum, Social Policy of Togliatti Duma [7];

project partnership Museum Quarter Togliatti, with the possibility to involve external specialized experts of economic, urban planning and cultural policy, territory marketing, tourism and ecology in order to develop a comprehensive draft proposal for the project, which takes into account all the requirements for the creation of multi-functional territorial complexes;

the inclusion into the project "Panoramic (circular) tourist route around the city of Togliatti" within the framework of the Regional Program for the development of tourism and recreation cluster of Samara-Togliatti agglomeration;

fixing the borders of Museum Quarter Togliatti in the general plan of the city.

References

[1] BELLAT, F. Togliatti. Birth of the New city. Ekaterinburg, TATLIN , 2014. – 144 p.

[2] BAUDRILLARD, J. Symbolic exchange and death. – Moscow, "Dobrosvet", 2000. – 387 p.

[3] TALEB, N.N. On the secrets of sustainability: Essay; The Bed of Procrustes: Philosophical and Practical Aphorisms/ Nassim Nicholas Taleb. – Moscow, Kolibri, Azbuka-Attikus, 2012. – 240 p.

[4] MAKARENKO, N. The Report (part 1) of "Central Square of the city: Lenin boulevard" at project seminar "Museum Quarter Togliatti", the 16th Interregional Cultural Action “Museum Picnic”, 23 May, 2014, Togliatti, http://www.slideshare.net/eshlienkova/ss-41911442

[5] MAKARENKO, N. The Report (part 2) of "Central Square of the city: Space and time – Azimut 9.5^{0}” at project seminar "Museum Quarter Togliatti", the 16th Interregional Cultural Action "Museum Picnic", 23 May, 2014, Togliatti, http://www.slideshare.net/eshlienkova/ss-41911504

[6] MAKARENKO, N. The Report (part 3) of "Central Park: Integration in favor of the landscape" at project seminar "Museum Quarter Togliatti", the 16th Interregional Cultural Action "Museum Picnic", 23 May, 2014, Togliatti, http://www.slideshare.net/eshlienkova/ss-41911567

[7] The Mayor’s office of Togliatti of Samara Region, Order of "On the creation of a working group for the design of the Plan for Complex development of the territory limited by Banykina Street, Lenin Boulevard and Mira Street", 09.09.2014 No 6904-r/1 "Museum Quarter Togliatti".

[8] "Museum Quarter Togliatti", Project session at the 16th Interregional Cultural Action "Museum Picnic", Togliatti Local History Museum, Togliatti, 22-24 May 2014, http://tltmuseum.ru/news/863-muzejnyj-piknik-2014-muzejnyj-kvartal-tolyatti.html; http://www.slideshare.net/eshlienkova/mqt-session-2405press

[9] SHLIENKOVA, E. Culture of Thinking for Management of the Future. Local Models in the Creation of Systemic Effects. North Karelia University of Applied Sciences, Joensuu, Finland, 2013.

[10] SHLIENKOVA, E., Malakhov A., Repina E., Sperk E. "Metaphilosophy" pre- and post-project reality. Volga Palmira or play with new meanings. IX International forum of researchers "Le Via dei Mercanti": S.A.V.E. Heritage, Aversa, Capri, Italy, 2011.

[11] SHLIENKOVA, E. Experiment-cities or Unrealized Horizons. Philosophical and Social Yearbook Civitas Hominibus, Faculty of Humanities of The University of Humanities and Economics in Lodz, Lodz, Poland, 2013.

[12] SHLIENKOVA, E. Issues of global and local in transcultural space of a modern city. Challenges, realities, integration and self-identification prospects. Information and research collection on the issues of Eurasian integration of the Volga Region Institute of Management named after P. A. Stolypin, Saratov, 2013.

[13] SHLIENKOVA, E. Museum Quarter Togliatti (part 1), newspaper "Svezhaya gazeta. Kultura", No 4 (51), March 2014, Samara.

[14] SHLIENKOVA, E. Shcherbina A., Kljueva I. Museum Quater Togliatti (part 2), newspaper "Svezhaya gazeta. Kultura", No 5 (52), March 2014, Samara.

[15] SHLIENKOVA, E. "Museum Quarter" at "Museum Picnic", newspaper "Svezhaya gazeta. Kultura", №9 (56), May 2014.

[16] SHLIENKOVA, E. "The core of urban balance" or "Museum Picnic" in non-stop mode, newspaper "Svezhaya gazeta. Kultura", No 10 (57), June 2014.

[17] SHLIENKOVA, E. The Report of "The Demand of society and development. Museum Quarter Togliatti as a model of project partnership": the 3rd Specialized Forum "Development. Building. Resource Efficiency", 9-10 September, Avtograd Expo, Togliatti, 2014 (report, discussion "Urban planning pragmatism in revitaliaztion of public spaces. Models of project partnership") http://avtograd-expo.ru/programma-dsr; http://www.slideshare.net/eshlienkova/mqt-development-tsz

[18] SHLIENKOVA, E., Stepanova, M. The Report at thematic session "Economy of Urban Spaces". The 3rd International Forum "The City of the Future. Togliatti", Togliatti, 4-5 December 2014, http://future.tgl.ru/; http://www.slideshare.net/eshlienkova/2014-4512-42486954

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Roman period survivals in modern farms: the case of Masseria Tuoro in Vitulazio

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Abstract
The phenomenon of the survival of Roman sites in modern buildings appears quite widespread.
In Campania there are many examples of rustic villas incorporated from rural farms built in later periods representing, with the first ones, signs left by history in the agricultural landscape over the centuries.
A relevant testimony is represented by Masseria Tuoro in Vitulazio; located in the so-called *Ager Calenus*, it returned the remains of structures dated to the Roman period found in the enclosure, and a large quantity of ceramic materials outcropping on the ground.
The old structure was rediscovered during archaeological surveys conducted by the writer with the essential support of photo-interpretation, made on frames and historical satellite images of the area under consideration.
The interesting archaeological traces, supplemented with information materials, have allowed to reconstruct the structure and spatial topography of this ancient villa which during the Roman period is supposed to dominate the eastern boundary of the *caleno* territory.

Keywords: rustic villa, masseria, direct survey, photo-interpretation, topography.

1. Introduction
The human occupation of the land dates back to ancient times: man, through the creation of rural factories, has tried to adapt the nature of the soil to the necessities of life.
The rural housing settlement is in fact consequential to the establishment of a stable work commitment on the chosen territory in order to initiate a productive ongoing.
Land use for agricultural purposes and the buildings installation follow natural requirements that remain unchanged over time, so that it is not uncommon to find similar settlement dynamics over the centuries.
From Roman times rustic villa to the *masseria* of the modern age, these needs have found success in different settlement patterns responding however same needs [1].
The *masseria* has a very remote and in its more complex forms is often identified with its rustic villa so that many modern farms were born on the place of the older ones.

The presence of the ruins of the Roman villas, whose historical value was ignored in the past, supported the creation of rural complex, that exploited the presence of the previous settlement for utilitarian purposes because of consistency and functionality of the walls foundations that are well suited to the construction of new housing, built redeploying the building materials of the previous structures.
This phenomenon has a wide spread between the XVII and XVIII century when there was the establishment of *masserie*, residential complexes, with adjoining buildings for animals and storage of grain [2].



Fig. 1: Vitulazio. Satellite image of the territory of Vitulazio, with location of the site (© Google Earth 2014).

New buildings established on older ones showing in fact a double value from an historical and archaeological point of view: an extraordinary example of this phenomenon is Masseria Tuoro in Vitulazio.

1.2 Historical and topographic background of Vitulazio

Masseria Tuoro is located in Vitulazio, in the northern portion of the province of Caserta, north of the river Volturno.

The territory of Vitulazio is characterized by vast plains bordered to the north by a unique mountain, Monte Tutuli, and is lapped by a single stream, the river Agnena, regularized in a channel in the last decades of the 1800s [3] (fig. 1).

In Roman period, Vitulazio constituted a portion of the territory so-called *Ager Calenus*, that was defined «by the natural boundaries of Monte Maggiore and the river Savone and those legal-administrative of *Campus Stellatis*, *Ager Falernus*, and the territory of Casilinum» [4].

In the Middle Ages was under the Norman rule, being *casale* of Capua that remained tied until 1807 when thanks to an administrative decree it gained its political autonomy [5] .

The country retained the original name of “Vitulaccio” until 1882 when a royal decree established that took the name of Vitulazio from January 1, 1883.

During the fascist period it constituted a single territory with neighboring Bellona, forming together the municipalities of Villa Volturno. After the end of World War II it returned to its earlier spatial planning [6].

1.3 The modern structure

Masseria Tuoro (Sheet 172 II N.O., 41° 07’ 51.43” N - 14° 13’ 03.37” E) is located in a flat area next to the river Agnena, east of the point where road *Platani* crosses the *Autostrada del Sole*: this ancient and monumental structure stands out in a very evocative way for the distinguishing red-ancient color, dominating the wide expanse of adjacent land under its control.

Currently it houses the *masseria*, it is surrounded by an area mainly cultivated with cereal crops while the remaining is characterized by the presence of a citrus grove and a peach orchard.



Fig. 2: Vitulazio. Masseria Tuoro view from different angles.

The building presents all the tuff walls and square plan; it is on three different levels with windows on all sides except the eastern and, on the south side, a sort of circular tower attached with a sloping base, today hosting a spiral staircase giving access to the various floors (fig. 2).
Each level includes residential rooms, except the last one, it would probably be used as a dovecote tower as still testifies its particular morphology with rectangular recesses for the birds.
The *masseria* is also bounded to the east by an added building, rectangular in shape, which functions as a deposit, to the west by an cemented courtyard and is completely enclosed by a wall made of rectangular blocks of tuff in irregular shape and irregular perimeter [7].

Although now contaminated by modern renovations that have transformed the original functions, in the bottom of the structure, in particular in the circular tower, remains of the oldest walls are visible, almost certainly dating to the Middle Ages.

1.4 The studies and the discovery of the Roman site with the direct survey

The only known information about Masseria Tuoro belonged to Gérard Chouquer that, as part of his research on Southern Italy ancient agricultural division, during the Eighties he had found in the nearby of this structure, the presence of traces of alteration in composition of the soil (*soil-sites*) that he interpreted as possible indicators of an ancient settlement; this was not followed by a direct feedback on the area [8].

The correct location of the site, however is possible as a result of surveys conducted by the writer in the municipality of Vituazio, as part of the project *Carta Archeologica e Ricerche in Campania*, directed by the Ancient Topography research team of the *Dipartimento di Lettere e Beni Culturali* of the *Seconda Università degli Studi di Napoli* [9].



Fig. 3: Vitulazio. Outcrop of archaeological material on the soil of Masseria Tuoro.

In the area indicated by Chouquer in fact, although there were not perseveres outcropping structures, thanks to surveys, it was possible to identify a dense amount of old materials, from the point indicated by him, continued eastward.
A higher concentration of material, about 10x50 cm, was found between a citrus grove and a peach orchard, located south and west of the masseria (fig. 3).

The materials identified cover a very broad chronological horizon that goes from the late Republican to the Middle Ages; in particular were distinguished: *Black-gazed pottery*, fragments of *Italian Sigillata*, *Eastern Sigillata*, ceramics in common use, amphorae, *opus doliare*, glazed pottery, brick fragments quarter-circle due to the remains of columns, roof tiles and red plaster fragments and nails (fig. 4).
Besides these material we report the discovery along the eastern boundary wall of the *masseria* of a significant amount of building materials and many remains of flooring in *cocciopesto* well preserved and massed near the wall.

The most interesting finding, however, was possible thanks to the boundary wall of Masseria Tuoro presenting in some points visibly exposed foundations in several points and this allowed the analysis of the layers below the current ground level (fig. 5).
In particular about 10,90 m from the corner of the north-west wall, in the foundation layer remains of a Roman times room have been identified, it is barely visible because of the thick vegetation.



Fig. 4: Vitulazio. Materials found on the ground: *Black-glazed pottery* with stamp, red plaster and remains of the floor.

The setting is stored about 1,70 m long, with a floor plane placed at a height of -1,46 m from the crest of the modern wall and relies on a perimeter wall of 60x40 cm retaining traces of red plaster on the external wall (figs. 4, 6).

The floor is made in *cocciopesto*, in the visible part, from brick fragments of medium and small size (maximum thickness: 45 cm) and in some parts by quadrangular dotted tiles limestone irregularly arranged and kept together with a thick layer of lime.

The laying surface of the latter one is made with a layer of tuff bricks, tiles and broken amphorae (maximum thickness: 17 cm) that goes directly to set itself on the foundation consisting of brown soil mixed with limestone flakes in medium-sized and tuff blocks from remote places with irregular and probably static function (maximum thickness: 14 cm).



Fig. 5: Vitulazio. Masseria Tuoro and indication of the remains of the Roman period.



Fig. 6: Vitulazio, Masseria Tuoro. Remains of Roman structures preserved in the foundation of the modern wall.

In the western section of the enclosure wall, although all traces of the walls of the Roman period seem to be missing, they were observed, even in conditions of poor visibility due to the thick vegetation, the remains of masonry in limestone blocks well squared, in whose gaps fragments of glazed pottery were identified, it was also found in other parts of the site, whose construction technique, similar to that which is still visible in the walls of the *masseria* below, refers again to the Middle Ages.

1.5 The data of the photo-interpretation

The second phase of the work was aimed to conduct photo-interpretation of historical frames [10] (fig. 7), which did not reply to trace what was marked by Chouquer, but allowed to observe on shuttle area traces of vegetation (*grass-weed-crop-marks*) and of alteration in composition of the soil (*soil-sites*) which had not been identified in previous studies [11].

In particular, near the eastern boundary wall of the *masseria*, where it had been noticed a remarkable concentration of remains of paving in *cocciopesto*, observed light trails that describe a rectangular element delimited by an element in a semicircle interpreted as alteration traces in the composition of the soil (*soil-sites*), probably due to the disintegration of structures, as it is shown by the discovery on the place of structural elements.

South of the southern wall where the remains of the structure with the floor are still visible, there are clear remains that describe a quadrangular element which seems to be connected to an additional rectilinear track, and the center of the southern boundary continues towards south.

These elements, in view of the findings in the area, could be attributable to the perimeter wall which leans the room identified under the modern wall and so constitute likely to continue.

Near the western boundary wall of the *masseria* were no obvious clear alteration traces in the composition of the soil that outline a rectilinear form element, perpendicular to that found previously.

Additional data have emerged from the analysis of satellite images that returned interesting elements for the purpose of this study (fig. 8).

The land of Masseria Tuoro has been cultivated in part with tree crops and partly with cereal crop. You notice abnormality in the growth of the trees that are significant at the points where traces of historical frames had been observed, in particular in satellite images, at least in four points in correspondence to the orchards.



Fig. 7: Vitulazio. Detail of vertical aerial photo indicating the traces identified (Flight ALISUD 1973).

In the eastern and south of the southern boundary wall, where traces probably referable to a quadrangular structure had been found, however you notice only abnormalities in the growth of trees but especially interesting is the irregularity in the growth of the orchards located in the western end, going on to describe a quadrangular, structure especially where Chouquer reported previously that had not given direct feedback on the place, but just for the presence of ancient materials.



Fig. 8: Vitulazio. Satellite image indicating the archaeological traces identified (© Google Earth 2014).

It is interesting to notice, finally, that the strip of land that lies between the two orchards had given a greater recognition of materials, photographic documentation examined, appears almost always spared from crops.

1.6 Conclusions

The numerous archaeological evidence, both those found with the direct results and data through the photo-interpretation, analysis and the study of materials, allow to establish that the area housed a rustic villa of considerable size in Roman period of which it is possible recognize *in situ* at least a room with floor in *cocciopesto* and part of a red plastered perimeter wall, of which probably, given the strong correspondence, the straightaway identified in the frames is the historical continuation.

The square plan, described by Chouquer and visible in satellite images, the main areas of materials identified in particular those closest to it were instead to be a single body with the villa, tampered over the years by various farm work.

It is also possible to speculate on the way used by this villa, identifiable in the other light color of track alteration in the composition of the soil (*soil-sites*), found in the western sector; the modern country of the *masseria* lane in this case might therefore be the perpetuation of an older path functional to the villa and that was to join perpendicularly the current *Via Platani.*

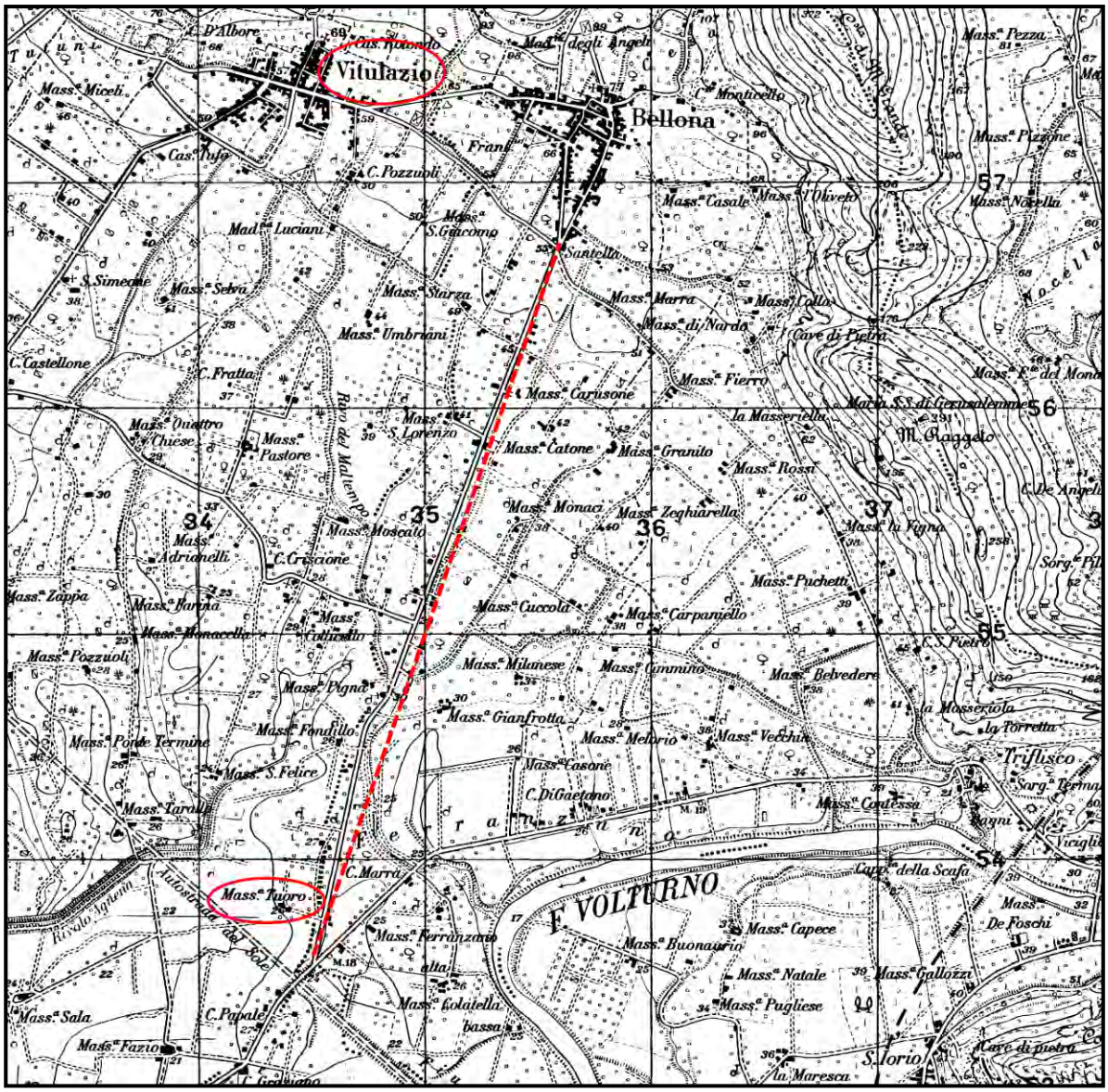

Fig. 9: Vitulazio. Detail of the IGM tablet II NO, sheet 172 Pignataro Maggiore (scale 1:25.000), indicating the location of the site and the hypothetical road.

An important ancient road it is possible to recognize right in *Via Platani*, a modern road marked by a straight path, whose existence since Roman times is evidenced by a significant amount of rustic villas on its course, including the very same Masseria Tuoro (fig. 9).
This road, which was therefore parallel to the route of the via Latina of the Roman age in connection with *Casilinum*, probably served to support communication with the inner areas and eastern *Ager Calenus*, very relevant in terms of topography, as evidenced by the monumental and near bridge over the Volturno, the so-called “of Hannibal" [12].

The choice to build a rustic settlement at that point was certainly due, in addition to the vicinity of the most important roads, especially for the presence of the nearby water course of the river Agnena.
This position was so favorable with holding interest even in later times; in the Middle Ages in fact, as evidenced by the remains of walls and ceramic, the area was occupied again, probably with a tower to control the road, whose remains are to be found in the tower with a sloping base incorporated in the eighteenth-century *masseria*, which reused, as usual, the remains of the Roman building in ruin.
The last phase of life of this structure is represented by the *masseria* today visible, probably formed between the XVIII and XIX century for the agricultural exploitation of the area, which is bounded by a wall surrounding the perimeter which probably has assumed particular irregular shape because of pre-existing structures that have the shape (fig. 8).

This area of the eastern *caleno* territory was thus occupied for centuries through different forms of settlement that continued on the site of Masseria Tuoro; this is an extraordinary site, in which the traces of structures of different periods which have marked it are still legible in a continuous stratigraphy that makes this structure similar to a story book read backwards.

Bibliographical References

[1] About the topic on Roman villas: QUILICI, QUILICI GIGLI, Lorenzo, Stefania. Elementi per lo studio delle città e del territorio. Le ville. In *Introduzione alla topografia antica*. Bologna: il Mulino, 2004, with bibliography.

[2] For comparisons about the transformation of the Roman villas in modern farms: STEFANI, Grete. *Casali di ieri, casali di oggi: architetture rurali e tecniche agricole nel territorio di Pompei e Stabiae.* Boscoreale, Antiquarium Nazionale 16 aprile – 30 maggio 1999. Napoli, Palazzo Reale, Sala Dorica, 28 marzo – 15 aprile 2000. Ministero per i Beni e le Attività Culturali, Soprintendenza archeologica di Pompei. Napoli: Arte Tipografica, 2000, with bibliography.

[3] The current path of the river Agnena is not as old, if not in the east-west direction, as regularized in a channel in the XIX century: GUANDALINI, Francesca. Il territorio ad ovest di Capua. In *Carta Archeologica e ricerche in Campania.* Fascicolo 2: *Comuni di Brezza, Capua, San Prisco*, *ATTA* suppl. XV, 2, 2004. Roma: «L'Erma» di Bretschneider, 2004, p. 55.

[4] COMPATANGELO, Rita. *L’Ager calenus: saggio di ricognizione topografica*. Napoli: Arte Tipografica, 1985, p. VIII.

[5] An interesting local study: SCIALDONE, Alfonso. *Vitulazio. Historie et Nugae*. Vitulazio: Pezzulo Editore, 1997.

[6] About the recent history of Vitulazio: CECERE, Alessandra et ALII. Una finestra sulla storia. Vitulazio negli ultimi duecento anni. In *Rivista di Terra di Lavoro – Bollettino on-line dell’Archivio di Stato di Caserta* – Anno III, n° 1 – Aprile 2008.

[7] Examples of similar architectures in Campania: GAMBARDELLA, Alfonso (a cura di). *Ager campanus ricerche di architettura*. Napoli: Edizioni Scientifiche Italiane, 2002, with bibliography.

[8] CHOUQUER, Gérard et ALII. *Structures agraires en Italie centro-méridionale. Cadastres et paysages ruraux* (*CEFR,* 100). Roma: «L'Erma» di Bretschneider, 1986, p. 304.

[9] QUILICI GIGLI, Stefania. La ricerca per la Carta Archeologica della Campania: continuità e innovazione in un antico progetto. In *Carta Archeologica e ricerche in Campania.* Fascicolo 1: *Comuni di Alvignano, Baia e Latina, Caiazzo, Castel Campagnano, Castel di Sasso, Dragoni, Piana di Monte Verna, Ruviano*, *ATTA* suppl. XV, 1, 2004. Roma: «L'Erma» di Bretschneider, 2004, pp. 9-18.
EADEM. La Carta Archeologica tra continuità e innovazione: applicazioni in Campania. In *Rendiconti dell'Accademia di Archeologia Lettere e Belle Arti* LXXIII. Napoli: L'Accademia, 2004-2005, pp. 49-62.

[10] Particular of Flight Alisud 1973. Sheet 172, series 20. Frames n. 8137-8140. The frames examined are part of a relevant series of a flight performed by that company in 1973 in connection with the work of the Autostrada del Sole.

[11] About the methodology: PICARRETA, CERAUDO, Fabio, Giuseppe. *Manuale di aerofotografia archeologica. Metodologie, tecniche e applicazioni*. Bari: Edipuglia, 2000.

[12] QUILICI GIGLI, Stefania. I dintorni del Santuario con il Monte Tifata. In *Carta Archeologica e Ricerche in Campania.* Fascicolo 6: *Ricerche intorno al santuario di Diana Tifatina*, *ATTA,* suppl. XV, 6, 2012. Roma: «L'Erma» di Bretschneider, 2012, p. 18.

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The Waterway from the Royal Palace of Caserta to the Royal Palace of Carditello

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Abstract
This abstract is the result of the experience of Graduation theses concerning the Degree in Architecture in English language. The theme of the study relates the Waterway, the branch of "Carolino" aqueduct, that starts from "Peschiera Grande" of the Royal Palace of Caserta and comes to the Royal Estate of Carditello. The path of the aqueduct and the context of the Carditello Estate are symbols of the historical identity of the Bourbon age that in the later centuries have been forgotten and have become the object of the barbarism and are now in a state of total decay and neglect. Because of the lack of researches, studies and the limited sources related to the topic, it was necessary the use of GIS (Geographic Information System). Through the use of this support it has been possible to georeferred the current and historical cartographies regarding the path, the context of the urban centres and the rural areas surrounding the Palace of Carditello. Subsequently the georeferred has allowed the identification and to carry out the surveys to analyse the current state of the areas crossed by the path with its symbols and the connected farms. The aim of this study is to create the basis for a work of protection and enhancement to allow the knowledge and the transmission of these historical testimonies of our past for the future generations

Keywords: GIS, Waterway, Aqueduct, Symbols, Carditello.

1. Evolution knowledge through Geographic Information System
The waterway, call in the historical document "Cardito Aqueduct", was realize in the 1786 from Francesco Collecini [1], it was wanted by the Bourbons. The water, which from the royal park of Caserta was brought by the "Carolino" Aqueduct (the imposing work of Vanvitelli), came to Carditello, thanks to the architect Collecini that in 1789 designed its extension. From the Castelluccia, through the lands leading up to San Tammaro, the new section of the aqueduct reached Carditello. In detail this aqueduct was directed to the west, borders the historical town of Casanova, along Casapulla, through the municipality of Curti, reaching Pratilli street in San Tammaro, and goes directly to the Real Fabrica di Cardito [2], the state of building of this aqueduct started from the 30 September 1786, for the cost of 1711,31 ducats. The register was written by Francesco Collecini the construction manager and by his collaborators. This document refers to the work performed by the contractor Pietro Fiorillo of Casale di Casanova, was accompanied by the contract for the excavation, from the grove of the Palace to Cardito, the depth "of 7 palms until 9 and somewhere deeper", with coupons for payment signed by Francesco Collecini and Carlo Patturelli. The 11.850 stones for the construction of the aqueduct, originate from Monte San Giovanni, were provided by Elpidio Iannotta and Giuseppe De Lillo. The water of the Aqueduct improved the territories who housed the passage as the municipalities asked for connections for supplies. The reconstruction of this path is not simple, because today we have not many elements that describe this waterway so it was necessary the use of Geographic Information System, indeed with the software Quantum GIS it was possible "georeferred" fifteen raster images (cartographies) on the bases of actual orthophotos, in detail have been georeferenced ten historical and five current cartographies, based on mapping was possible to reconstruct the path. The reconstruction of the path has been realized through the shapefile linear, from which it was possible to analyse different trends of the paths which change according to the cartographies. To the Shapefile "the waterway" was attach a range of information, including historical documents, that describe: the realization, the men who have made the aqueduct, describe the

lands crossing, the morphology of the territories, the buildings that the waterway lapped, the concessions of lands, and the payment of the workers, mostly this documents are signed by Francesco Collecini and also from his collaborators, including Giuseppe Di Lillo. The waterway is not only the aqueduct in itself, but it is made up of different elements, making it visible and premise to understand the importance of this hydraulic work and are: turrets, obelisks, fountains and the farms, also in the final part of the path near the Royal Estate of Carditello were also analysed the access points, and the small chapel. The turrets are the first elements that are located along the path of the aqueduct, they allow for the inspection of the duct and served as vents, from historical cartography, it was conducted a census through Geographic Information System, there are eighty two turrets on the historical cartography, through the realization of the punctual shape file, for each point shown in the software has been possible to attach to it a series of documents which indicate the position of the turrets, the historical documents, and talk about it and were attached pictures.
Other elements that are reported in the maps are the obelisks, they are placed in the last section of the path near the Real Estate of Carditello and represent signalling elements of the passage of the aqueduct, from historical cartography was possible census twenty seven obelisks, as for these elements the type of shape file choice is punctual, for each element were attached information about photos, location and degradation.
Inside the estate of Carditello existed several fountains that were used from the workers of the countryside and animals, in particular by the different historical cartographies "*Plan of the defence of Royal Carditello,1834, Historical Archives of the Royal Palace of Caserta*" and "*Topographic plant, of the Royal Delight of Carditello, 1806, commissioned by the Price of Caposele, on release of His Majesty, by order of your Majesty, by order of your Eminence the Duke of Campochiaro of State Councilor and Minister of the Royal House. State Archives of Caserta*", was conducted a census of ten fountains, represented in the GIS from punctual elements, to which were attached various information, such as for the "Carolina" Fountain in the historic Center of San Tammaro. The Public Water of the "Carolina" Fontain granted especially for the benefit of future generations of San Tammaro (Caserta), the plaque affixed to one of the sides of the building dedicated to the "Carolino" Aqueduct casertano: that desired by Ferdinando IV (to discover that affixed by the town of San Tammaro) the effigy is a tribute to the king and a confirmation of eternal gratitude for allowing the use of water to the people, demonstrated with this monument. The plaque dating back to Bourbon. The plaque celebrates the sale to public use of the waters granted by King Ferdinando IV for the territory of Caserta Carditello; fruition exploited both by the subjects of the time that by posterity. So you imagine the future use for future generations. Not only the use of water will be allowed in any form, even and especially imagining the use that will make future generations. Many will be the benefits resulting from this grant of "'indulgent" monarch and, for this reason, the people will be eternally grateful to the king. The "Carolina" fountain marks the final route of the aqueduct, is a kind of monument to the water that is organized in a structure of rock and stone with five little fountains. On either side of the wall there are two plates, the first devoted to the king and the second of the town of San Tammaro.

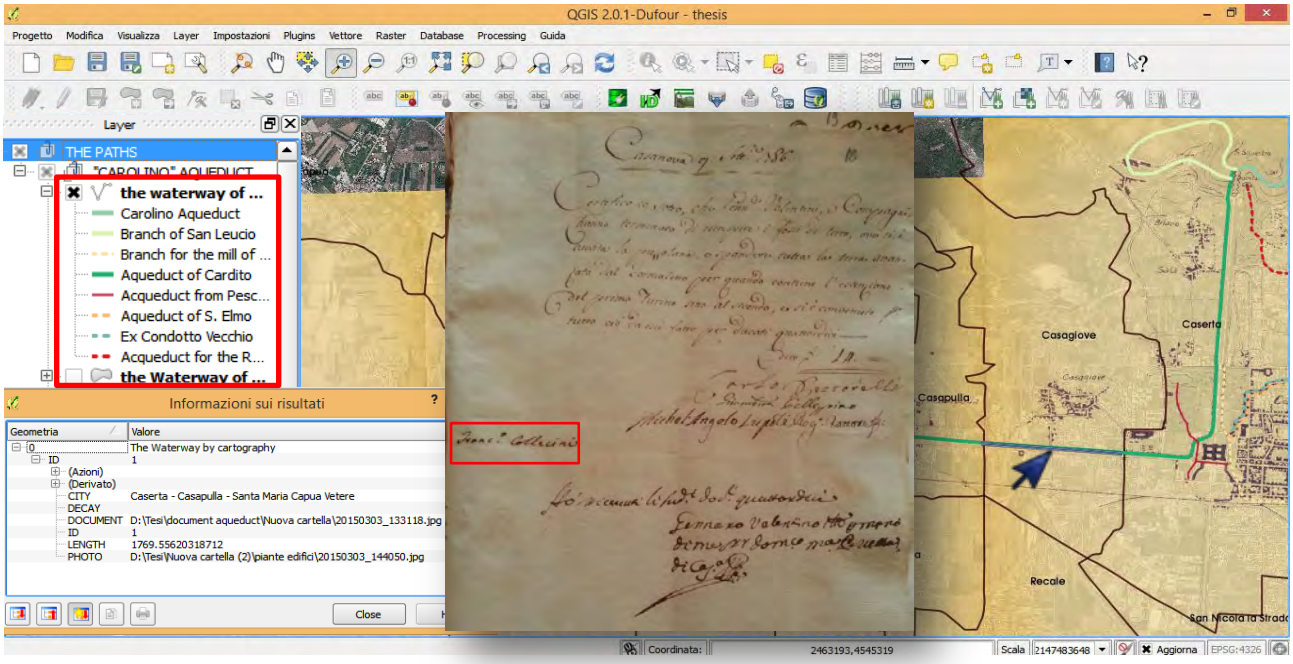

Fig. 1: Plan of the path of the "Carolino" Aqueduct, "Soprintendenza BAPSAE" for the province of Caserta and Benevento and photo of original document about "Cardito" aqueduct, "*Volume delle cautele per la Real Fabbrica di Cardito ed Aquidotto"*.

The latter contains the following inscription: “These clear waters of “Carolino” Aqueduct / for the great concession of the 1789 / here in large tanker / public use collected / were afterwards increased lustre / the proud work / this new fountain with real rescript / of June 17, 1842 / the municipality of San Tammaro / it with great expenses / because the work has not forgotten / the novella administration / this marble attach them / in 1874”.Analyse in detail this plaque in 1874 so that the "work was not forgotten" and in fact many do not remember it. The intent of the plaque is to recognize the magnitude of the entire “Carolino” Aqueduct and to do everything possible to ensure that the structure was remembered in time. The plaque explains exactly the story of “Carolino” Aqueduct: here comes the water from one of the ramifications that starts from the central basin of the park of the Palace of Caserta, continuing the long journey of 38 Km from Taburno that arrive in Caserta. In 1789 (the year of the French Revolution), the king granted the public use of the water with a tank right in the town of San Tammaro and for this reason, this fountain was built with the five fountains attached.
It seems that the queen would use the cistern covered by the license plate, to water the horses, when she went in Carditello [3]. In this respect, to honour the event and the grandeur of granting the water to the people from the king the town built this fountain June 17, 1842. A worthy tribute to “Carolina” water, use granted by the king also to the people. For the fountains were attach information about the geographic location, the current state and pictures. Connected to the waterway there were the production sites, placed in the area inside and outside of the Estate of Carditello, from historical cartographies "*Plan of the Royal defense of Carditello, 1834, Historical Archives of the Royal Palace of Caserta*" and *"Surrodings of Naples and Caserta, 1876. Florence. Miitary Geographical Institute*" shows twenty three farms, and a mill called “Sant’Antonio” Mill. The “Defense of Carditello” vast land belonging to the family of Count of Acerra since 1628, located in “Terra di Lavoro”, not far from the town of San Tammaro, was considered by Charles of Bourbon particularly suited to the improvement of the breed horses and 1744 took him busy for 2,800 ducats. The area chosen turned out later perfectly integrated in the programs of planning that would lead to the design of “a new city (Caserta) connected in addition to Naples to Capua and other neighbouring suburbs”. Ferdinando IV continued the paternal project expanding the estate with several territories. In the map drawn in 1834 by the Office of Topographical War were given fourteen funds, divided into sixty nine parks. These were bordered by ditches, embankments and hedges and inside still divided into several parts taking particular denominations. The Estate of Carditello, the oldest, was divided into thirteen land for pasture or woods. The latter covered the largest area, where lived “boars, goats, rabbits, for the hunting of the king”. In the Estate was also cultivated cereals, fodder, vegetables, hemp and linen. But the whole structure of the company was in operation of horse farms, buffalo and cows whose presence gave incentives to the application of new agricultural systems which included the integration of farming and agriculture as was the case in the rest of the peninsula. Ferdinando IV bother to build all the necessary comfortable rural livestock, processing of the products as well as the homes and shelters for the staff: the “stud” of the team, the home of the “cowboys”, the stable of the buffaloes, the tower where they were handling of dairy products,

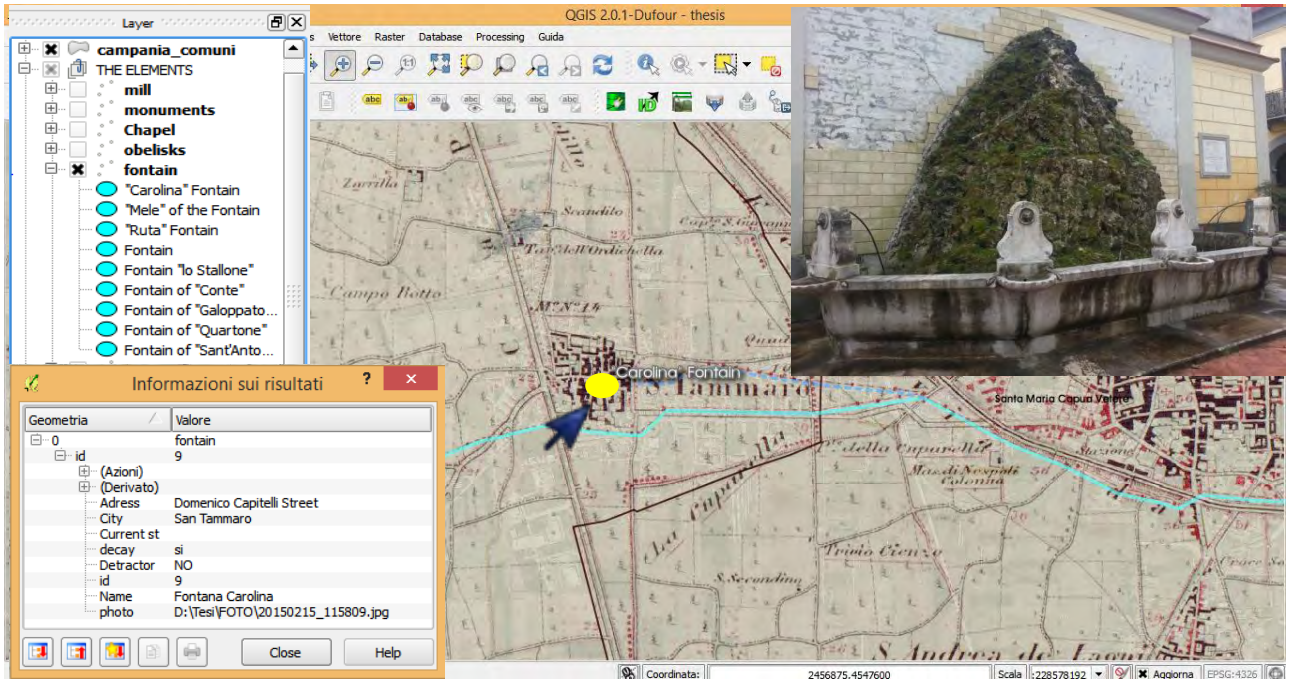

Fig. 3: Detail “Carolina” Fountain. Surroundings of Naples and Caserta, 1876. Florence. Military Geographical Institute.

the granary over the stable of horses, etc. These buildings, all described the farms of Carditello and Calvi, give a measure of the consistency of the rest of the farms widely documented since 1780. In June 1787 he finally dug the foundations of the Casino Royal by architect Francesco Collecini. The building is located almost in the center of the estate, at the intersection of the four main boulevards that crossed: included in the middle part destined to royal residence and laterally the buildings for the needs of a farm. He was left a space in front of the casino to the track of the horses and one behind divided into five courtyards, four of which were used in agricultural activities. Concerning the breeds, the “cows lodigiane” introduced perhaps because they considered most suitable for the production of dairy products that the king intended to increase. In the August 1780 was create “La Bufalaria” Farm, that is manipulated for “the first time to use Lodi cheese” and in subsequent years it began production of “parmeggiano”, along of course with local cheeses and dairy products (mozzarella, milk, cheese, ricotta, butter, “butirri”). During the reign of Ferdinando II (1830-1859) Carditello lost those characteristics that made him a place of delight: the hunts were suspended and were proscribed the horse races that were held on Ascension Day in the presence of the sovereign. Were made further innovations in agriculture and cattle farming was introduced cows from the Alps “Elvetie”.

The breeding of the breeds buffalo was fairly consistent in the Royal Estate of Carditello and certainly existed prior to its own constitution considering the nature of the territory - the extended “Defense” to grazing in a swampy area - and the characteristics of the cattle “whose breeding is cheaper than, that of the cow is against hospitalizations that being a great power transformer fodder coarser”. So many funds were sent for grazing animals such as the 1185 bushels of “park” called the “Count” and several buildings was provided to "manipulate" the dairy buffalo as in Tower built in “park” called the “complain of S. Lorenzo, which also served as home to the farmer and Bufalari. In the Geographic information system it is possible interrogating point elements of shp Farms are related information about the plants of seven historic farms, taken from historical drawings of “*Antonio Notarangelo 1911 plan annexes to the Estate of Carditello, Historical Archives of the Royal Palace of Caserta”*, but not only also actual pictures, addresses where is possible find these elements.

It was also carried out a study on the elements that are not directly connected to the waterway but are elements that describe the access points of the Estate of Carditello, as elements that describe the importance of this site, and then also the aqueduct. The Access points indicated on historic cartography are two, “Cancello a Rivo” and “Porta Sant’Antonio”. The Royal Estate of Carditello was much broader than today's tasks: the land that composed, in fact, have been divided among several owners and this has caused the loss to the estate its primeval grandeur. The first door of the Royal Delights Bourbon, which is on the road to San Tammaro: “Cancello a Rivo” or “Rivo” Gate The composition is similar to another “door Carditello”, leads “Porta Sant’Antonio” or “Sant’Antonio” Door on the road to Casaluce.

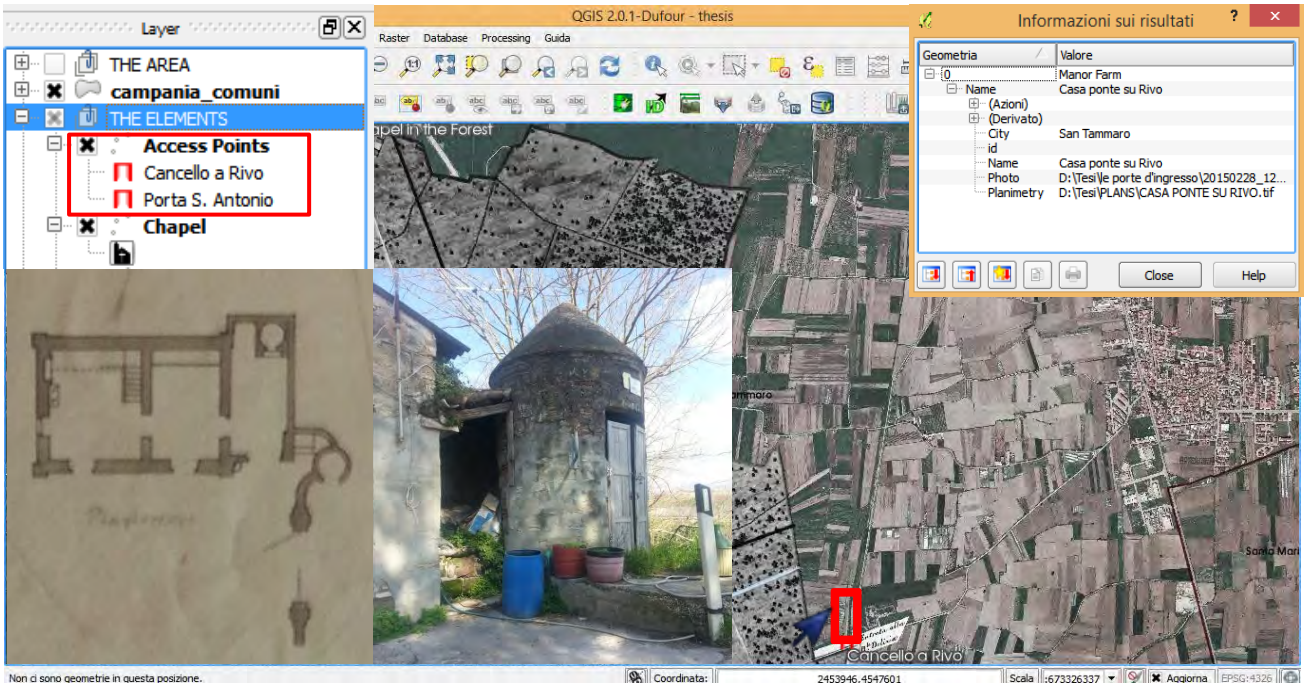

Fig. 3: Topographic plant, of the Royal Delight of Carditello, 1806. State Archives of Caserta with detail of “Cancello a Rivo”, plan of Notarangelo Antonio “piante dei fabbricati della Real Tenuta di Carditello”, 1910. State Archives of Caserta.

The “Cancello a Rivo” , in according with the historical plan of State Archives, was composed from two parts, a buildings and a sentry box for the military protection, but this building had also the other kinds of elements that were typically of Vanvitelli structures. While “Porta Sant’Antonio” is placed near the Regi Lagni, is in fact on the road that leads to Casaluce about three kilometers from the Palace.
Also on this roof are the chimneys lined shelves, typically Vanvitelli and Bourbon era Even here the "hand" of Vanvitelli students, perhaps of the Collecini who oversaw Carditello whole, should have design Porta Sant’Antonio. Via the georeferred work with Geographic Information System with the use of punctual shapefile called “Access points” it was possible to give information about the historical plants, addresses, photos, and status of these elements.
The last one element research in this study placed in the Royal Estate is a small chapel called “Alla Foresta” chapel, but, it was in function in the ‘700 as a religious place, when Carditello was an estate in full operation, for the people that worked in the construction of this Royal Site, but also for the people that after the construction of the site live in this Estate, such as other churches of the Bourbon period, such as San Carlo Chapel, near the aqueduct Carolino, or as the Royal Chapel of the State Property of Calvi.
The significance of this magnificent hydraulic work is immense, the waterway that not only was going to serve the territory of the estate Carditello that is placed, in the centre of two “waterway” between the Volturno on one side, and Regi Lagni on the other side, but also to supply the crossing urban centers, having several branches which supplied water to the municipalities of Casagiove, Casapulla, Curti, Santa Maria Capua Vetere and San Tammaro. In the present day along the path of waterway is not possible find all symbols of this aqueduct, because the negligence have bring to lose many elements, so, from this historical research, that represent a discover of our identity was start a study of the real actual state of this elements, for the preservation of the elements, that actually survived to this carelessness. Moving with this spirit, the work was continue with analysis of the present age.

2. Present age through Geographic Information System

The second stage of this work is about the identification of the current state of the path that starts from the Royal Palace of Caserta and reaches the Royal Palace of Carditello and is on the current state of Carditello context. According the studies, the abundance of water allowed the creation of other pipelines from the “Caroline” aqueduct as that started from “Peschiera Grande” of the Royal Palace of Caserta that reaches the Carditello Estate. The path was headed west, skimmed the village of Casanova (Casagiove), ran through the actual Via Musone of Casapulla, ran through the municipality of Curti (now Via Piave) reaching via Pratilli in San Tammaro, and came directly to Carditello.
For the study of the present age, as for the first part, the use of Geographic Information System has allowed the analysis of the current state of the path, of the ancient Carditello Estate and has allowed the census of detractors placed in the entire area. Through the “georeferred” of the current maps, has been possible to identify the current settlement areas and to create the layers related to the municipalities crossed by the ancient path. Through the overlap of the historic and the current urban centers, it was possible to establish that the actual boundaries entailed the loss of the tracks about the ancient path. Now is difficult to identify the section of the path which starts from Real Palace of Caserta and that ran through Casagiove, Casapulla and reaches San Tammaro because the signaling elements most probably were destroyed and were replaced by the human settlements.
During the centuries, the ancient path and the historical elements, have been forgotten and now there are only few tracks in a state of decay that allow its individuation. Therefore is possible to identify only the path that starts from Real Palace of Carditello and reaches the center of San Tammaro for the presence of some obelisks. Thanks the potentiality of Geographic Information System and in particular way thanks to the software Quantum GIS, it has been possible the correct management of territorial data that are the results of the studies and the surveys. Through QGIS, it has been possible to create the shape-files of the path and of the obelisks and to insert the data about the identification of the different path sections and about the present state of the same route. The software has been a great help for the activity of census relates the decay and the typology of decay about the path. With the interrogation of the different sections of the path shapefiles, we can see the data and the attached photos that show the current state, for example, about the decay of the access points and of the inspection locals of the ancient path. Regarding the decay of the route, have bee also carried out a census about the different typologies of decay. Among these, for example, has a great impact on the environment, the presence of the concrete elements in a state of disrepair. They were the irrigation canals realized subsequently, in the fascist period, with the work of reclaim in the entire area. With the overlap between the obelisks shape-file relates the ancient cartographies and the obelisks which has been identified during the surveys, it has been possible to categorized the obelisks signed on the IGM map of 1876 and the existing obelisks. The number of existing obelisks of the path, that start from real palace of Carditello, is sixteen and in the table of the attributes, associated to the shapefile of the obelisks, have been inserted info about the identification and the state of decay of a single element.

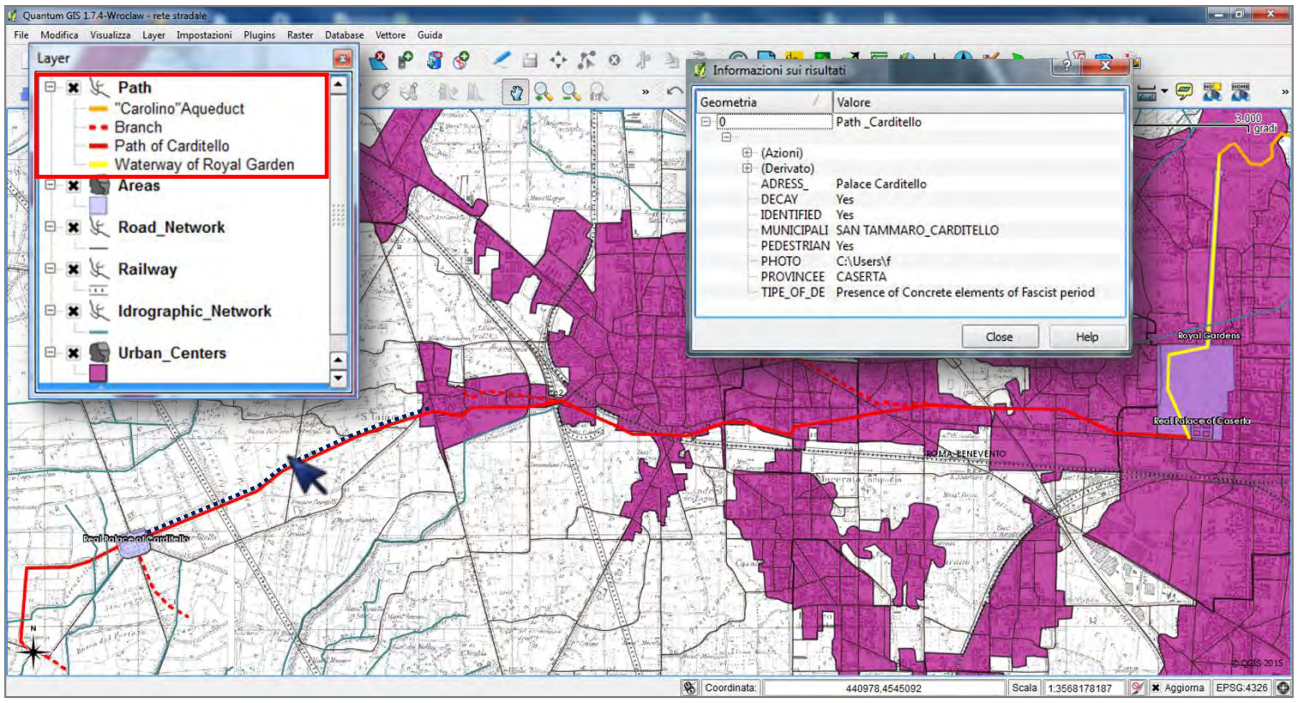

Fig. 4: The overlap of the historic and the current urban centers through Quantum Gis. Topographic Tables 15-16 of Chart of Italy _ 1984

It is possible to see the state of collapse of the obelisks identified along the way localized in the area of Carditello and in the area near the center of San Tammaro. The state of instability and the fallow vegetation that covers these signaling elements, denote the state of abandon and the lack of maintenance.
During the study about the branch of “Carolino” duct, has been very important to analyze the function of this waterway to understand its connection with the ancient estate of Carditello.
This important path was built to offer social wellbeing through the use of large quantities of water for the municipalities and agricultural areas. Therefore the construction of the “Cardito” conduct gave wellbeing to the territories because it represented the supply of water that allowed the development of a large quantities of productive activities, the expansion of the urban settlements and the agricultural centers in this areas. For this reason it has been important the analysis of the Carditello context and its ancient buildings. It has been used the same operation, through the use of the software, for the different historical elements of the context of Carditello Estate: the fountains, the point of access, the farms and the productive sites.
The number of historic fountains was ten but now is possible to identify only three, two of these fountains are the “Galoppatoio” fountains placed in the garden of real palace of Carditello and the last element is placed in the center of San Tammaro, it is the “Carolina” fountain. Through Quantum Gis was carried out the subdivision in existing and destroyed fountains and it has been indicated the current state of these elements because many of them, in addition to being destroyed, have been replaced with the other buildings or the industrial areas. The Bourbon farms, the buildings and the ancient elements are difficult to detect because they now are in advanced state of deterioration or during the years were destroyed by the human neglect.
In excessive state of decay are the farms as the “Falciata, “Casa di Mazzolla”, “Casone” and the ancient “Cavallerizze”. They are partially destroyed, completely covered from the vegetation and often covered from the dump waste piles. All information and the attached pictures about the present state of these sites, have been included in the properties of the relative shapefiles. The number of historic manor farms of this estate, was about twenty-two but now is possible to identify only seven farms, subsequently they have been divided with the software in destroyed, unidentified and degraded sites.
In the territory of the Carditello Estate, three or four miles from the palace, on the road in the direction of Casal di Principe, is possible to see an Bourbon old chapel, the Chapel of the Forest. Today the church is a skeleton, a testimony of the splendor period and full function of the ancient estate, and also it is a testimony of the human wickedness. It is characterized by a fall of entire parts of the plaster and also the roof is destroyed in many points. It has been robbed of everything and the interior is inaccessible due to the presence of dump and the vegetation in the surrounding area. Near the chapel, in the Bourbon period, was located "The Forest", probably a productive and agricultural site or an animal shelter site. Until 2010 it was

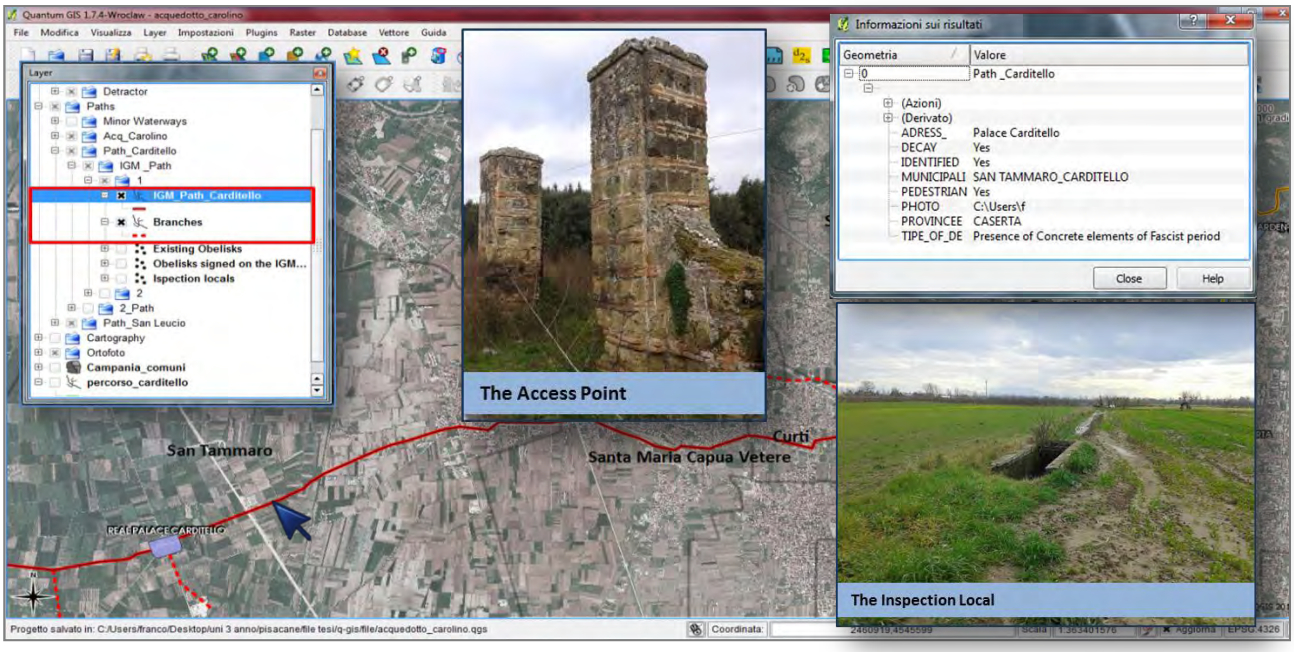

Fig. 5: Data processing relates the current state of the access points and the inspection locals of the path

possible to identify the structure of this building although in conditions of extreme degradation, today remains a pile of rubble because it was completely destroyed.
The ancient perimeter of the Bourbon estate was bounded by the old access points that today have been transformed and have been become private properties. On the road that leads from Casaluce to Carditello, just after the Regi Lagni, was once positioned the gateway of Sant' Antonio with the gatehouse. Today remains very little or almost nothing because now is a private property or farming depot and during the year it has lost the typical Bourbon connotations. Following the road from San Tammaro to Carditello, near the Rivo river, there is another access point: "Porta a Rivo". It now consists of two parts, one side there is a sentry box (garitta) and on the roof there is a chimney that is a recurring element in the Bourbon construction and in the eighteenth-century. Today this ancient building is used as a private residence.
Proceeding in the Sant'Antonio area , beyond the Regi Lagni, about three kilometers from the palace, there is another Bourbon building, probably one of the mills of the same Regi Lagni, the old "mill of Sant'Antonio". This building, compared to the others, isn't in a state of excessive decay even if isn't enhanced and protected. It consists of two buildings, one with octagonal plan. Also on the roof of this building there is a chimney similar to that of the access point near the Rivo. From the mill of Sant'Antonio, continue on the left, at the end of a rural path is present the " Casa di Mazzolla" in extreme a state of decay. In the same area was originally present the "Ruta" fountain that was supplied by a branch of aqueduct of Carditello. Today there isn't the trace, the only elements, that are always recurring, are the waste and the neglect. Going to the palace of Carditello, is possible to enter in the "Quartone" area where there was another Bourbon destroyed fountain. Now in the same area there is a cement plant that with its dust contributes to pollute the surrounding agricultural area. From this area we proceed to another ruin of a farm, which is the " Falciata" that now is a deposit of waste and the perfect habitat for green fallow. Another similar farm is located at northeast of the palace near the "Colonna" bridge, it is the "Casino di Prisco". Even here, there is only one part of an Bourbon ancient building skeleton where the walls and roof are destroyed and have been replaced to wild vegetation. Two the other points of extreme importance in the estate were the Bourbon "Bufalaria" and the "Cavallerizza" where were bred the buffalo and the Persian horses. The area of the old Bufalaria was still in use, and within the walls is possible to see the remains of an old site. Near the boundary walls is an old canal of water distribution that perhaps corresponds to the fascist period.
The other area of great interest is the area of the ancient "Cavallerizze" replaced now from the new "Cavallerizze". It is partially destroyed and probably part of the building is occupied. Proceeding along this area is still possible to identify other degraded buildings and ruins that probably were of the Bourbon period. In addition to the state of decay of different historical elements, is possible to see the general state of decay of the entire historical site, which during the Bourbon period, were the production sites of great importance for the surrounding area. The last stage of this work has been the identification of the different typologies of detractors as the presence of general and punctual waste, the presence of the garbage dump, factories, private properties and the other elements. These detractors have been subsequently detected and categorized in different

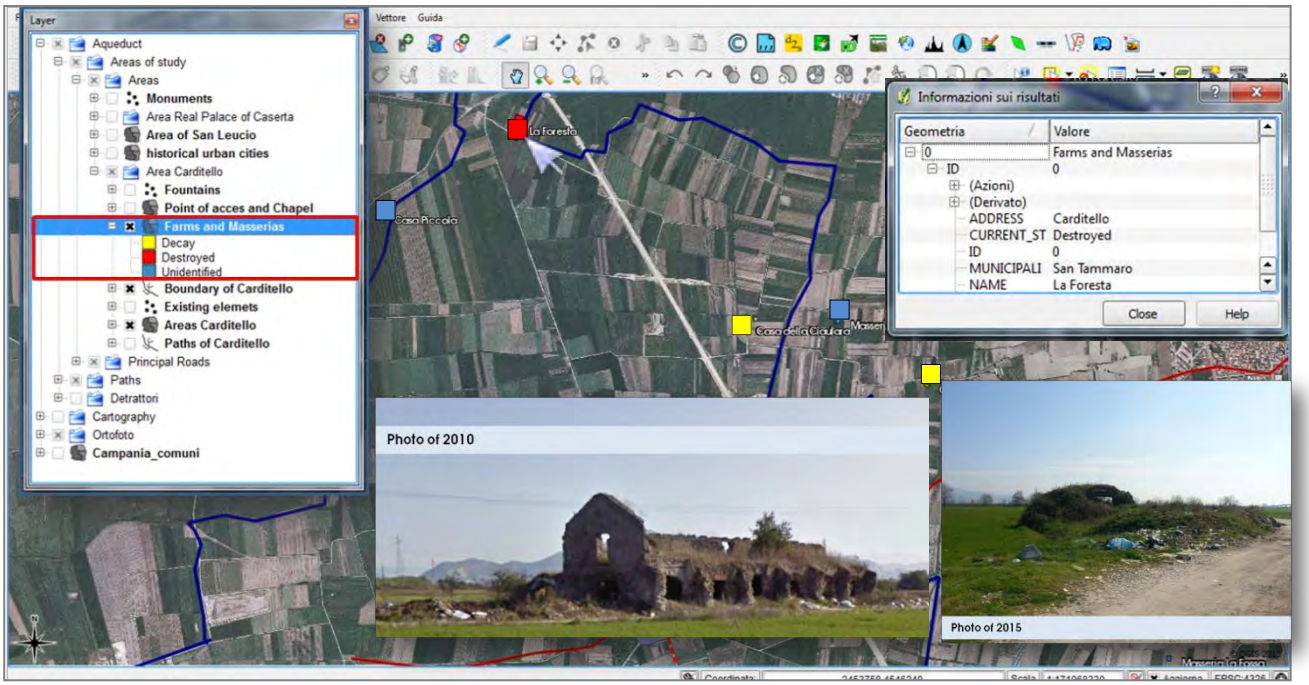

Fig. 6: Data processing relates the current state of the productive sites " la Foresta" placed in the context of Carditello

shapefiles and with the software GIS have been inserted the relative data. The estate of Carditello was located at the centre of two river basins that are the Volturno and Regi Lagni. The latter is the lower limit of the estate. Therefore it was, of fundamental importance, a quick analysis of the current state of its path. Also in this case has been recognized elements of decay that have been categorized, through the software, in three different shapefiles: the discharge points, the garbage dump and the points of general decay.
The branch of "Carolino" aqueduct is an important historical testimony that has been deprived of the protection, the promotion and finally the management. Given their complexity, the Geographic Information Systems, represent the supports not only for the identification of the path but also for the management of the territory and consequently also for the restoration, the protection, the improvement and the enhancement of this historical path and its context that now are in a great state of decay and neglect.

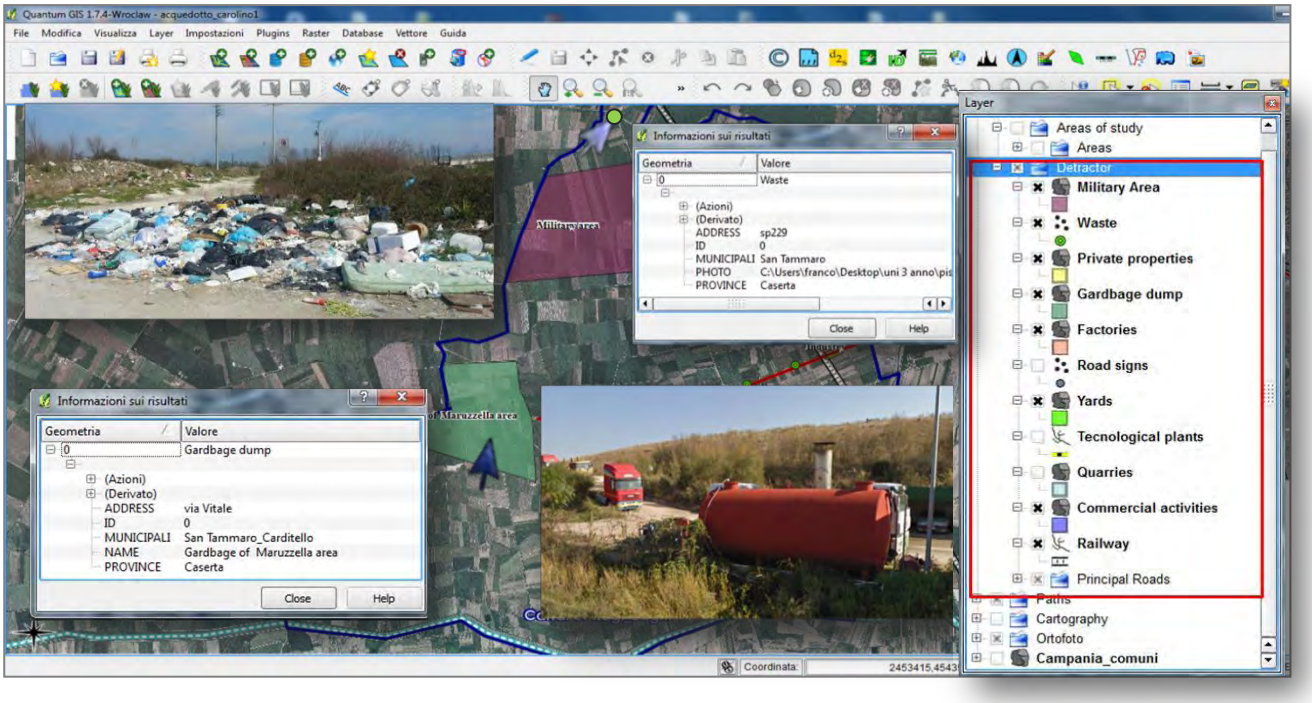

Fig.7: Data processing relates the detractors located in the context of Carditello

Bibliographical References

[1] Archive of Royal Palace of Caserta- *Volume delle cautele per la Real Fabbrica di Cardito ed Aquidotto,* n.92 and n. 563.

[2] VERDILE, Nadia. *La Reggia di Carditello, Fasti e Feste, Furti ed Aste, Angeli e Redenzioni*. (Translated by MAURO, Gina*). 1ª ed. City: Capodrise (CE), Ventrella Edition, 2014. 215 p.* The Royal Palace of Carditello*. ISBN 9788-88-908389-8-9.*

[3] Referring Web Pages Web: http://www.ilblogmariacarolina.blogspot.it

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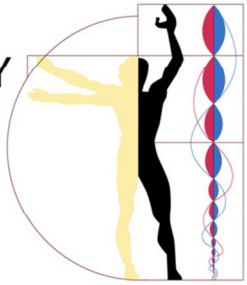

Among smart governance and smart communities. A survey in the city of Milan

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Abstract
The present article offers a contribution to the debate on smart cities, focusing on the concepts of smart governance, smart communities and the involvement of the city's population. There are two reasons why we decided to investigate these issues. The first reason is of a theoretical and methodological nature i.e. it is useful, for the debate on smart cities and smart communities, to develop a method for field research that may help to comprehend how urban populations are informed about the smart city initiatives in their cities. The second one is of an empirical nature and it concerns the possibility of evaluating how the urban population of Milan was provided information on the smart initiatives in the city.
A questionnaire analysing how the urban populations of Milan (Italy) was informed about "projects", "practices" and "initiatives" that are included under the smart city umbrella and strongly triggered by EXPO 2015 was submitted to 1330 respondents. The results of this research highlight the fact that, even if the vast majority of the interviewed population uses the ICT in their daily life, awareness of the "smart" initiatives promoted in the in the city is scarce. The results suggest the need to improve or modify communication strategies adopted so far to communicate with the population of Milan.

Key words: smart city, smart community, governance, human-centred approach

1. Introduction
The *smart city* debate assumes that *smart* cities are those which emphasize the positive and propulsive role of new technologies in order to improve the quality of life of its citizens. In order to achieve such a function, studies on *smart cities* are increasingly focusing their attention on *governance* and on which governance strategies are most capable of improving people's quality of life (Deakin, 2014; Giffinger and Huilui, 2015; Komninos, 2014; Hollands, 2014). The reasons for which interest tends to focus on these issues is due to the conviction that a city can never be smart if it does not define a system of governance that is effective and efficient. That is, able to manage changes and satisfy social needs.
Literature seems to agree in considering a system of governance effective and efficient when it defines open and inclusive processes (Healey, 2012 and 2015; Deakin, 2014 and 2015; Davoudi and Madanipour, 2015).
The term *smart governance* thus indicates an administrative body that coordinates the definition of a plan for transforming a city into *smart city*, involving the identification of common objectives, the interaction and involvement of formal and informal institutions from the private sector, as well as of socio-economic and industrial players, and the programme of interventions to be made in order to achieve these objectives. This form of management then implements the use of new technologies of communication precisely for channelling and simplifying these interactions and involvements.
The concept of *smart governance* and its attention to the form of involvement and engagement of the local population, has led to the introduction of another concept, the *smart community*. The term *smart community* implies a community capable of implementing know-how and activities, putting collective processes into effect, building new codes and new expressive approaches in context of the opportunities that derive from new technologies.
"The concept of *smart community* implies the convergence between a complex conceptual category such as that of "community" – the particular configuration of temporary and adaptive state of a group of individuals who cooperate for the pursuit of defined objectives – and a category defined primarily as an attribute such as that associated with the term *smart* – commonly employed to define emerging properties that are too specific to be defined by the term *intelligent.* Such a concept identifies as characterising requisites - which provide value and are facilitated by technologies and the sharing of information – cognitive connection, the diffusion

of an innovative culture, the human and social capital linked to these and the cohesive aspects that derive from them – and which are consequently legitimized – and a series of activities geared towards common and/or general interest according to specific modal prerogatives pertinent to creativity, interactivity and dynamism.
A community is therefore *smart* when it is prepared to get involved in open and inclusive decision-making processes, accustomed to making its voice heard, to elaborate on the meaning and reasons of its positions and to actively take part in the processes of inclusive *governance*.
The relevance of issues linked to *smart cities* and *smart communities* are also supported by the European Union that has identified in these categories two of the key strategic *assets* on which to invest over the next few decades. Considerable funding is in fact available at least until 2020 to cities which, through networking, can show their ability to combine technology, energy saving, efficiency in public administration, involvement etc. etc.
The study hereby presented has been conducted considering the aforementioned problems in terms of what it means to be a *smart city,* what it means to implement *smart governance* and *smart community* processes*.* In that sense, assuming people can be involved and take action from the moment they are aware of what is going on in their city, the aim of the research was to highlight what activities - that can be included under the *smart city* umbrella - are known to the urban population*.*
The reasons for which it has been deemed useful to undertake this type research are two. The first is of a theoretical-methodological nature: to define the approach to an on-site study that can help understand the involvement of the local community. The second more pragmatic reason is driven by the desire to understand what knowledge urban populations have of the commended *smart* processes implemented by the City of Milan.
In brief, the study hereby presented is in context with the debate on *smart cities,* with particular focus on the *governance* of a *smart city* and its connections with the *smart community.* The reasons for which such a research has been carried out can be linked to the now widespread debate on *smart cities* and *smart communities* which questions the extent to which *smart* actions implemented by a city can involve local populations. The paper is largely the result of a survey carried out in Milan with the aim of understanding how much the local population is aware of *smart* initiatives. For the purpose of presenting the study undertaken, the paper has been organised as follows. Initially it introduces the *smart city* project for Milan. The methodological issues are then addressed, looking in detail at the description of the surveyed group. This is followed by a theoretical evaluation and the analysis of the data collected. Finally, in the conclusion, it will be highlighted how, even if the vast majority of the interviewed population uses ICT in their daily life, awareness of the *smart* initiatives promoted in the in the city is scarce. The results suggest the need to improve or modify communication strategies adopted so far to communicate with the population of Milan.

2. The smart city project in Milan

The city of Milan is trying to become *smart*. Such processes of smartness began a few years ago, as demonstrated by research studies that focused on analysing the smartness level of Italian cities[1]. In the Italian *smart cities* classification made by forum PA (Forum PA, 2013), Milan is in the third place of the general classification, and it is in the first place for its performance in the economy and mobility fields. In the icitylab classification drawn up in 2014 (http://www.icitylab.it/il-rapporto-icityrate/edizione-2014/dati-2014/), Milan was awarded first place in the general classification followed by Bologna and Florence [2].
Even though the city of Milan was already motivated to implement and develop smart projects, the organisation of EXPO 2015[3] has strongly triggered the smartness processes. For this reason, Expo was included as ranking seventh in the famous Giffinger (2007, 2008) dimensions related to the creation of a smart city and as a partner together with large multinationals, social enterprises, SME, research centres, universities and associations. Public institutions play a role of facilitation, connection and co-ordination, in order to create a favourable environment for the local excellences and support of not only the technological dimension, but also of economic development, innovation, social inclusion, training, research and participation.
In order to start this virtuous process, the City of Milan and the Milan Chamber of Commerce signed a memorandum in which they are committed to power up a process of public-private partnership and to encourage the creation of a governance model for the smart city. They started with a public debate and with seven active working groups to support participation[4]. Alongside this, there is the already existing Digital Milan, made up of fibre-optic networks[5], Wi-Fi hot spots, digital islands, portals, open data; but also sensors for traffic, electronic gas meters, alternative mobility and projects on environmental respect and social well-being. With the infrastructures realized in view of Expo 2015 the technological background of the city has grown significantly. At the same time, as will be further demonstrated in the following pages, the city of Milan is organising thematic panel discussions aimed at getting to know the point of view of the local population in terms of what could be the most fitting strategies in various sectors from mobility to the environment, from economy to governance.

This brief overview shows the presence of a well-defined strategy, designed top-down, but that tries to be inclusive and careful to the needs of the various stakeholders and to support sustainable development.
The public administrators are well prepared regarding smart processes[6], meanings and rhetoric; they are aware that an urban area full of networks such as Milan needs a different role also at the institutional level, following proper governance strategies; they understand the importance of human capital and of the active participation of the communities. As reminded by Telecom *"Through the relationship between the public administration, agencies that offer infrastructure, technologies and people, the quality of life can be improved and the environmental impact can be reduced".*
However, despite the presence of more or less shared goals and strategies, and the clear interest in evaluating the human capital and the active participation, what has lacked until now is the comprehension of how people are really informed about what is happening in Milan in terms of development of smart initiatives.
The aim of the study undertaken is that of verifying how aware the local population is of *smart* initiatives.

3. Methodology

3.1 The research approach

As mentioned above, the study sets out to take an in-depth look at how the *smart* processes currently implemented in the City of Milan are known to the local population and what the level of interest is in them.
The operational approach to these areas of interest was carried out by creating two dependant variables: level of *knowledge of* the initiatives considered part of the concept of Milan as smart city and promoted on occasion of Expo, and the *interest in* taking part of them.
The study set out to examine the trend of these variables in the city's population. Moreover, the theoretical model assumed that the independent variables capable of explaining the differences in the population group examined, were represented by the socio-demographic data and by data collected on usage of new technologies

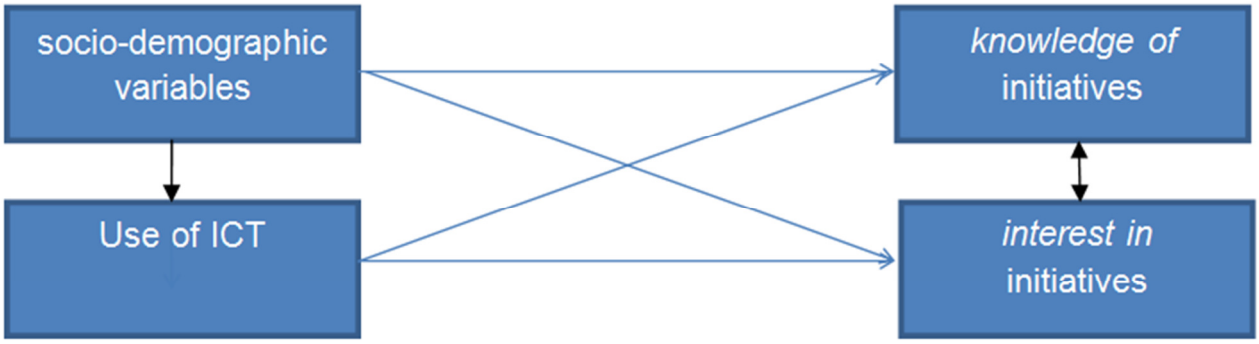

Fig. 1: The theoretical model

A series of hypotheses were then formulated in more detail, namely that the socio-demographic data correlated with that on ICT usage and with the *knowledge of* and *interest in* the initiatives promoted by EXPO; that the data on ICT usage correlated with the *knowledge of* and *interest in* initiatives promoted by EXPO.

3.2 Description of the questionnaire

Data was collected using a dedicated questionnaire, comprising 18 questions that covered the following subject areas:

- Relationship with technology: 4 questions (3 with Likert-scale answers and 1 with multiple choice answers) collected information on technological devices owned by the subjects, the frequency, importance and context in which they are used and the frequency with which hardware is upgraded.
- Level of *knowledge of* the smart initiatives available in Milan: 3 multiple choice questions
- Level of *interest in* the smart initiatives available in Milan: 4 Likert-scale questions
- Socio-demographic data

3.3 Survey methodology

Survey participation was anonymous and voluntary. The questionnaires were submitted in different areas of Milan, taking care to include areas that were diversified in terms of type of frequentation (commercial areas, parks, street markets, city centre, university area, outskirts) and to cover different times of day. People were approached by an interviewer who, after a brief introduction and explanation of the purpose of the research, would remain available during completion of the questionnaire in order to provide any required clarification.

4. Brief description of the survey group

The final group of individuals who completed the survey comprises 1303 subjects of which 50.5% male and 49.5% female. It consists of a relatively young group with 69.9% under the age of 30, 17.5% between the ages of 31 and 45 and 12.7% over the age of 46. During data collection, older people tended to decline taking part once realising the objective of the survey, considering it too irrelevant to them.

With regards to qualifications the surveyed group is primarily formed by individuals with a medium to high level of education: 57% has completed secondary school; 29.7% have graduated and 2.6% have a PHD; whereas 10.5% have not completed secondary school. In terms of occupation 41.7% are students and 10.1% are working students (meaning 51.8% of the group are students), 23.7% are employed, 11.2% are self-employed. Other forms of employment form under 10% of total.

The group is formed primarily by Milanese citizens (51.6%) and 23.9% by residents in the Province of Milan and 15.8% in other municipalities of the Lombardy Region. The group also comprises residents in other Italian regions, and a small percentage (1%) of people who reside abroad.

Even more significant is the percentage of those interviewed who work in Milan (74.4%), 12.2% working in the Milan Province, 6.9% in Lombardy and 5% in other Italian regions. 1.4% of those interviewed works abroad.

In terms of the frequency of use of new technologies, contrary to expectations, there are no significant correlations in the survey group between any of the socio-demographic variables: neither gender, age, qualifications, occupation or even area of residence determine a greater or lesser use of new technologies.

Desktop Personal Computer	72,2%
Laptop or notebook	88,1%
Traditional Mobile Phone	43,7%
Smartphone	77,6%
Tablet	49,3%
iPhone	44,2%
iPad	40%

Tab. 1: Percentage of usage of new technologies among respondents

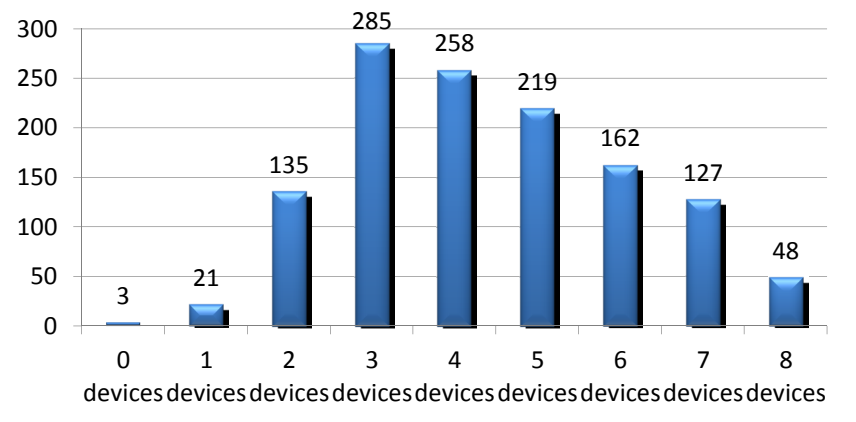

Fig.2: Multiple use of devices within the group surveyed

With regards to the context in which ICT is used (communication, education, photography, entertainment, music and audio, video and multimedia, books and reference, transport and mobility, travel information and local news, games, apps and websites connected to type of occupation, purchases and online trading) a diffused, but differentiated, use of new technologies emerges among the subjects. Nowadays virtually everyone uses technology, what changes are the reasons for using it. Games, music, videos and multimedia are the main use made of new technologies by the very young and young (up to the age of 30). Thirty seems to be the watershed between the more recreational use by younger people and the more functional approach to new technologies by individuals in higher age groups. In almost all areas of use (except for music, games and travel) there is a marginal correlation with educational qualifications, which indicates that the higher the level of education the greater the use of new technologies, particularly for functional applications.

	Age		Gender		Qualification		Profession	
	Corr	Sig.	Corr	Sig. (2-tailed)	Corr	Sig. (2-tailed)	Corr	Sig. (2-tailed)
Communication	,151**	0	-0,041	0,131	-,096**	0	,034	,161
Education	,143**	0	-,068**	0,007	-,155**	0	,074	,001
Photography (Flickr, Photoshop)	,077**	0,001	-,065**	0,01	-,093**	0	-,022	,347
Entertainment (searching for events)	,100**	0	0,042	0,095	-,117**	0	-,027	,233
Music Audio	,327**	0	-0,014	0,593	0,018	0,472	,118	,000
Video and Multimedia	,211**	0	,072**	0,005	-0,045	0,065	,076	,001
Books and Reference	,066**	0,005	-0,027	0,278	-,169**	0	,026	,264
Transport and Mobility	,146**	0	-0,042	0,097	-,110**	0	,033	,159
Travel and Local News	-0,002	0,947	0,006	0,825	-,190**	0	-,053	,021
Games	,199**	0	,100**	0	,064**	0,008	,111	,000
Work-related Websites	-,139**	0	,073**	0,004	-,236**	0	-,175	,000
Online Purchases or Trading	0,031	0,199	,058*	0,023	-,196**	0	-,035	,132

Tab. 2: Correlation between areas of use of ICT and socio-demographic variables

The correlations become more interesting if we look at occupations: work-related websites are in fact more uses and consulted by individuals whose profession has closer links to these thematic areas, such as the self-employed, managers, free-lancers and entrepreneurs. The correlation occupation/area of use decreases, though still remaining significant, as far as online purchases are concerned by the employed and the self-employed.
The characteristics of the survey group confirm that what device is used[7] is, nowadays, no longer important because of the widespread use of technology by all people regardless of gender, age group, profession or qualification. What does make the difference are the reasons for using new technologies, what makes individuals turn to ICT.

5. Data analysis and key findings of the research

The aim of the analysis is to evaluate the "knowledge of the smart initiatives available in the City of Milan" of citizens and city users, as well as the "interest" stirred by these initiatives.
Our theoretical model started from the assumption that the two variables, *knowledge of* and *interest in*, would be influenced by the socio-demographic variables and therefore by age, gender, qualification and occupation, as well as by those relative to the use made of new technologies (which technologies are used and for what reasons).
A series of items verified the *knowledge of* the different initiatives promoted in Milan. The answers to these items allowed for the creation of a scale on the basis of which the following different knowledge groups were identified: *no knowledge*, *little knowledge* (where the respondent was aware of 1 to 3 initiatives), *good knowledge* (where the respondent was aware of 4 to 8 initiatives), *excellent knowledge* (where the

respondent was aware of 9 to 12 initiatives). However only one, meagre, correlation was registered between the *knowledge* variable and the independent variable of *occupation (Cramer's V = .169; p>,001),* which does not allow for significant differences to emerge, but only to reconsider the groups previously identified.
In fact, considering *occupation,* three broad groups can be recognised: one of scarce knowledge which includes housewives, pensioners and employees; one of medium-high knowledge which includes significant percentages of students and free-lancers; and one of uncertain knowledge which is randomly distributed and does not show any significant trend from which specific conclusions can be drawn, and includes the self-employed, entrepreneurs, lecturers, doctors, working students and the unemployed. An especially surprising factor is that certain categories, which would particularly benefit from the existing initiatives, are completely absent from the higher knowledge groups. The proportion of housewives and pensioners with good and excellent knowledge of the initiatives is, for example, slightly higher than that of entrepreneurs. Even within the better-informed groups it must be noted how the difference in distribution between the different groups is not as marked as the lesser-informed groups.

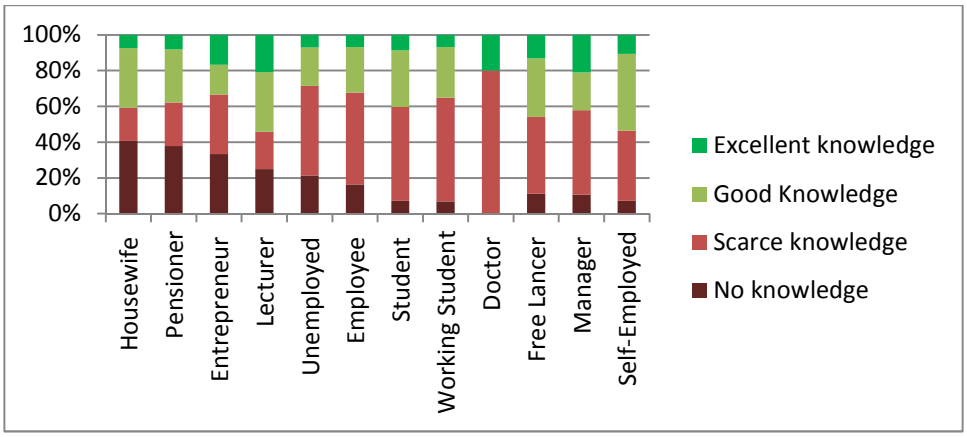

Fig.3: Distribution of *knowledge of* initiatives by occupation

It should be additionally noted that there are no significant correlations between the knowledge variable and the frequency of use of ICT devices, nor with the variable relating to the areas of use of technologies. There is only a marginal correlation between knowledge and the use of technologies for the topics photography, books and consultation and, to an even lesser degree, for travel and local news.
The correlation between the *knowledge of* projects and initiatives variable and the variable that measured the *frequency of purchases and renewal of owned technologies* has very low values (Kendall's tau b = ,110; p>001). This tells us that, in general, those who invest more in technology are only marginally more aware of the initiatives that are taking place in Milan.
However, given that it is an important, but very weak, correlation, it is not possible to deduce that a heightened technological sensitivity (leading to exchanging/purchasing technological devices more frequently) can influence levels of knowledge in a structured manner.
Lastly, the correlation between knowledge of *smart* initiatives and the importance given to the use of technologies in specific areas (mobility and transport, economy and finance, contact with public bodies and entertainment) registers important values, although contained, in the area of economy and finance (Kendall's tau b = ,115; p>001). This tells us that those using technologies to acquire information regarding economic and financial assets are, on average, more aware than others of what is happing in Milan. In other words, a greater interest in using ICT in connection with economy and finance correlates with an increased level of knowledge of the initiatives considered in this survey.

The second dependent variable considered in the model is connected to the ***"interest"*** shown by the survey group in those very events, meetings and projects, which were earlier analysed in terms of "knowledge of".
The scale of interest was constructed on the basis of the answers to 3 items, where interest was measured on a Likert scale from 0 (no interest) to 10 (very interested). The group was thus divided into the three broader groups: *very little interest* (from 0 to 4) *little interest* (from 4.01 to 6), *average interest* (from 6.01 to 8), *high interest* (from 8.01 to 10).
As we can see from table n.3, the groups of interest show significant correlations with the variables relating to *interest in* the use of ICT in the field of economy and finance, consultation of institutional websites, transport and mobility. Those who consider technology important for "being in touch" with these sectors are also, on average, more interested in the different *smart* projects, meetings and events.

	Kendall's tau b
Visiting economy and finance websites	,303 (p<,001)
Visiting and interacting with institutional websites	,276 (p<,001)
Use of technologies for mobility	,247 (p<,001)
Use of technologies for entertainment	,209 (p<,001)

Tab.3: Correlation between *interest in* initiatives and type of ICT usage.

The groups of interest do not show significant correlation in terms of gender or age bracket. There is a marginal correlation with level of qualification (Kendall's tau b = ,091; p<,001). It can in fact be said that those with higher levels of education show, on average, a higher interest in *smart* activities taking place in the city.
The scale of interest does however appear to be moderately influenced by the occupation of those surveyed (Eta = ,179), meaning there is a correlation between at least two of the categories considered and such correlation partially serves to confirm what emerged from the *interest* variable, but also to highlight some of the incongruences already mentioned. Free-lancers are those who, overall, have most assimilated the information, for whom communication has had greater effect and who are most interested in the technological evolution of the city, as well as in the programmes and meetings promoted by the city. Other occupation categories, despite declaring an interest, have stated not to be aware of what is happening in Milan. If, on the one, hand categories such as housewives and pensioners are not very informed and not particularly interested in technologically innovative projects linked to Milan as Smart City and promoted on occasion of Expo 2015, entrepreneurs and lecturers declare an interest but appear considerably unaware of what is happening in the city. The position of the self-employed category is also interesting, stating a good knowledge but little interest, and that of employees who, on the contrary, despite having little knowledge manifest a reasonable interest.

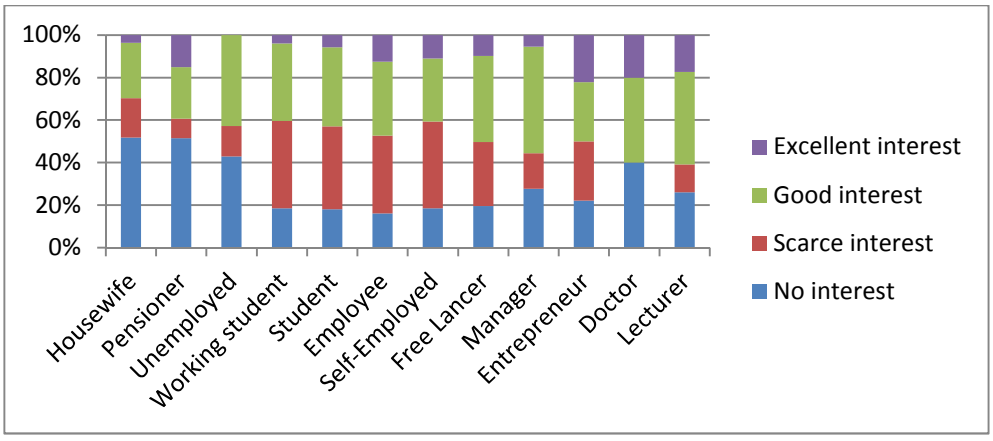

Fig.4: Distribution of interest level per occupation

From this it emerges that certain groups are not being reached by an ad hoc communication aimed at their target group, receiving only average levels of information. There is clearly room for increasing/improving levels of communication for these categories by studying a specific strategy for the different target groups to be reached. Instead, for other categories, it appears necessary to develop an intervention plan that conveys a more comprehensive explanation of the initiatives allowing for better understanding and providing reasons to encourage higher involvement.
With regards to this it is useful to observe the valuation given by the surveyed group to the communication of innovative technologies. Individuals who expressed a positive opinion of communication received (>7 on a scale of 1 to 10) are in 50% of cases between the ages of 21 and 30, with a medium-high level of education (secondary school 54.3%, degree 28.2%), in 37.8% of cases still students, employees in 25% of cases and

free-lancers in 14.2% of cases. In reality these numbers merely confirm that communication has not reached specific targets, but has touched different individuals across the board.
The two dependent variables considered in this research demonstrate reasonable correlation between themselves (Kendall's tau b = ,205; p< ,001), meaning that there is a moderate influence between *interest in* the initiatives and *knowledge of* them. The data does not provide the possibility of verifying a purely casual link, though it does seem plausible to assume that the variables have reciprocal influence on each other. Certainly the absence of a more significant relationship can be read as further confirmation of a relative detachment between what people know and what they would like to know, to what extent they have been reached by communication and information and to what extent they would actually like to increase their knowledge.

6. Conclusions

In conclusion it is possible to state that initial assumptions have been by and large proven wrong by the data collected. The extreme diffusion of ICT makes generic socio-demographoc details less relevant for predicting its usage, whereas as far as *knowledge of* and *interest in* initiatives promoted by EXPO are concerned, it is necessary to make a more in depth analysis.
The survey confirms, as previously mentioned (see note 5), the national data indicated. Use of technologies today is highly diffused; therefore, for the purpose of identifying significant differences in the population and defining specific profiles, it is necessary to employ more subtle variables, such as the type of usage made.
As far as *knowledge of* what is currently happening in Milan in terms of *smart city* initiatives, on the basis of the research undertaken, it can be stated that people do not seem to be adequately informed about *smart city* initiatives and this also applies to individuals who have explicitly shown some interest in being informed on what is happening.
Those using technology for professional reasons demonstrate a greater interest in being informed about *smart* initiatives; this does not necessarily imply that these subjects have received better or more detailed information and communication.
Although themes linked to the smart community have now become part of the general language employed by politicians and administrators, the population as a whole does not seem to be sufficiently aware of what is occurring in Milan in terms of smart actions and initiatives.
This, far from being interpreted only in negative terms, must act as stimulus for considering what additional strategies and actions can be employed that are truly capable of promoting the circulation of information among different social realities.
Lastly, it seems important to clarify that a limiting factor of this study is the composition of the survey group, which is decidedly young. This limit, which undoubtedly implies greater effort is needed in the future to involve a more mature segment of the population, nonetheless does not invalidate the above conclusions. The younger population is in fact more accustomed to new technologies and it therefore follows that the fact of not even reaching that particular segment of the population only serves to further confirm what previously stated, namely that communication must be improved and redefined with the view of creating *smart communities* and effectively putting into practice the principles of a knowledge-based society.

Bibliographical References

[1] CURI, Sergio, DALLARI, Fabrizio. *Network Milano. Morfologia dei flussi logistici internazionali*. Milano: Bruno Mondadori, 2012.
[2] DAVOUDI, Simine, MADANIPOUR, Ali (eds). *Reconsidering Localism.* London: Routledge, 2015.
[3] DEAKIN, Mark. *Smart Cities: Governing, Modelling and Analysing the Transition*. Abingdon: Routledge, 2014.
[4] DEAKIN, Mark, CRUICKSHANK, Peter. SCRAN: the network smart. In DEAKIN, Mark. *Smart Cities: Governing, Modelling and Analysing the Transition*. Abingdon: Routledge, 2014, p. 150-170.
[5] DEAKIN, Mark, HUSAM, Al Waer. From intelligent to smart cities. In *Intelligent Buildings International*, 2011, vol.3, no.3, p.133-139.
[6] DEAKIN, Mark. *The Smart Cities Governance Agenda: Mapping out the Inter-disciplinary Landscape*, Milano: Fondazione Feltrinelli, 2015. Available from http://patrimonio.fondazionefeltrinelli.it/new-feltrinelli/pubblicazioni/detail/FF9000006696/the-smart-cities-governance-agenda-mapping-out-the-inter-disciplinary-landscape-1.html?jsonVal={%22jsonVal%22:{%22startDate%22:%22%22,%22endDate%22:%22%22,%22fieldDate%22:%22dataNormal%22,%22_perPage%22:20,%22collanaName_text%22:%22%27laboratorio%20expo%20keywords%27%22}}
[7] GIFFINGER Rudolf, FERTNER Christian, KRAMAR, Hans, KALASEK, Robert, PICHLER-MILANOVIĆ, Nataša, MEIJERS, Evert. *Smart Cities: Ranking of European Medium-Sized Cities*. Vienna: Centre of Regional Science (SRF), Vienna University of Technology, 2007. Available from http://www.smartcities.eu/download/smart_cities_final_report.pdf.

[8] GIFFINGER, Rudolf, KRAMAR, Hans, HAINDL, Gudrun. The role of rankings in growing city competition. In *Proceedings of the 11th European Urban Research Association* (EURA) Conference, Milan, Italy, 2008.
[9] GIFFINGER, Rudolf, LÜ, Hui. *The Smart City perspective: a necessary change from technical to urban innovations*, Milano: Fondazione Feltrinelli, 2015. Available from http://patrimonio.fondazionefeltrinelli.it/new-feltrinelli/pubblicazioni/detail/FF9000006700/the-smart-city-perspective-necessary-change-from-technical-to-urban-innovations-1.html?jsonVal={%22jsonVal%22:{%22startDate%22:%22%22,%22endDate%22:%22%22,%22fieldDate%22:%22dataNormal%22,%22_perPage%22:20,%22collanaName_text%22:%22%27laboratorio%20expo%20keywords%27%22}}
[10] HEALEY, Patsy. *Making better places: the planning project in the twentyfirst century*. London: Palgrave Macmillan, 2010.
[11] HEALEY, Patsy. Re-enchanting democracy as a way of life. In *Critical Policy Studies*, 2012, vol.6, no.1, pp. 19-39.
[12] HEALEY, Patsy. Civil Society Enterprise and local development, *Planning Theory and Practice* (accepted in publication), 2015.
[13] HOLLANDS, Robert. Critical interventions into the corporate smart city. *Cambridge Journal of Regions, Economy and Society,* 2014. Doi: 10.1093/cjres/rsu011
[14] KOMNINOS, Nicos. What makes cities intelligent? In DEAKIN, Mark (ed.). *Smart cities. Governing, modelling and analyzing the transition*. London and New York: Routledge, 2014.
[15] MAGATTI, Mauro, GHERARDI, Laura (eds.). *The City of Flows. Territories, agencies and institutions*. Milano: Bruno Mondadori, 2010.
[16] MAGATTI, Mauro, SENN, Lanfranco, SAPELLI, Giulio, RANCI, Costanzo, MANGHI, Bruno, DENTE, Bruno, COLOMBO, Alessandro, CIBORRA, Claudio, CERUTI, Mauro, BALDUCCI, Alessandro, ARTONI, Roberto. *Milano, nodo della rete globale*. Milano: Bruno Mondadori, 2005.
[17] TAYLOR, Peter. Milano nella rete delle città mondiali. In PERULLI, Paolo (ed.). *Nord. Una città-regione globale*. Bologna: Il Mulino, 2012.

[1] In Italy numerous studies have been made aimed at understanding which cities are smart. Following is a list of the most well-known ones. EfficienCITIES, 2013 realized by SIEMENS; Smart City Progetti di sviluppo e strumenti di finanziamento 2013 realized by Cassa depositi e prestiti; Smart City Index, 2013 realized by Between; ICity Rate, 2013 produced by FORUM PA –; "Vademecum per la città intelligente", 2013 realized by ANCI - Osservatorio nazionale sulle smart city ITALIANE. In all the reports cited Trento and Milan are classified as the smartest in Italy. http://www.icitylab.it/il-rapporto-icityrate/edizione-2014/dati-2014/

[2] For Milan also see Taylor, 2012; Curi Dallari, 2012;Magatti and Gherardi (2010); Mauro Magatti, Lanfranco Senn, Giulio Sapelli, Costanzo Ranci, Bruno Manghi, Bruno Dente, Alessandro Colombo, Claudio Ciborra, Mauro Ceruti, Alessandro Balducci, Roberto Artoni , 2005.

[3] Expo Milano 2015 is the Universal Exposition that will be held in Milan from May 1 to October 31, 2015. The crucial theme will be: *Feeding the Planet, Energy for Life*. In 184 event days more than 130 participant countries will welcome over 20 million visitors.

[4] The groups correspond to the traditional six pillars of the Smart City (Smart Economy, Smart Living, Smart Environment, Smart Mobility, Smart People, Smart Governance) plus Expo 2015.

[5] Milan is the most wired city in Europe with more than 7,000 km of cables for its fiber optic network. http://company.fastweb.it/en/fastweb-a-fianco-di-f2i-e-a2a-in-metroweb/

[6] In order to understand the smart processes in Milan a list of people were interviewed. People interviewed are: Director of Economic Innovation, University and Smart city division, Municipality of Milan; Director of Information System and Telecommunication, Public Transportation Enterprise of Milan (ATM); Manager of Domestic Media, TELECOM Italia; Event Management Division of Technological Innovation & Digital Director, EXPO 2015 Inc. (hereafter referred to as DIPS); Event General Manager, Expo 2015 Inc., Business Planning & Control Sustainability Manager EXPO 2015 Inc; President of Legambiente Innovation Foundation; President of Triulza Foundation. Along with this 9 interviews, other 8 informal conversations were carried out with people belonging to civil society.

[7] For this purpose it is important to highlight the report by *We are Social "GLOBAL DIGITAL STATISTICS 2014"* which states that in Italy today internet reaches 58% of the population meaning 35.5 million Italians. 42% of Italians have a Facebook profile and, as far as mobile devices are concerned, there are over 97 million active SIM cards in Italy. Italy has always been considered a nation with more smartphones than inhabitants: the penetration of mobile devices is 158%, exceeded only by the Arab Emirates (252%) and Russia (184%)

HERITAGE and TECHNOLOGY
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The design for the modification of the Marina and the Sentiero Terramare in Praiano

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Abstract
The Marina di Praia, is located in the municipal borders of Praiano: town of the Amalfi Coast that summarizes, in the characters of their own identity within the landscape, the environmental quality, natural and artificial, of its geographical and cultural context of belonging. A cultural landscape is strongly marked by a building tradition that tends to rationalize and tame, through infrastructure and architecture, the roughness topography of the area in question. A single condition, unrepeatable, can transform the limits imposed by the nature of the place, in a diversified and inexhaustible source of resources and opportunities for architectural and landscape. Between the marine areas of the municipality of Praiano, the village of Marina di Praia is, with its exceptional environmental configuration, a condensate, natural and artificial features of their identity of the Amalfi Coast. Originally a small cove with a few fishermen's houses set against the western ridge, partly dug in the rock, also a generous storage area for fishing boats on the beach and, beyond it, the presence of the small Cappella of the Annunziata. From the sixties to the present day earlier work reconfiguration of Marina di Praia and the Sentiero Terramare, a continuous and inexorable decline, blurs the architectural beauty and landscape of the Mediterranean cove.

Keywords: Design, Rappresentation, Marina of Praia, Praiano, Amalfi Coast

1. Introduction
The verticality of the rocky slopes and the horizontality of the sea surface, the shyness of the interior valleys and sunny unfolding of coastal beaches, the impetuous flow of the rivers and the meandering course of the road layouts, the promiscuity of residential and magnificence monumental architecture, the arches of the bridges and the linearity of the piers: these are some of the different characteristics of identity, natural and artificial, of the territory of Amalfi. A rugged geography which prevented, always planning the towns based, as a rule, on a preconceived design paths: the irregular shapes of the urban towns of Amalfi, coastal and hilly, tells of a foundational origin is dictated by the curves level of steep mountain slopes and is the size of marine generated, over millennia, as a result of torrential transport of rock debris and mud coming through the valleys perpendicular to the coastline, from the peaks of the Monti Lattari. Cetara, Maiori, Minori, Atrani, Amalfi and Positano respond, in terms of form "urbis", in those particular geographical features. Not only. Along the Amalfi Coast, it is possible to identify some areas that the small scale, responding to similar characteristics of settlement even though, for the particular conditions of limited space, have never been able to evolve in urban centers by building, on the contrary, as small villages marine functional the landing of boats and small vessels to activities related to the activities of exploitation of the sea. The fiord of Furore is the area most emblematic of this particular settlement geography: a narrow inlet overridden by a semi-circular arched bridge characterized by minute and residential architectural service to crafts. In fact, rather than a fiord, understood in the canonical sense, it is an "ria" or a narrow sea inlet located at the mouth of the river Schiato that, descending from the Agerola, into the Gulf of Salerno. Specifically, with in the "ria" of Furore, in addition to small domestic buildings are located two buildings, the Drying and Calcara, who in the past were used, first, to dry the sheets of paper produced by local mills and the second, for the processing of limestone extracted from the context of origin to be used in the construction of houses and Macerine rural. In

addition to the fiord of Furore, to the west, another “ria”, characterizes the coast between Furore and Praiano: the Marina di Praia, which is a picturesque bay that allows, through the path Earthsea, to push, tangentially to the coastline, to the foot of a fortification Angevin circular or the Torre Assiola. On this environment that the research presented in this paper focuses his attention, trying to show how, for the recovery of areas of natural and man-made unique and precious design, intended as a plucked instrument data recording existing materials as well as through graphical proposal amending, it can contribute to the improvement of what is already there. Especially when what is already there staged a disgraceful neglect and decay is suggestive of episodes of spontaneous architecture and both the natural heritage and Mediterranean-type vegetation.

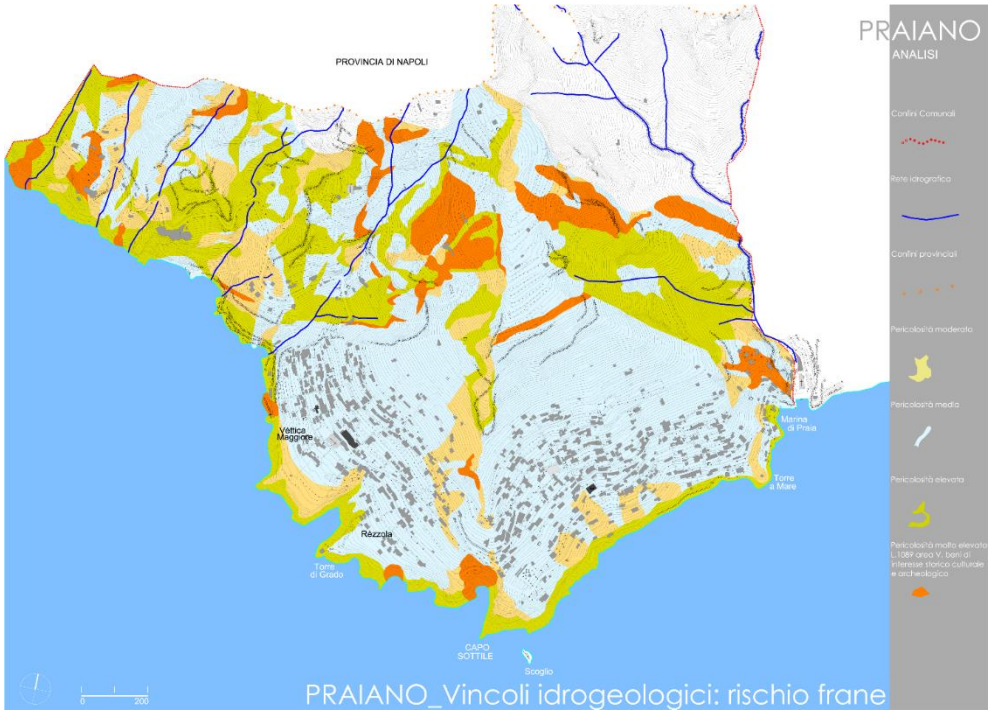

Fig. 1: Amalfi Coast, thematic maps of Praiano

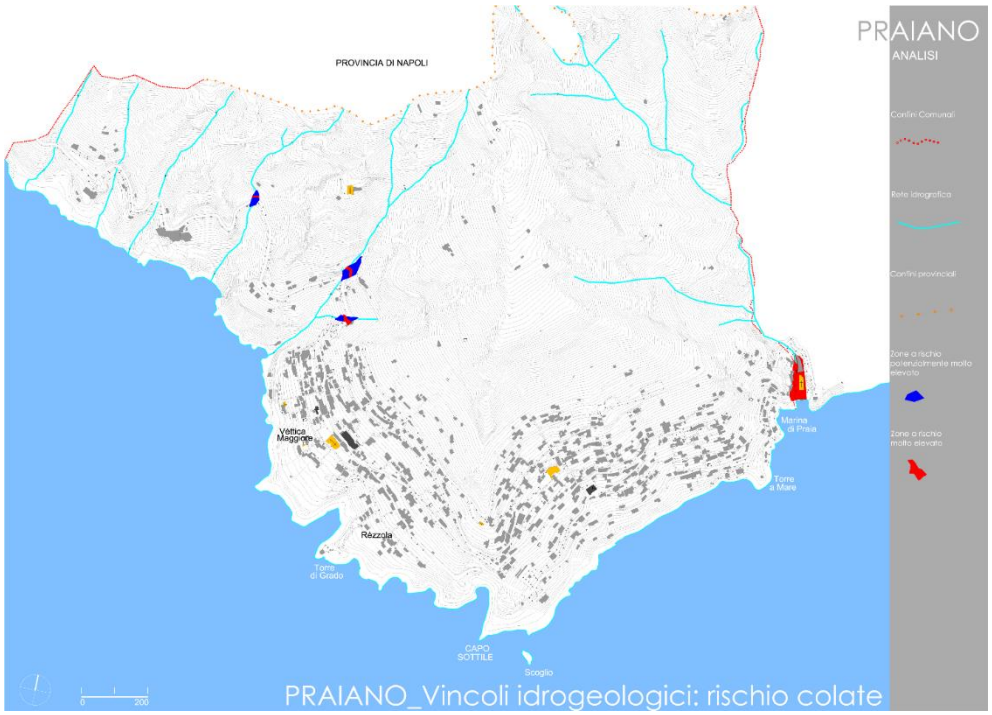

Fig. 2: Amalfi Coast, thematic maps of Praiano

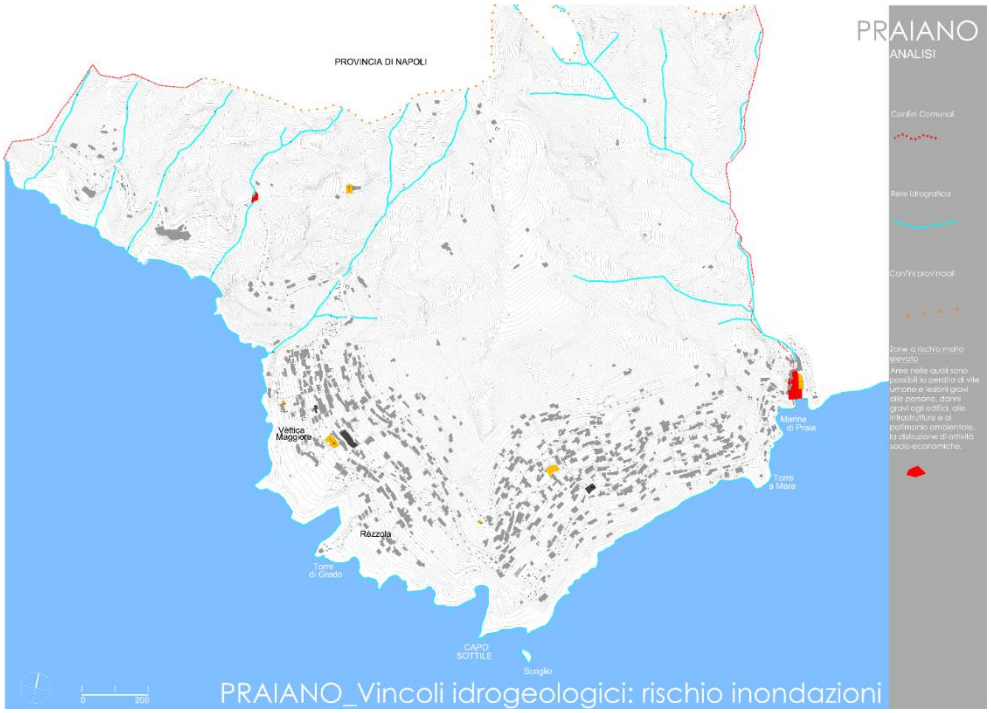

Fig. 3: Amalfi Coast, thematic maps of Praiano

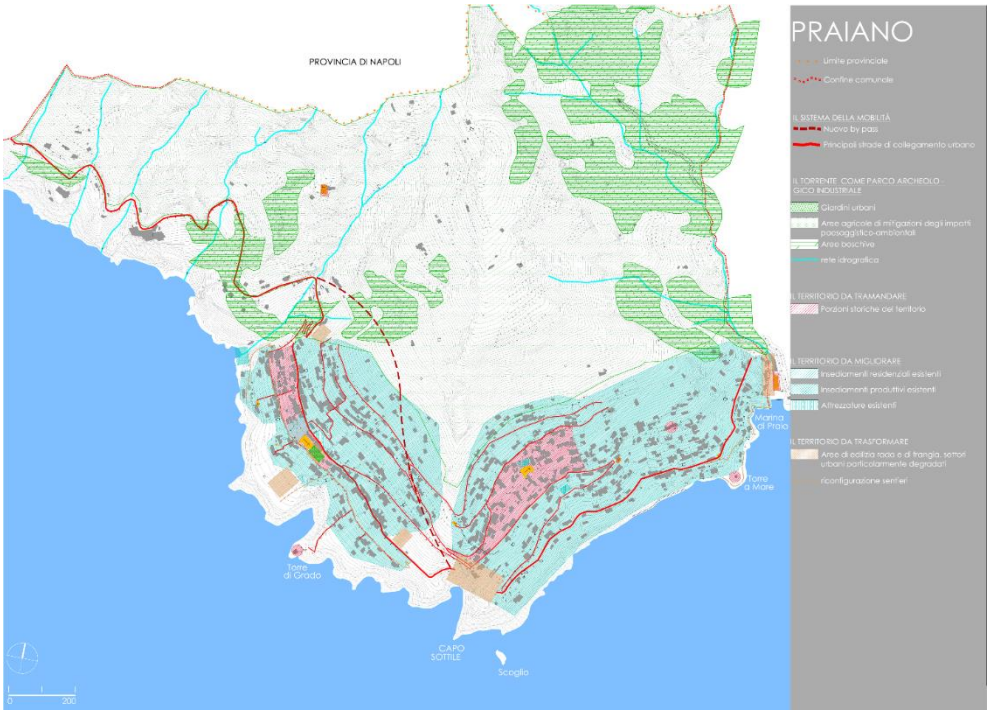

Fig. 4: Amalfi Coast, thematic maps of Praiano

2. The territory

The Marina of Praia, is located in the Praiano town of the Amalfi coast that summarizes, in characters identity of its field landscape, the environmental quality, natural and artificial, of its geographical context and cultural environment. The territory of Praiano is characterized by natural promontory located at the foot of Mount Tre Galli that, by Colle Serra, goes so as to the sea at Capo Sottile: real head of separation between the eastern and western called by Praiano and Vettica. A hilly region divided between a shallow coastal and a high hill characterized, both from very steep limestone cliffs and poor vegetation. The upper part of the township, bordering the province of Naples, is marked by horizontal paths - the path of the Gods - vertical and able to relate the coast line to steep hill towns. The territory of Praiano is characterized mainly by a wooded landscape and Agricultural Mediterranean: citrus groves and terraces of vines on the southern slopes of the eastern and western promontory and woodlands in the upper north of San Domenico characterized by the large presence of olive trees, oaks and woods coppice. In addition to trees of medium stem lush vegetation bushy made of blueberry and blackberry characterize the hilly area. Along the coast line of a series of natural coves characterizes the rocky seafront of the municipal area from west to east: the Bay of Gavitella, the bay of Cape thin and the Marina of Praia, with trail Earthsea, represent the most picturesque coastal places municipal scope.

The verticalized presence, in the town of Praiano, in different geographical areas - mountains, hills and sea - is the main environmental feature of a complex territory and not attributable, in his analytical reading, the simple and obvious dialectic seen among its dominant elements that is constituted by the close presence of the sea and mountains. The latter are, in fact, only antithetical to a territory that is much more complex than a made environment defined by the many variants of natural and artificial, in the dichotomy apparent sea-mountain, they built their own specific and unique relationship with tangible the different places of belonging. A cultural landscape is strongly marked by a building tradition that tends to rationalize and tame, through infrastructure and architecture, the roughness topography of the area in question. A unique condition, unique, capable of transforming the limits imposed by the nature of the sites, in a diversified and inexhaustible source of resources and opportunities architectural and landscape.

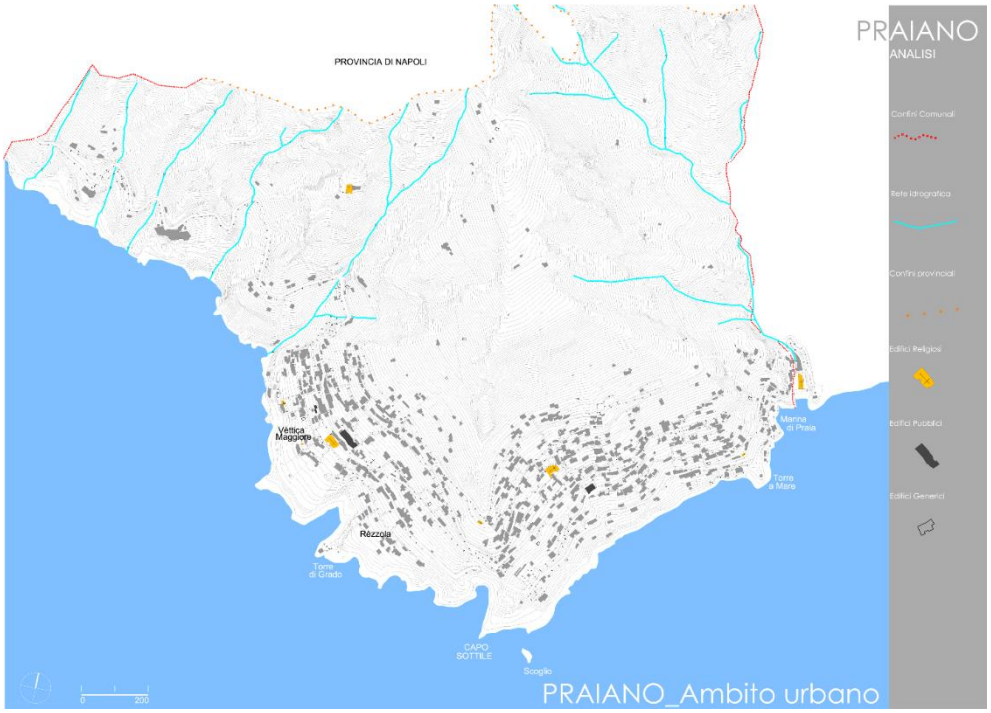

Fig. 5: Amalfi Coast, thematic maps of Praiano

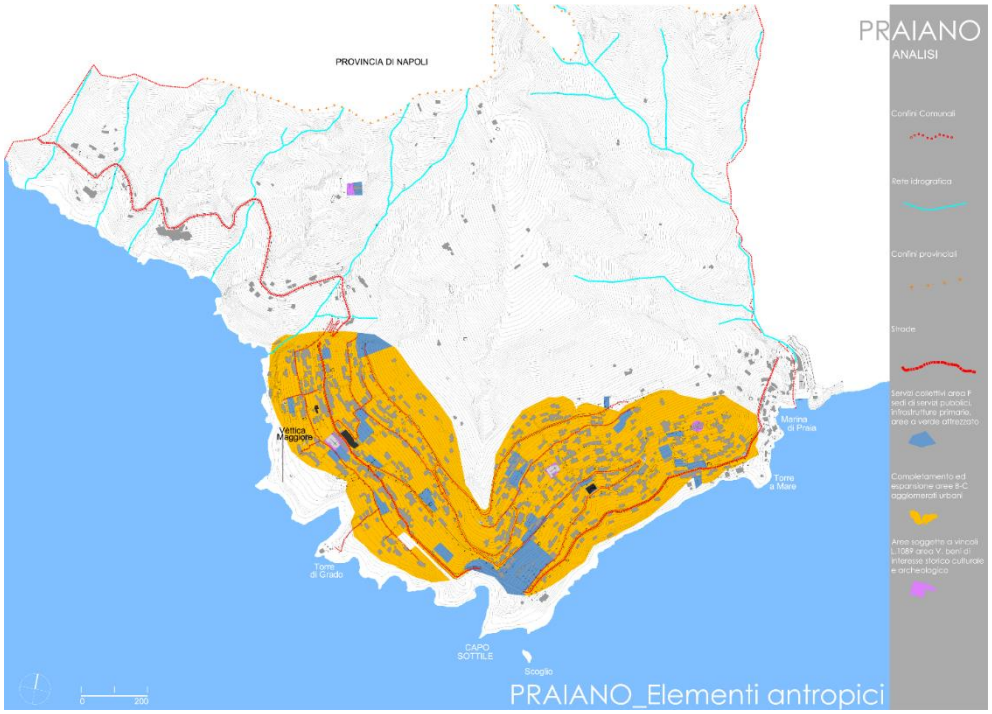

Fig. 6: Amalfi Coast, thematic maps of Praiano

3. The city center

From the perspective of urban, Praiano is a town located on a promontory overhanging strongly Gulf of Salerno and is divided into two villages located on the eastern side Praiano and on the western side Vettica. The cornerstones typological and monumental of these fractions are represented by the two churches of San Luca, to the east, and San Gennaro, to the west. If the church of San Luca dominates the residential fabric of Praiano, conversely the church of San Gennaro is under the street level of the State Road 163 which, infact, cuts through urban areas, one upper and the other lower, the fraction of Vettica. This condition makes perceptible settlement complex morphological coverage of the church from a vantage point that the opulent architectural forms of the drum of the dome, lantern and bell tower directly on the natural background of the Gulf of Salerno. The architectural mass of the church of San Gennaro stands well, almost like a metaphysical object, the changing scenery of the sea and the Mediterranean sky. This illusory inaccessibility is strengthened by a condition of settlement that, historically, has never made easily accessible scenic churchyard and then, accordingly, it's interior spaciousness. Infact, at present, the possibility of access to the churchyard, then the religious building, is limited to a narrow staircase that descends from State Route 163 until a pedestrian ramp, parallel to the longitudinal axis of the church, the square of church. Such as access from the north is implemented by an accessibility Southern attested, and always mediated by an inclined ramp, on the footpath of Via Masa relaxing, at a lower level, parallel to State Road 163. Steep stairs perpendicular to the coastline close, on the east by Via Rizzola and, to the west by Via Casa Rispoli, lot urban and rural within which lies the Church of San Gennaro. This difficulty is a recurring feature in the positional system of road layouts primary and secondary and pedestrian the two hamlets, Western and Eastern Europe in Praiano.

Specifically, in terms of overall mobility, Praiano turns out to be one of the centers of the Amalfi Coast the most penalized by the traffic flows, either from east to west, burden, especially during spring and summer, along the narrow and winding Highway 163. If, for example, in Maiori, Minori, Atrani and Amalfi the SS 163 becomes avenues and squares with characteristics of waterfront or, even, for example, in the above Positano artery functions as an outer ring road to the town, in contrast in the town of Praiano along the connecting route through the town ravaging, infact, the lifestyle and its environmental quality. This difficulty was represented through a pad of tracks which highlights the anomaly and at the same time the charm of Praiano positional or of an urban place characterized by a kind of diffused parallelism, with respect to the coast line, of the primary roads of a network of stairs and walkways perpendicular to the latter.

A whole Praiano is a reality on the characteristics of the urban and the rural hybrid that is characterized by the simultaneous presence of monumental structures, housing, open spaces defined, places and atopic unresolved, road layouts and footpaths as well as, more or less extensive, inhabited urban gardens by citrus groves and vineyards placed on artificial terraces arranged in parallel, upstream, to State Road 163 and, downstream, to the coastline. From the morphological point of view can be identified besides the two urban

areas of Praiano and the Vettica and two sub-urban areas around the landing condensed Gavitella and Marina di Praia: areas extremely attractive from the point of view of landscape and architecture defined by building and fragmentary disaggregated or different from that of the aforementioned urban areas.
Sub-urban areas that can evoke, the better the Mediterranean nature of the places of belonging: an evocative traditional still present and able to emerge and be present with respect to the serious damage caused by the transformations consisting of coastal promenade of other realities. It protection precisely because of the difficult accessibility of geographical coastal Conquerable only through long winding ramps or staircases obtained by force in the rocky cliffs overlooking the sea.

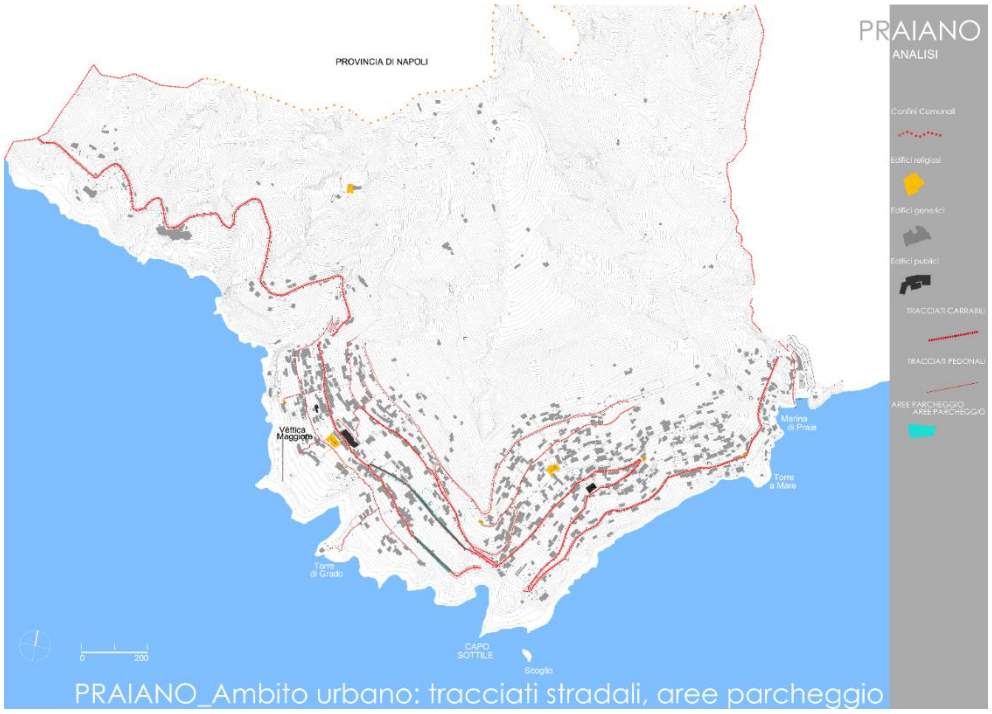

Fig. 7: Amalfi Coast, thematic maps of Praiano

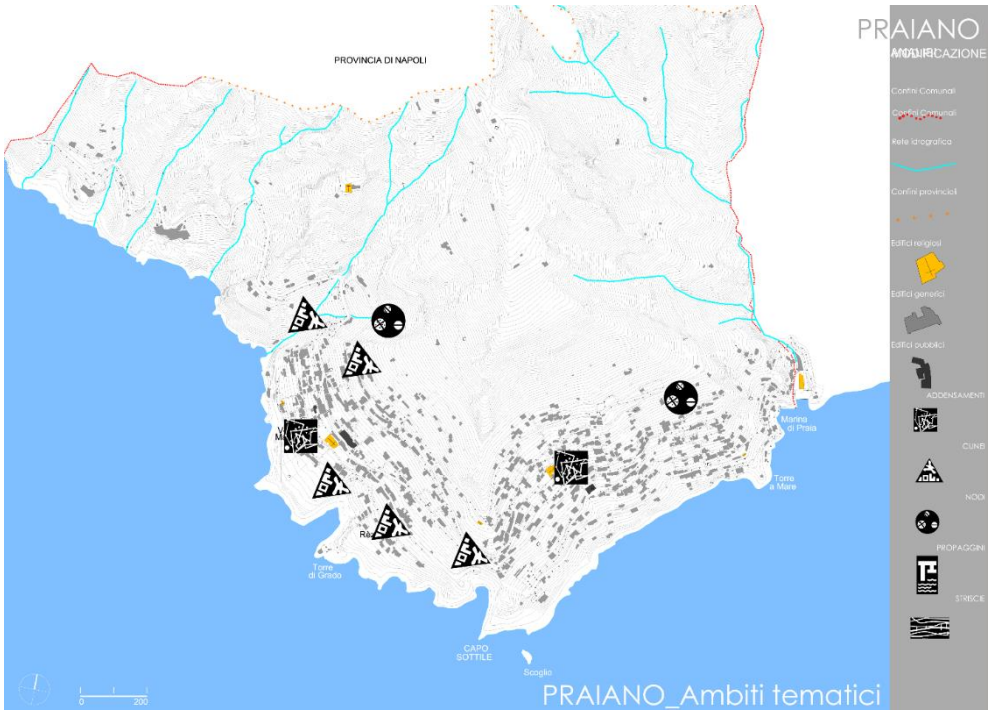

Fig. 8: Amalfi Coast, thematic maps of Praiano

4. The coastline: the Marina and the Path Earthsea

Among the marine areas of the municipality of Praiano, the village of Marina di Praia is, the exceptional layout of the building, a condensed natural and artificial features of their identity on the Amalfi coast.

Originally a small cove with a few houses of fishermen set against the western ridge, partly dug into the rock, also a generous storage space for fishing boats on the beach and, beyond this, the presence of the small Chapel of the Annunciation. A tiny seaside village has always remained unchanged since when, on the morning of March 26 1924, a flood, swelling out of proportion the small stream of Praia, sweeps and sweeps away, at sea, everything he encounters. Buildings, boats, nets and people. Thirteen victims are counted at the end of that tragic day. In the following years, slowly, we proceed to the reconstruction of the village providing to channel the stream in a river bed that marks, among other things, also the administrative border between the town of Praiano, and that of Furore, the hill town known for its famous fjord. A channel bounded by two low walls in the final stretch of the waterway for about fifty meters, at the village, until near the small bridge that allows the overpass near the beach. In the fifties, also, the opening of the path Earthsea, a promenade, which, from Marina di Praia, leads past the tip of the promontory on which stands the tower of Praia, until the natural cave inhabited, in the sixties, the legendary nightclub of the African. From the sixties to the present day earlier work reconfiguration of Marina di Praia and the path Earthsea, a continuous and inexorable decline, blurs the architectural beauty and landscape of the Mediterranean little cove.

Faced with this worrying environmental involution graphical analysis, through survey, and design modification, through appropriate assumptions, tried to stop and reverse its degradation process simply by identifying the primary elements of context and using them as project materials giving also a symbolic value to the two events characterizing the history of twentieth-century Marina Praia through the installation of two commemorative stone monoliths: the first dedicated to the memory of the victims of the flood of 1924 and the second, entitled realization of the walk Earthsea, carved into the rock and along the shoreline, for about six hundred meters from the village up to the cave of Africana.

Specifically, the design modification involved the coverage of the riverbed of the stream defining a rectangular square in proportion, a true terrace on the small bay in front. The square below, irregularly shaped, has been defined by a perimeter of stone slabs gray limestone of various size and shape that include a mixture of opera composed by white cement and limestone aggregates recovered site and evoke transported pebbles on the shore by the sea. The two old banks in masonry of the riverbed were ennobled by redefining formal and aesthetic that has changed function and position: in the middle part of the western wall of the body has made a long bench covered with slabs of limestone gray in color contrast with the white plaster characterizing the finish of the structure. The position of the southern terminal of the linear structure has been modified by bending the head towards the cliff in order to make it more easily, with stairs to the appropriate size, the descent to the beach of Praia below. The final part of the western wall of the riverbed becomes a real articulation element where you can access the beach or, after the monolith, advancing along the path Earthsea, or even through the narrow quay berthing, arrive at the pier at noon. The latter artificial platform, real piece of fine terrae, has been added, in its end, a bench on the underlying pool of water reached via a narrow staircase steps monolithic limestone sinking in a little cove Natural dominated by overhanging path Earthsea reconfigured. The path Earthsea finally scored in the starting point of a monolith limestone is characterized not only by new flooring similar to that of the square of the Praia, with which stands in continuity, even by a simple railing. At the point where the rock overhangs, cantilever, the path a bench asymmetric approaches the cliff face giving shade and rest to the users of the scenic walk. The same construction method which characterizes the realization of the protective barrier of the path Terramare was also used for the railings that protect the jump in height between the upper square and the square background at the top of Marina of Praia where, among other things, in addition to the monolith that the thirteen flood victims placed in a tub of water, have been provided four fountains of service to users of the village. If the southern part of the intervention is an intervention at landscape scale, and the northern part of the village square with the lower and upper, highlighted not only by the presence of the tank and the four fountains also by the structure of the small bridge riverbed, signifies the intervention of the ladder, albeit minimal, urban. Ultimately, the sober underscore amending the various environmentally related, natural and artificial, of the Marina di Praia tried to adapt, quietly, in the suggestive nature of identity, strongly contrasting the Amalfi coast.

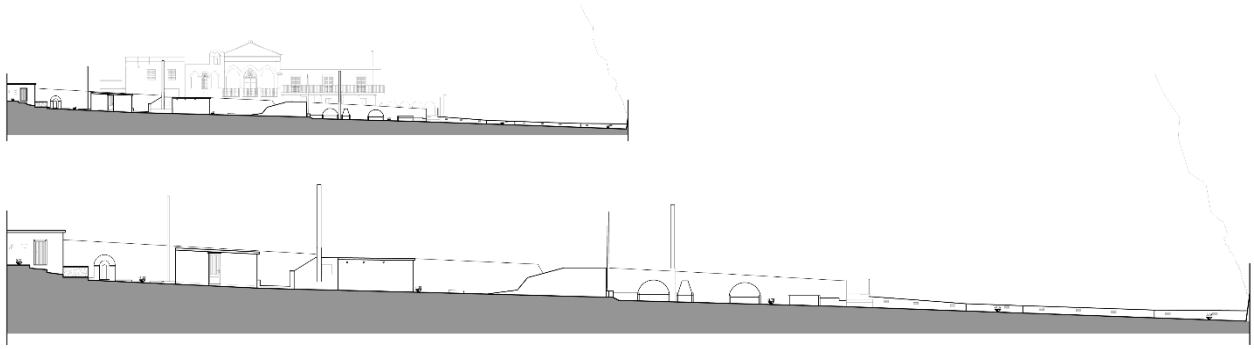

Fig. 9: Amalfi Coast, relif of Marina di Praia of Praiano



Fig. 10: Amalfi Coast, relif of Marina di Praia of Praiano

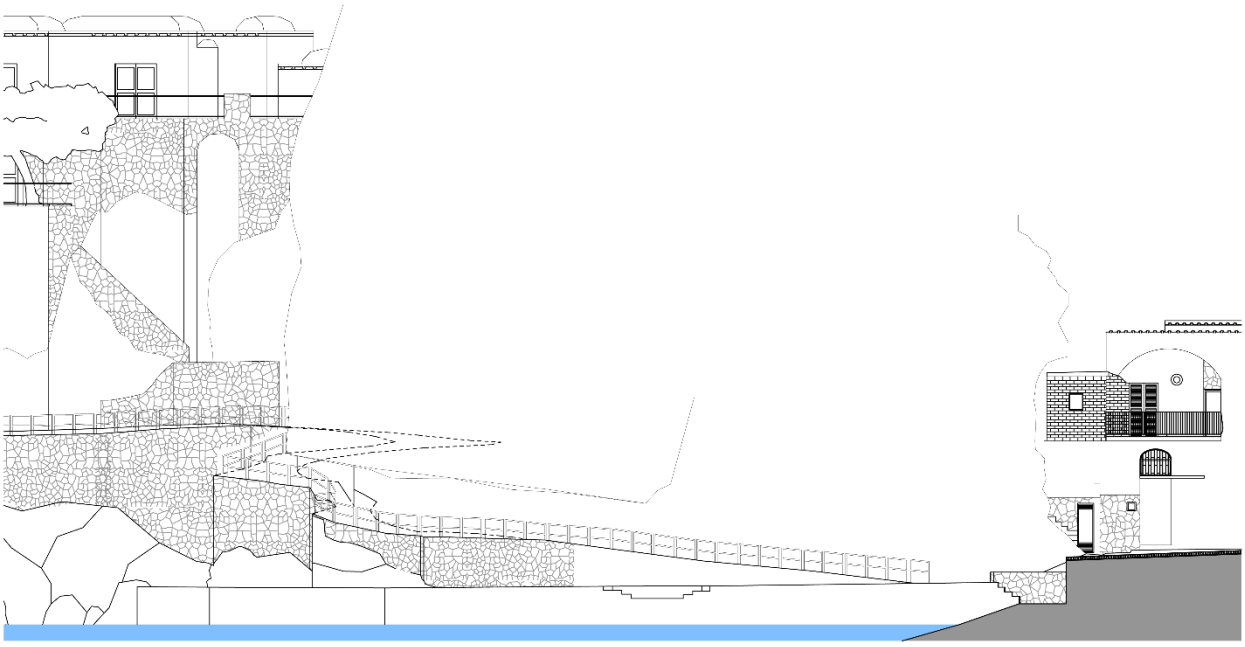

Fig. 11: Amalfi Coast, relif of Marina di Praia of Praiano

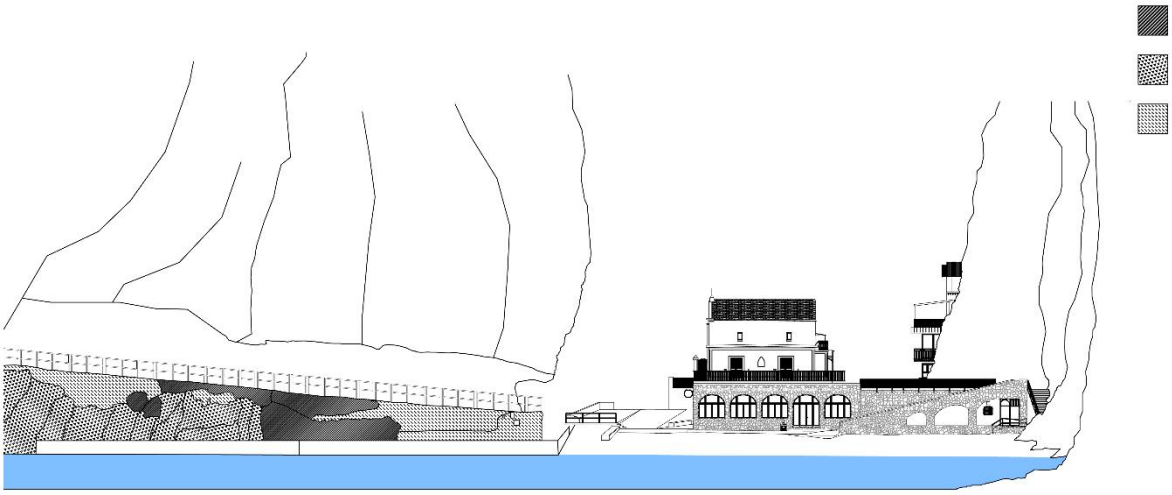

Fig. 12: Amalfi Coast, relif of Marina di Praia of Praiano

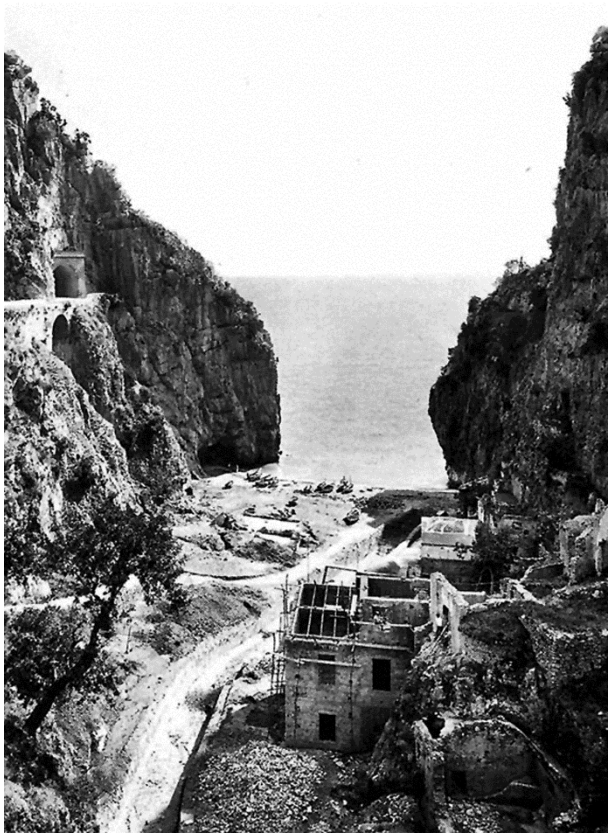

Fig. 13: Amalfi Coast, Marina di Praia of Praiano

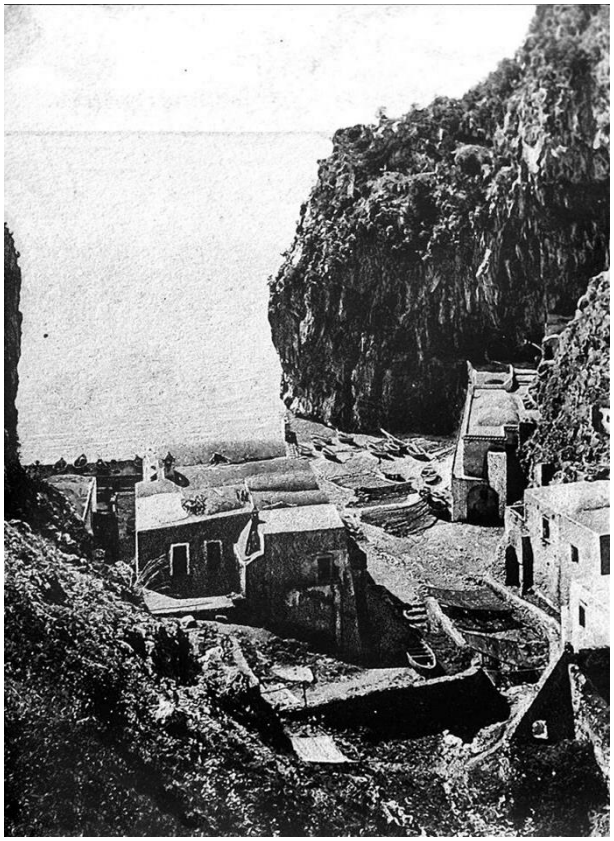

Fig. 14: Amalfi Coast, Marina di Praia of Praiano



Fig. 15: Amalfi Coast, Marina di Praia of Praiano



Fig. 16: Amalfi Coast, Marina di Praia of Praiano

Bibliographical References

[1] Giordano Paolo. 1997. Ferdinando Fuga a Napoli. L'Albergo dei Poveri, il Cimitero delle 366 Fosse, i Granili. Lecce: Edizioni del Grifo, 1997.

[2] Giordano Paolo. 2006. Il disegno dell'architettura funebre. Napoli, Poggio Reale, il Cimitero delle 366 fosse, il Sepolcreto dei Colerici. Alinea Editrice, 2006.

[3] Giordano Paolo. 2011. The design of simplicity against the representation of artificiality or kósmos Vs chaos. In Le Vie dei Mercanti. Less More Architectural, Landscape, Design, Atti del Decimo Forum Internazionale di Studi, Aversa - Capri 31 maggio/ 1-2 giugno 2012. La scuola di Pitagora, 2012.

[4] Giordano Paolo. 2011. Il disegno del suolo, in "Le Vie dei Mercanti. S.A.V.E. Heritage. Safeguard of Architectural, Visual, Environmental Heritage, Atti del Nono Forum Internazionale di Studi, Aversa - Capri 9/11 giugno 2011", La scuola di Pitagora, 2011.

[5] Giordano Paolo. 2012. Il disegno dell'architettura costiera. La costiera amalfitana, il territorio, le città e le architetture. La scuola di Pitagora editrice, 2012.

[6] Giordano Paolo, Corniello Luigi. 2012. Atlante Grafico e Teorico Amalfitano. La conoscenza e la modificazione del paesaggio costiero. La scuola di Pitagora editrice, 2012.

[7] Giordano Paolo. 2014. L'Albergo dei Poveri a Napoli. La scuola di Pitagora editrice, 2014.

HERITAGE and TECHNOLOGY
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XIII International Forum Le Vie dei Mercanti

Aversa, Capri 11-12-13 June 2015

Istanbul World Heritage property. Representing and cataloguing the material and intangible assets for local sustainable development.

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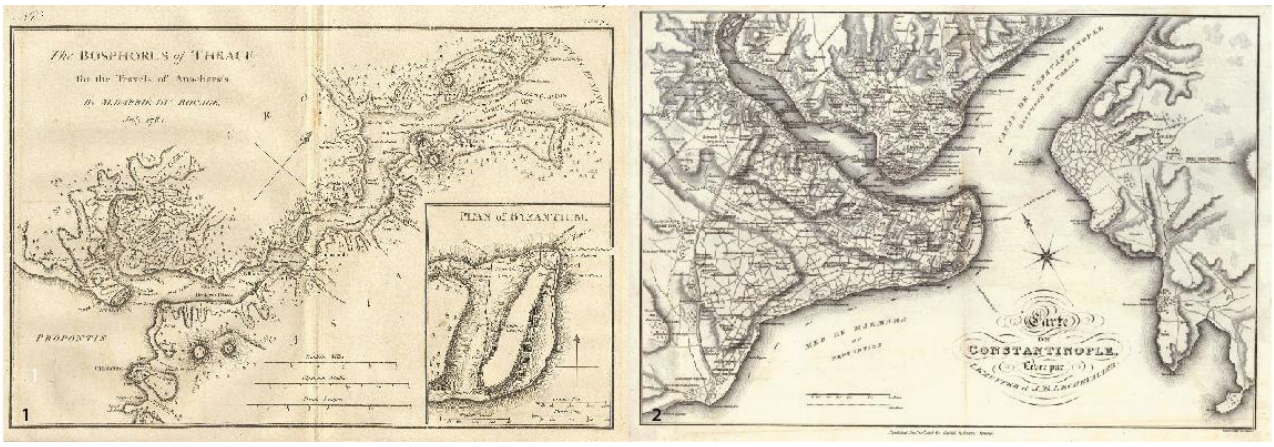
Abstract

The purpose of this paper is to present the criteria for the inclusion of the Historic Areas of Istanbul in the World Heritage List in 1985. Representing and cataloguing the material and intangible assets as well as considering the integrity and authenticity of historic sites, monuments, architectures, and immaterial heritages are all aspects which need to be considered for a World Heritage Property (WHP). These criteria are related to multidimensional and multidisciplinary approaches which represent the cultural and natural assets through their material and intangible values. The paper focuses on the representation of this Outstanding Universal Value in terms of sustainable development for the local community. How are Istanbul's cultural and landscape heritage perceived by residents and tourists? How was the restructuring of Istanbul integrated, in terms of skyline and urban landscape, within the historical area? Can the urban re-development process in the Istanbul WHP be considered a 'best practice' for the regeneration process of site? How does this regeneration affect the property's management? After the 1980s, the major cities of Turkey have experienced urban transformation processes following the changes in the international trade policy and perception of cultural heritage. Istanbul took the highest amount of share from these transformation processes and has become the most important economic, cultural and tourism center as well as the most integrated pole to the world economy of the country.

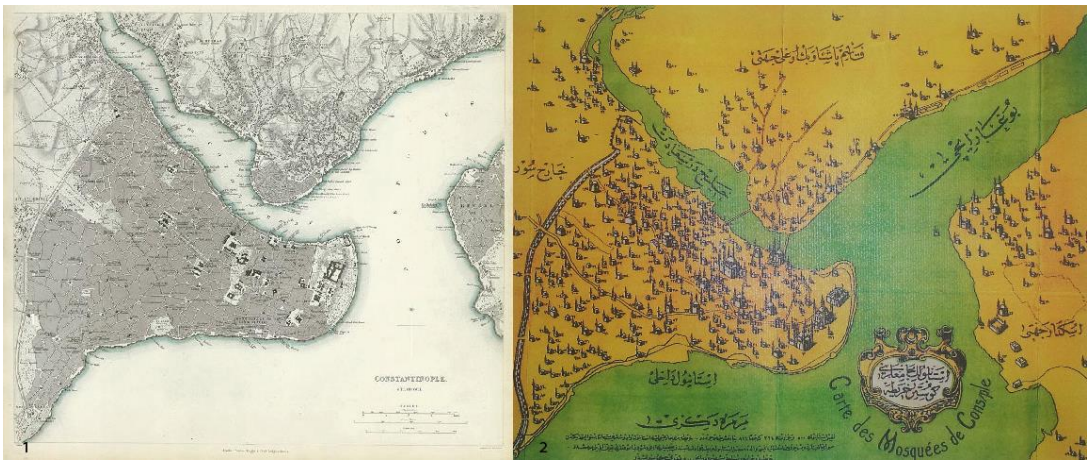
Keywords: representation, design, landscape, heritage, culture



1. Plan of Byzantium – The Bosphorus of Thrace for the Travels of Anacharsis by M. Barbie Du Bocage (July 1784); 2. Plan of Constantinople by F. Kauffer and I.B. Lechavalier (1807).

The Outstanding Universal Value of the Historic Areas of Istanbul

The Historic Areas of Istanbul were inscribed in the World Heritage List (WHL) in 1985 on the basis of criteria i, ii, iii, iv. The property's Outstanding Universal Value (OUV) resides in its unique integration of architectural masterpieces that reflect the conjunction of Europe and Asia over many centuries, and its incomparable skyline formed by the creative genius of Byzantine and Ottoman architects.
'Founded on the peninsula surrounded by the Golden Horn, Sea of Marmara and Bosphorus, the city was the capital of the Ottoman Empire and the East-Roman Empire, and it was inhabited since B.C. 6500.
The four areas registered on the WHL are: Sultanahmet Archaeological Park, Suleymaniye Conservation Area, Zeyrek Conservation Area, City Walls Conservation Area. These four areas reveal the urban history of Istanbul, vary in terms of the nature and qualities of cultural properties' (WHP Management Plan, 2011).
'Criterion (i): The Historic Areas of Istanbul include monuments recognised as unique architectural masterpieces of Byzantine and Ottoman periods such as Hagia Sophia, which was designed by Anthemios of Tralles and Isidoros of Miletus in 532-537 and the Suleymaniye Mosque complex designed by architect Sinan in 1550-1557.
Criterion (ii): Throughout history the monuments in Istanbul have exerted considerable influence on the development of architecture, monumental arts and the organization of space, both in Europe and the Near East. Thus, the 6,650 meter terrestrial wall of Theodosius II with its second line of defence, created in 447, was one of the leading references for military architecture; Hagia Sophia became a model for an entire family of churches and later mosques, and the mosaics of the palaces and churches of Constantinople influenced both Eastern and Western art.
Criterion (iii): Istanbul bears unique testimony to the Byzantine and Ottoman civilizations through its large number of high quality examples of a great range of building types, some with associated artworks. They include fortifications, churches and palaces with mosaics and frescos, monumental cisterns, tombs, mosques, religious schools and bath buildings. The vernacular housing around major religious monuments in the Süleymaniye and Zeyrek quarters provide exceptional evidence of the late Ottoman urban pattern.
Criterion (iv): The city is an outstanding set of monuments, architectural and technical ensembles that illustrate very distinguished phases of human history. In particular, the Palace of Topkapi and the Suleymaniye Mosque complex with its caravanserai, madrasa, medical school, library, bath building, hospice and imperial tombs, provide supreme examples of ensembles of palaces and religious complexes of the Ottoman period' [1].
Representing and cataloguing the material and intangible assets as well as considering the integrity and authenticity of historic sites, monuments, architectures, and immaterial heritages are all aspects which need to be considered for a World Heritage Property (WHP).
The Historic Areas of Istanbul escaped major changes and deterioration in the 19th and 20th centuries even though they were already protected by national legislation at the time of inscription. Vernacular timber houses in the Süleymaniye and Zeyrek quarters, were recognized as vulnerable when the property was included in the WHL. The setting of the Historic Areas of Istanbul and the outstanding silhouette of the city are vulnerable to development as well.
Referring to authenticity, the ability of the monuments and vernacular houses to express truthfully the OUV of the property has been compromised to some extent since inscription in terms of their design and materials.



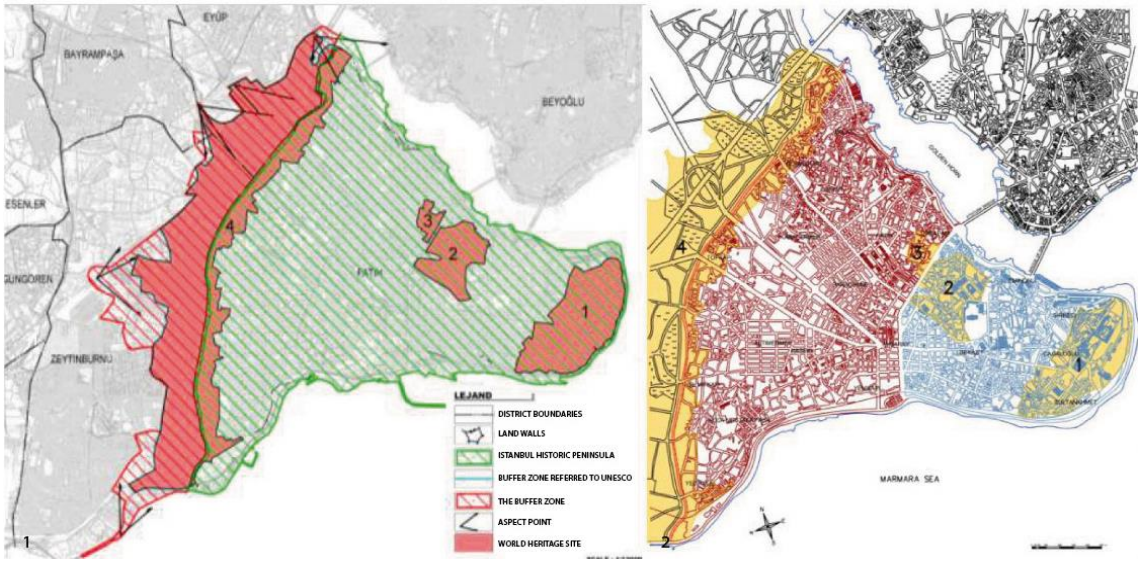
1. "Constantinople, Stambool" engraved by B.R.Davies after a map by Hellert, published by The Society for the Diffusion of Useful Knowledge (SDUK), 1844; 2. Plan of Mosques in Constantinople (photography: Alessandro Ciambrone).

The multidimensional and multidisciplinary methods

World Heritage Properties are under the control of international and governmental institutions in charge to evaluate their state of conservation and management linked to the criteria for inscription in the WHL. These criteria relate to multidimensional and multidisciplinary approaches which represent the cultural and natural assets through all their material and intangible components [2] [3].
The Periodic report – Second Cycle – for the Historic Areas of Istanbul elaborated in 2014 by the Istanbul Cultural and Natural Sites Management Directorate highlights cultural, social, economic, tangible and intangible factors able to define the current state of conservation and management for the property. Additionally, the Management Agency presents assessments to face with the current negative factors. These factors and assessments relate to: building and development; transportation infrastructure; services infrastructure; pollution; biological resource use / modification; local condition affecting physical fabric; social / cultural use of heritage; other human activities (illegal activities, deliberate destruction of heritage); climate change and severe weather events; sudden ecological or geographical events; management and institutional factors (low impact research / monitoring activities, management activities).
The multidimensional and multidisciplinary approaches, which analyze the state of preservation and propose operative actions for the listed property, are deeply illustrated in the Istanbul Historic Site Management Plan, which was approved by the Supervision and Coordination Council in 2011, and was already submitted to the World Heritage Centre and ICOMOS [4].
The Management Plan, among other, focuses on the representation of the property's OUV in terms of sustainable development for the local community. This overall aim can be reached if the operative projects of preservation and management involve the local community and the main stakeholders of the territory in the planning process. In synthesis, the Management Plan and the Periodic report state that:

- there is coordination between the range of administrative bodies / levels involved in the management of the property but it could be improved;
- the management system / plan is only partially adequate to maintain the property's Outstanding Universal Value;
- the management system is only partially being implemented since the property's inscription in the WHL;
- an annual work / action plan exists but few of the activities are being implemented;
- the cooperation / relationship among WHP managers and local communities, indigenous peoples, landowners, visitors, and tourism industry is poor. This cooperation is good with local / municipal authorities and researchers, but scientific studies and research projects are not sufficiently shared at local level.

Another important factor to keep in consideration for local sustainable development is the awareness and understanding of the existence and justification for inscription of the WHP. Tourism industry is perfectly aware of the importance of the Historic Areas of Istanbul. This awareness is in the average for local and municipal authorities within or adjacent to the property as well as for visitors, local businesses and industries. The level of awareness is poor for local communities, residents and landowners.

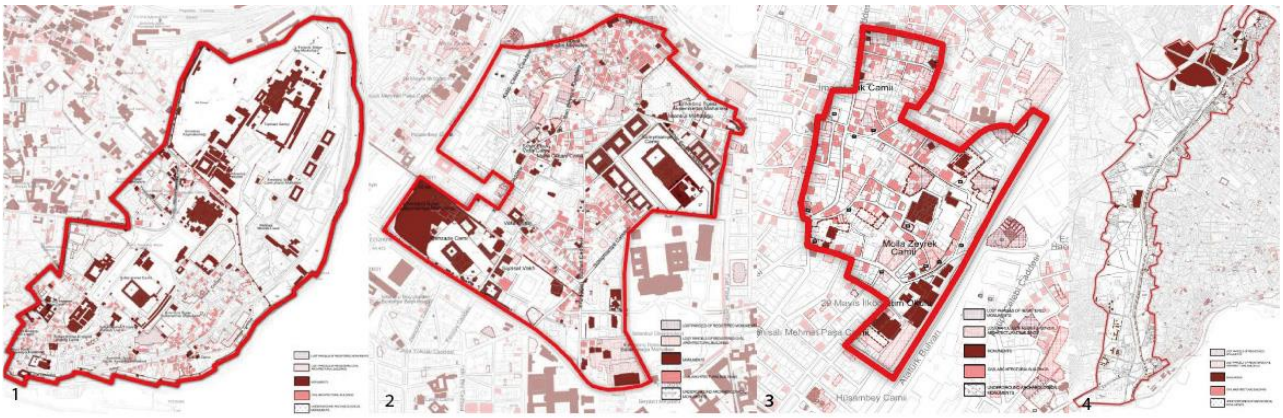


1. Boundaries of the Site Management Plan and World Heritage Sites approved by the Ministry of Culture and Tourism (source: Istanbul Natural and Cultural Site Management Directorate, 2011); 2. World Heritage Site of the Historic Peninsula (source: Unesco, 2006)

Ertuğrul Günay, former Minister of Culture and Tourism in Turkey, states: 'Conservation, maintenance and transference to the next generations of cultural properties, which are invaluable and irreplaceable values of nations, are social responsibilities and the condition of keeping the national consciousness alive. Conservation of cultural and natural properties will only be possible if public awareness is created as a whole that everybody, every institution, organization and occupational group takes part.
According to the Operational Guidelines for the Implementation of the World Heritage Convention, the management plan of the area is regarded as the guarantee for the efficient preservation of OUV of the property through a participatory approach, and there has to be a management plan for the areas to be nominated to the WHL. Therefore, concepts such as "Site Management" and "Management Planning" are included in our conservation regulations according to the Additional Article 2 added to the Law 2863, namely the "Law on the Conservation of Cultural and Natural Properties" and the Law 5226 in order to provide the efficient conservation of the natural and cultural values of both our properties on the WHL and the properties in the Tentative List with a participatory strategy in the framework of a vision' (Management Plan, 2011, p. i).

Historic Istanbul and tourism

For the purpose of this paper, it seems interesting to understand how Istanbul's cultural and landscape heritage are perceived by tourist and residents. City marketing plays an important role, forming a bridge between a city's potential and the use of this capacity for the benefit of the local society [5].
The city's unique strategic position as a bridge between East and West renders Istanbul as one of the culturally richest and more diverse cities in the world [6].
There are a number of primary tourism elements that have the ability to attract tourists and visitors. Among these factors are the cultural facilities, including museums and galleries [7].
Istanbul, being a city of culture throughout its history, boasts 56 museums all around the city, including palaces, monuments and other historical areas.
The Turkish Ministry for Culture and Tourism has provided special importance to the restoration and rehabilitation of the museums and historical monuments in Istanbul, indicating the importance given to these attractions within the context of the Istanbul 2010 European Capital of Culture project.
The city, for its historical assets, museums and cultural activities was rated third most attractive city to be visited in Europe and ninth in the world [8]. According to Altınbasak (2009) Istanbul is perceived as a historical city with different culture and atmosphere. The historical places, monuments and museums of Istanbul, constitute an important part of the city image. Moreover, the modern face of Istanbul is an emerging aspect of the city's brand identity, created by art galleries, art museums and cultural activities that carried out by world famous artists, singers and groups [9].
Altınbasak and Yalcın (2010) state: 'Although the Nation Brand Index focuses on the country image rather than that of a city. In fact Turkey's underestimated attribution to the ''culture and cultural heritage'' might be alarming; Turkey was ranked as ninth among 11 countries in 2005 and 38th among 50 countries in 2008. Furthermore, although the existence of cultural monuments is important, visitors still expect continuous and differentiated cultural activities in a city.

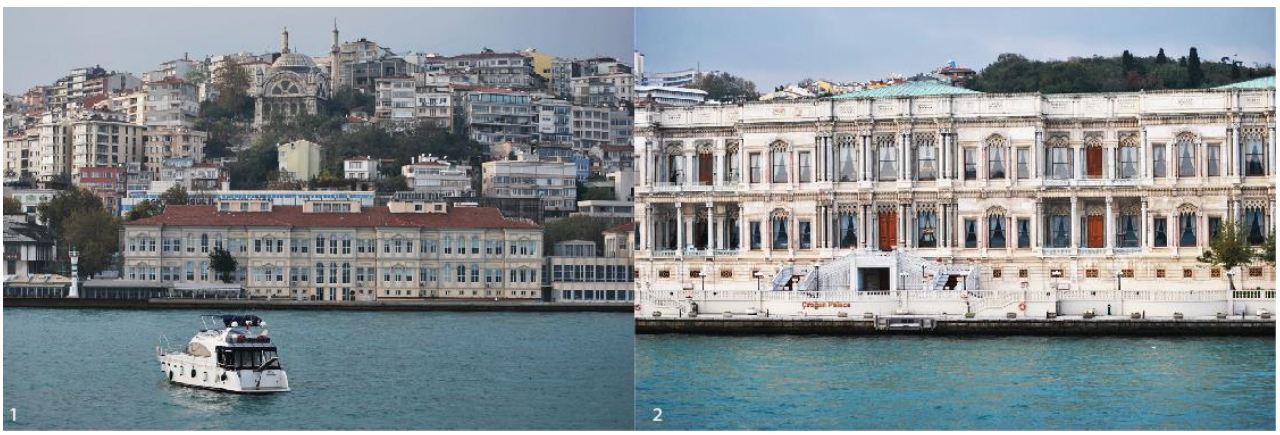


1. Cultural Properties in Sultanahmet Archeological Park World Heritage Site (source: IMM, 2010); 2. Cultural Properties in Suleymaniye Mosque and its associated Area World Heritage Site (source: IMM, 2010); 3. Cultural Properties in Zeyrek Mosque (Pantocrator Church) and its associated Area World Heritage Site (source: IMM, 2010); 4. Cultural Properties in land Wall of Istanbul World Heritage Site (source: IMM, 2010).

Therefore, countries / cities which do not have a rich historical past can differentiate themselves through the vast alternatives of cultural activities held and communicate to the world regularly. To strengthen its city image, Istanbul should increase the variety and provide the continuity of cultural activities throughout the whole year, using its historical places and museums as a source of attraction. Furthermore, those activities should be communicated not only in Turkey but throughout the world to different target groups. The support of both the State and NGOs is crucial for the success'.
The positive image for visitors and tourism industry does not correspond to a real sustainable economic development for local communities. This is the case in the listed historical areas due to, among other aspects, luck of an integrated management system. This does not include all the stakeholders in the planning process, especially in the tourism sector [10].

Restructuring Istanbul, urban landscape and historical areas

According to Ozus, Turk and Dokmeci (2011) multi-centre development and modern housing projects, outside Historical Areas of Istanbul and in their surrounding caused the decline of the old central district, which is included in the WHL, and its neighborhoods as it was in some other metropolitan cities [11][12].
Istanbul was a mono-centric city until the second half of the twentieth century. Due to rural migration it experienced population growth after the 1950s. After the 1970s, construction of peripheral highways and bridges, suburbanization, and a new form of commercial development and development of telecommunication technology have caused multicenter development of the city. At the same time, these new centres in the periphery stimulated redevelopment of the squatter areas in their surroundings [13].
The low income rural migrants mostly moved in the historical areas and were not able to afford the conservation and restoration of ancient buildings.
During the eighteenth and nineteenth centuries, many traditions were adopted from the Western world, including laws and regulations related to the city planning issues, city designing principles aiming to create a monotone urban pattern, new building types and new architectural styles [14].
In the 1970s and 1980s, after the construction of bridges on Bosphorus and peripheral highways, suburbanization movement started in Istanbul similar to that in developed countries.
After the 1980s, the major cities of Turkey have experienced urban transformation processes following the changes in the international trade policy and perception of cultural heritage. Istanbul took the highest amount of share from these transformation processes and turned it into the most important economic, cultural and tourism centre as well as the most integrated centre to the world economy within the country.
From 1950 to 2000, the population in Istanbul passed from around one to ten million [15]. In order to facilitate the increasingly growing motorized transportation, all possible areas in and around the city have been filled by highways, bridges, bridged crossroads, underpasses and parking garages.
Istanbul has been the subject of a quick and spontaneous urbanization that totally ignores its natural and geographical aspects. Highway projects damage the historical heritage and the architectural texture of the city. The city is spreading in all directions, distancing itself from its water-based identity. Maritime lines are no longer the backbone of transportation, and the sea is not as accessible as it used to be [16].
Istanbul Metropolitan Municipality has transformed to the most important actor in local physical planning decisions related to Istanbul. The historical areas of the city lost importance in the planning process. Also it lost the attraction for economic investments, depending on different reasons. The old structures of the historical areas were unable to cope with demand for modern office space and traffic congestion.



Istanbul: 1.Karakoy; 2. Besiktas, Dolmabahçe Sarayı (photography: Alessandro Ciambrone).

Moreover, building restrictions, high land prices and lack of space for car parking caused the decentralization of jobs. Despite the advantages of multi-centre development, their existing unplanned and haphazard development caused undervaluation of land prices and urban development without an identity.
The consequences of the urban landscape of Istanbul and its historical areas generated a lack of economic investments for their conservation and management as well as caused problems for the preservation of their integrity and authenticity. This can be considered a result of the construction of modern infrastructures which do not respect the historical urban landscape, and do not integrate with the sense and identity of places.

'Best practices' for the regeneration process of the property

Since the Historic Areas of Istanbul were inscribed in the WHL, many attempts to preserve and manage the property were carried out by international organizations, institutional agencies and universities. In this framework, the author considers as a 'best practice' the "Istanbul project" developed through the partnership Unesco-WHC, Istanbul Technical University (ITU Faculty of Architecture) and ITU Urban and Environmental Planning and Research Center [17].
The primary aim of the "Istanbul project" is 'to formulate general planning determinants and to propose the conservation strategies that maintain the appropriate and contemporary development of the social and physical / environmental fabric of the chosen areas of Istanbul Historic Peninsula, namely Zeyrek, Suleymaniye and Yenikapi while preserving their historical, archaeological, natural, architectural and functional values'.
Zeyrek and Suleymaniye all bearing importance from historical, aesthetic and architectural perspectives. Those areas have been included in the WHL in 1985, but today, they are unfortunately under the threat to be included in the List of World Heritage in Danger because of lack of effective and continuous conservation attempts by competent institutions.
Yenikapi is located at south shores of Historic Peninsula and until 1960s, it was successful with conserving its unique architectural characteristics. Church of Surp Tartios Partihiminios is the only monumental structure in the area. After the construction of Kennedy Street through the sea shore the areahas significantly changed both physically and socially.
Zeyrek is situated on the fourth hill of Historic Peninsula. One of the most significant examples of Byzantion Architecture, Pantokrator Monastery founded by Empress Eirene in the 12th century, and timber houses of Ottoman Architecture gives the unique identity to Zeyrek. The social structure of the area changed completely after the 1950's. This change hasreflected itself in spatial structures too.
Prior users moved outwards and immigrants from Eastern and South-Eastern Anatolia settled in the area. Most of the migrant families have low income levels. The lack of interest in conservation and lack of feeling of possession accelerate the deterioration of timber buildings.
Multi-storey reinforced concrete buildings were built after the demolition of traditional ones resulting in a lack of harmony with the traditional urban texture.
In Zeyrek, the efforts are directed towards the elimination of land uses that are not in accordance with the traditional urban fabric of the area and the replacement of these land uses with more harmonious functions as it was envisaged in the upper-level plans.



Istanbul: 1. Galatasaray University, Ortakoy; 2. Historical Grand Bazaar Istanbul (photography: Alessandro Ciambrone).

Suleymaniye is an important node for historical townscape of Istanbul. Monumental buildings constitute an important defining role of the historic area. Though, there seen an important decay in the listed timber structures. It is Istanbul's one of the most important distribution node of goods and services. Bazaar on Atatürk Boulevard has an important impact on the development of commercial and manufactural facilities and on the type of residents, with the replacement of previous housing units by warehouses or manufactural units.

The site was a place where the rich and elegant society of Ottoman administrative class were living in 17th century, unfortunately, in the 20th century, the structures were left to worker immigrants and their families from eastern regions of Turkey in order to be used for housing, manufacture or wholesale ateliers with the industrialization and development competition of Istanbul metropolis.

The efforts are directed towards the prevention of the economic role of Suleymaniye as a distribution node of goods to eliminate the land use not in accordance with the traditional urban fabric of the area and the replacement of these land uses with more harmonious functions.

Yenikapi-Yali Mahallesi is a typical historic urban quarter of old Istanbul with its masonry and timber civil architecture and its cultural inheritance. It has always been a residential area. However, the increasing density of manufacturing sector, warehouses, car repairing activities has been damaging the residential character of the traditional physical and social layout of Yali Mahallesi recently. Such developments on main boulevards create job opportunities for residents, but does not effect the economical development of Yali Mahallesi as a whole.

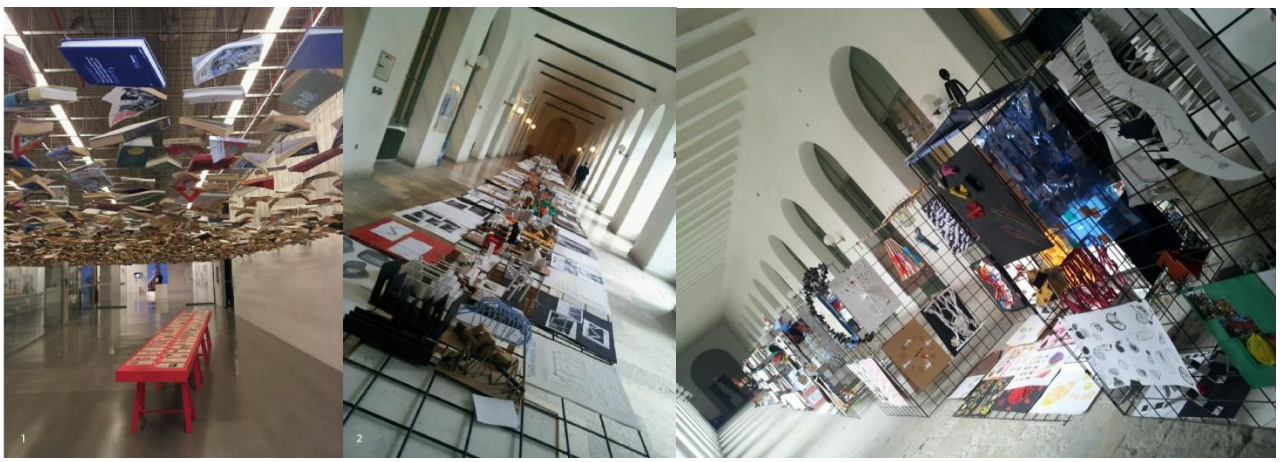
The increase in non-residential activities caused Yenikapi-Yali Mahallesi's own residents to leave the settlement. The empty places, generally listed buildings, were filled by the immigrants of low income coming from the economically undeveloped regions of Turkey, especially from Southeast and East Anatolia regions.

Planning efforts are directed towards the reorganization of the role of Yenikapi-Yali mahallesi to be in accordance with the traditional urban fabric of the area and to serve in its hinterland. New economic functioning is proposed to provide new job opportunities reflecting the potential to increase the income level of inhabitants.

Researches and studies are taken into consideration to obtain a more advanced progress to support operative projects. 'Historic Peninsula, the richest part of Istanbul in terms of cultural heritage, has long been without conservation or plan, the best parts of the city became gradually dilapidated, getting its share from the social and economic developments in a negative way. Only after 2005, a conservation master plan could be made for the site with the self-denying works of the authorized local governments.

Restoration and conservation works and activities of raising awareness and promotion gained momentum visibly after this date. The foundations of institutional structures were laid in this period within the local governments such as Directorate of Projects for Cultural Properties, Directorate of Supervision of Conservation Implementations (KUDEB) and Site Management Directorate.

On the other hand, Special Provincial Administration allocated serious amounts of funds collected from the property taxes to the restoration and revival of cultural heritage especially in Historic Peninsula. Similarly, General Directorate of Foundations also allocated substantial resources to the restoration of monumental building which has long been without maintenance or repair in Historic Peninsula. Especially in the last ten years, a great fund like 1 billion 160 million Turkish Lira was allocated for the restoration of cultural heritage in Historic Peninsula' [18].



1. Istanbul Modern Museum; 2. Istanbul Technical University, Faculty of Architecture (photography: Alessandro Ciambrone).

Site Management Directorate, which was founded in 2006, brought together the related and authorized institutions, organizations, NGOs, constituted the Advisory Board and Coordination and Supervision Board and started the studies for the Historic Peninsula Management Plan in 2009. As a result of a-two-year of examination, research, search conferences and workshops, Historic Peninsula Site Management Plan could be completed with the contributions of related stakeholders and qualified experts at each phase and submitted to the Unesco World Heritage Center. Representing and cataloguing the material and intangible assets for local sustainable development means, first of all, involving local community in the planning process.



Historic Areas of Istanbul Sultanahmet Mosque, Blue Mosque (source: Ministry of Culture and Tourism, Author: Umut Özdemir); 2. Maiden Tower (source: World Heritage Centre).

Bibliographical References

[1] Periodic Report – Second Cycle (2014). Unesco World Heritage Centre (online).

[2] GAMBARDELLA, C. (edited by), *Heritage, architecture, Landesign. Focus on Conservation, regeneration, Innovation*. In proceedings of the XI International Forum of Studies “Le Vie dei Mercanti”, Aversa and Capri, 13 / 15 June 2013, Napoli, La scuola di Pitagora.

[3] GAMBARDELLA, C. (edited by), *Best practices in Heritage, Conservation, Management. From the world to Pompeii*. In proceedings of the XII International Forum of Studies “Le Vie dei Mercanti”, Aversa and Capri, 12 / 14 June 2014, Napoli, La scuola di Pitagora.

[4] Istanbul Historic Site Management Plan (2011). Turkish Ministry of Culture and Tourism (online).

[5] DEFFNER, A., LIOURIS, C., *City marketing: a significant planning tool for urban development in a globalised economy*', paper presented at the 45th Congress of the European Regional Science Association, Amsterdam, 23-27 August 2005.

[6] ALTINBASAK, I., YALCIN, E., *City image and museums: the case of Istanbul. International Journal of Culture*, Tourism and Hospitality Research, 2010, Vol. 4 Iss 3 pp. 241 – 251.

[7] EJIGU, A., SJOHOLM, J., NORDGREN, E., LINDSTROM, P., *Twinning identities – Losing uniqueness?*, Twinning Cities, Planning for Regional Development Across Borders Project Work, 2004, Royal Institute of Technology.

[8] Travel and Leisure, Top 10 Cities in Europe, 2008 (online).

[9] ALTINBASAK, I., *Understanding the prejudices in order to improve the image of Turkey: a qualitative study on the prejudices of Italians about Turkey*, Bogazici Journal, 2009, Vol. 23 No. 1.

[10] KARMOWSKA, J., *Cultural heritage as an element of marketing strategy in European historic cities*, Proceedings of the 5th European Commission Conference – Cultural Heritage Research: A Pan-European Challenge, Luxembourg, January 2003, pp. 139-41.

[11] OZUS, E., SENCE TURK, S. & DOKMECI, V., *Urban Restructuring of Istanbul*, European Planning Studies, 2011, 19:2, 331-356.

[12] LEINBERGER, C., *Urban cores, Urban Land*, 1990, 49(12), pp. 4–9.

[13] DOKMECI, V., BERKOZ, L., *Residential-location preferences according to demographic characteristics in Istanbul*, Landscape and Urban Planning, 2000, 48(1), pp. 45–55.

[14] CELIK, Z., *The Remaking of Istanbul: Portrait of an Ottoman city in the Nineteenth Century*, 1993, Berkeley, University of California Press.

[15] TurkStat, Turkish Statistical Institute, 2000, Demographic statistics.

[16] ENLIL, Z. M., YENEN, Z. & UNAL, Y., *Istanbul: A city of waterfronts or a city inland*, in BRUTOMESSO, R. (Ed.), *Waterfronts: A New Frontier for Cities on Water*, 1993, pp. 116–123 (Venice: Rizzoli).

[17] Istanbul project. Istanbul Historic Peninsula Conservation Study. Istanbul Technical University (ITU Faculty of Architecture) and ITU Urban and Environmental Planning and Research Center, Unesco-World Heritage Centre (online).

[18] Historic Areas of Istanbul. State of Conservation Report, 2015, Unesco-World Heritage Centre (online).



1. Hagia Sofia (source: World Heritage Centre); 2. Istanbul, Blue Mosque dome (photography: Moyan Brenn).



1. Istanbul, open space; 2. Istanbul Technical University, Faculty of Architecture (photograpy: Alessandro Ciambrone).

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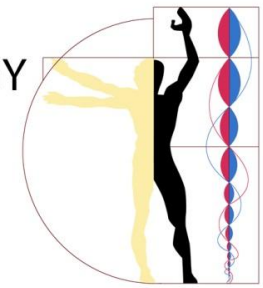

Analysis and Landscape Planning. The Landscape Project of Taburno-Camposauro.

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Abstract

This work focuses on the development of the Landscape Analysis in a purposeful way to identify a new strategy in the planning process. An approach in which the cognitive analysis, at the base of the study of the landscape, do use a methodological paradigm that does not only consider the data and information from different disciplines, but also their proper aggregation oriented towards the identification of Areas of Landscape from which to assess the more appropriate type of action or intervention. The National Legislation in Italy applies the Legislative Decree no. 42/2004 which, on the one hand, considers the landscape as the result of historical and anthropogenic transformations and their interaction with the natural environment, on the other hand, seems to constrain the possible future transformations only to their compatibility with the needs of conservation and protection of landscapes already established (constraint-protection-preservation). The aim of this work, is to recognize to the landscape an evolutionary character: landscape project for the enhancement and restoration of existing landscapes, but also for creating new landscapes by using compatible transformations with the existing values consolidated. It's about overcoming the constrained vision of landscape plans and to reach that of the transformability limits of the territory; in this way the Landscape Planning becomes a tool for the management of the Landscape.

Keywords: Landscape plan, Areas of Landscape, Transformability Limits.

1. Concepts and issues of landscape planning

The theme of the landscape is a very complex and intricate topic and the landscaping analysis is, perhaps, more than others, a subjective analysis rather than an objective one considering that it can not reflect the point of views of the operator, its culture, its interpretations and his judgments. Therefore, it's not easy to recognize an exact legal and technical meaning of the term "landscape", either because it underwent deep changes in time, either because it has been affected for decades by a terminological confusion which created many difficulties in the recognition of its essential aspects.

Just think about the evolution of the landscape concept. Firstly in the Legislation of 1939 it's referred to "natural and scenic beauty", with the Law no. 431/1985 (L. Galasso) it becomes "cultural heritage protected", till the European Landscape Convention (signed in Florence in 2000 by 34 states of the Council of Europe and ratified by 27 of these states) which, defining landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors", gives it a double meaning, that of "perceived object" connected to the cultural heritage of the perceiver (subjective point of view) and that one connected to the product of the action of natural and human factors (objective point of view), shifting the identity from the individual perception to the collective one of the people who live a place. In other words, the perceptive vision of landscape has been gradually replaced by a more ecological vision based on the recognition of local territorial identity as opposed to the aesthetic perception of the individual [1]. The field of cultural heritage in Italy is now regulated in Italy by the Code of Cultural and Landscape Property (Legislative Decree no. 42/ 2004, January 22nd, 2004, as amended by Legislative Decree n. 157, March 24th, 2006 and by the Legislative Decree no. 63, March 26th, 2008). Under the influence of the European Convention, the Code of Cultural Heritage and Landscape has (re)allocated to the landscape an autonomous dimension, and in this sense, it is significant that in the code has been abandoned the

terminology "environmental goods", used by the consolidated text of 1999 (Art. 138 Legislative Decree no. 490/1999) and now replaced with the category of "landscape goods" (Articles 2 and 134 of the Code). The reading of the landscape in the Code is both a *reduced reading* (with reference to the inventory of the landscape assets as agreed upon art. 134) and an *ecosystemic reading*, that consider the landscape as a filter of the culture of the reader (with reference to the Areas of Landscape). So, on the one hand, it consider the landscape as the result of historical anthropogenic transformations and their interaction with the natural environment, on the other hand, seems to constrain the possible future transformations only to their compatibility with the needs of conservation and protection of landscapes already established (constraint-protection-preservation) [2].
The aim of the "Landscape Project of Taburno-Camposauro" is about overcoming the constrained vision of landscape plans and to think in terms of limits of transformation of the territory for the protection and enhancement of the character and of the qualities that distinguish it and for its sustainable development. It introduces a methodological approach according to which the cognitive analysis, placed at the base of the of the landscape studies, do use a methodological paradigm that does not only consider the data and information from different disciplines, but also their proper aggregation oriented towards the identification of Areas of Landscape from which to assess the more appropriate type of action or intervention.

1.2 Contents of the Plan

The organization of this Plan has provided two key activities: the first one referred to a more general recognition and knowledge of the area, the second one more linked to a proper planning activity. In particular:
- the first step concerned the recognition of the territories subjected to restriction (from the point of view of the landscape) and to more general knowledge of the whole territory to be submitted to the plan;
- with the process of the Plan have been defined and identified the areas of protection, their elements and landscape values that must be protected and enhanced through specific norms.

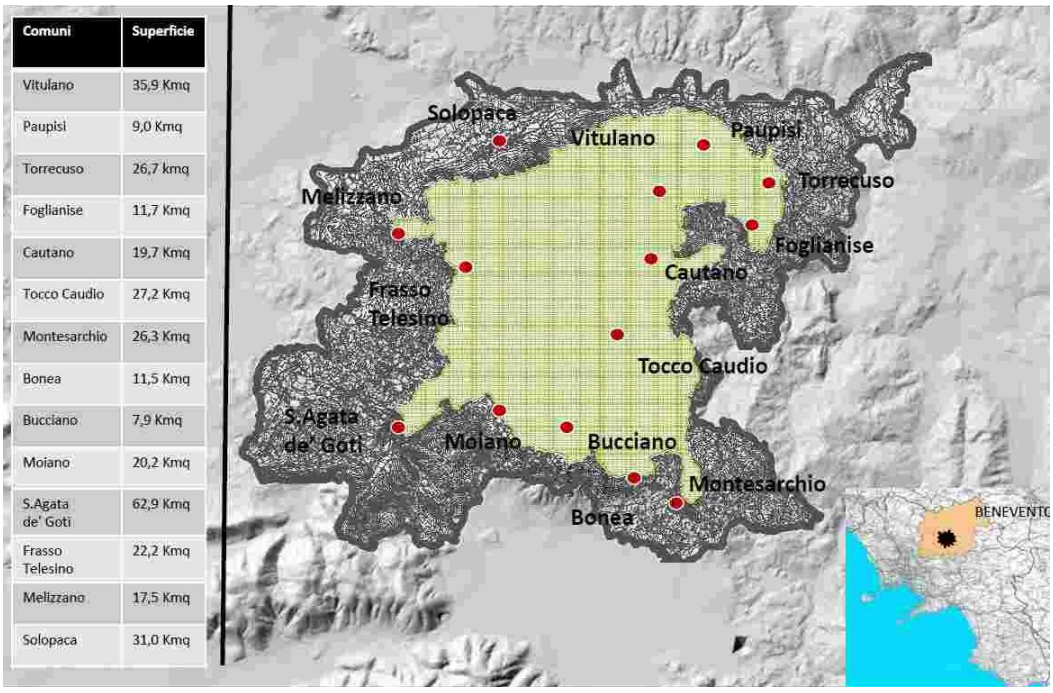

Fig. 1: Territorial framework of the concerned area.

2. Recognition of landscape heritage

The area of Taburno-Camposauro, has great architectural and urban strongholds which have created the urban structure of historic centers and their monumental hierarchies. They are characterized by an architectural and urban complexity and inseparability born from the relationship between the individual building (or the complex of special buildings) and the open space around it closely connected, formed by streets, squares with related fronts, gardens and unique architectural elements.
Having hired the protection and integrated enhancement of cultural and environmental Heritage as cornerstone, the interventions of transformation of the territory must not impair the readability of the historical

traces and of the archaeological, architectural and monumental elements present. There has been an accurate recognition of the landscape assets present in the selected area and their geo-referenced planimetric description.

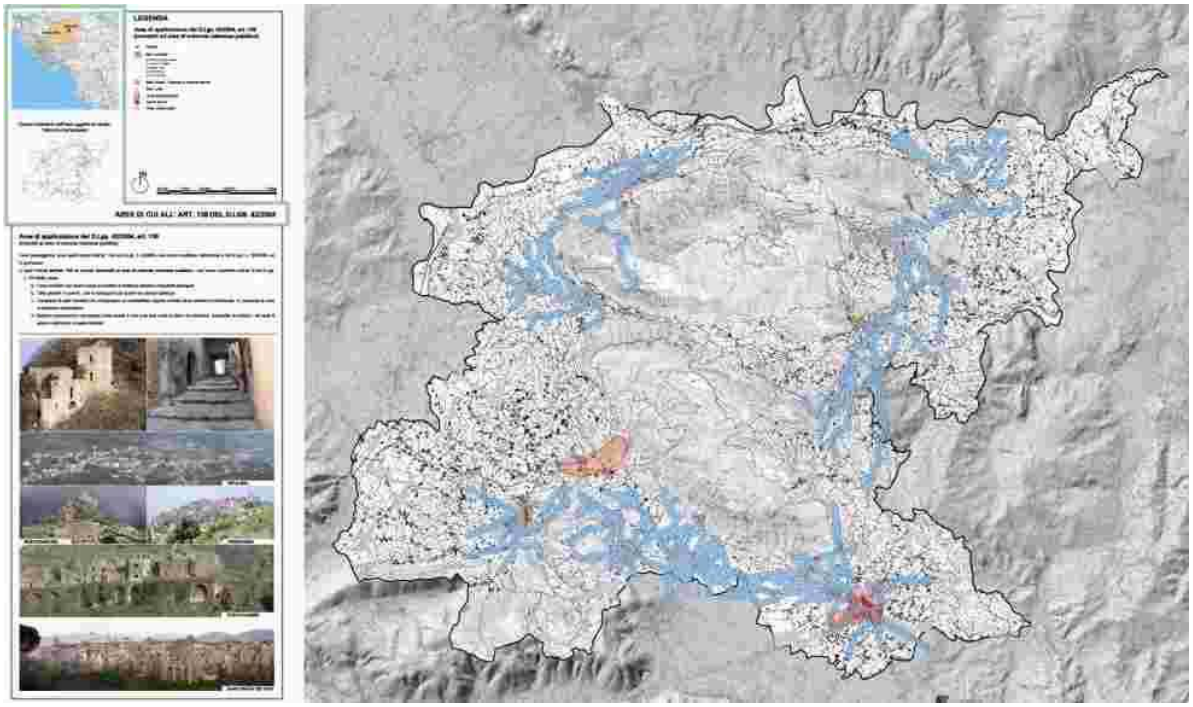

Fig. 2: Areas of art.136 of Legislative Decree no. 42/2004.

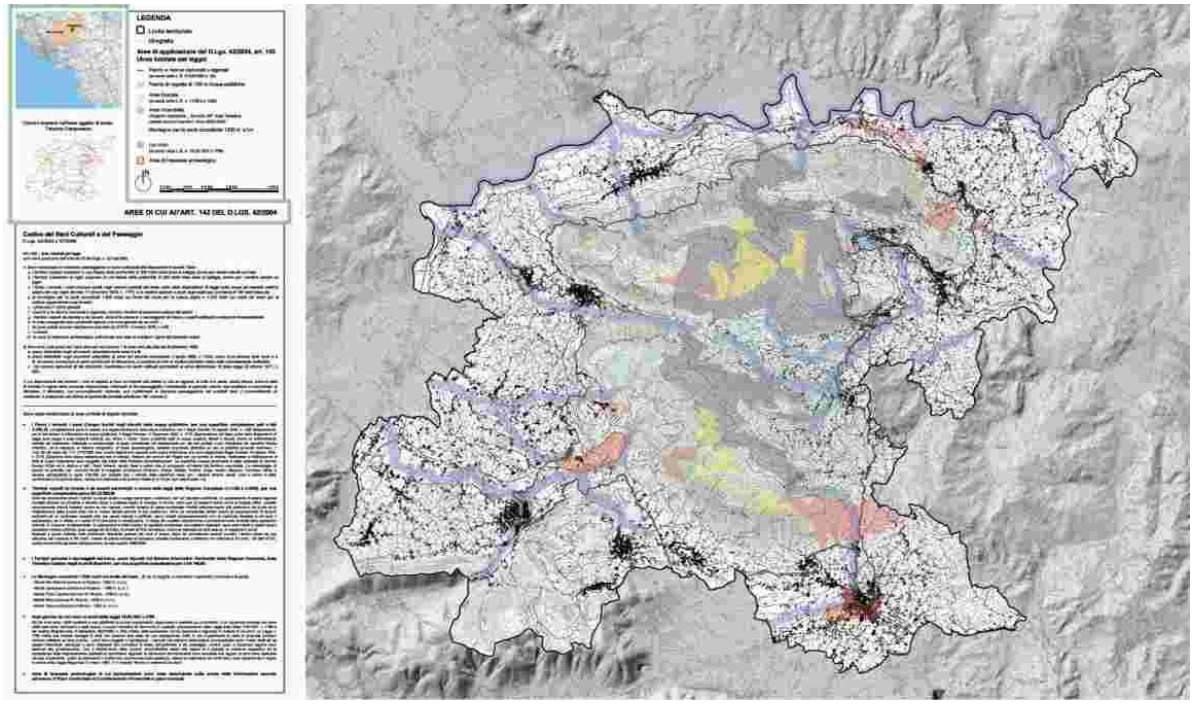

Fig. 3: Areas of art. 142 of Legislative Decree no. 42/2004.

According to the analysis performed, it was defined the interest degree of the elements of historical, archaeological and environmental landscape. The results and the readings described above, were therefore synthesized in some maps which contain, on the one hand the value / degree of interest of some elements (areal, linear and point elements), on the other hand, the level of alteration of themselves or of other elements.

3. Identification of Areas of Landscape, Systems and Subsystems Landscape

The identification of Areas of Landscape was made by using a scientific method named “hierarchical classification of the territory” and starting from the identification of regions where climate, lithological and morphological conditions are similar, from the analysis of their land cover and from the comparison with the historical aspects of their cultural and historical territory that is being analyzed.
Then it was carried out a check of the Areas of Landscape identified, to ensure their uniqueness on the territory [3].

3.1 Hierarchical Classification of the Territory

The hierarchical classification of the territory is a methodology developed by C.Blasi et al., (1998; 1999; 2000) in order to identify areas with the same climatic, lithological and morphological conditions, or portions of land increasingly homogeneous, in physical and biological terms, featuring by the same structural and functional characters [5]. This method assumes that the definition of the territorial mosaic comes from the natural conditions on which acts secondarily the man and has allowed the identification of:
- Regions of the Landscape, on microclimatic basis;
- Systems Landscape, mainly on lithological basis;
- Subsystems Landscape, based on morphology.

3.2 Application of hierarchical classification to the interested area

To carry out the classification, the following themes have been used:
- the Climate Charter has been used to identify the regions of landscape;
- the Lithological Charter and the Charter of the land use were drafted for the identification of systems landscape;
- the Morphological Charter was drafted to identify subsystems landscape.

The hierarchical classification of the territory was performed through processing in GIS [6] of the themes described above. In particular, it was made a model in ArcGIS and a relational database that allowed to speed up complex processing, making it possible, as a result of subsequent verification and validation of the results obtained, to correct at the source inconsistencies derived from deficiencies in the matter of base, repeating the process until a satisfactory degree of accuracy.
Primarily, with regard to the climate, the main thermo-pluviometric stations have been localized within the territory considered. For the investigation, have been used the data (related to values of temperature and precipitation) provided by the CAR (Regional Agro-meteorological Center) [10] and by the Civil Defence and referred to the surveys conducted at the points of measurement of the stations located. The data were processed to obtain Annual Rainfall Map in mm and a Card of Average Annual Temperatures, as shown below:

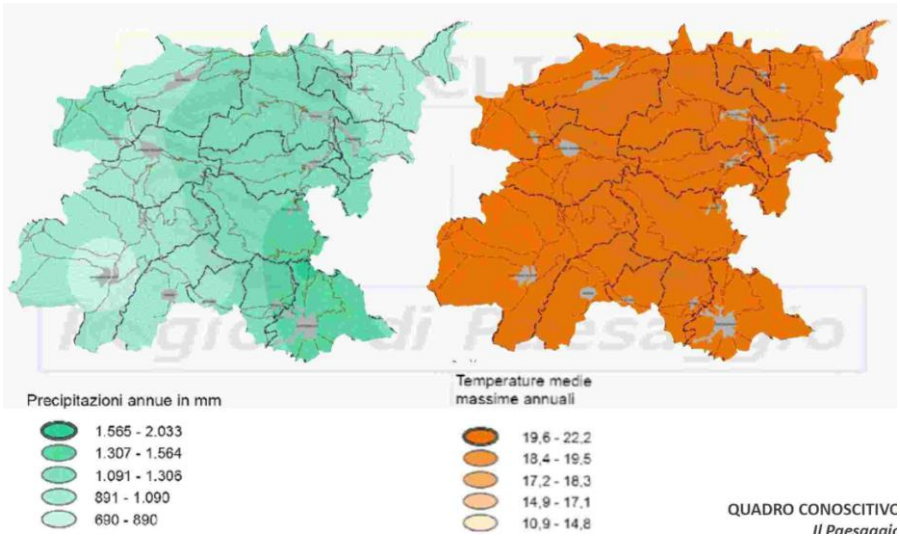

Fig. 4: Annual Rainfall Map in mm - Card of Average Annual Temperatures.

Secondly, we proceeded to the classifications of the thermo-pluviometric stations using the scientific approach proposed by S.Rivas-Martinez [3] which consists of a classification in four levels: macro-bioclimate,

bio-climate, termotipo and ombrotipo. In this way it has come to the division of the territory into two macroclimatic regions: the Temperate zone and the Mediterranean zone.

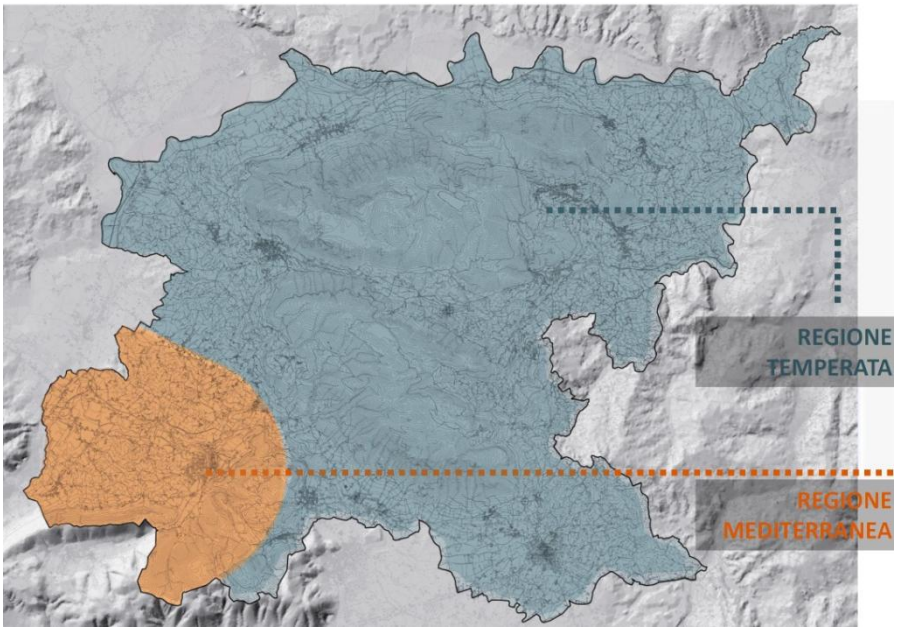

Fig. 5: Climate Charter. Individualization of bioclimatic macro-regions.

Starting from the consideration that the climate influences the distribution of natural vegetation on the earth's surface and that, therefore, there is a relationship between the vegetation and climate conditions, we proceeded to the elaboration of a Charter of Lithological Systems [7]. This is a basic map that describes succinctly the great variety of lithologies outcropping in the area (nature and composition of rocks and soils): 20 categories grouped by color were identified according to the lithological classes .

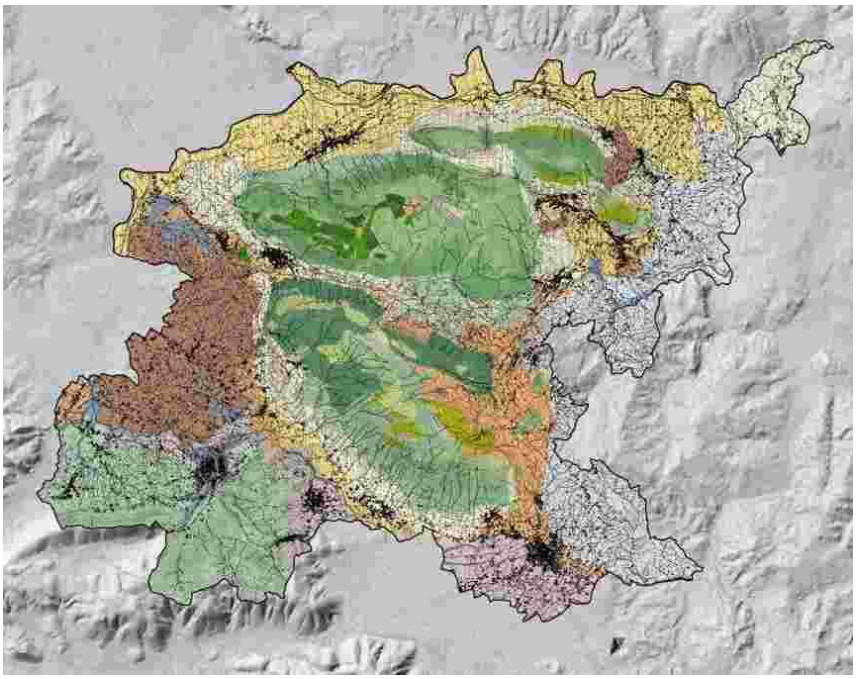

Fig. 6: Lithological Charter.

As we can see from the charter: the range of greens are carbonate rocks that mainly constitute the mountains of Taburno and Camposauro; the range of brown refers to a marl arenaceous complex; the range

of yellows are the screes; the range of purple are the eluvial-colluvial deposits; the range of dark purple are deposits of volcanic ash lithoid; the range of the blues are the ancient floods.
To identify the main morphotypes that characterize the concerned area, starting from the height profiles geo-referenced to WGS84 UTM33N, the study of the territory has been carried out through the elaboration of the DEM in GIS [6].

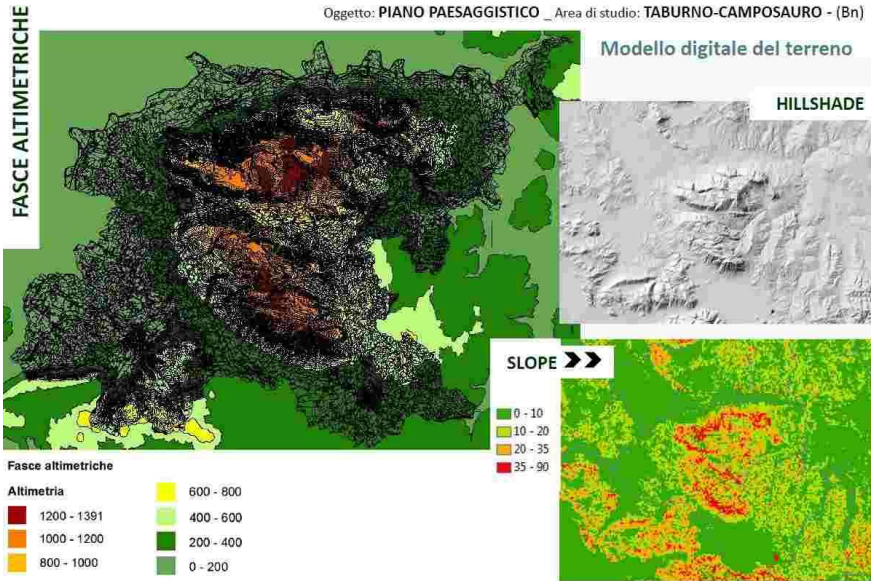

Fig. 7: Morphological Charter

The charter of slopes, drawn in GIS with shapefiles support, was drafted with the intention of giving the representation of the average slope of the land area concerned. The map contemplates 4 slope classes.
These Studies lead to the elaboration of the morphological charter that describes 8 morphotypes.

3.3 Subsystems landscape and validation of the results

From the union of the information contained in the individual thematic maps and by topological operations of overlapping of themes previously described, it has come to the classification of the territory in REGIONS (n.2 - Temperate zone and the Mediterranean zone), SYSTEMS (n. 13 of which 6 in the Mediterranean zone and 7 in the Temperate one), SUBSYSTEMS LANDSCAPE (n. 70), for a total of 853 polygons.

3.4 From Morphological and Perceptual Analysis to the identification of the Areas of Landscape

In order to identify areas of landscape it was performed a morphological and perceptual analysis. The reading key according to which we pointed out the features of each area, is that of consider the landscape as a complex of visible and interpretable signs impressed by the man on the earth and as an expression of the relationship between man and nature.
From a visual point of view, these areas are perceptually uniform sets in which the elements that constitute them are placed in such a way as to trigger close relations of mutual intervisibility. The morphological and perceptual analysis is based on a selective reading of the forms that become significant, namely elements highly communicative.
This analysis has allowed to recognize three areas (A-B-C-) that cross lengthwise the concerned territory; they correspond to the different physical conformation of the two main promontories: Taburno and Camposauro.
Area of Landscape “A” – “C” are characterized as open areas for their notable visual amplitude. On the one hand they are delimited by the top of the adjacent mountains with a high degree of panoramic view.
Area of Landscape “B” is characterized as a closed area with an introverted character. The morphological structure is clearly defined for both sides by steep slopes of Taburno-Camposauro that draw a valley.

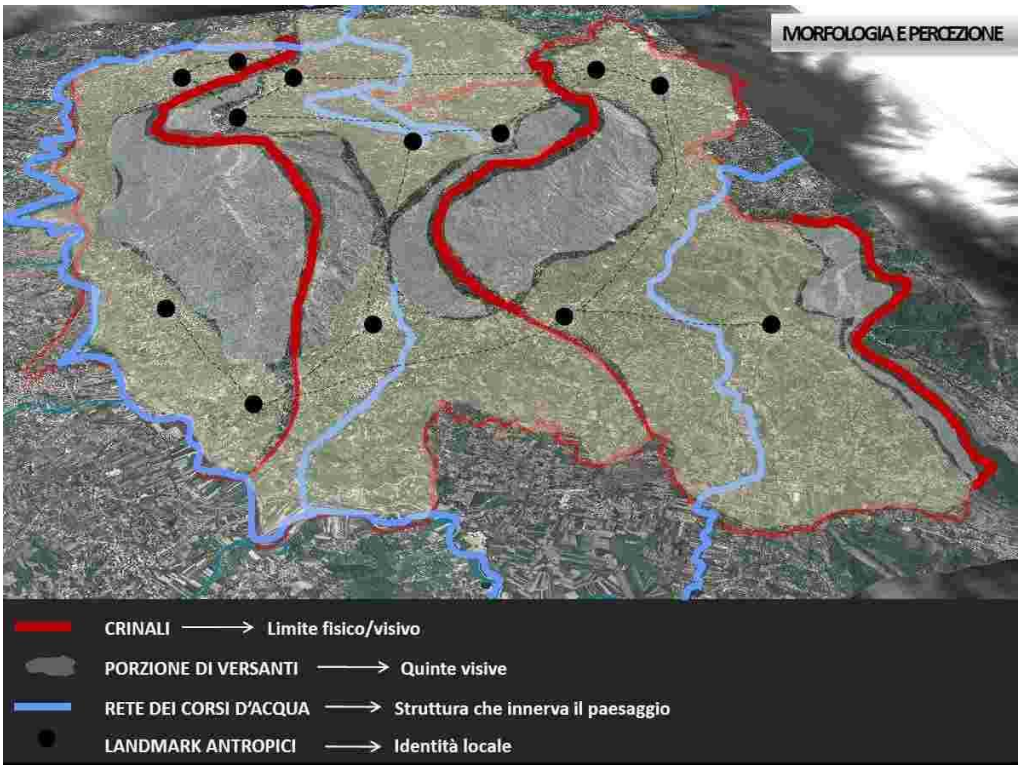

Fig. 8: Morphology and perception.

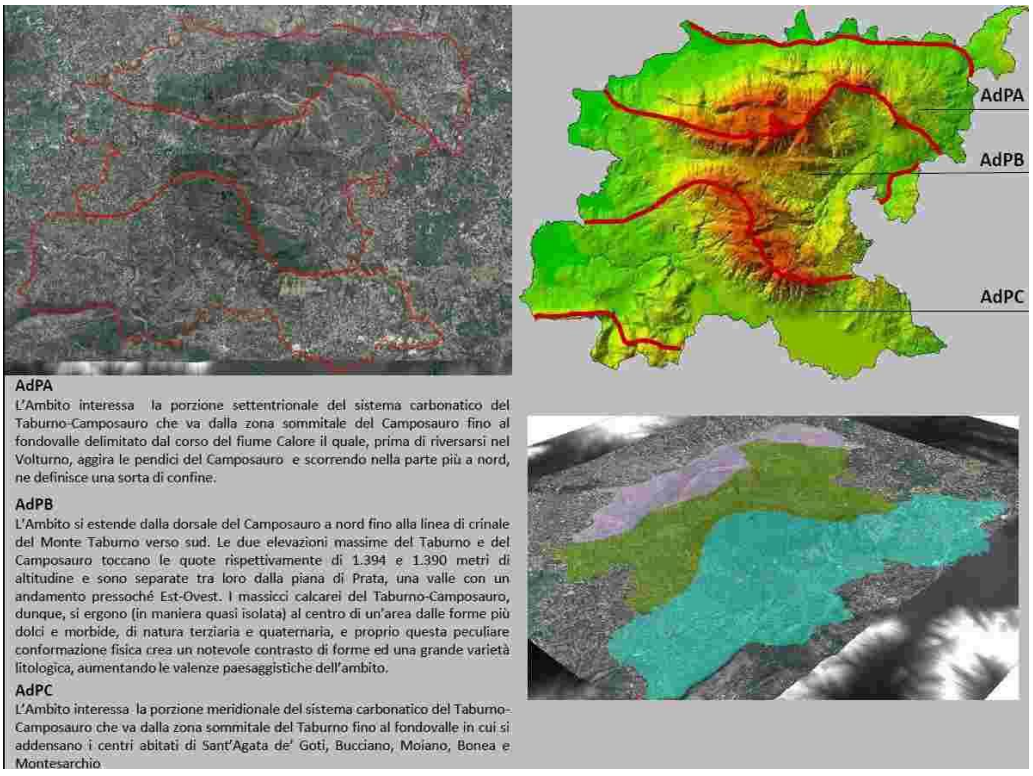

Fig. 9: Identification of Areas of Landscape.

The Areas of Landscape are defined as “a large portion of land with similar characteristics, different from those areas to the boundary, whose distinctive character is expressed by specific systems of ecological relationships, perceptual, historical, cultural and functional between heterogeneous components, that give them an image and a distinctive identity, recognizable by the users of the land and that for that reason it is functional to the planning and management of the territory".

In order to facilitate the comprehension of the investigation described above, to outline the guidelines for the drawing up the urban plans in relation to the theme of landscape and define the objectives to be achieved, we proceeded with the drafting of a board for each area.
On each tab you can see:

- administrative data on the extension of the area [9];
- a concise description of the area to highlight its peculiar and characterizing aspect;
- the main geological and morphological aspects;
- the description of the land cover and its peculiarities;
- the analysis of the subsystems that constitute the area of landscape;
- analysis of the environmental quality and the state of conservation;
- the natural and agro-forestry-pastoral elements characterizing the landscape [8];
- analysis of the structural elements that characterize the landscape of human matrix [9].

The analyzes and descriptions above have identified a set of objectives to be pursued through the local planning and the tool of the project, aimed at the planning, design and management of the good landscape, dictating specific addresses, guidelines, requirements and forecasts.
The targets to be achieved identified were structured in the following five levels:

1) Macro-objectives: inherent elements that characterize and widely qualify the area;
2) Relational Objectives between areas: inherent to structuring elements quantifying and characterizing the provincial territorial whose relations or whose extension affects more areas;
3) Specific Objectives: inherent elements that characterize and qualify the specific subsystem, as well as its intrinsic value at the level of landscape and environment. These objectives have been identified taking into account the level of the state of conservation of the landscape (ILC) [11]; of the individual subsystems;
4) Relational Objectives between internal subsystems: inherent elements, qualifying and characterizing the territory whose relations or whose extension affects more subsystems;
5) Specific objectives of the areas of special landscape value: inherent elements that characterize and qualify portions of territory of special landscape value.

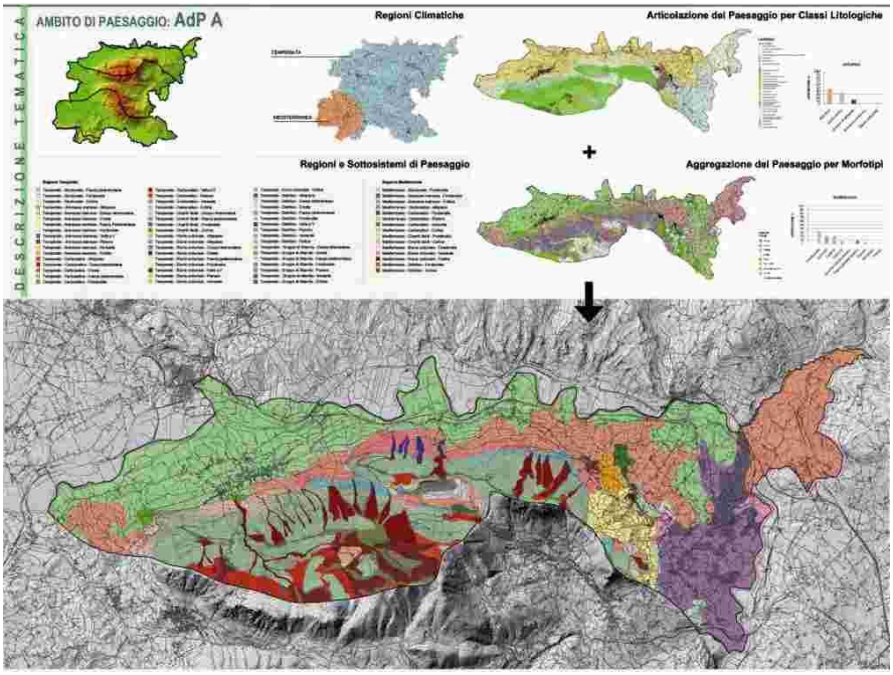

Fig. 10: Area of Landscape “A”.

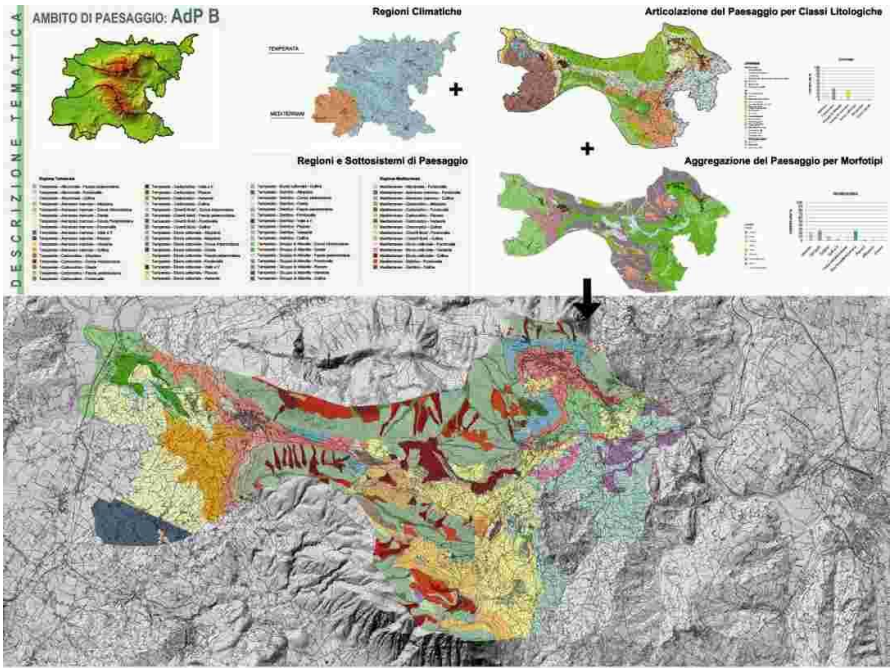

Fig. 11: Area of Landscape “B”.

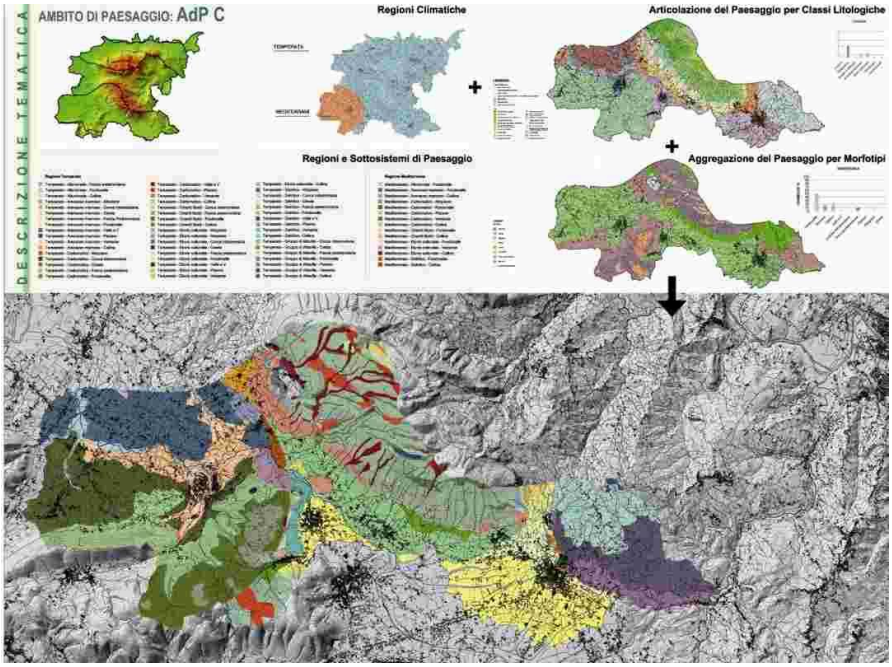

Fig. 12: Area of Landscape “C”.

4. General Conclusions

Landscapes are the result of a complex interaction of physical, biological and social economic factors. Given the importance of land planning, land management and biodiversity conservation, landscapes need to be described, characterized and spatially located.

The aim is to recognize to the landscape an evolutionary character promoting a new approach to the plan and thinking in terms of transformability limits of the territory overcoming the existent constrained vision of landscape plans. In this way the Landscape Planning becomes a tool for the management of the Landscape.

Bibliographical References

[1] LEVY Pierre. *L'intelligenza collettiva.* Feltrinelli, Milano, 1996.

[2] PIEMONTESE Luigi, CAPUTI Paride. *Urbanistica e metamorfosi del paesaggio italiano.* P&P Piani e Progetti, Napoli, 2008.

[3] PIEMONTESE Luigi. *Per il Piano del parco dei Monti Aurunci.* Centro L.U.P.T., Napoli, 2000.

[4] STEINER F. Costruire il paesaggio. MacGraw-Hill, New York, 1993.

[5] BLASI C., CAPOTORTI G., MICHETTI L., ROSATI L., SMIRAGLIA D. Landscape heterogeneity *and vegetation potential in Italy.*

[6] PIEMONTESE Luigi. *I GIS come strumento di supporto alle decisioni.* P&P Piani e Progetti, Napoli, 2013.

[7] PIEMONTESE Luigi. *Carta dell'uso del suolo della provincia di Latina*. Gangemi, Roma, 2004.

[8] *Piano faunistico venatorio della provincia di Benevento 2007-2011.* Sannio Europa.

[9] http://www.istat.it

[10] http://www.meteoambiente.campania.it

[11] PIZZOLOTTO R., BRANDMAYR P. I*ndex of landscape conservation (ILC).* 1996.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
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Investigate the values and recognize the elements: Discretize, Analyze, Arrange.

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The Caserta's Centre: cataloging as an instrument for knowledge.
Past and present merge in signs and symbols on a territory, it is through these assets, although this is not always tangible, but is full of information just waiting to be read.
Analyze, design, know an area or a portion of it is never easy, unless you have a method, a tool suitable for the purpose.
The objective of this contribution is to provide a method of study, act both to the knowledge of the subject culture understood as that the knowledge understood as an analytical tool and design.
Based on four fundamental steps as georeferencing of historical land registry, overexposure and comparison with the orthophoto contemporary realization 3d volumetric and drafting a summary schedule of the property investigated, this study method through the investigation stands as research target production a Gis queryable database platform and implemented in time.
In this case we wanted to apply this method to study the portion of land in the center of Caserta.
The property investigated are: Reggia di Caserta, hemicycles Vanvitelli, Palazzo Vecchio, Palazzo Paternò, Casino of St. Anthony, Casino of St. Rosalia, Vaccheria of Aldifreda, ex Casamento Marchesa, ex home of Vanvitelli, Edmondo de Amicis school.

Keywords: Cataloging, Analyze, Investigated , Database, Caserta.

1. Representation

In the contemporary reality of the Italian city, the past and the present mix, forming a historical, architectural and social filled with information. Critical to the understanding of the area is the breakdown of its portions, the identification of the architectural elements and the recognition of social identity that they have given to places. To investigate the values and recognize the building blocks that make up the identity of the whole, you have to compose and decompose parts, complex operation which must be conducted in a holistic cognitive structure that allows to deepen specific topics of the individual elements, but also putting them in relation with each other and with the reality that contains.
This information forms the tangible and intangible heritage of the Italian territory, which presents itself as a laboratory from the blue 'open where you may face trials, discussions and reflections.
The city homegrown centuries have undergone many cultural influences, creating a layering complex full of elements, almost never easy to understand. The layers tell the change of culture, reveal the identity of the places and people, character and potential.
Therefore it recognizes the difficulty of approach to the study of the different realities that make up a territory like Italian, which is steeped in historical and cultural heritage.
The present contribution, confirming the above mentioned things, has the objective to provide a method for analytical study and functional, easy to use, applicable in all contexts, to which it can interface all types of users, creating a sort of interaction between user and cultural heritage.

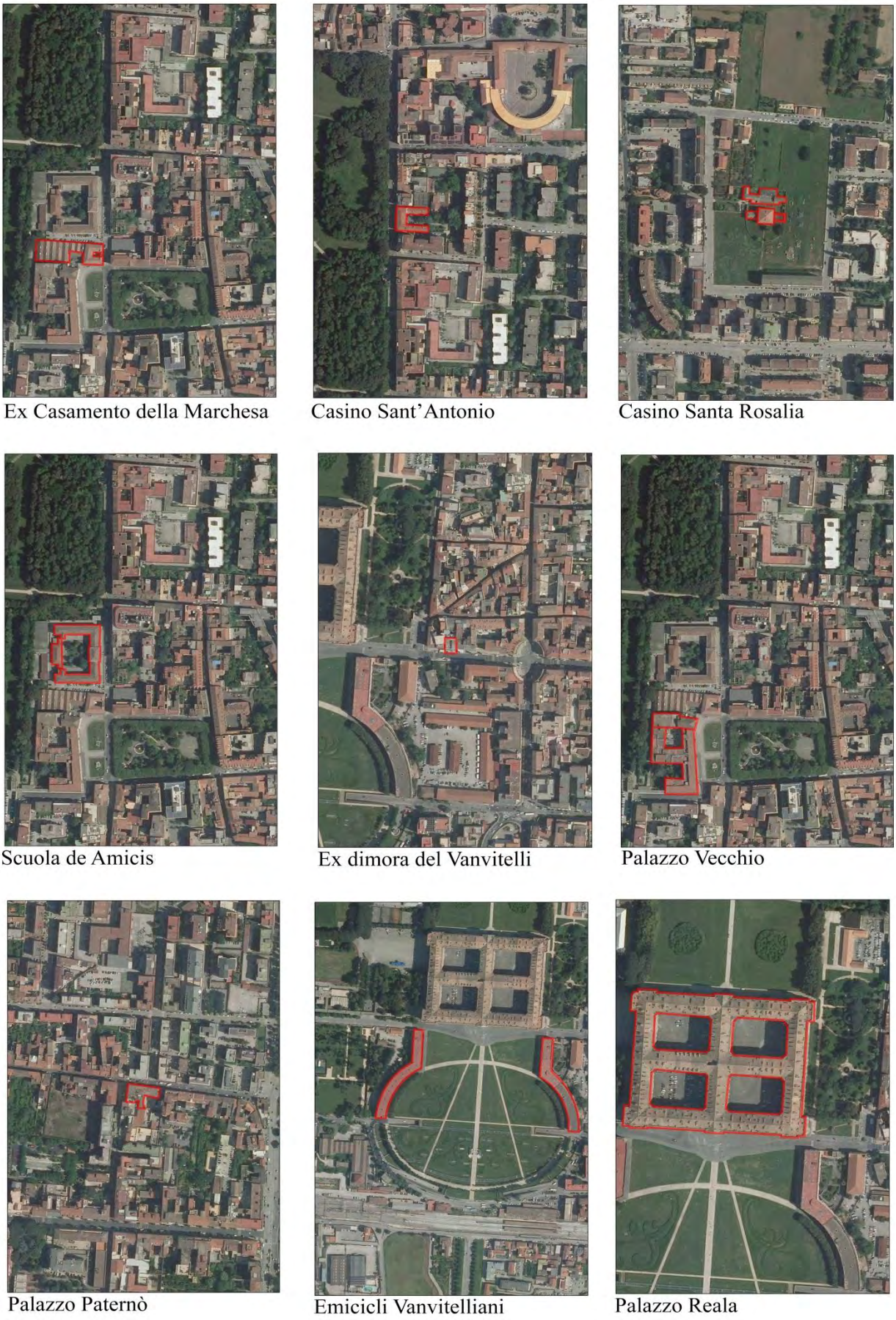


Fig. 1: Cataloguing of building on Ortophoto image (2011)

Based on the integration of different disciplines, resulting in the analysis and understanding, trying summarizes enclose information as location, land registry, historical notes, structured notes, state of the art, constraints, floor plans, photos, all key information of the object under investigation in a database implemented and integrated over time.
Therefore this study is to facilitate the analysis of the architectural-urban, to identify and explore the peculiarities present in different portions of the city, their relationship and the evolution of form and function, starting from their creation, through the use of today to get to the future project. This analytical tool was used to study the reality of the city of Caserta. The territory of Caserta occurs spontaneously, as a complex set of information that form the shape and / or a fulcrum to the architectural culture of the Bourbon kingdom, historical period emblematic for understanding the contemporary design of the city of Caserta. They are analyzed for both the following buildings: Reggia di Caserta, hemicycles Vanvittelliani, Palazzo Vecchio, former Casamento of Marchesa, school Edmondo de Amicis, Casino of S. Antonio, S. Casino Rosalia, Paterno Palace, former home of the Vanvitelli, cowshed of Aldifreda.
These buildings have been selected for their indisputable valence architectural-urban and for that of their designers, both for the relationship they have with the context and both for what they have between them.
In this case the major assets and documentation is connected to protection interventions and knowledge, each other to a protection intervention in order to allow a monitoring of the conditions of the monument in time.
The study reported here was faced with the integration of different study techniques, in fact, the goal of making a database full of technical information, and historical graphic was achieved using both archival sources that have allowed us to know the history of the well investigated, the land registry to identify the historical and contemporary changes undergone over time, and the GIS "Geographic Information System" which allowed the georeferencing of the land registry and the historic union of the information in a searchable database associated with each building designed .

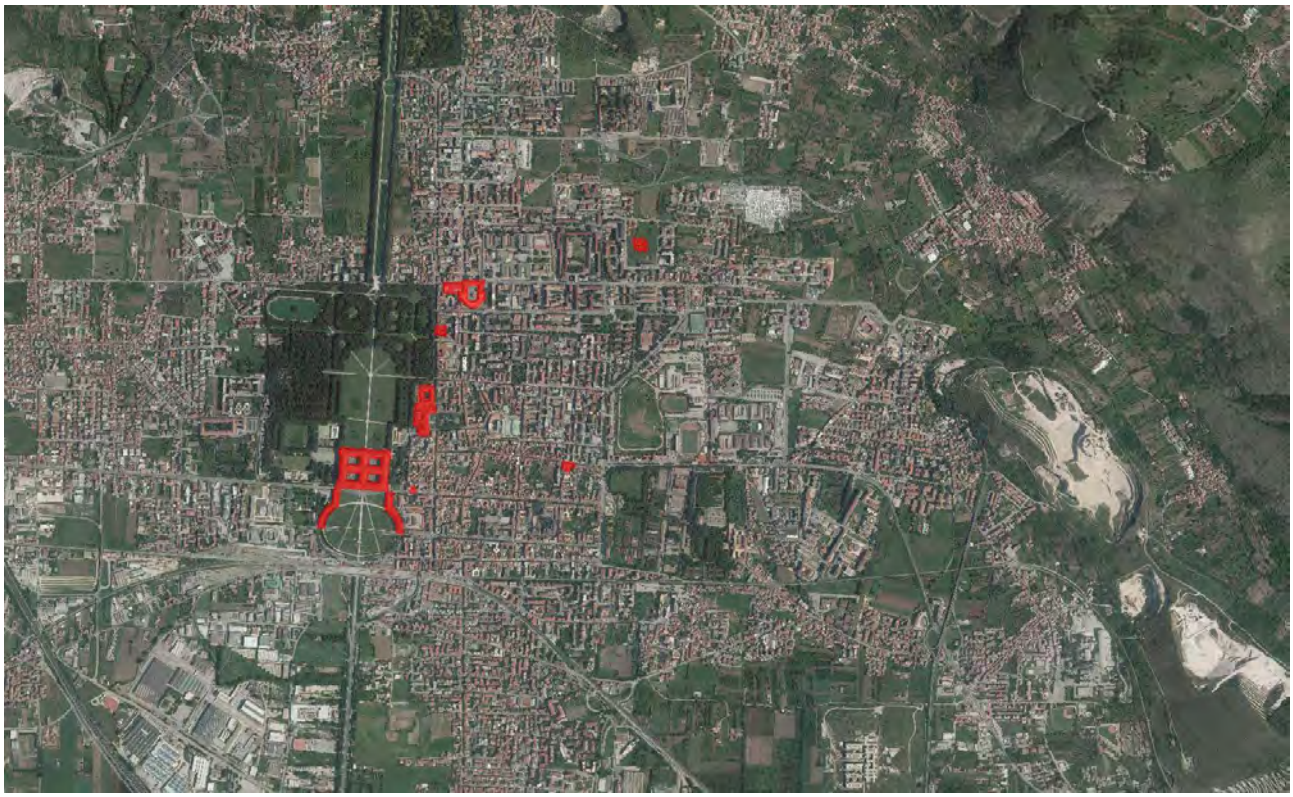


Fig. 2: View of buildings on Ortophoto image (2011)

The study done at the archives office catalog, office constraints, the current archive and the archive historiography allowed to learn all the technical information for well investigated, the qualification of the object planimetric, location constraints falling on the right, from the history of the current situation. The information obtained was decomposed and inserted into a card specially made, so with all entries allow easy reading and understanding of the information. All this information allows discretize the good, to know its parts and provide relevant information for the protection of the same.
Methodological support in order to knowledge comes from the breakdown of the parts that form the whole, understood as innovation of reality, a scheme in leathers you can measure all the elements and the

relationship between tangible and intangible parts, with the order to return the territory as a simple container discretize, but as a dynamic entity in constant evolution. The tool that allows integration and information management platform is the GIS, which allows you to associate the images like that of Catasto history of earth work of 1875 and the orthophotos of the Campania region in 2011, various information organized in structures and "levels". This information can be said as of different type, in this case using the GIS platform to switch from the georeferencing of historical land registry of 1875 based on the orthophoto already georeferred of 2011, the three-dimensional modeling of the buildings under investigation, integration scede of synthetic digitized. A data base, therefore, constantly changing, which allows the user to query the area about a remarkable breadth of information and manage a parallel display photo-realistic object of volumetric models.
The platform "Geographic Information System" also allows its user, you choose in respect of a complete freedom of the point of view of the observation, the data to be processed and integrated into a knowledge structure in the same totalitarian and specific.

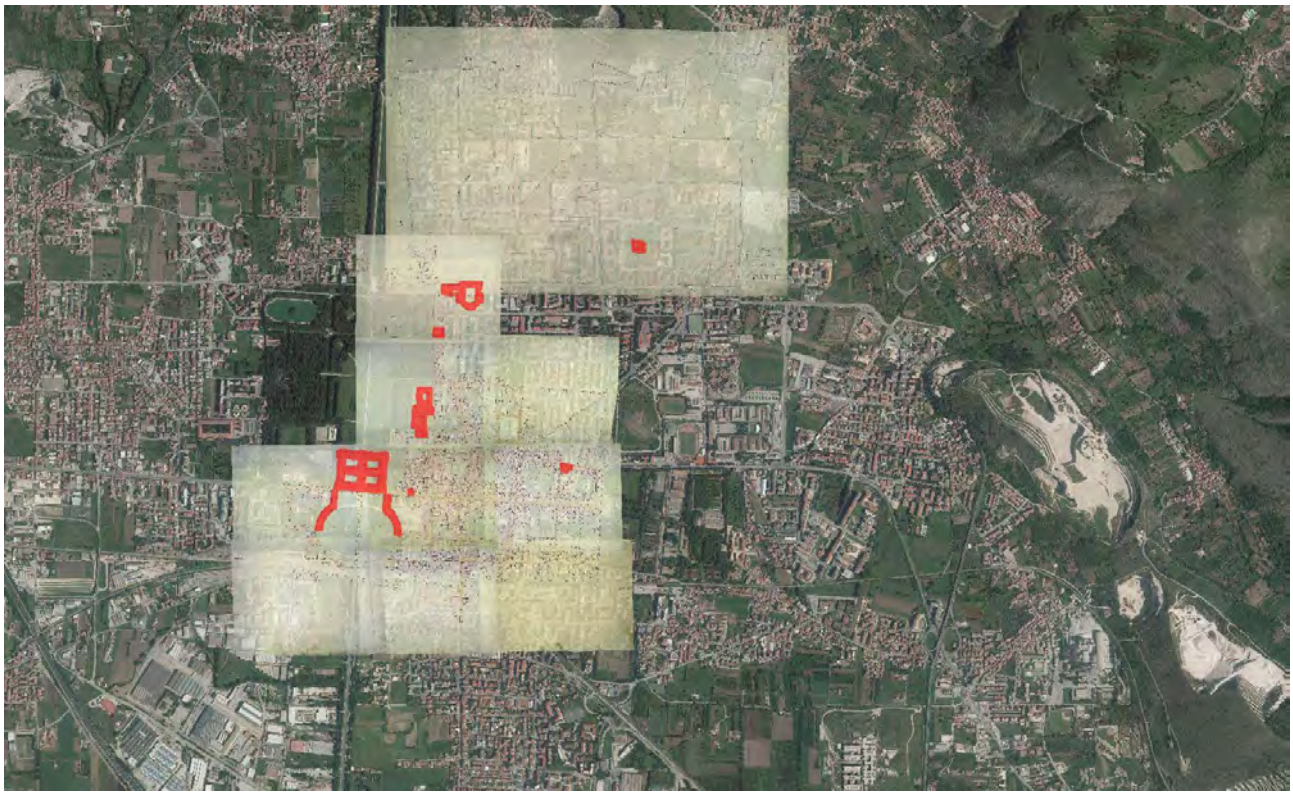


Fig. 2: View of buildings on Catasto Storico of Terra di Lavoro (1875)

The treatment of news regarding a territory or a portion of it, with the integration of historical information and digital processing, makes the analysis virtual action but at the same time tangible, allows to draw information of different levels of knowledge in real time. The analytical approach applied lets you know, monitor, maintain and plan a territory and its elements, in a simple but complete, other techniques would be lascivious and complex to manage, and to project into the future, not allowing to have efficiently and immediate control of the future potential and a thorough knowledge of its past.
Georeferencing of cadastral town of Caserta was made in GIS environment. The first step was to identify the points easily recognizable both on land registry historical image taken as a reference or the orthophotos of the Campania region for 2011.
Following the detection of the points it proceeded with the transformation type of spline and with the inclusion of the image thus obtained within the database.
Thus it has been observed a good overlap between the two images under consideration. The operation of georeferencing helpful as it allowed a comparison of the buildings, the object of study, in the course of time in order to study their evolution.
After georeferencing, was made the volume of the buildings under investigation, this procedure was carried out with ArcScene. The processing volume took place in a very simple way, within the program have been loaded ArcScene the necessary data, such as orthophoto base in the region of Campania in 2011, and the heights of the buildings taken out and placed in a DWG file table attributes. After extruded buildings and created the shp file is loaded and all in GIS.

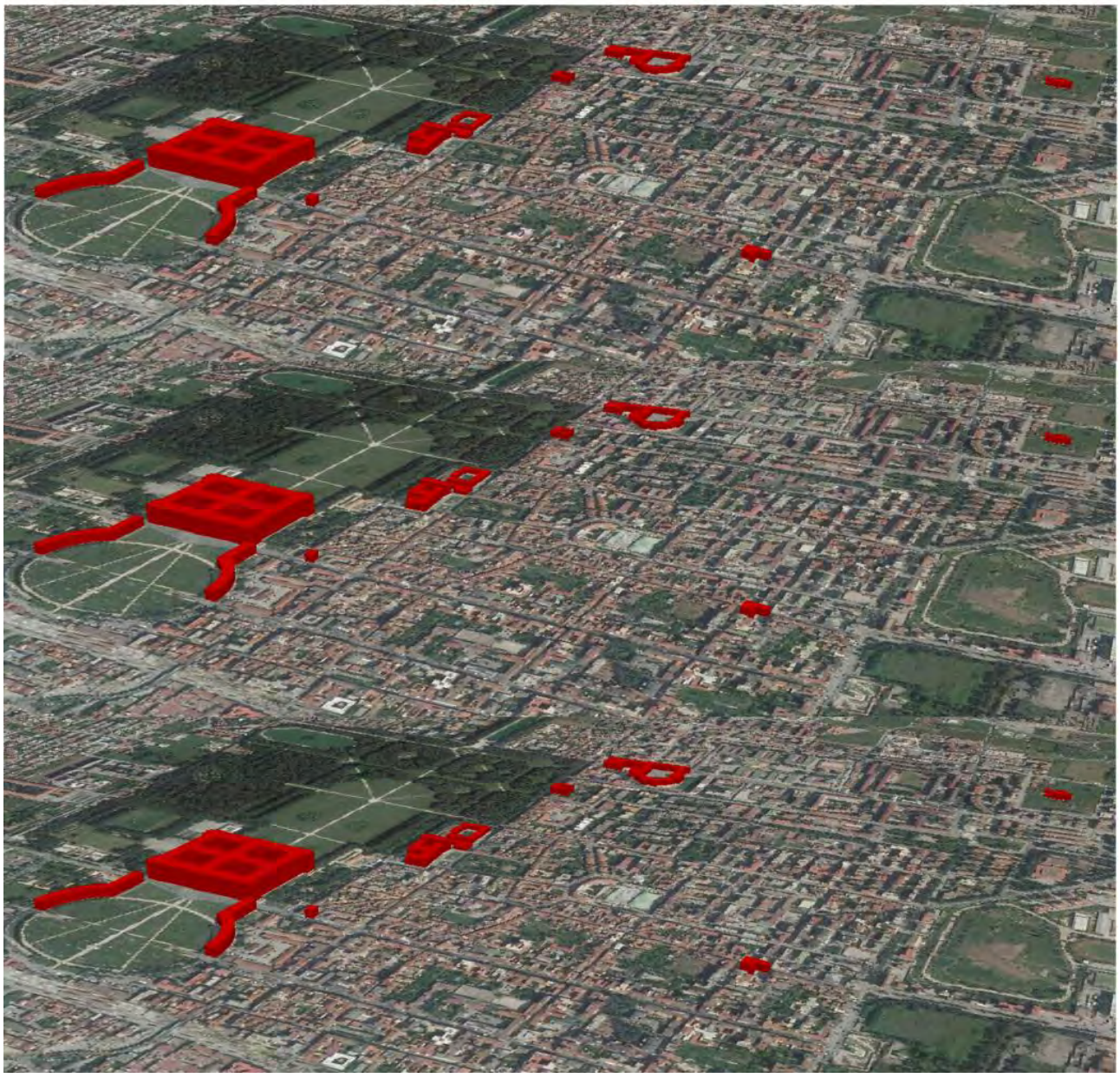


Fig. 3: The volumetric of the buildings analyzed on Ortophoto image (2011)

On aid to the achievement of the mentioned goal over the drafting of a summary sheet that encapsulates information such as: the Discovery, the Object Reference Geo-Topographic, land registry, Historical, Historical for Archival, News Structural Attachments Cartographic and / Attachments or planimetric and / or attachments Photography. All information is entered into a database and GIS geographic are visible through a card attributes associated with the element mapping, in this case is used as the base map 'Ortophoto Campania 2011.
Therefore the result was to achieve data-base queryable and implementable in time, which can be used both as a tool for knowledge of the actor as an analytical tool and design of the technician, so as to ensure control of the territory and of its portions, and totem queried filled with the knowledge and information to the project.

SIMULAZIONE DI SCHEDA	
Individuazione	
Provincia	Ce
Comune	Caserta
Denominazione spazio viabilistico	Corso Pietro Giannone 
Oggetto	
Tipo	Palazzo
Qualificazione	Casino
Denominazione	Casino di Sant'Antonio
Riferimento Geo-Topografico	
Sistema di riferimento	UTM zone 33N
Longitudine significativa	443858.924
Latitudine significativa	457790.924
Altitudine significativa	71.777



Fig. 4: Sheet's prototype

SIMULAZIONE DI SCHEDA	
Pianta	
Riferimento alla parte	Intero bene
Schema	Rettangolare
Forma	Composta
Struttura verticale	
Genere	Muratura
Materiale	Tufo
Copertura	
Genere	Volta
Materiale	Laterizio
Conservazione	
Riferimento alla parte	Intero bene
Stato di conservazione	Buono
Utilizzazione	
Riferimento alla parte	Intero bene
Uso attuale	Servizi commerciali, abitazioni
Uso storico	Abitazione
Condizioni Giuridiche	
Indicazione giuridica	Proprietà privata
Strumento urbanistico vigente	PRG 1987
Vincoli	L.1089/1939 atr.1,4
Catasto	
Foglio e data	1
Particella	
Catasto storico	
Foglio e data	f. 1 anno 1875
Notizie Storiche	
Sulla scia della tendenza revisionista dell'Età dei Lumi, la riforma dell'agricoltura divenne lo strumento per la rivoluzione economica e produttività del Regno, mediante l'integrazione di abitazioni urbane e campagna, realizzata nei nuovi insediamenti reali. Numerosi edifici alla fine del XVIII secolo configurarono il nuovo assetto urbano della Città, tra questi il Casino di S. Antonio. L'edificio fu progettato intorno al 1795-98 da Pietro Bernasconi, omonimo dello zio morto nel 17661. Situato all'interno dell'area denominata la Starza Grande, nell'attuale Corso Pietro Giannone, l'edificio fu costruito per volontà del Principe Ereditario, Francesco di Borbone2. 1 Fonti cartografiche, 1987, p. 43. 2 D. Jacazzi, 2005.	
Impianto Strutturale	
La facciata del Casino di S. Antonio è scandita dalle lesene che compongono il prospetto in riquadri modulari, e dalla coppia di paraste che incorniciano il portale d'ingresso. Il palazzo è articolato in pianta in tre strutture distinte. Il primo fabbricato è identificabile con il Casino del Principe Ereditario, che delimita il cortile rettangolare mediante due corpi laterali, collegato da un viale all'esedra posta all'ingresso di un giardino quadrato, caratterizzato dall'incrocio di viali ortogonali e diagonali. Il secondo edificio si sviluppa intorno ad un cortile rettangolare più grande posizionato accanto al corpo centrale e ospita gli ambienti di servizio. Il terzo corpo, di minore grandezza, sottolinea il cantone angolare dell'intero complesso, al quale è unito un muro con vano d'ingresso che conduce direttamente sul lungo viale d'attraversamento della Starza Grande. Il giardino murato presentava ampi parterre organizzati secondo uno schema geometrico basato sull'incrocio dei viali. Al centro del giardino si trovava una vasca circolare, che sottolineava il ritmo dei viali, costituendo il centro ideale nell'incrocio dei percorsi. L'edificio, con la misurata articolazione degli elementi decorativi, l'equilibrio dei volumi, il trattamento dei parametri esterni delineati da fasce di bugnato nel basamento e da essenziali modanature negli spigoli, è espressione dell'estrema misura dell'insegnamento vanvitelliano2. 2 Ibidem.	

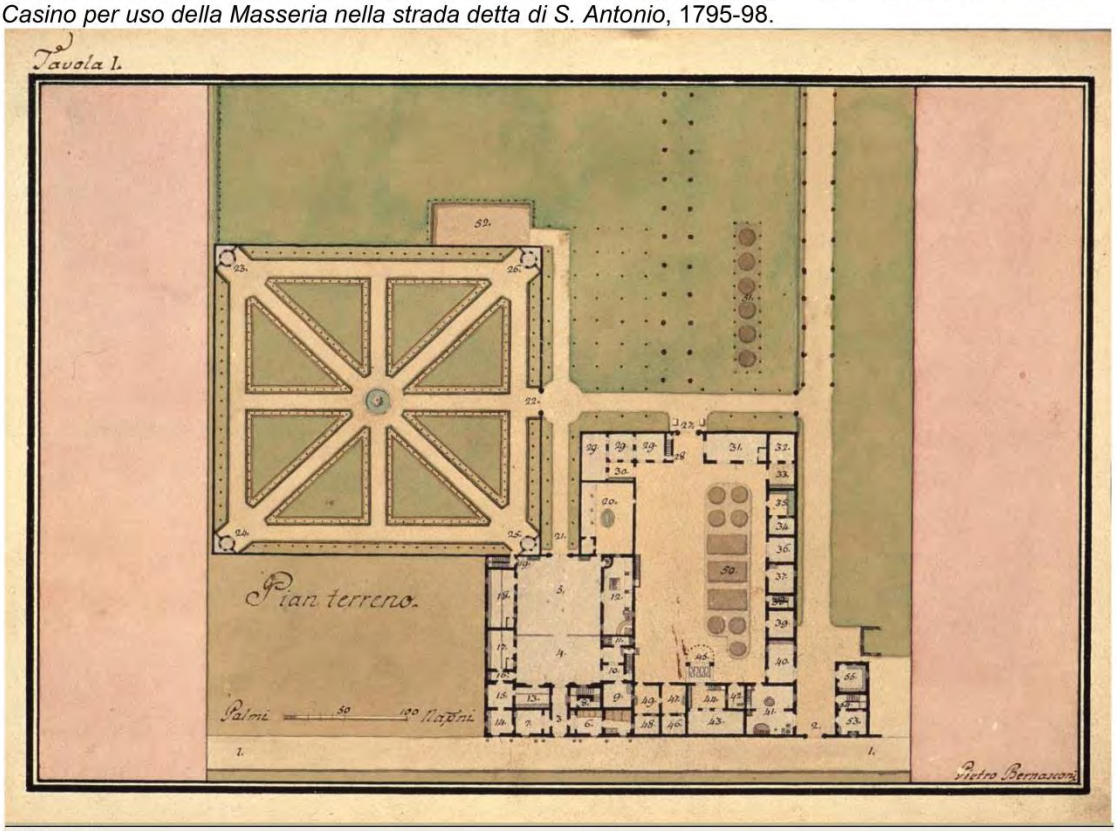
Fig. 5: Sheet's prototype

SIMULAZIONE DI SCHEDA

Allegati

Pianta, Prospetto, Sezione

A.S.N., Casa Reale Amministrativa, Archivio Amministrativo, IV inv, b. 1177, tav. I, *Pian Terreno del Casino per uso della Masseria nella strada detta di S. Antonio*, 1795-98.



Allegati

Pianta, Prospetto, Sezione

A.S.N., Casa Reale Amministrativa, Archivio Amministrativo, IV inv, b. 1177, tav. II, *Secondo piano/ Terzo piano,* 1795-98.

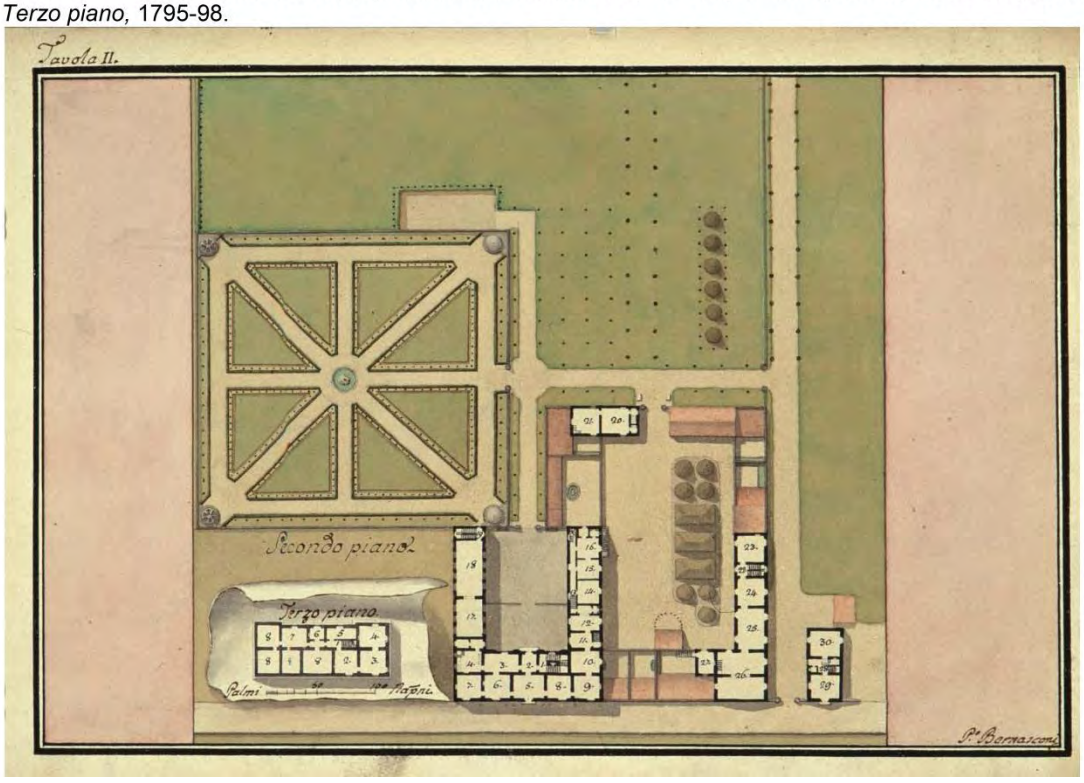


Fig. 6: Sheet's prototype

SIMULAZIONE DI SCHEDA

Allegati

Pianta, Prospetto, Sezione

A.S.N., Casa Reale Amministrativa, Archivio Amministrativo, IV inv, b. 1177, tav. III, *Facciata di detto Casino di maggior proporzione, che guarda occidente sulla strada di S. Antonio,* 1795-98.



Allegati

Pianta, Prospetto, Sezione

A.S.N., Casa Reale Amministrativa, Archivio Amministrativo, IV inv, b. 1177, tav. IV, *Facciata verso il Cortile, che guarda oriente, coi tagli dei due bracci laterali,* 1795-98.

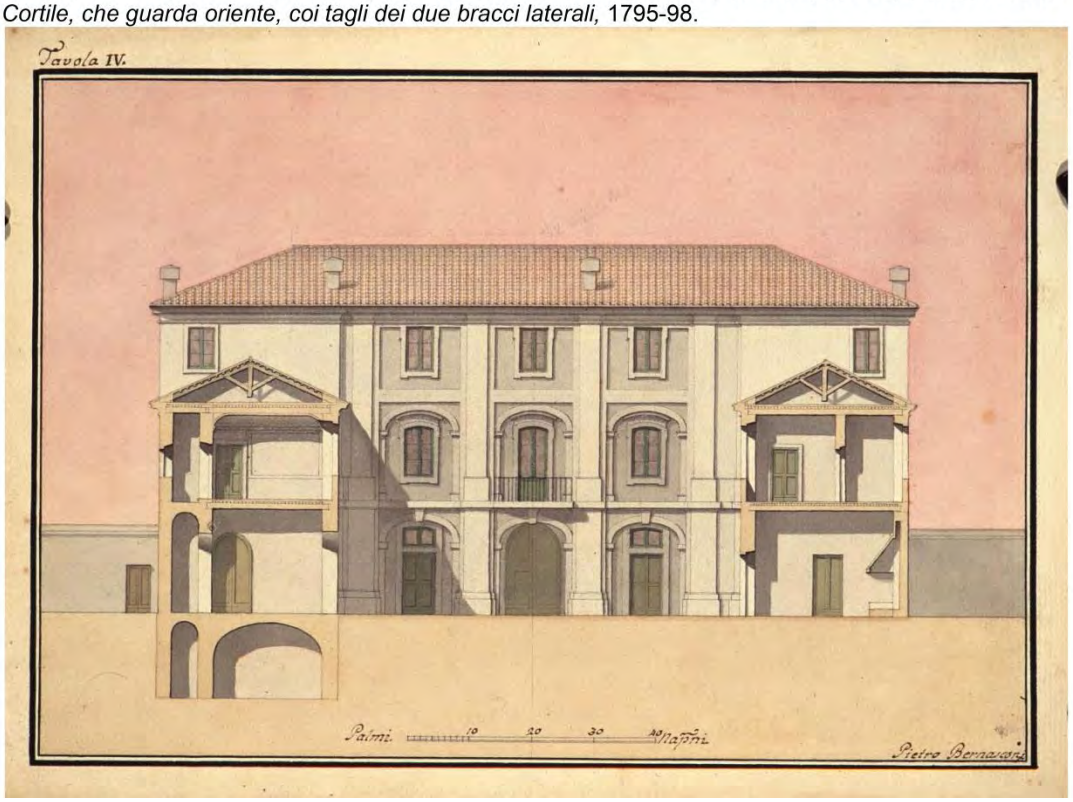


Fig. 7: Sheet's prototype

SIMULAZIONE DI SCHEDA

Allegati

Foto



Fig. 8: Sheet's prototype

SIMULAZIONE DI SCHEDA

Allegati

Riferimenti iconografici

A.S.N., Casa Reale Amministrativa, Archivio Amministrativo, IV inv., b. 1177.

A.S.R.C., *Planimetrie di edifici e siti dello Stato di Caserta e sue pertinenze*, sec. XVII-XIX.

V. Di CARLO, *Pianta della città di Caserta*, 1857.

Città di Caserta, 1935 ca.

Atlante dei catasti storici di Terra di Lavoro, a cura di M. Borrelli, responsabile della ricerca S. Polito.

Riferimenti bibliografici

Fonti cartografiche nell'Archivio di Stato di Napoli, Napoli 1987.

D. JACAZZI, *La sperimentazione agricola in Terra di Lavoro: i Casini del Principe ereditario a Caserta*, in *Casa di Re. La Reggia di Caserta fra storia e tutela*, a cura di R. Cioffi, G. Petrenga, Skira, Milano 2005.

Fig. 9: Sheet's prototype

Bibliographical References

A. Gambardella, *Considerazioni sullo sviluppo urbano di Caserta*, in *Caserta La Storia*, Paparo Edizioni, Foggia-Napoli 2000.

E. Manzo, *Architettura sociale*, estratto anticipato da *L'architettura dei Borbone di Napoli e delle Due Sicilie,* a cura di A. Gambardella, ESI, Napoli, 2003.

G. Abate, *Landscape/Inscape. Dall'ambiente alla realtà spaziale, in Atlante del Cilento,* a cura di Carmine Gambardella, Edizioni Scientifiche Italiane, Napoli 2009.

O. Zerlenga, *L'informazione territoriale nella rappresentazione della linea di costa*, *in Atlante del Cilento,* a cura di Carmine Gambardella, Edizioni Scientifiche Italiane, Napoli 2009.

Quaestio studi e ricerche per il disegno e l'la documentazione dei beni Culturali. Cesare Cundari. 21-22, anno XII – Ottobre 2010. Roma, Edizioni Kappa, 2011.

Scheda *ad vocem* in Archivio Corrente della Soprintendenza BAPSE per le province di Caserta e Benevento.

HERITAGE and TECHNOLOGY
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Virtual architecture: 3D representation in archeology - a new approach to the presentation of ancient architecture –

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Abstract
Reconstruction based on studies, drawings, plans and literature credited along with a reworking scientific suitable to increase the three-dimensional realism. Especially the lighting simulation of light will be assisted by the latest technologies that embrace the techniques of photon mapping and Importons and Irradiance Particles from the latest discoveries in the field of simulation of materials using the calculation algorithm called BRDF (bidirectional reflectance distribution function) with regard to the reflections of the surfaces.
The next step to the description of the project is the implementation of the work in an archaeological context plausible with extremely realistic by adding plants typical of the place and the climate of the place. Of high importance is the presence of objects, tools and all the tools accredited by written evidence that framed the environment giving a sense of lived and permeated the scenes of daily life.
The software suggested for this type of analysis and creation are:

- Generic software of polygon modeling that supports the subdivision mesh (OpenSubdiv) uses advanced software technology from Pixar for modeling and animating subdivision surfaces on massively parallel CPU and GPU architectures.
- Generic software that is specialized in the simulation of the tissues, for example Marvelous Designer
- Generic software for modeling realistic vegetation, for example SpeedTrees, ideal for creating realistic foliage in architectural visualization projects, delivering fast procedural modeling and rendering of a vast range of highly detailed animated trees and plants.

The complete three-dimensional model will be developed on two types of multimedia platforms, the first, light usable mainly on portable devices such as phones and tablets equipped with GPS, accelerometer and gyroscope. The second usable on professional platforms equipped with adequate hardware sector to ensure a more effective experience exploratory virtual archeology. Platforms suggested for this purpose are respectively Unity 3D and Unreal Engine.

Keywords: 3d – 3d archeology – Modeling - rendering

1. New BRDF in light simulation
Reconstruction based on studies, drawings, plans and literature credited along with a reworking scientific suitable to increase the three-dimensional realism. Especially the lighting simulation of light will be assisted by the latest technologies that embrace the techniques of photon mapping and Importons and Irradiance Particles from the latest discoveries in the field of simulation of materials using the calculation algorithm called BRDF (bidirectional reflectance distribution function) with regard to the reflections of the surfaces.The deadline for submission of full papers is March 25th 2015. After that date, papers will not be considerate for oral presentation and publication. lighting simulation processed by one of the houses of hardware and software world's most famous: NVIDIA. As the world leader in visual computing, NVIDIA constantly advances visualization by developing rendering technologies that leverage the most advanced GPU architectures and compute languages.

NVIDIA solutions range from the underlying technologies for building or accelerating custom rendering applications, to complete rendering solutions shipping within leading 3D design and entertainment applications.

2. NVIDIA Iray

NVIDIA Iray is a highly interactive and intuitive physically based rendering technology that generates photorealistic imagery by simulating the physical behavior of light and materials. Unlike traditional production renderers, Iray delivers results reflecting real-world behaviors. Designers don't need expert knowledge of computer graphics techniques to quickly achieve photorealistic results.

Iray progressively refines its image until completion, providing consistent results from interactive editing to final frame. It's a highly predictive approach that marries with the scalable, world-class performance across NVIDIA GPUs to give constant feedback and rapid results. This slashes the time needed to perfect scenes and deliver images rivaling photographs.

Iray is a high-performance, global illumination rendering technology that generates imagery by simulating the physical behavior of light interaction with surfaces and volumes. Images are progressively refined to provide full global illumination including caustics, sun studies, and luminance distributions.

3. Global Illumination

Global Illumination works from light sources that emit photons into the scene, bouncing them around to deposit indirect illumination on the surfaces they strike. This illumination is typically cleaned up using Final Gather and then combined with direct illumination and surface finishes to produce a final render. I find that Global Illumination is essential for most interior scenes and is not generally as useful for exterior scenes. Exterior scenes that use Final Gather with a daylight system often produce great results without adding Global Illumination.

That said, Global Illumination can be effective for specific outdoor scenes and can greatly boost illumination, as I cover later in this chapter. Final Gather was first used as a cleanup mode for Global Illumination, eliminating the need for exceptionally high settings for photons and removing noise from the Global Illumination solution.

Although Final Gather has improved greatly over the years, the combination of Global Illumination with Final Gather often produces the best results with the least amount of render time.

The photons for Global Illumination and Caustics are two-dimensional points in 3D space and are bundles of red, green, and blue (RGB) light energy emitted from a light source. Each photon carries only a portion of the energy from a light source; the total RGB color energy of each light is divided by the number of photons emitted by that light. Brighter lights in a scene emit more photons than dimmer lights to help even out the Global Illumination solution. This way each photon has a more similar weight and a more even distribution. Photons are reflected off diffuse surfaces in your scene, transporting color energy from surface to surface. The photon method of producing indirect illumination is closer to what occurs in nature, and photons can trace through reflections, can bend through refractions, and are absorbed and reflected by surfaces in a scene. A diffuse surface, however, is required for a photon to have an effect on that surface, because mirrored and transparent surfaces will reflect or refract a photon and not store the photon's energy.

There are two diagnostics modes for Global Illumination: Photon Density and Irradiance. They each produce color images with blue, cyan, green, yellow, and red, and each color represents a different quantity of photons or value for irradiance. On the blue end of the spectrum, the value is always zero photons or irradiance.

Photon Density is a representation of your scene with colors ranging from dark blue at the lowest photon density to cyan, green, yellow, and red, with each progressively "hotter" color representing a relatively higher density. The Photon Density diagnostics mode is useful for identifying the overall coverage of photons in your scene and helps determine whether adjustments need to be made to photon quantity to ensure all surfaces have an even coverage in photons. The left side of Figure shows Photon Density, and in this case Blue is 0 photons, Cyan is 591 photons, Green is 1183 photons, Yellow is 1775 photons,
and Red represents 2367 photons, which is the maximum density in this rendering of half the Sponza image.

Irradiance Irradiance is defined as the "area density of flux" and is measured in watts per meter squared (W/m^2). This diagnostics mode shows the relative brightness of the stored photons in the same color scheme as Photon Density. On the right side of Figure, Blue is 0 irradiance, Cyan is 4949 W/m^2, Green is 9918 W/m^2, Yellow is 14878 W/m^2, and Red is 19837 W/m^2, as read from the Render Message dialog box. It only displays the irradiance of the photons and not direct illumination or Final Gather.

4. Importons and Irradiance Particles

Importons and Irradiance Particles are two relatively new indirect illumination technologies in mental ray. The term Importons is short for “importance photons” and is a technology that minimizes Global Illumination data based on how important a rendered area is to the illumination of the final image. Importons allow you to emit more photons into your scene; they keep just the photons you need for your image to reduce the memory requirements that high photon numbers might require.

Importons also work with the next technology, Irradiance Particles. Unlike the other indirect illumination technologies, irradiance particles calculate direct and indirect illumination for every particle. Importons determine the placement of irradiance particles on surfaces in your scene, ensuring that irradiance particles are placed along the most important regions of your image. Irradiance particles can replace Final Gather and Global Illumination for use in scenes, and they produce faster and higher-quality renders in many cases. Irradiance particles have a set of parameters similar to Final Gather, and they can produce image-based lighting effects that include shadows.

Both importons and irradiance particles are evolving technologies and continue to improve with each release of 3ds Max/Design and mental ray.

Importons are “importance-driven” photons used to clean up and optimize Global Illumination in your scene and to define where mental ray stores irradiance particles. Like Global Illumination photons, importons are distributed throughout your scene by bouncing from surface to surface; however, unlike Global Illumination and Caustic photons, importons do not distribute light energy and are emitted from cameras instead of light sources. Rather than transferring light energy, importons measure how visible a surface is in the final image and how the illumination at a point contributes to the final image. Objects shown in a reflection, for instance, would receive less importance — and less attention at render time — based on its visibility within the reflection. Less important areas have their photons merged in varying amounts depending on their contribution to the image. Merging photons transfers the illumination from the merged photons into the remaining photon, and energy is never lost. This intelligent merging helps improve the quality and smoothness of the Global Illumination solution and greatly reduces the memory requirements because fewer photons are stored. The PMAP file size will be a small percentage of the size it would be without importons, and although the new PMAP size depends a lot on the content of your visible scene, file reductions of 90 percent or more are common.

Rendering with importons adds another preprocessing phase to the rendering of your image which happens before Global Illumination photons are emitted from light sources or before irradiance particles are generated. There are no visual diagnostics modes for importons because they are discarded right after they are used by Global Illumination or irradiance particles; however, you can see the end result they have on Global Illumination with the Global Illumination visual diagnostics modes. As with Global Illumination calculation, with importons creation, there is no visual feedback to the user beyond what is visible in the Render Message dialog box. 3ds Max/ Design displays the “Current Task: xx.x% Rendering” status in the Rendering status dialog box as importons are emitted and importance calculated.

5. Simulating Light with Maxwell render: great result

Other software capable of achieving highly realistic representations is Maxwell by Next Limit Team.

Maxwell Render is a standalone render engine for making perfect images, films and animations from 3D models. It is the complete solution for anyone who demands immaculate results on a deadline.

Offers maximum quality, speed, and compatibility for architects, designers and visual effects artists.

Maxwell Render is impeccably accurate, because its engine is based on the physics of real light - so this means predictable and beautiful results with a lot less tweaking.

The Maxwell Render camera is designed to work like a real camera so it is important to understand some photographic concepts. One is exposure, the other depth of field. Understanding these two concepts is a crucial first step towards your virtual photography with Maxwell and we recommend reading carefully through this page if you are not already familiar with them. If you're already an amateur or pro photographer then you will feel right at home with the Maxwell camera.

In Maxwell V3 we introduced the concept of material **Types**, which use a reduced set of intuitive parameters that greatly simplify and speed up the material creation process. These are the current simplified Types available:

- Metal (all kinds of metals)
- Opaque (any kind of opaque diffuse or shiny materials such as solid plastics, shiny wooden floors, concrete etc.)
- Transparent (all transparent glass and plastic materials which are not translucent - ie, they do not have sub surface scattering)
- Translucent (all transparent and semi transparent materials which are translucent - plastics, marble, milk)
- Car paint (for creating multilayered paints such as metallic car paint)

- Cloth (useful for velvet, satin, and any other types of cloth)
- AGS (special transparent material useful for speeding up interior renders).
- Emitter (for creating light emitting materials and light projectors)
- Custom (this simply switches the material editor to the advanced version)

At the heart of the Maxwell material system is the BSDF (which stands for Bidirectional Scattering Distribution Function, - a set of algorithms that describe how light interacts with various material types). The BSDF contains all the parameters needed to create many different types of materials, ranging from clear glass to sandblasted glass, plastics, metals and translucent materials such as skin, porcelain, and wax. The most simple materials are created with one single BSDF, while others are a mix of several BSDFs, or even several Layers containing several BSDFs

6. Plants: botanic in virtual world

The next step to the description of the project is the implementation of the work in an archaeological context plausible with extremely realistic by adding plants typical of the place and the climate of the place. A generic software for modeling realistic vegetation, for example SpeedTrees or , is ideal for creating realistic foliage in architectural visualization projects, delivering fast procedural modeling and rendering of a vast range of highly detailed animated trees and plants.
SpeedTree is a powerful toolkit used to create 3D animated plants and trees for games, animations, visual effects and more.
Easily export cached SpeedTree models into the open Alembic framework (.abc) for exchanging animated scene data with popular platforms like Maya, Houdini and 3dsmax.

Of high importance is the presence of objects, tools and all the tools accredited by written evidence that framed the environment giving a sense of lived and permeated the scenes of daily life.
The software suggested for this type of analysis and creation are:

a) Generic software of polygon modeling that supports the subdivision mesh (OpenSubdiv) uses advanced software technology from Pixar for modeling and animating subdivision surfaces on massively parallel CPU and GPU architectures.
b) Generic software that is specialized in the simulation of the tissues, for example Marvelous Designer

The software of choice for the kind of modeling in high detail is 3dsmax for this proposal.

7. Immersive 3d space

The complete three-dimensional model will be developed on two types of multimedia platforms, the first, light usable mainly on portable devices such as phones and tablets equipped with GPS, accelerometer and gyroscope. The second usable on professional platforms equipped with adequate hardware sector to ensure a more effective experience exploratory virtual archeology. Platforms suggested for this purpose are respectively Unity 3D and Unreal Engine.

Bibliographical References

L. Murdock, Kelly. *Autodesk 3ds Max 2014 Bible*, 2013. p ISBN 978-1-118-75507-5

Dutre Philippe. *Advanced Global Illumination, Second Edition.* 2ª ed. City: Publisher, 2010, ISBN 978-1568813073

Pharr Matth. *Physically Based Rendering, Second Edition: From Theory To Implementation*, 2010. p ISBN 978-0123750792

Henrik Wann Jensen . *Realistic Image Synthesis Using Photon Mapping*, 2013. p ISBN 978-1568814629

Mary Beard . *The Fires of Vesuvius: Pompeii Lost and Found* 2010. p ISBN 978-0674045866

HERITAGE and TECHNOLOGY
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XIII International Forum Le Vie dei Mercanti
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Design And Communication For The Volturno Rivers, Between Capua And The Mediterranean Sea

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Abstract

This paper is focusing on a new model of design and communication in order to preserve and promote the river Volturno's identity, between the city of Capua and the costline. The territory under the study encloses five municipalities: : Capua, Santa Maria La Fossa, Grazzanise, Cancello e Arnone and Castel Volturno. The Volturno, which is the longest and most important river in the South of Italy, crosses these cities and it was the gate, in the past, for who arrived by sea and wanted to reach the inland, until the port of Casilinum, which is the actual city of Capua. The author developed a photographic survey during March 2015. Particularly he focused on the relationship among the river and the urban centres of Capua and Castel Volturno with pictures related to historical landscapes, local traditions, agricultural productions, archeological, natural and cultural assets. The photographic survey is part of a larger study connected to the critical knowledge of the territory in all its material and intangible components. Also, the elements of degradation were considered in the analysis, such as landfills and illegal constructions, which is contributed, along the years, to compromise one of the most appreciated territory of the Mediterranean basin by travelers of XVIII Century. Despite this, the landscapes of the Volturno river preserves their authenticity and can become an economic and cultural resource of the area, for example, through cultural tourism.

Keywords: representation, design, landscape, heritage, communication

Methodology

The knowledge's method, intended as a preparatory phase for every project's activity of this research is linked to the principles of the multidimensional and multidisciplinary analysis [1] "it allows to survey from the landscape's scale to the architectural one, to the single object – the human and natural factors as complex and continue realities through a careful process of discretization and measurement in order to study in the essence each connotative aspect".
Monuments, landscapes, architectural assets, through this method's criteria are analyses, interpreted, discretized by the integral of knowledge – the differ disciplines of study – which is not limited to measure the formal and geometric aspects, ma it extends to the intangible ones, able to give indications on the history, environmental, sociological and cultural context, in which the particular object was born and configured.
The phases of analysis and multidimensional survey of the heritage, in this sense, are directly connected to the project's action that, in the case of the territory, is expressed by the concept of Knowledge Factory. According to Carmine Gambardella "More knowledge one includes in the process of transformation of raw material of the territorial resources, more it is possible to have two outcomes: competitive products and work of Art. This is the challenge because the human capital can express the talent generated by a formative and continuum, adequate and innovative process connected to heritage, identity and genius loci". [2]



1. Plan of the area of study with all the five Municipalities.



City of Capua: 1. Church of Annunziata; 2. Church of Sant'Eligio; 3. Basilica

It is in the discovery of the identity's matrix of the territory e in enhancement of the human capital of the area, that one researches the tracks able to stimulate the action of preservation and valorization of the heritage. These are intended as parts of a collective project and process, coordinated and concerted, among the in charge institution's – at different territorial scale – such as public bodies, Universities, Research centers, and local communities, represented by the main stakeholders of the associations and entrepreneurs.

Thus, the history, intended as knowledge, is memory. It is at the base of any project that respects the traditions and the contemporary needs of local communities.
Historians, philosophers, sociologists showed how during centuries, the concept of *historia magistra* was abandoned, which feeds the present, giving models and examples.
This is replaces by the concept of *historia memoria* that today explodes and affirms.
The evolution of the doctrines and content of World Heritage reflect these changes.
The affirmation of a common humanity, that accepts and encourages cultural diversity and biophysics in the world, also supports the growing diversity of sites and landscapes worthy of being considered and protected.
The *historia magistra* has no more reason to exist because every local context port has in itself new items that cannot be only related to the basis of past experience and knowledge already acquired.
On this basis the author propose a project for a communications plan that seeks in the roots of local history a message of innovative promotion for the territory.

Landscapes of history

The Volturno River crosses two cities rich of history; Capua in the hinterland, and Castel Volturno on the coast, which are both object of this study.
Capua is a city located in a bend of the river Volturno, founded in the middle of the eleventh century by Count Lombard Landone I.
It is surrounded by defensive walls, on the Volturno River in the ancient port of Casilinum, and it takes the name by the ancient city of Capua, which was located in the actual area of the city of Santa Maria Capua Vetere.



Capua: 1. Church of Sant'Eligio; 2. Chiostro dell'Annunziata

Among the more important architectural assets the author highlights the "Reale sala d'armi", the "Chiesa di S. Angelo Audoaldis" and the "Castello delle pietre".
The three monuments are located in a symbolic point in Capua, the "Piazza dei Giudici, where is located the "Palazzo di Città" and the Church of Saint Eligio.
Going through "Giovanni Andreozzi" street one reachs the "Piazza Medals of Gold", where once stood the "Church of the Souls of Purgatory", which was destroyed after the bombings of 1943.
It was completely demolished. To date, the square facing the rear side of the "Church SS.Annunziata" [3]
Castel Volturno owes its name to the "Castle" and the Volturno River. The old town is situated on the left bank of the river, on the last bend in this form before flowing into the Tyrrhenian Sea. Located at the end of the plain of the Campania region on the last offshoot of Mazzoni, the area was first inhabited by Opici, then by the Etruscans, who built the city of the Volturno, and then by Osci.
The city carried out the function of emporium, or collection and market of goods produced by the entire lower basin of the Volturno, and was forced crossroads for those who wanted to advance from the sea to the inland, at the port Casilinum on the Volturno and hence, from here to the ancient city Capua.
Among the architectural and landscape assets in the historic center, there are the Borgo San Castrese and the Oasis Variconi, protected by the Ramsar International Convention [4].

Rural landscapes

The historical identity of the province of Caserta is marked by activities related to the land and in particular to rural activities.
The landscape of Terra di Lavoro has been, over the centuries, careful and conscious expression of peasant culture that, despite the industrialization and the illegal construction of the last sixty years, allowed the territory to be into a system of excellence's production.
This rural landscape, suitably enhanced, would encourage the provincial economy linked not only to agricultural production but also the food and wine tourism and cultural oriented industry looking for authentic experiences outside of mass tourism.
The deteriorating situation is due not only to the illegal disposal of waste but is also related to the exponential growth of industry related to buffalos.
Despite a state of deterioration due to environmental pollution and the uncontrolled building expansion since the II world war to date, there are numerous testimonies of excellence of the agricultural heritage of the Terra di Lavoro, proserved through Protected Designation of Origin (PDO) products, and Protected Geographical Indication (PGI) products.
Among these, just to remember some of theme, there are the mozzarella cheese of "Campania", the oil of Terre Aurunche, khaki, the "a nurca" apple, and the famous Falerno del Massico wine [5].

Flooded landscapes and contemporary urban landscapes

The floods of the Volturno, as they occur, cause many damages, also due to the fact that it was built in a very abusive way in hydrogeological areas of risks and flood.
In particular, Castel Volturno in 1970 is placed on the top of the classification for illegal constructions: one abusive building out of five in Italy was consumed there [6].
Only in the area of "Lago Piatto" on the right bank at the mouth of the Volturno, there are 4000 illegal houses.If one adds the lack of maintenance of the sewerage system it is easily to undestand the problem is far from to be solved.



Capua: 1. Basilica; 2. Chiostro dell'Annunziata; 3. Basilica

Therefore, the author analyzes the interventions of contemporary construction in the five municipalities considered. Capua (area 30 km², 18 853 inhabitants) is a city full of historic, artistic and architectural assets, characterized by gates and interior courtyards or cloisters.
This type of building was, in the last 60 years, re-used in the areas of expansion of the city, which are composed primarily of multi-family buildings and buildings in line, as in the "Madonna delle Grazie" district, in the "Risorgimento" district and in the "Fuori Porta Roma" area.
Between Capua and Castel Volturno, on the river axis under study, there are three other urban realities closely connected with the life of the river: Santa Maria La Fossa (29,5 square km surface, 2.722

inhabitants), Grazzanise (47 square km surface, 7.085 inhabitants) and Cancello ed Arnone (49 square km surface, 5.290 inhabitants).
These three Municipalities are characterized, in the majorities of cases, by simple typology buildings, such as line buildings of one or two floors, with a main entrance door and a court.
These typologies, in fact, are functional and fit with the exigencies of local populations linked mainly to the work activities of agriculture and livestock.
Castel Volturno (72 square km, 24.183 inhabitants) presents in the historical center, building typologies which comprehend small buildings of two or three floors (mono or plural-familiar) and examples of court houses, with two or more families, and a common central court.
In the last 40 years, people have been built, on the margins of the river, many homes, most of them are illegals.
This uncontrolled urban development differs substantially simultaneous constructions of Castel Volturno from that of Capua, which does not have, except in rare cases, an illegal urban development.

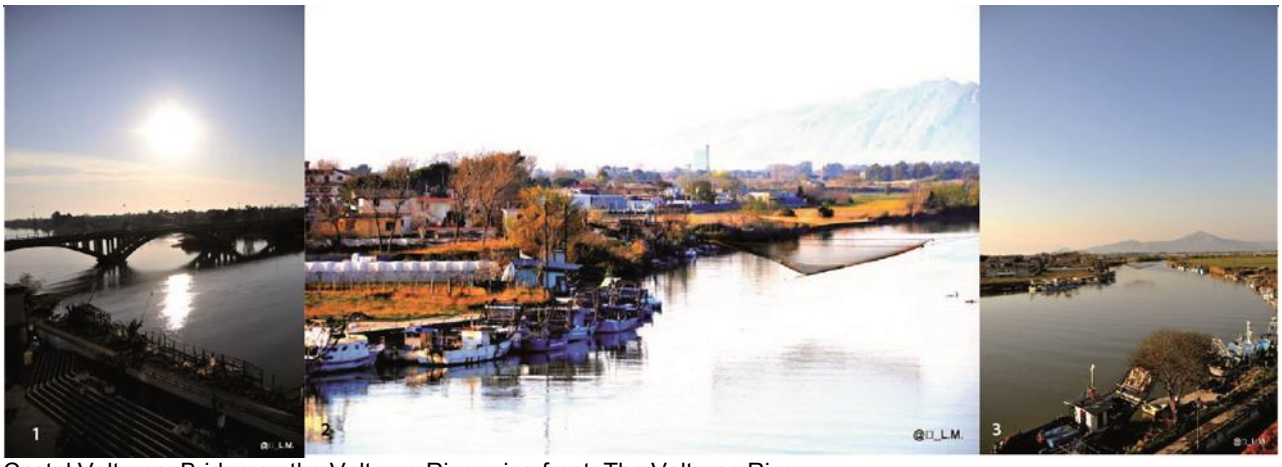


Castel Volturno: Borgo San Castrese

Castel Volturno is considered today in Italy one of the most evident urban case where the predominant degradation faced by some of these residential areas, lack of public services and commercial equipment.

Landscape of beauty

The town of Castel Volturno is characterized by fourteen kilometers of flourish Mediterranean vegetation, twenty-seven of sandy continues coastline, and it has a surface of seventy square kilometers.
The Volturno River, the main waterway of southern Italy for both length and water flux, borders the City, which was the crossroads for those obliged, coming from the sea, meant to advance for the Port Casilinum (current Capua) and then to Capua (now Santa Maria Capua Vetere).
Among the natural beauty, of great environmental value, we remember the Oasis Variconi and the area of the Nature Reserve “Foce Volturno”:
the first is one of the most important wetlands of Campania for the functions they perform in the life cycles of many species of migratory birds and the presence of some species of rare plants;


Castel Volturno: Bridge on the Volturno River; riverfront; The Volturno River

The second covers the twenty-seven kilometers of beaches of the coast and includes some SCIs (Sites of Community Importance) and SPA (Special Protection Areas); then also it includes the Patria Lake.
The Ecopark of the Mediterranean coast, offers unique emotions with its landscapes and nature trails thanks to its lakes of brackish water (about 60 hectares left of Foce Volturno) are a source of pride for the area.
As well as for the entire stretch of the Volturno that with its magnificent creeks arrives to Capua, whose ancient architectures border the banks of the river drawing it.


Castel Volturno: The old Castle; the historical centre; the Church of Annunziata

II provincial and regional network of landscapes

The project suggests to network, through a single management system, UNESCO sites in the region, both Man and Biospheres of the National Parks of Mount Vesuvius and Cilento, and the "minor" heritage, in line with Article 12 of the World Heritage Convention, on the basis of the concept of Outstanding Universal Value, condition inseparable from the concept of World Heritage.
The design of the network between the sites of excellence in Campania – at the basis of a Memorandum of Understanding signed between the BENECON and the World Heritage Centre - provide suggestion for coordination of all the activities of integrated management and sustainable development for the regional heritage of the World Heritage, and extend also to the "minor" and immaterial heritage.
In compliance with the administrative limits of the five provinces of Campania, in addition, for each UNESCO site, is proposed a governance structure that would allow the creation of a "local tourism" district, which would allow to the provincial assets to be included in the regional "cultural district".
The similar concepts of "cultural district" and "local tourism" district (valid into legislative Italian code) are used as part of the article, in reference to the territorial contexts, respectively regional and provincial.
In particular we analyze the "tourist system" of the Province of Caserta, focused on the UNESCO site of the Royal Palace, its gardens, the Belvedere of San Leucio and the Carolino Aqueduct and the stunning landscape, architectural and cultural heritage, such as the more than 30 provincial museums [7].



Capua, Church of Annunziata

The World Heritage site, in the "local tourism" district, becomes the main node and hub of permutation of the cultural network that we aim for the Province and which also includes the assets of the "minor" and intangible heritage [8].

Bibliographical References

[1] GAMBARDELLA Carmine. *Ecogeometria in Venafro, identità e trasparenze*. Napoli, Edizioni Scientifiche Italiane, 2001; GAMBARDELLA Carmine. *Altante del Cilento*. Napoli, Edizioni scientifiche Italiane, 2009.

[2] GAMBARDELLA Carmine, ZERLENGA Ornella. *Rilievo come piattaforma tecnologica della conoscenza: il paradigma di Pompei*. In proceeding of the X International Conference on Graphic Expression applied to Building, APAGEA 2010.

[3] ROBOTTI Ciro. *Capua. Città d'arte*. Edizioni del grifo, 1996

[4] CIAMBRONE Alessandro. *Economic Development strategies. The USA experience for Castel Volturno*. Napoli, La Scuola di Pitagora, 2012.

[5] CAPRIGLIONE Jolanda. *Le eccellenti eccellenze della provincia di Caserta*. Camera di Commercio di Caserta, 2014.

[6] DE JACO Aldo. *Inchiesta su un comune meridionale. Castelvolturno*. Editori Riuniti, 1972.

[7] CAPRIGLIONE Jolanda. I Musei della provincia di Caserta. Camera di Commercio di Caserta, 2005.

[8] CIAMBRONE Alessandro. *Cultural Tourism and Sustainable Development. A Management Network for the Campania World Heritage properties*. Napoli, La Scuola di Pitagora, 2012.

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Knowledge, survey, technology for carbon neutral restoration: from an old hospital to a luxury hotel

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Abstract
Rethinking the existing buildings is a non-deferrable imperative for the very life of the contemporary city. The implementation of well-established techniques in the architectural project, such as intelligent and "informing" BIM modelling, the Life cycle analysis, the energy and waste management for the purpose of savings and of efficiency, can be applied in cases of reuse and transformation of the built heritage.
The paper illustrates, through the presentation of a project carried out on a former hospital pavilion, the path followed. From the survey and the historical-critical analysis, through the study of the vocation of the building, up to the planning, to end with the yard. The interventions aimed at reducing energy consumption begin with the evaluation of materials, that are preserved as much as possible, to focus on the thermal and acoustic insulation of windows, roof, walls and floors, to the search for an appropriate energy source, in this case the geothermal. The result is that a historical organism, bound by the Superintendent, comes back to life with function of hospitality, in a carbon neutral intended production cycle.

Keywords: Survey for knowledge, Functional vocation, Life cycle analysis, Carbon neutral restoration.

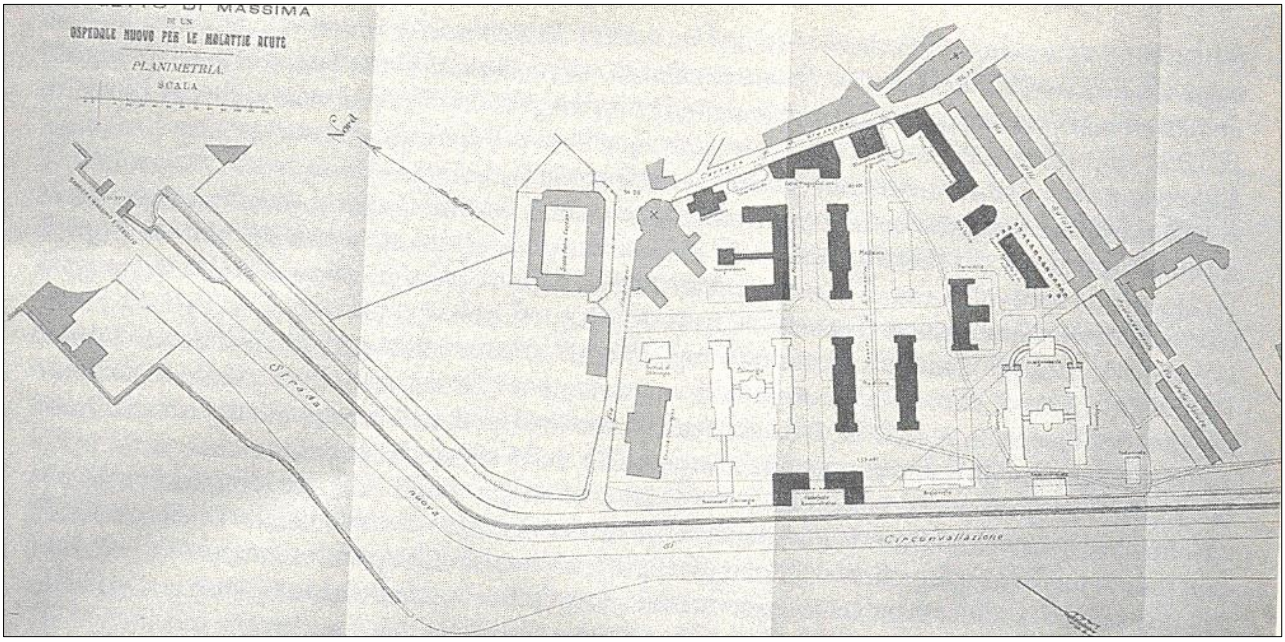


Fig. 1: G. Albertelli, Preliminary project of the new hospital for the city of Parma, 1908 (A.A.O.Pr.).



Figg. 2-3: Planimetry and aerial view of the building and park.

1. The importance of planning for the management of the existing architectural heritage

History teaches that the city has always evolved within itself, adapting to changes in lifestyles and technologies. Today, after a period of uncontrolled expansion, it is imperative for many reasons to return to this type of settlement model: to stem the use of land, to take care of abandoned existing heritage, to optimize the use of resources and energy. Finally, especially in Italy, to revitalize the historic centres.

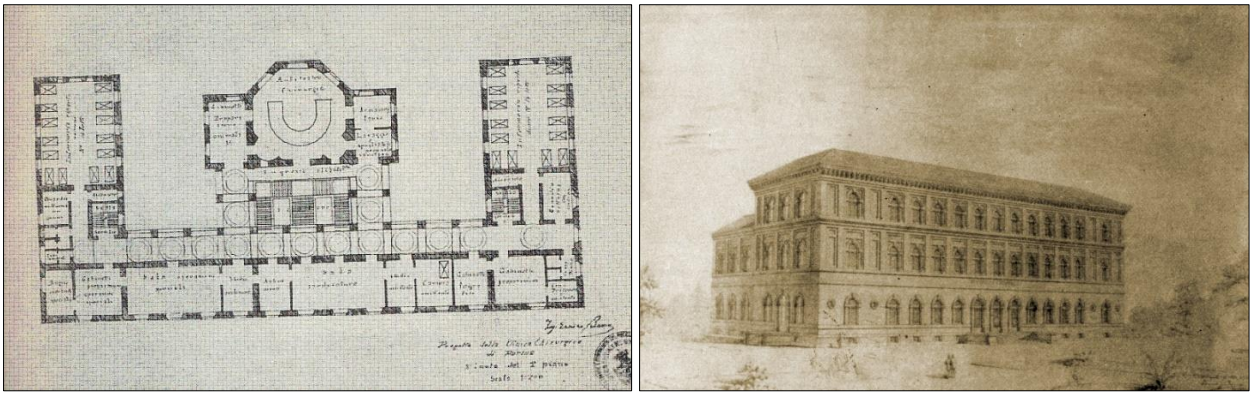
Often, however, a series of negative considerations overshadow the approach to the requalification of the existing: most of the heritage consists of inadequate buildings from the point of view of legislation (constructive and energy), but also for functionality, comfort and contemporary necessities in living and working. The redevelopment of these buildings is thought to be too expensive and, especially in the case of poor architectural quality, it is preferred to demolish and rebuild. This approach, economically efficient, is not at all for the waste management: the Environment Ministry estimates that, in Italy, the construction activity of demolition and construction produces 50% in volume and 90% by weight of all MSW. It is evident that a project that limits the possible demolition obtains the first savings. To maintain the materials and to choose to build "zero-mile", prevents that the project is borne by costs due to picking up and disposing / recycling of the materials, costs that have been neglected for a long time and for which it is still difficult to arouse sensitivities.

Also, demolish and reconstruct is an underperforming approach from the point of view of energy. Here as well, if it is clear to the customer the advantage of saving energy (i.e. the reduction of fuel consumption during the life of the building), it is less than the reduction of energy in the production phase, or "energy efficiency" (given that the building sector consumes one third of the total energy annually burned). The research of the performance retrofit, or the technological operations aimed at a new or higher quality of construction, should not be limited to the time of construction, but should expand to include the entire history of the building.

1.1 The role of the survey and the historical and iconographic analysis in the application of the BIM design to existing buildings

In the project of a new architecture, the setup of the Life Cycle Analysis is a standard practice, which uses BIM software in which the drawing of structural elements and finishing is associated to quantitative, qualitative and performance information. New technologies in the field of architectural survey, particularly laser scanning, allow today to have an accurate three-dimensional model of the technological structure and surface, including any instability and degradations. The ability to integrate the survey with diagnostic information for the restoration, and graphically display the results, is a big step forward in the definition of an accurate “clinical picture” of the patient, which you are going to take action.

In this perspective, the meticulous collection of all the historical documentation concerning the opera takes on a greater significance than the mere task of preserving cultural memory of what it was. Read in the light of the current situation, these documents help to understand in depth the reasons of the changes that occurred over time, the succession of layers, additions and subtractions to the structure, up to appropriate the morphological and functional reasons the building. Finally, the graphical analysis directed to the investigation of the proportions, metrics and sizing, is an additional tool to understand the will of the architect and any subsequent modifications, in accordance with the construction techniques of the time. All this constitutes a picture of the work that we face, far more complex and articulated that the mere vision of its architectural skin and its current condition of inadequacy, if not disuse.



Figg. 4-5: E. Bovio, Royal Surgical Clinic, project of the first floor (A.S.C.Pr). Perspective view.

1.2 The evaluation of the vocation of the building: functional potentiality and criticality

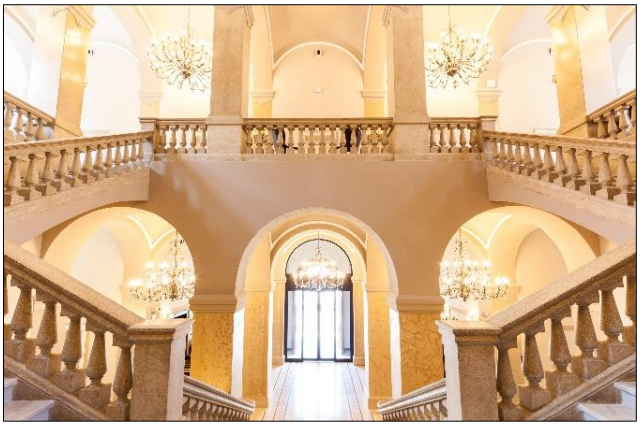
Until now, the emphasis has been placed on the need of the economy and energy conservation, so the historical research, graphical analysis and architectural survey applied to the building may seem like a waste of resources. Instead, they are the basis of the assessment of the convertibility of the building itself. The principle of minimum intervention should not be seen as a law imposition applied to protected buildings, but must become the practice for all interventions on the existing heritage.

First, the analysis must expand to contain the urban surroundings and consider the functional demand of the city, the reading of urban phenomena and social change, and finally the real estate market. The choice of the function to be assigned to the building cannot only come from the customer or architect, but must answer to a real need in the community. This can become a problem for example in the case of former production buildings, which are often converted to residence: this replacement leads the loss of the original functional mix and deprives the life of the neighbourhood. In a second step, the evaluation must descend into the bowels of the building. Which intended uses are compatible with the existing distribution and functional logic? What new role involves the least amount of construction work? What kind of actions are compatible with the existing structure? What is their economic impact, energy and waste production?

Obviously, depending on the characteristics and the value of the building to be redeveloped, we will follow the rules of scientific rather than conservative restoration, restructuring or extraordinary maintenance. The architect has to dress up from time to time the role of the historian, the restorer, the technician, the legislature, acting as each discipline is integrated with the other in the greatest harmony.



Fig. 6: Sections from the survey.




Figg. 7-8: Photos of the common spaces.

2. Case study: former Vighi Pavilion from Royal surgical clinic to luxury hotel

The application of the principles above mentioned is now applied on a concrete experience, a building that stands at the edge of the historic centre of the city of Parma, near the ancient city walls, on whose grounds arise today the avenues of the old city ring.

In the early twentieth Century, the public authority played a driving role in the city economy and social life, promoting the construction of various infrastructures and urban poles and starting the process of formation of the contemporary city. Great importance was given to health facilities, with the aim of creating a new city hospital to replace the inadequate Old Hospital by Strada d'Azeglio. A cultivated area was chosen near the Chiesa del Quartiere, in which progressively realize the four pavilions of the new Polyclinic, as designed in 1908 by Eng. Guido Albertelli with Medicine, Surgery, Maternity and University Clinics.

The "Royal Surgical Clinic" (renamed in memory of Guido Vighi, 1844-1924, for 35 years director of the Hospices Civils) was built between 1904 and 1913, on a project by the engineer Enrico Bovio of the Special Office of Civil Engineers. The site, optimal for characteristics of orientation and ventilation, was not suitable for the presence of superficial groundwater, so the rest of the project was abandoned and the current shape of the lot, on which the pavilion stands, remains as isolated excerpt of a larger drawing.

Meanwhile, in 1912, a Commission identified the area of "Prati di Valera", outside the city limits and with access from the Via Emilia, for the location of the new hospital, not too far from the city, where there still is the city hospital. The plan of 1913 that identifies this new project area, drawn up in the competition for the construction of new halls, represents the structure in the large lot bordered on the north-west from Strada del Quartiere, which overlooks the entrance, and south-west from Viale Vittoria, but without landscaping and internal roads.

In 1928, the city administration promoted an extensive restoration intervention in the Oltretorrente, aimed to improve the health, hygiene and ventilation of one of the most deprived areas of the city. The new road network, matrix of the demolition, intended to create long and wide straights, opening wide gaps in the existing urban texture and denaturalising the peculiar characteristics of the old blocks. In the immediate vicinity of the Vighi Pavilion, the project included the opening of two roads around the building: Via Riva, orthogonal to Via Imbriani, and via Primo Maggio orthogonal to Viale Vittoria. These two new roads end in Piazzale Matteotti, determining the presence of an incongruous edge in the perimeter of the present lot.




Figg. 9-10: Photos of the rooms.



Figg. 11-12: Pictures taken during the construction of the roof structure.

The property did not suffered transformations of the overall structure over the years, but some demolition and superstructures, due to the necessity of the use, in part distorted the internal distribution (it was the Neurological Clinic of the University). The Hospital of Parma dismissed it, and finally sold it at auction in 2004. The planning category at the time of purchase was, within the areas of Urban Renewal, "available container". Among other uses, it was allowed the change of function from hospital to hotel, provided that the 'intervention is within the "Scientific Restoration", because of the building is subject to the provisions of protection of the Superintendence for Architectural Heritage and Landscape in the provinces of Parma and Piacenza

2.1 Description of the building and of the project

The building, conceived by one of the designers of the Rome General Hospital, was the maximum cutting edge at the time of its inauguration. Designed with large hallway corridors for diseaesd's rooms, it was equipped with surgeries, radiographic, sterilization and electrical laboratories and a large surgical theatre capable of over two hundred people, made on a small-scale model of the Hospital of Moscow. The body of the building has an "E" plan form, the front entrance faces the road and branches three orthogonal extensions, which the central one contained the staircase and the double volume amphitheatre, namely the surgical theatre already mentioned and a library with an iron and glass curtain. The arrangement of the common areas and route of rooms and services is very orderly and rational. The monumental stairs separates two symmetrical sides in which are disposed the accommodations at ground and first floor, with a planimetric scheme substantially similar to all floors except the roof. Two interior stairs at the ends of the central body connect the basement and the mezzanine to the main floors. The project included the conservative restoration and rehabilitation of the existing building in the four main floors (basement, ground, first and roof) and two mezzanines, in order to place the functions for the construction of a luxury hotel, including wellness area and fitness centre and restaurant. The structural condition of the property were decent, even if it required substantial renewal of plant design, vertical connections and complete maintenance, because of the longstanding abandonment.

In the basement, although previously intended to full functionality hospital functions (medical offices, laboratories, etc.) and with large illuminating surfaces, is not prevised the permanence of people in a stable way. There are the bathrooms of the ground floor suites (connected with internal stairs), the fitness and wellness area, the meeting area, the thermic station and accessory rooms for storage, changing rooms, cellars, etc. Specific doors give access to separate corridors for the service staff of maintenance and room cleaning.

In the central part of the ground floor, in front of the grand stairway, is situated the entrance hall, administration and management offices, the restaurant that from the central octagon directly leads to the park. The adjacent rooms are destined to service staff for preparing meals and pantry, while in the side wings are disposed the double and single rooms and junior suites with the connection to the floor below. On the mezzanine floor, with access from the first landing of the staircase, there are some rooms and technical compartments at the side of the octagon, were the double height loft houses a piano bar exclusively for the guests. The most suites and double and single rooms, jr. suites and two roomed units are located on the first floor.

The second mezzanine is similar to the first, with four rooms on the side of the octagon, whose access is via two spiral staircases in the octagonal room, which already housed solutions similar to the functionality of the former library. It is once again present the technical horizontal cavedio. The attic floor is entirely occupied by rooms, some with additional skylights for more natural light and part of the terrace overlooking the inner park is left to the exclusive use of some adjoining rooms. Overall, the hotel has 79 rooms of different types (rooms, suites and junior), with two rooms for disabled people per floor.



Figg. 13-14: Pictures taken during the construction of the plasterboards and windows.

2.2 The interventions of energetic regeneration

The design procedure and construction work, which overall lasted eight years, followed a series of integrated steps: Architectural project of reuse to hotel activity; Structural consolidation; Functional upgrading and retrofitting concerning seismic, Antifire and elimination of architectural barriers laws; Mechanical, electrical and special pants project; Conservation project of architectural surfaces; Project of the green; Geothermal plant project.

The analysis of the building required numerous specialized investigations to establish the state of things and to validate the performance characteristics planned. The diagnostic studies focused on both the building and the appurtenant outdoor area, integrating the geometric, material and instability survey with instrumental analyses on the structural behaviour of the building, a stability test of the existing tree with VTA method and geological surveys in preparation for the implementation of the geothermal plant. All this, to ensure the recognition and the consolidation or recovery of every valuable elements of the entire structure.

The primary purpose of the project was to test the suitability of the building to accommodate the hotel functions, optimizing the very characteristics of the property for the least invasive intervention and restorating the original morphologies and materials, varied from past incongruous uses. The totality of the interventions was aimed at the preservation of the original features and the reintegration of those demolished: most of the realizations are of recovery, and only those related to toilet facilities and technical rooms are functional.

The structural consolidation was performed with materials similar to the original ones. Where it was necessary to restore bearing walls previously demolished, they were made up by handmade solid bricks collocated in the pre-existing positions. The partition walls were made of plastered and painted 12 cm. solid bricks for the recovery parts, and of double wall painted plasterboard for most of the new functional divisions.

The existing slab floors are of varied type: in-place reinforced concrete for the first floor, steel beams with hollow core bricks for the second and wooden beams and joists for the third. They were all consolidated and maintained. The vaults were consolidated with superiorly armed screeds and metal rods, to support the horizontal thrusts of the major corridors. The ceilings, not being present pictorial decorations, were plastered and painted, the guest rooms were provided with false ceilings with insulated plasterboard for noise reduction. In general, the existing plaster have been preserved and consolidated, the crumbling or ex-novo ones were reinstated with lime plaster. Even the trusses of the roof, by calculus found structurally adequate, were entirely recovered and isolated by partition walls of ventilated plasterboard. The secondary frame and hollow tiles have been preserved with sheathing and insulating materials on top of them, for the repositioning of the existing roof covering tiles (improvement: 0,22 W/mq K).

As for the finishing materials, the outer surfaces in facing bricks with ground slabs of hammered stone were cleaned and conserved. The 90% of the building still has the terrazzo paving: the original decorated tiles yet present were the basis for the reproduction of the missing or substituted flooring elements. Only in toilets, tiles from scratch was used for paving and walls. The same procedure was used, where possible to stucco, mouldings and original decorations. In order to preserve the existing floors, airborne tunnels were provided for the distribution of all the plants and devices to the rooms, and head height tunnels for the technical staff, who can perform all maintenance and settings without enter in the rooms.



Figg. 15-16: Pictures taken during the construction of the floors and of the geothermal plant.

The fire prevention law compliance involved the construction of a new internal thermal power station and external technical rooms, with new hydrothermal and electrical plants. That modern system was placed in aerial tunnel made of removable metallic structure, while all the previous under plaster raceways were closed, in order to leave as intact as possible the building structure for greater strength.
From an energetic point of view, the entire project was conducted with innovative construction techniques, both in the consolidation that in the use of dry technologies to insulate, soundproof and reduce consumption of the shell, roof and floors. In addition to the cover system already mentioned, new bespoke windows with hyper-performance features substituted the existing ones: very similar in shape and size, but made by wooden covered aluminium structure and anti-breakage sealed double glass (improvement: frame and glass 2,2 W/mq K, glass 1,7 W/mq K). The main door and the wooden doors were restored and preserved.
Even the energy supply is left in a very small percentage to fossil fuel, as the hotel has a heat pump with a large number of closed-loop geothermal pipes, 90% reducing the environmental impact in terms of carbon dioxide emissions compared to traditional solutions (by project, less 160,000 kg of CO2 annually). This choice has a financial and management positive effect because it ensures significant energy savings in the winter heating and summer cooling, compared to the use of the CNG: estimated from more than 210 kWh/mq to 104 KWh/mq per year.
The levelling of the floors and the landing of the lift to all main floors meets the requirements of the law n.13/89 and the D.M. 236/89 in terms of accessibility and adaptability of the building and guest rooms. The existing elevator has been norm-complied and a new one were realized in a symmetrical position. They were covered by a painted metallic plate in order to mitigate the insertion in recalling the hidden mouldings. The entrance staircase was maintained, flanked by a new one in the same materials, slightly spaced from the facade, to allow the positioning of the new ramps for the handicapped.
Outside, on the large private garden, the project consisted in the recovery of the original drawing of the park, which is named the new hotel, including the preservation of masonry and fences, the redevelopment of the stone walkways. A two-levels underground parking were built, including plant equipment and escape routes as well as pedestrian and vehicle entrances to the garages. The careful classification of the present tree species and their condition granted limited substitutions, while numerous additions of native specimens integrated the original arrangement, restoring the relationship between interior and exterior of the ancient monument.

2.3 Conclusions

With 10,000 square meters, this is the broader reuse ever made in the city of Parma of an abandoned building. Despite the difficulties due to the constraint of protection, the facility equipment, performances and sustainability are perfectly comparable to a contemporary brand-new building. The entire intervention did not increased any volume or surface area, since the increment of living rooms on the upper floors was compensated by a reduction of the same in the basement, so there are no charges on the urbanization or construction costs.

This is due to the special attention to the used technology, but also to a careful planning of the philological restoration of the morphology of the structure, based on a historical-critical research. Therefore, it was possible to return the image of the former hospital, retaining any details that characterize it, with new functions and life. The example presented, which followed a strict sequence of methodological steps from the analysis of the existing project to the reuse, demonstrates the applicability of the method not only in monumental buildings, but also in any intervention aimed at reconsidering the existing.

Bibliographical References

[1] VERNIZZI, Chiara, GIANDEBIAGGI, Paolo. Il rilievo architettonico dell'anfiteatro di Durazzo: la conoscenza per il i progetti di restauro e rifunzionalizzazione, in AA. VV. *Conoscere, curare, mostrare. Ricerche italiane per il patrimonio archeologico e monumentale dell'Albania*. Tirana : Green Advertising, 2014, ISBN 9789995632427, p. 47-56.

[2] VERNIZZI, Chiara, GIANDEBIAGGI, Paolo. The Roman Amphitheatre in Durres: the survey as a means of multidisciplinary knowledge for urban regeneration, architectural recovery and archaeological excavation, in AA.VV. Proceedings of *BUILT HERITAGE 2013. Monitoring Conservation and Management*. Milano : Politecnico di Milano, ISBN 9788890896101, p. 524-533.

[3] GIANDEBIAGGI, Paolo. Il rilievo architettonico per la salvaguardia dei beni culturali: peculiarità e casi-studio. In AA.VV. Proceedings of *Le Vie dei Mercanti*. Napoli : La scuola di Pitagora, 2011, ISBN 9788865420461.

[4] GIANDEBIAGGI, Paolo. Forma e immagine dell'architettura medico-universitaria. Analisi dei disegni di rilievo e di progetto tra il XVII ed il XX secolo. In AA.VV. *Figure, luoghi e momenti di vita medica a Parma*, Parma : Silva, 2003, BNI 200311250, p. 357-369.

[5] BANZOLA, Maria Ortensia, *Ospedale di Parma, 1201-2001 : 800 anni per la salute : cenni storici*, Parma : Avant Garde, 2001, IT\ICCU\RMS\0144150.

[6] http://www.parmaelasuastoria.it

[7] GIANDEBIAGGI ARCHITETTURA – Parma http://www.giandebiaggiarchitettura.it. Project reports and various materials. Co-designer Arch. Gianluca Mora, Commissioned by Pacchiosi Drill SPA.

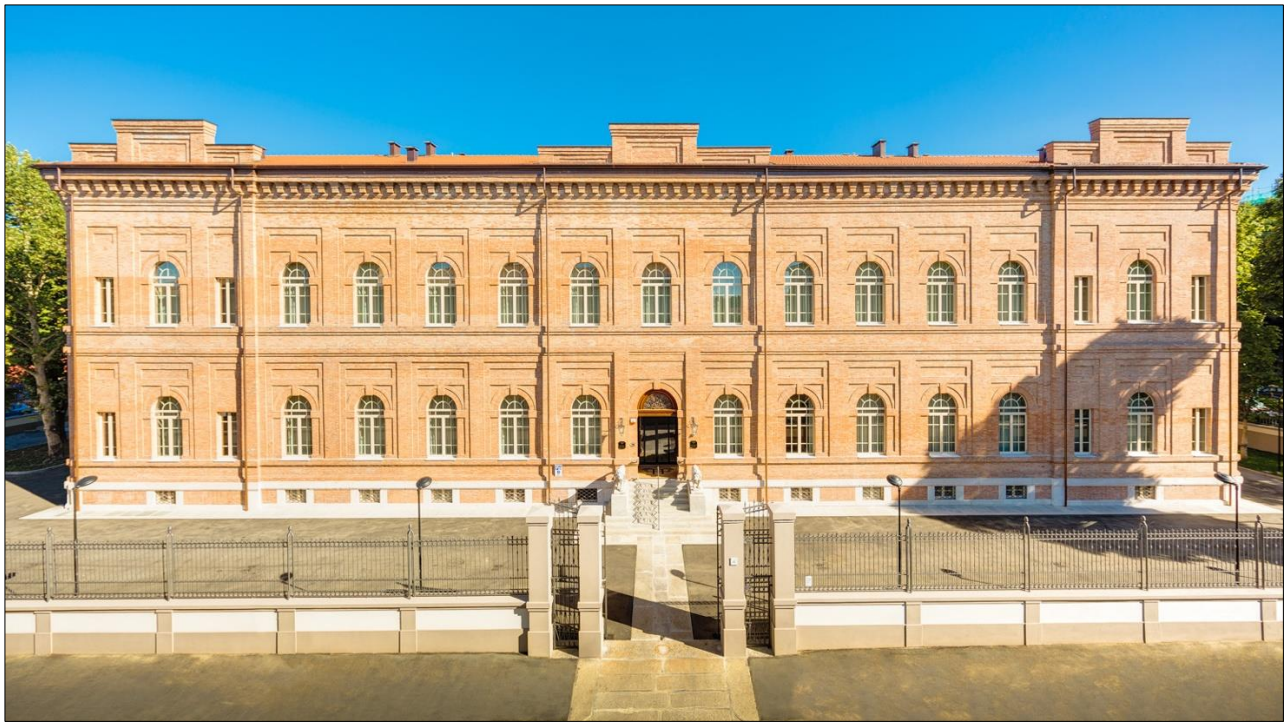


Fig. 17: Photograph of the entrance facade.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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The activity of Neapolitan military engineers in the court of the King of Spain in the 18th century.

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Abstract
In Spain, from the sixteenth to the eighteenth century, the military engineers played a leading role in the training of technicians employed for defensive purposes and war. The Corps, officially created in 1711, was also a vital and active contributor to the Crown in the work of land management, through their active participation in public works. It worked on the design and management of the real paths, roads, sewers and channels to collect water as well as the defense of the country with important strategic and defensive buildings of historical interest.
The work presented recreates through documentary and bibliographic sources, the history of the Corps of Engineers Military, highlighting the contribution of some of Vanvitelli's pupils that, under the reign of Charles III of Spain, were of fundamental importance for the efficient industriousness of the institution.

Keywords: Corps of Engineers Military, Francesco Sabatini, Pietro Vanvitelli, Francesco Vanvitelli, Carlo III.

1.
The military engineering developed in America in response to the concern of the Spanish crown to militarily safeguard the new territories of the colonies and to create the infrastructures necessary to the establishment of new urban centers.[1] Their main activity was primarily the safeguard of the conquered areas, a task that took shape in the end of the 16th with a plan of defense of the Gulf of Mexico, Caribbean Sea and Central America, prepared by Italian Tiburzio Spannocchi, engineer major and superintendent of the fortifications in Spain and the Indies (the plan will be completed during the following centuries).[2]
Just in 1582 Spannocchi and the mathematician Juan Herrera founded a school of Mathematics with treatise writer Cristobal de Rojas and Father Juan Bautista Ferrufino, where lessons of theoretical and practical engineering, architecture and artillery were teached.[3] In 1675 Charles of Aragon y Gurrea, Duke of Villahermosa, Captain General of Flanders, founded in Brussels the Royal Military and Army Academy of the Netherlands, directed by Sebastian Fernandez de Medrano.[4]
Cornelius de Verboon attended this school, and, in the end of the century, was appointed Engineer Major of the Netherlands: he was succeeded by his son Jorge de Prosepro Verboon.[5] Until that time in Spain the staff who served technical work to the crown was made up of humble workers without special training and expertise in the professional field. With the arrival of Philip V the lack of qualified staff was remarkable, so much that in 1704, during the campaign of Portugal, he had to borrow from the French King a brigade of experienced engineers. [6] In 1709 the Marquis de Bedmar, as secretary of the district of the war, proposed to the king to use Jorge Prospero de Verboon to organize a professionals corps in the civil and military field. On 27 of July, Verboon was captured during the Battle of Almenara [7] and taken to Barcelona where he completed and gave final shape to the project of organization of *Real Cuerpo de Ingenieros.* [8] On 17 of April 1711, Philip V approved in the city of Zaragoza, the *Plan General de los Ingenieros y Plaza de los Exércitos Fuertes* suggested by Verboon: the order defined the responsibility of the military engineers who concerned the study of military

construction as well as marine works, including ports and docks. On July 4, 1718 the first *Instrucciones y Ordenanzas para el Cuerpo de Ingenieros* were drawn up: they indicated the tasks, objectives and priorities of the order. Verboon, as General Engineer of Corp, created one of the most important tools for the education of students: the *Real y Militar Academia de Matemática de Barcelona.* In 1739 the guidelines for the Academia de Matemática de Barcelona were approved on indications of Pedro Lucuze and with the experience gained in the previous decade during the courses of Officer Matteo Calabrò. The courses concerned the teaching of basic concepts of mathematics, geometry, topography and, later, of artillery fortification techniques of attack and defense of the square. Those who aspired to be military engineers had to supplement the plan with additional academic teachings, such as mechanics and machines, hydraulic, gnomonic, perspective, construction, training and use of maps, concluding with lessons about drawing and design of civil and military buildings. As noted emphatically by historian Horacio Capel in his book *De Palas a Minerva (1988) "con el programa previsto en la Ordenanza del 1739, la Academia de Matemáticas de Barcelona impartía las enseñanzas más completas y avanzadas que era posible obrener en España en aquellos momentos"*



Fig. 1: Emblem of *Real y Militar Academia de Matemática de Barcelona*.

In 1756 it was ordered to bring together, under a single corp, the artillery and engineers, with the name of *Real Cuerpo de Artillería y Ingenieros* and in 1762 the goals were separated and redefined. [9] After many vicissitudes and conflicts, in 1765, the king signed the *Nuevo Pie del Cuerpo de Ingenieros* and, in June 1766, Juan Martin Cermeno was appointed inspector general of the fortifications of the kingdom. In 1767 he proposed to the king to increase the number of engineers and to create a corps specialized in the construction of bridges, walkways and canals. [10] Even if its recommendations were not immediately accepted, they were taken into account in subsequent reforms. In 1768 the *Nuovas Odenanzas de S.M. para el régimen, disciplina, subordinación y servicios de sus Exércitos* realized the guidelines previously established. The organizational principles for military engineers included an unification with the Corps Artillery under the common command of the engineer Francesco Sabatini, who was appointed *Director y Comandante General en propiedad de caminos, puentes, edificios de arquitectura civil y canales de riego y navegación, e Inspector General de los ramos de Academias y Fortificaciones* that, with the centralist policy of Charles III, assumed full powers up to the creation of the Naval Civil Engineer Corps in 1770. [11]
Sabatini introduced, first for those days, the principle of meritocracy: in fact, until then, the professional hierarchies were established on the basis of seniority. Since his speech, however, the promotions were established for "merited, aptitude and ability."

The presence of Sabatini in such circumstances constituted an important link between Spain and Italy so that, starting from 1763 many students of Vanvitelli went with him to Spain occupying roles and positions relevant to the growth and management of the Kingdom. These included Francesco Vanvitelli, son of Luigi Vanvitelli, who was born in Rome in 1745. He was called in Spain between 1763 and 1765 by his brother in law Francesco Sabatini as his assistant, and appointed by the King Military Engineer Designer. Important recent acquisitions and archival reveal that in 1775 he drawn up the draft of the of Chapultepec Castle, in Mexico City. During the era of the Viceroy, the Viceroy Bernardo de Gálvez ordered the construction of a country house for himself at the highest point of the hill of Chapultepec. Francisco Vanvitelli, Lieutenant Spanish Army Colonel and engineer, wrote the project and began construction on 16 August of the same year. After the departure of Vanvitelli to Havana, the leadership of the project was in the hands of Captain Manuel Agustín Mascaró.
As statement and proof of the high regard in which Italian architects were esteemed by the Spanish crown, in 1784 Vanvitelli received the title of Knight of the Order of Santiago, honor reserved for few Spaniards and, rarely, to foreigners: in fact this institution, founded in the 12th century, was attributed only to the nobles, Christians and practicing Catholics.(fig.2)

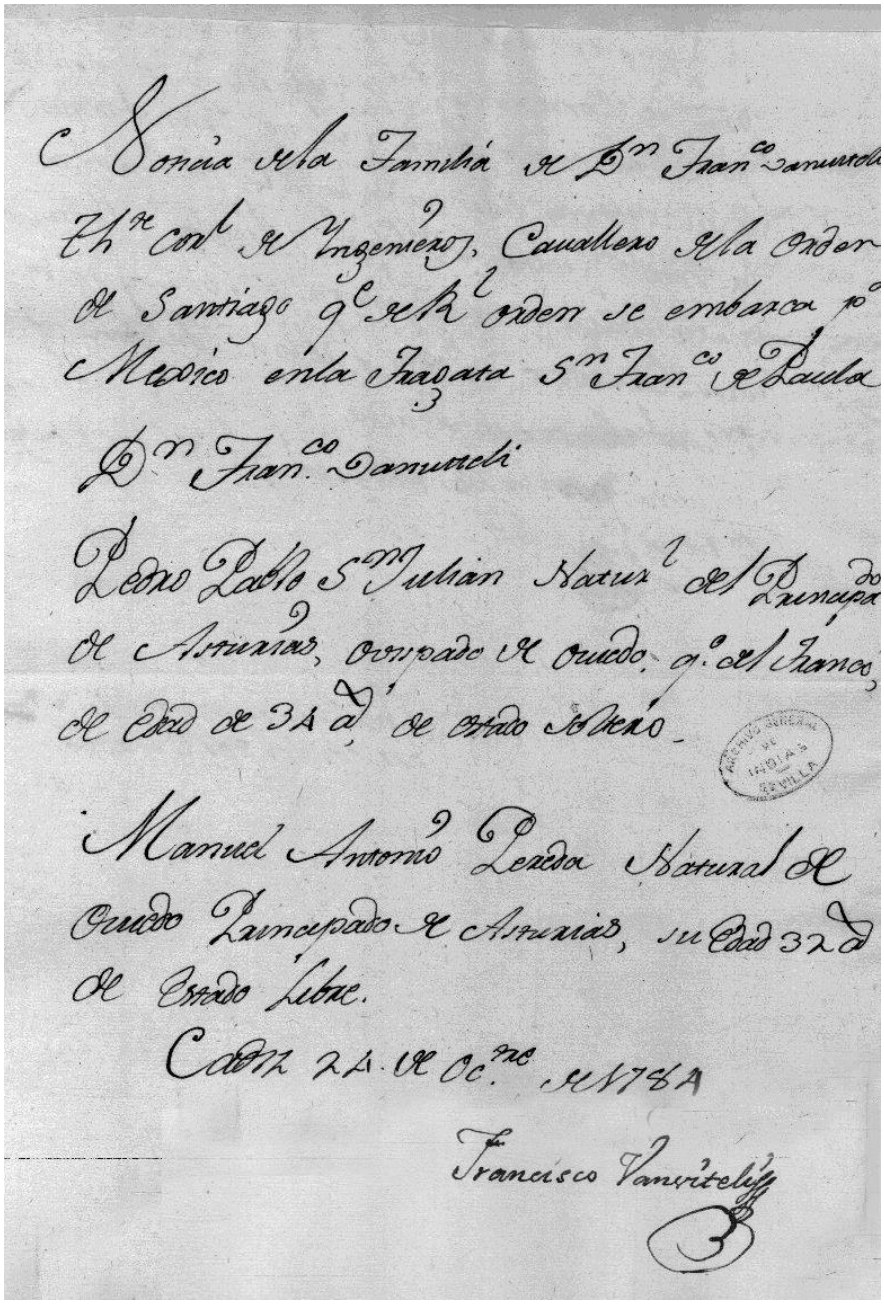

Fig. 2

In 1795 he was present in India, specifically in la Havana: Sabatini testifies its presence in a paper dated 28 of October, 1795 kept in *Archivo General de Simancas*.(Fig.3)

Exmo. Sov.
El Coronel e Ingeniero en Gefe Don Francisco Wanwiteli hace once años que se halla en Indias, teniendo actualmente su destino en la Havana, y haviendo sido nombrado por S.M. desde el fallecimiento de su hermano Don Pedro, por substituto mio en el cargo de las obras del Real Palacio que estan bajo mi direccion, no puedo menos de hacer presente a V.E. la notable falta que hace este Oficial para atender al ciudado de la citada comision, y poder ayudarme en el grande cumulo de asuntos que penden de ella, por cuyo motivo, como por haver estado en America el expresado tiempo, contemplo indispensable relevarle, y no haviendo actualmente aqui sugeto de alguna graduacion que vaya à remplazarle en la Havana, y si en la Isla de Santo Domingo, respecto de estar cedida a la Francia, la parte que poseia España, propongo à V.E. para mudar a WanWiteli, al Ingeniero Ordinario Don Pedro Roig de Lluio, que se halla en dicha isla: en este concepto espero, que siendo del agrado de V.E. se scriva mandar expedir las ordenes convenientes para el citado relevo.
Madrid 28 de Octubre de 1795.
Fran.co Sabatini

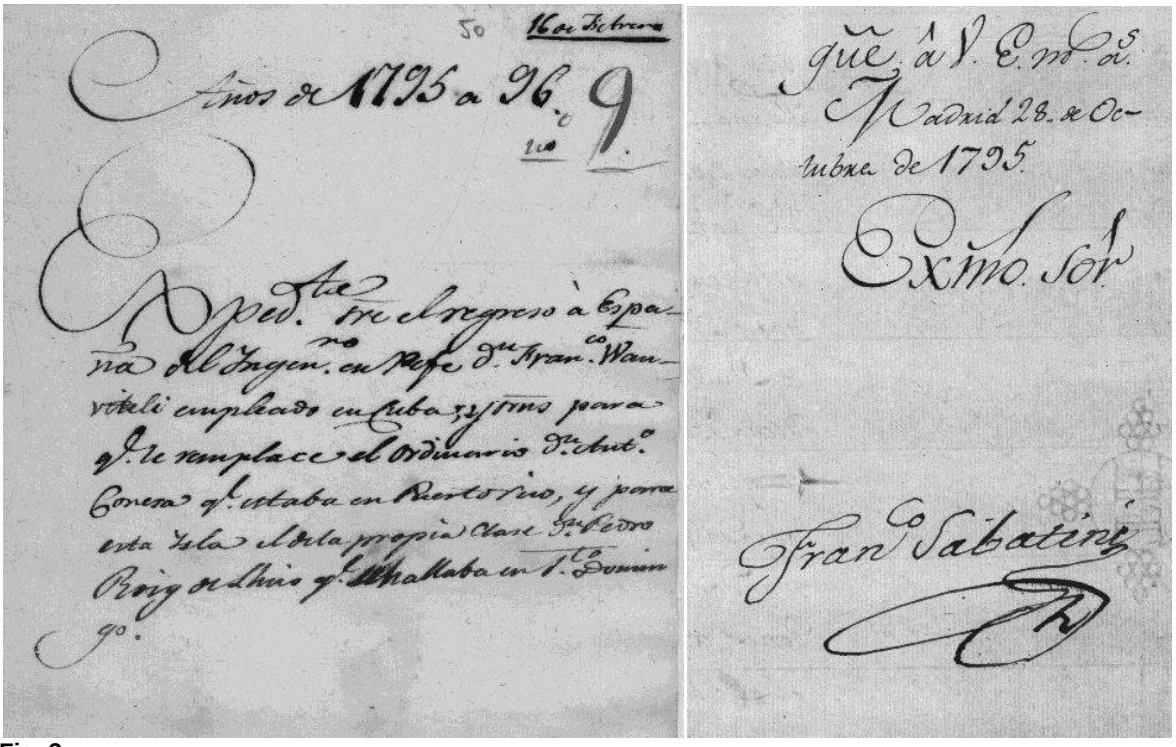

Fig. 3

As statement and proof of the high regard in which Italian architects were esteemed by the Spanish crown, in 1784 Vanvitelli received the title of Knight of the Order of Santiago, honor reserved for few Spaniards and, rarely, to foreigners: in fact this institution, founded in the 12th century, was attributed only to the nobles, Christians and practicing Catholics.

Another character is Pietro Vanvitelli, son of Luigi, who was born in Rome in 1741. In 1763 it was called in Spain by the King with the task of Military Engineer. To open the doors to him was just Francesco Sabatini that on 15 March, asking to marry his daughter Cecilia, wrote to Vanvitelli; [12]

« Bramerei finalmente potesse venire accompagnando la sorella il di lei figlio Don Pietro, ed io procurerò che possa avere qui alcune incombenze delle mie, o altre, e così rimanere al servizio di questo Sovrano, restando a me la cura di far presente al Re che il suddetto di lei figlio è il solo a proposito che possa continuare le mie commissioni, le quali sono molte, e di molta durata ».

Caserta 26 Marzo 1763

[…]In questo corriere ultimo di Spagna mi scrive l'amico che riceverò la patente per il mio figlio D.Pietro, e che il soldo corrispondente lo pagherà qua in Napoli D.GiovanniGonzueta, che è successore di Squillace, cioè segretario dell'Azienda del Regno. Per altro, farò il memoriale ed averà ancor esso il suo soldo corrispondente, che saranno ducati 14 il mese. Dello spagnolo poi non ne so niente, ma saranno almeno ducati 18 o 20, e forse più. Ci vorranno delle spese per le monture, che sono guarnite d'argento; basta, vedremo. Circa il rischio non puotrà mai essere, perché alloracché fra il Corpo degli'Ingegneri Militari esso starà, dovendo da me imparare, puotrà essere successore al Sabatini, cioè Architetto Civile nel Corpo Militare. Circa all'altro, procurarò ritenerlo appresso di me per lo stesso fine, onde il pericolo ideato non vi puol'essere.
Per altro, voglio levar di testa a Pietro il Vacabile e farne lochi di monte, perché alle figlie femmine conviene pensare o presto o tardi, ché non voglio siano per invecchiare e rimanere in casa.
La patente di Spagna si spedirà dal Segretario di Stato e Guerra, il Conte D. Riccardo Wall. Spero che, col nome di Dio, tutto abbia a riuscire in bene; dovrò farne molte lettere di cerimonie.[…]

Caserta 14 Maggio 1763
[…]Mi giunge ora la patente per Pietro d'ingegnero (sic) ì, sottoscritta da Riccardo Wall, che è il Segretario di Stato di Guerra del Re Cattolico, con il soldo di scudi 30 di Vaglion, i quali convengono a ducati ventiquattro e qualche carlino di Napoli, cioè circa scudi 20 Romani il mese. Sia però un milione di volte benedetto il Nostro Benefattore Re Cattolico. Scriverò a Wall lettera di ringraziamento, ad altri se occorrerà, di cui prenderò consiglio.[…]Mandatemi l'istruzzione di ciò che occorre e devo fare per l'officio del Vacabile che à Pietro, a cui voglio levarglielo da testa, o sia per venderlo e farne Lochi di Monte, o si a per intestarlo ad un altro figlio.[…]

Caserta 17 Maggio 1763
[…] Il figlio Pietro viene decorato di Sottotenente, cioè un grado più dell'Alfiere; questo, se vive, farà molta fortuna.[…]

Suo figlio Pietro è a Madrid con la patente di ingegnere militare, ma finora non ha ricevuto stipendio: i tempi sono difficili, tuttavia l'assegnamento l'avrà, scrive Sabatini.[…]
Napoli 3 Agosto 1765

The Neapolitan architects of Vanvitelli family were, ultimately, of great importance for the development of urban agglomerations in the Americas Spanish. The centrality of the crown in political decisions proved once again to be forward-looking, because, beyond the aspects of the tyrannical measures, it had the great merit to modernize, with these choices, the urban policy, importing models already tested in Europe in the possessions of the Crown, just think about the location of the Royal Palace in Caserta's site.

Bibliographical References.

[1] FERRERAS FINCIAS, Francisco Javier. *Las memorias del Cuerpo de Ingenieros Militares: fuente para la historia de la construcció.* In BORES F., FERNÁNDEZ J., HUERTA S., RABASA E. *Actas del Segundo Congreso Nacional de Historia de la Construcción, A Coruña 22-24/10/1998*. A Coruña: Centro de Estudios Históricos de Obras Públicas y Urbanismo , 1998, pp. 165-166.

[2] CÁMARA MUÑOZ, Alicia. *Tiburzio Spannocchi, ingeniero mayor de los reinos de España.* In *Espacio, tiempo y forma. Revista de la Facultad de Geografía e Historia* Serie II. Madrid: Universidad Nacional de Educación a Distancia, 1988, pp.77-91.

[3] VIGANÓ, Marino. *El fratin mi ynginiero:i Paleari Fratino da Morcote ingegneri militari ticinesi in Spagna XVI - XVII secolo.* Lugano: Edizioni Casagrande, 2001, p.42.

[4] RODRÍGUEZ VIQUEIRA, Manuel. *Arquitectura militar, génesis y tipología*. México: Ediciones Limusa, 2010.

[5] MUÑOZ CORBALÁN, Juan Miguel. *Los ingenieros militares de Flandes a España (1691–1718),* Madrid: Ministerio de Defensa, 1993.

[6] CAPEL, Horacio. EUGENI SÁNCHEZ, Joan. MONCADA, Omar José Maya. *De Palas a Minerva- La formación científica y la estructura institucional de los ingenieros militares en el siglo XVIII*. Madrid: Ediciones del Serbal, 1988.

[7] VERDOGLIA, Franco. *La guerra di successione spagnola 1701-1715.* Roma: Chillemi Editore, 2009.

[8] CÁMARA MUÑOZ, Alicia. *Los ingenieros militares de la monarquía hispánica en los siglos XVII y XVIII.* Madrid: Ediciones del Serbal, 2005.

[9] GALINDO DIAZ, Jorge Alberto. *El conocimiento constructivo de los ingenieros militares españoles del siglo XVIII*. Barcelona: Universitat Politècnica de Catalunya, 1996.

[10] GALINDO DIAZ, Jorge Alberto. *El conocimiento constructivo de los ingenieros militares españoles del siglo XVIII*. Barcelona: Universitat Politècnica de Catalunya, 1996.

[11] VIGANÓ, Marino. *Architetti e ingegneri militari italiani all'estero dal XV al XVIII secolo,* Livorno: Istituto Italiano dei Castelli, 1994.

[12] STRAZZULLO, Franco. *Le lettere di Luigi Vanvitelli della Biblioteca Palatina di Caserta.* Galatina, 1976.

Archival References

ARCHIVO HISTÓRICO NACIONAL DE ESPAÑA
1784 *Pruebas para la concesión del Título de Caballero de la Orden de Santiago de Francisco Vanviteli y Starich, natural de Roma, Teniente Coronel é Ingeniero Ordinario de los Reales ejércitos.* Expediente 8518.

ARCHIVO GENERAL DE SIMANCAS
1795 Regreso a España de Francisco Vanviteli; Ingeniero de La Habana. Expediente en Febrero. 1796. Expediente 8518. Legajo 7242,37.

HERITAGE and TECHNOLOGY
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Neo-gothic influences on the academic architecture of Giovanbattista Patturelli.

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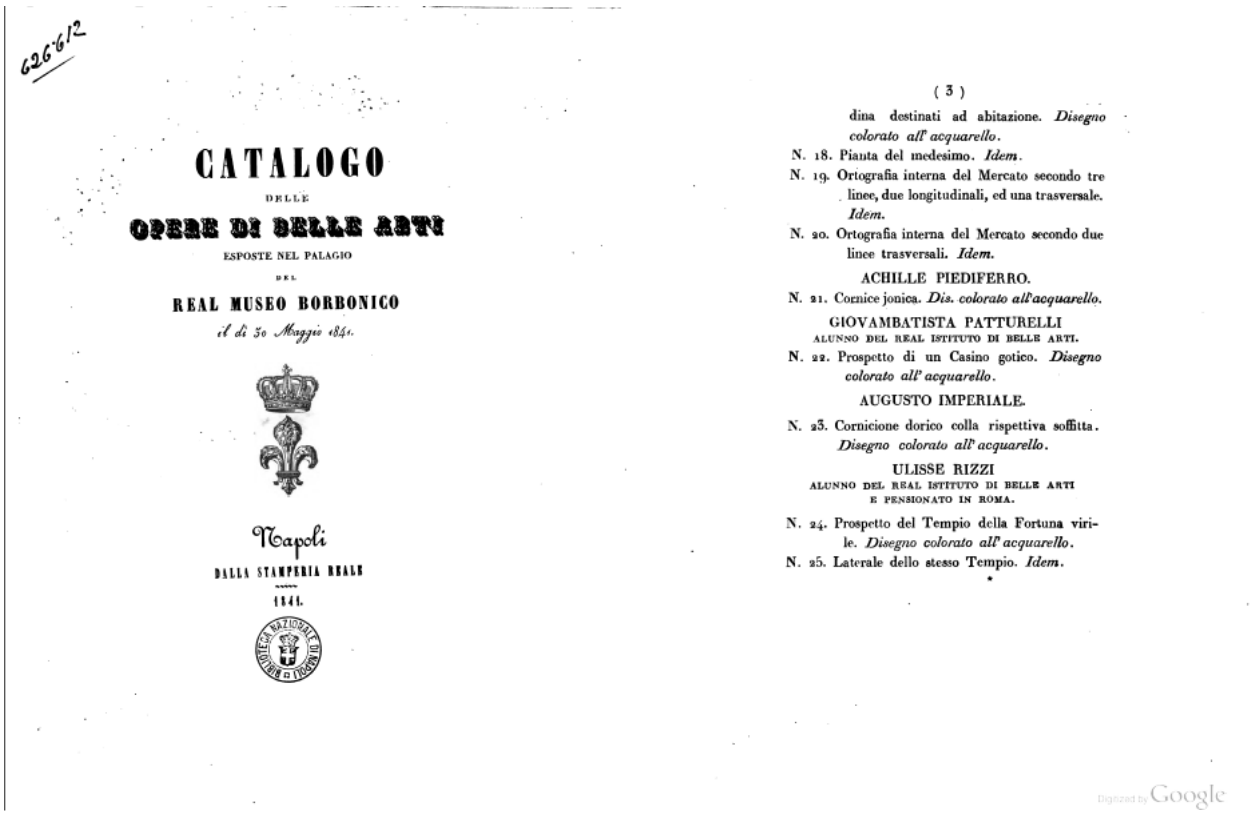
Abstract
This contribution represents the attempt to open a way through the knowledge of the professional path of the architect Gianbattista Patturelli (1821 - ?), architect of the Real Administration of Caserta and San Leucio, through the reading of the drawings of his didactic-professional activity that originate one of the possible ways which lead to the comprehension of creative paths linked to a specific professionality.
The idea of the research was born from the chance to work on some of the unpublished drawings traced found in the private archive of the Farro – Raucci's family, especially those one with a neo-gothic character, most likely the result of practice exercises conducted at the " Real accademia di belle arti" of Naples.
The study was addressed to the analysis of the drawings in the didactic activity of the architect Patturelli and through the reading of the expressive meanings of the representation has tried to reveal what is not immediately visible, tracking graphic analogies, cultural references connections, purposes, passions, attentions, interests.

Keywords: history, memory, private archives.

Giovanbattista Patturelli was born on 24th August 1821 from Giovanni and Maria Carolina Brunelli, daughter of Domenico, architect, who worked to the construction of San Leucio with his brothers, Carlo, a painter, and Angelo, a sculptor [1].
His name is well-known in various texts because he belongs to the important family of architects Patturelli, since always devoted to the Royal Administration [2], but very lacking are the news about his origin and his formation despite his professional successes. Although he was the last of twelve sons, he received his grandfather's name, Giambattista Patturelli, who was responsable of the works of Caserta and then was called by Carlo III to the Throne of Spains working as Architect of Escurial until his death [3].
The indication of these characters is useful to understand the cultured family entourage in which the first formation of the architect began.
The young Patturelli was pupil of the Real Istituto di belle arti in Naples [4], and these years spent at the Academy were very important because the influence of the talented professors and that of his family contributed to his formation and personality. The institute, according to a decree by Ferdinando I was shared in ten «studii» (drawing, painting, sculpture, architecture, perspective, ornamental design, landscape, copper plating, incision on stones, anatomy applied at the fine arts), to which corresponded a staff of ten ordinary professors, of which eight honorary, an ecclesiastical supervisor and one spiritual director. As the third title of the decree tells us, the apprentice architects, who had to attend ornamental decoration, perspective and design studies, were divided in two classes: one of analysis or formation, one of summary or posy. About the formation, they had to «disegnare gli ordini architettonici co' loro dettagli copiando prima buoni esemplari disegnati, indi dal vero le migliori fabbriche e monumenti, si antichi che moderni» and they were «istruiti della origine del carattere e della convivenza de diversi ordini». To the didactic system corresponded awards, contests and a retirement in Rome. To the seventh title of the decree were defined the modalities of the

architecture exam at the Institute where the commission classified on the basis of the Vitruvio's trinomial: solidity, convenience, and beauty of the planned buildings [5].
On 30th may 1841 he took part to the exposition of objects of fine arts, announced by the Academy of Naples for his own pupils. In this occasion, he received the award with a silver medal of 2nd class [6], as mentioned in the *Catalogo delle Opere di Belle Arti exhibited at the palace of the Real Museo Borbonico*, Patturelli showed a watercolor painting illustrating a façade of a Gothic Casino which seems to be the same one found at the private archive of the Farro-Raucci's family. The fund picks up a series of drawings, academic and not, which are, in part, the plot of the architectural and decorative theory of Patturelli.
As declared by possessors, these drawings derive from the heritage of the notary Paolo Emilio De Peruta who, at the beginning of the eighteenth century, to practice his profession, moved from San Nicola la Strada to Marcianise. Passionate of art and archaeology, he gathered a collection of prints and drawings of architecture that he bequeathed to his son Pietrangelo Gennaro. The latter joined the collection deriving from the engineer Fortunato Esposito, natural son of Leopoldo di Borbone, who had married his sister Rosina and tragically died in 1870. Pietrangelo lived as a bachelor with his other sister Laura who had married Salvatore Raucci, and left the entire collection to his nephew Donato. After diverse hereditary transfers, the collection arrived to the current possessors [7]. Is unknown the original arrangement of the drawings, loose, in small or medium-size large.
The collection also includes planning studies and exercises of buildings, probably realized, defined in graphics, realized on ivory paper. The drawings are done with Indian ink, traced with watercolor sepia or with other colors, carefully studied and contrasted to have lights and shadows effects. There are also quick pencil sketches, notes, preliminary elaborations of the idea indispensable to the next phase of accurate study. What really strikes is the diversity of experiences ranging from the neoclassical style to the neo-gothic. In this regard it is necessary to say that between the 19th and 20th century in the scenary of the European architectural culture appeared the neoclassicism and related neo-medieval movements, especially the neo-gothic one. Although in apparent contrast, these revivals were essential because the opposite poles profitably stimulated each other and vitally fed driven by artistic solicitations [8].


626.612

CATALOGO
DELLE
OPERE DI BELLE ARTI
ESPOSTE NEL PALAGIO
DEL
REAL MUSEO BORBONICO
il dì 30 Maggio 1841.

Napoli
DALLA STAMPERIA REALE
1841.

BIBLIOTECA NAZIONALE DI NAPOLI

(3)

dina destinati ad abitazione. *Disegno colorato all' acquarello.*
N. 18. Pianta del medesimo. *Idem.*
N. 19. Ortografia interna del Mercato secondo tre linee, due longitudinali, ed una trasversale. *Idem.*
N. 20. Ortografia interna del Mercato secondo due linee trasversali. *Idem.*

ACHILLE PIEDIFERRO.

N. 21. Cornice jonica. *Dis. colorato all'acquarello.*

GIOVAMBATISTA PATTURELLI
ALUNNO DEL REAL ISTITUTO DI BELLE ARTI.

N. 22. Prospetto di un Casino gotico. *Disegno colorato all' acquarello.*

AUGUSTO IMPERIALE.

N. 23. Cornicione dorico colla rispettiva soffitta. *Disegno colorato all' acquarello.*

ULISSE RIZZI
ALUNNO DEL REAL ISTITUTO DI BELLE ARTI
E PENSIONATO IN ROMA.

N. 24. Prospetto del Tempio della Fortuna virile. *Disegno colorato all' acquarello.*
N. 25. Laterale dello stesso Tempio. *Idem.*

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Fig. 1: Catalogue of the exhibition of fine arts works.

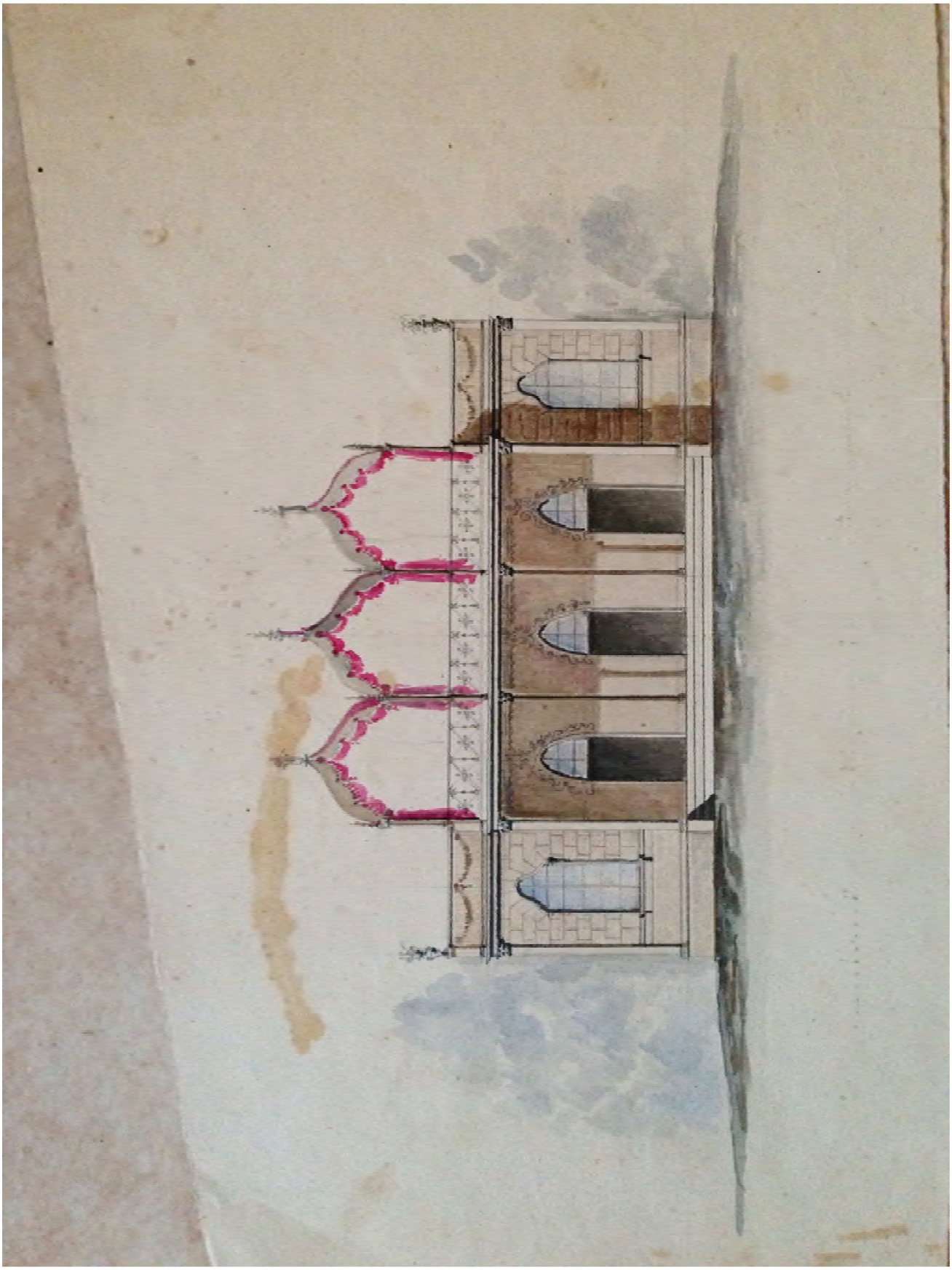

Fig. 2: Gianbattista Patturelli, drawing "Prospetto di un casino gotico. Disegno colorato all'acquerello" (Private Archive of the Farro-Raucci's Family).

The neo-gothic puts itself into a cultural current of the nineteenth-century architecture that in Naples, particularly in the first half of the century, did not have a large spread. During the Bourbon age, the neo-Gothic language was limited to some minor examples of religious buildings and to a series of "style" restoration works of medieval factories, of which the architect Federico Travaglini was one of the most active authors [9].
To the Neo-gothic belong other important works such as the guest house and the ogival niche of villa Ruffo in Posillipo, the church of Bellavista and the facade of the Vaccheria in S. Leucio [10] which was the last project entrusted to Collecini (1801) and that will be completed in 1805 by his pupil Giovanni Patturelli [11], father of Giovanbattista. And it is perhaps here that the young Patturelli, following in his father's footsteps, was inspired to create the façade of the Gothic Casino. The drawing is made on ivory paper, in small size and is defined by contour lines made with pen and ink black and soft with different watercolors depending on the effect desired. The façade is on one level, lifted up by three steps leading to a rearward porch from the two lateral bodies. The roofing consists of a terrace that in the central part is jutting out and supported by two slender columns probably made of iron.
The portico has three entrances characterized by glazed pointed arch decorated with moldings with a floral decorations. The same decorative apparatus is repeated in the part underlying the balcony.
The lateral bodies characterized by a smooth base and, at the top, by a regular bossage, with a single central arched trefoil window. The corners are concluded by pilasters with corinthian capitals.
The upper part of the lateral bodies is closed from a parapet in masonry that introduces decorative motives to festoons enriched by the presence of planters.
The central body, instead, is shut from a handrail in beaten iron with motives to rhombuses and floral; at the conclusion of the façade there is a triple iron canopy, with columns and pinnacles, which supports a draped curtain and ended by spires.
The drawing shows two kinds of interests: one documentary and the other one artistic; the latter is a contribution to the knowledge of the formation of the young architect.
Patturelli follows the criterion of the order and of the simplification, subordinating the distinctive features of the style (arches, fretworks) to strict geometric division of the façade, with an arcaded central portico, using minimum projections. What you get is the effect of a facade-scenario that seems to re-propose the building as a fantastic appearance, set and disoriented at the same time. In particular, the free use of the flamboyant gothic and arab formulas, reinvented and combined, produces a tasty "pastiche" where the Middle Ages and the East coexist, hinder, blend. These values seem to be one, maybe with the consciousness that there is in fact a common identity, deriving the pointed arch by Muslims compositional forms [12].
Patturelli activity as an architect is still a chapter that require analysis and research. Little is known about his professional assignments and projects actually carried out.
In his academic career, an important recognition was conferred with the designation of Architect Alumnus of the Royal Administration of Caserta and San Leucio. For twelve years he served as expert in the Court of Santa Maria Capua Vetere and had various municipal assignments [13].

Bibliographical References

[1] MARELLO, Battista. *L'Architetto Giovanni Patturelli e il Real Sito di S.* Leucio, *Testimonianze iconografiche e d'archivio*. Marigliano: 1992, p. 31.

[2] MARELLO, Battista. *L'Architetto …* cit, p. 32.

[3] MARELLO, Battista. *L'Architetto …* cit, p. 41.

[5] VENDITTI, Arnaldo. *Architettura Neoclassica a Napoli*. Napoli: 1961, pp.27-28-29.

[6] *Annali civili del regno delle Due Sicilie*. Napoli: 1841, vol. 25-27, p. 253.

[7] DE NITTO Giuseppe. I disegni attribuiti a Mario Giuffredo. In *Luigi Vanvitelli e la sua cerchia*, edited by DE SETA, Cesare. Napoli: Electa 2000, p. 120.

[8] CAVALLARI MURAT, Augusto. Il neoclassico Carlo Sada, neogotico suo malgrado In *Il Neogotico nel XIX e XX secolo*, edited by BOSSAGLIA, Rossana. Milano: 1990, p. 38, cit.

[9] On topic compares NAPOLEONE SASSO, Camillo. *Storia de' monumenti di Napoli e degli architetti che li edificavano dal 1801 al 1851*. Napoli: 1858, vol. II, p. 213; VENDITTI, Arnaldo. *Architettura …* cit, pp. 338-342. PARISI, Roberto. Sull'architettura neogotica a Napoli: la Chiesa anglicana si san Pasquale a Chiaia (1860-1865). In Napoli Nobilissima. Napoli: Arte topografica 1998, vol. 37, p.89.

[10] VENDITTI, Arnaldo. *Architettura …* cit, p. 342.

[11] ROSSO DEL BRENNA, Giovanna. Collecini Francesco. In *Dizionario Biografico degli Italiani*. Roma: Istituto dell'Enciclopedia Treccani, 1982, vol. 26.

[12] *Il Neogotico nel XIX e XX secolo*, edited by BOSSAGLIA, Rossana. Milano: 1990, vol. I.

Archival References

[4] Archivio Accademia Belle Arti di Napoli, Verbale del dì 30 Settembre 1842.

[13] ASN, Fondo Ministero di Grazia e Giustizia – Architetti giudiziari: 1835 – 1861, b.1583, f. 496.

HERITAGE and TECHNOLOGY
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Reading the Territory, sign graphics and remote sensing images. The case study of Historic Center of Naples

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Abstract

The historical maps provides information useful for the study of the territory and for its correct modification.
Read the Past Through historical maps and compare the present with modern orthophotos and satellite images can represent a valid tool for the interpretation of the territory.
This comparison is the first step for the construction of a Geographic database in which contain information related to the changes of a portion of territory.
This paper focus on the historic center of Naples that has an articulate stratification and cohabitation of the different customs. One of the peculiar aspects of this property is the massive presence of religious buildings with cloisters. The focus is verify the current state of cloisters by comparing the ancient geometric layout deducted on ancient plant in the city of Naples and the current one extrapolated from the most recent orthophotos. The research provides for the classification of the cloisters and the compilation a table attributes in GIS; this methodology is the best to manage a large amount of data.
The target is to evaluate the changes that occurred in time and compare also the presence of green areas in comparison to the dense urban area. The case study of Naples is interesting because it is a place permeated by a strong religious component that connects past and present. It is a network of different culture and that have been held in the centuries; the reading of historical maps in comparison with satellite images could orient In the discovery of tracks and signs, memory of what it is not longer there.

Keywords: Remote sensing, cartography, survey.

1. Reading the territory throught the survey and the cartography

The research aims to test a method of comparing the information obtained from reading the satellite imagery and the historical maps to quantify changes between the past and the present and predict the correct modification of the territory under investigation. The comparison between satellite images and maps can represent the first step for the construction of a geographic database in which contain the information related to the changes suffered by a portion of territory.
Find the current situation with that documented by old maps and views it represents a useful method for the analysis of the transformations of architecture and the city.
The survey of architecture and the city is an activity performed since ancient times, and especially since the fifteenth century has developed a growing interest in the representation of the city and the territory. Only with the eighteenth century were made the first sights zenith whose wording is continued until the birth of the official maps.

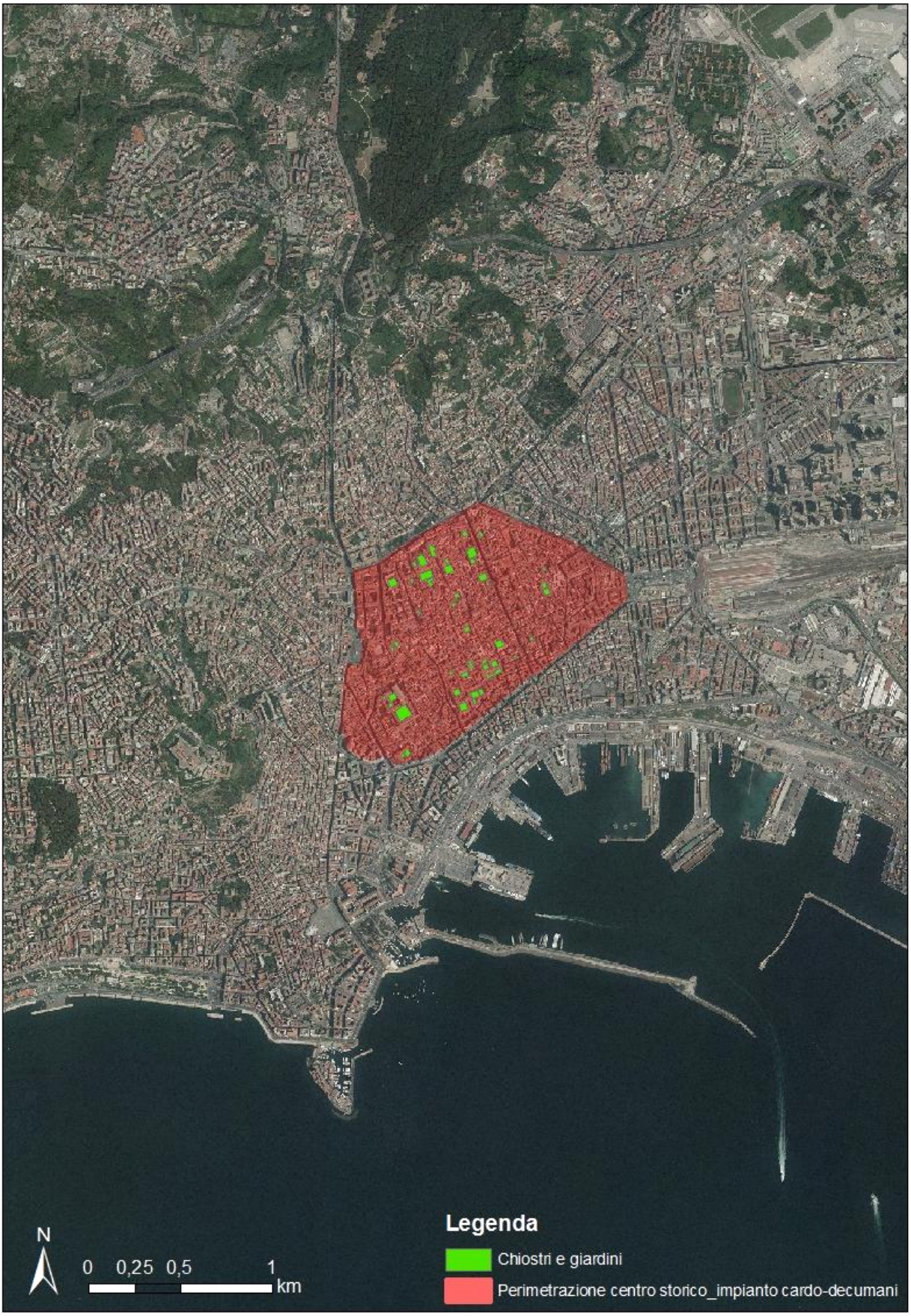

Fig. 1: Historic Center of Naples and cloisters on Ortophoto of Region Campania

During the twentieth century , with the progress of aeronautics - military and civilian - the study of the geometry of the Earth and its cartographic representation had significant developments related to aerial surveys and the emerging technique of photogrammetry from architecture (land) was strategically used in the recording of photorealistic large portions of the territory. Technological advances and the political and cultural events has always influenced the evolution of the representation of the Earth.Comparative analysis of ancient representations, in turn compared with the current situation is of great help to understand the transformations that occurred over the centuries in the territory.
In some areas of study and analysis of the natural and built , the reading of the information contained in the maps can be the basis for knowledge both punctual that general of the land . Modern technology , with the development of sophisticated digital atlases and web offers the chance to read the evolutionary processes and the urban transformation of the territory and stands as an indispensable instrument of knowledge, research and forecasting changes and transformations .
The web has also expanded the areas of architecture especially in the sphere of representation and knowledge management and detection systems in particular geographic information generating information very innovative.
As is known, since 2005 there is the opportunity to travel anywhere in the globe with Google Earth and examine maps with Google Maps. Since a large audience may fly over the earth and view satellite imagery has been changing the perception of the world and with it the very idea of representation.
The maps become accesible , upgradeable and communicable diseases .
The Internet made outstanding contributions in the discipline so geographic information has become available to everyone .
The mapping language has changed and it is open to more and more spectacular images.
The symbols , in fact, can be read by a more careful eye and preparation; reading an image by remote sensing is instead clear and immediate for eye not expert.
The great development of the cartographic distribution is related to the growth of the Internet as a means of communication , and in it the phenomenon of the world seen from above has become increasingly important over the years : just think of the great diffusion of digital atlases .
The situation becomes even more significant when one is able to extract information from the reading of the satellite images.
The critical analysis of the data it can bring out, in the direction of research, which marks georeferred referring both to natural traces that those man-made features of the territory. This traces may be the use historicized by man not known or poorly documented, or the tracks deliberately concealed lights of exploitation even "illegal" land.
The process of analysis and comparison of images taken from satellites with those resulting from historical maps is a critical step in the knowledge of the territory, environment and landscape and is preliminary action and indispensable for the government of human modification of the environment. In this thematic framework, the methodological approach of the design acquires again the intrinsic values etymological Project.
The contribution focuses on the center of Naples which has a complex layering.
One of the distinctive features of the geographical area is formed by the large presence of religious buildings with adjoining cloisters.

1.2 Gis: rapresentation of the reality

In order to verify the situation in this moment of the religious buildings and cloisters within the historical center of Naples for comparing the initial geometric layout inferred on the ancient city of Naples and the current extrapolated from the latest orthophotos it was necessary to find the historical maps.
To get a clear picture of the current situation, it was useful to work with GIS in order to catalog the buildings under study and fill in the relevant fields on the information collected for each of them.
This methodology was of great help in the management of large amounts of data.
It was also possible to make some geometric operations and quantitative manner as those of the immediate calculation of the green surface than the dense urban center.
The case study of Naples was particularly interesting because it is a place permeated by a strong religious component that connects past and present.
The center of Naples is a mix of different cultures that have taken place over the centuries; reading of historical maps in comparison with satellite images can ride in the discovery of traces and signs, memory of what it is not longer there. It is evident the importance to summarize all the important information, realize tabs with all data and insert them in a GIS, realizing a searchable and implemented database over time. This will make it possible realize a complete study for understanding of the territory or its portion. So the knowledge must be used as a tool to communicate the value of the investigated object like the case study of the Center oh Naples that is also an Unesco site.

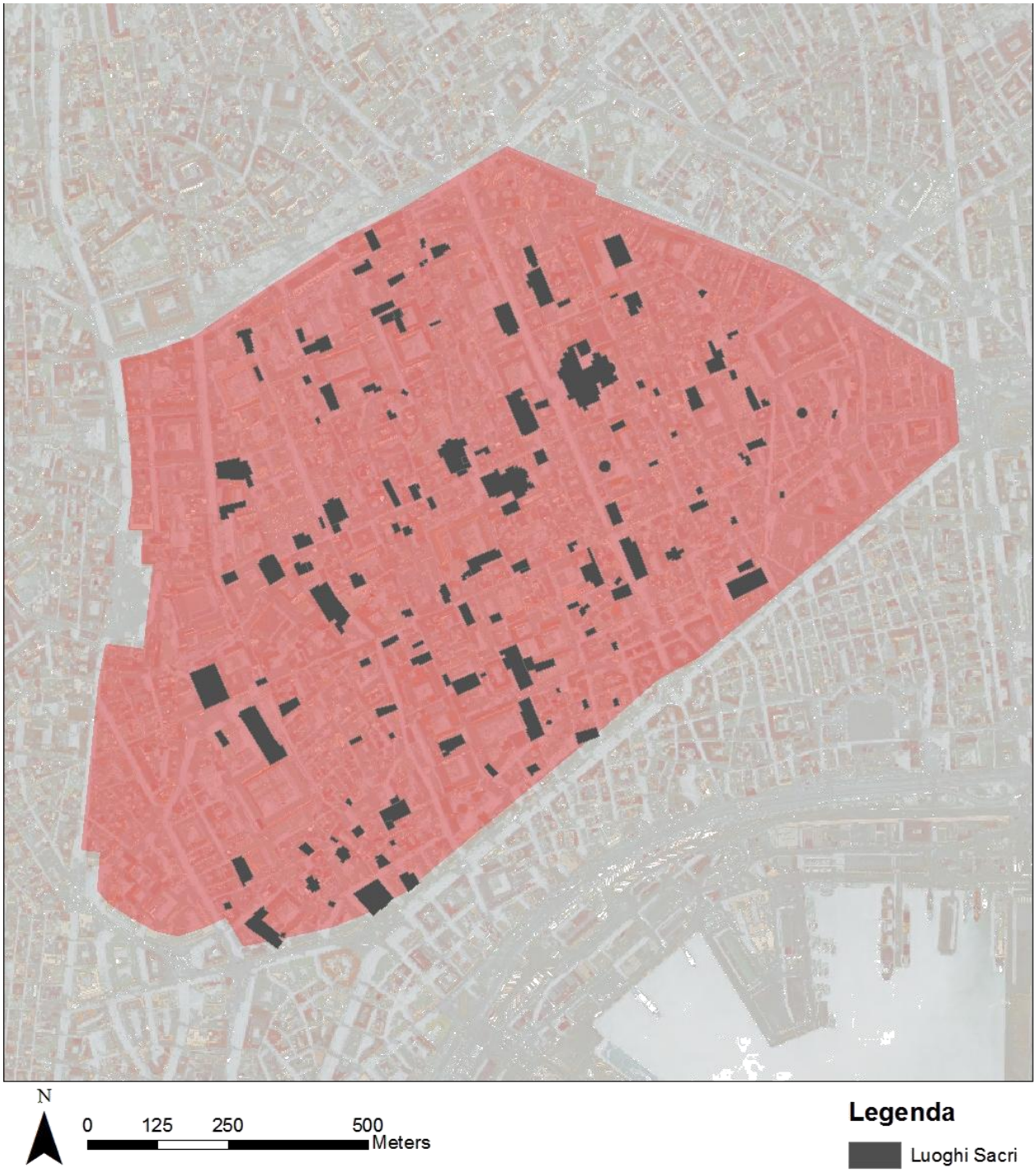

Fig. 2: Historic Center of Naples and sacred buildings on Ortophoto of Region Campania

1.3 The case study of Historic Center of Naples

During the research was made a selection of some cases studies including the cloisters of the church Regina Coeli, the Monastery of St. Andrea delle Dame, the church of Santa Chiara, San Giuseppe dei Ruffi and the church of Santa Maria delle Grazie. For each of them we have been collected certain historical information in order to have a reading of the changes undergone over time. The first step involved the reading on the cartography of Schiavoni in order to redesign the ancient drawing of each cloister.
It is a map designed for the city of Naples, in 1872, under the direction of Professor Federico Schiavoni.
On many of these specimens were subsequently drawn the most important projects of transformation of the city, between the end of '800 and the first half of' 900. Among them there are: the rehabilitation of the

neighborhoods on the track of today's Corso Umberto, the formation of the district Saint Lucia, the new districts Vomero and Arenella.
Cartography "Schiavoni", named after its initiator, formed over a long period, the base map of the City of Naples, as evidenced by its use, until 1940.
The monastery and the church of Santa Maria Regina Coeli was founded in 1590 according to the Augustinian order.
Work on the cloister was begun in 1682, it had a rectangular plan with cross decentralized; today is still such a system but with some changes of intended use. The area further south in fact serves as a football field.
Thanks to ancient map it is possible know the ancient system, without the drawing of ancient cartography maybe we could not know some layout of building of ancient Naples.
The complex of Santa Maria delle Grazie was founded in 1519 in the order of religious hermits Hieronymite; to the 800 the monastery was suppressed and incorporated in " Ospedale degli Incurabili".
The church of Santa Chiara was founded in 1310 following the order of the Poor Clares.
The various changes made over the centuries for various situation, also related to natural disasters, have also affected the Great Cloister and remained almost unchanged medieval Franciscan cloister, adjoining the former convent of the Friars Minor, which hosts since 1937 the nuns cloistered.
Nowdays, on the ground floor of the cloister of the Poor Clares there is the "museo dell'opera di Santa Chiara".
S. Andrea delle Dame, like most of the convent buildings arose in the sixteenth century, it was in a block with four equal sides and a large central courtyard with arches; its cloister is set according to the regular schedule of the Counter that, among others, saw substitute pillar square piperno stone the marble columns that support the arches in the courtyard Aragonese impression most decidedly Tuscan.
The formal setting of the cloister of St. Andrea delle Dame, has remained intact, despite the transformations nineteenth century; it consists of a succession of round arches, supported by pillars and topped faces framed by a curtain wall continuous, unlike in other cloisters of the Counter-Reformation, as San Gregorio Armeno, where instead accentuated the ' idea of sloping terraces in panorama function.
Its peculiarity lies in new proportions of the architectural elements, which in this case gives elegance to the whole at the expense of its monumentality.
This is interpreted as a significant reflection of the crisis lexical occurs in Neapolitan architecture in the post-Tridentine and which will find its solution only later, around half of the seventeenth century by Cosimo Fanzaga.
In order to preserve the memory of what was, literary sources and the mapping are an instrument of great value. The mapping may be, in fact, intended as a means of representation of the territory as document analysis and recognition of what has been lost; read the cartographic sources it means questioning of paths and shapes urban ancient to compare with the current situation. Rebuilding ancient layout through the tools of cartography, detection and aerial photos exploiting the ancient literary sources provides an important step in the direction of preservation. Representing an urban center in a given historical period is as giving a snapshot of that time and then preserve the memory of that place.

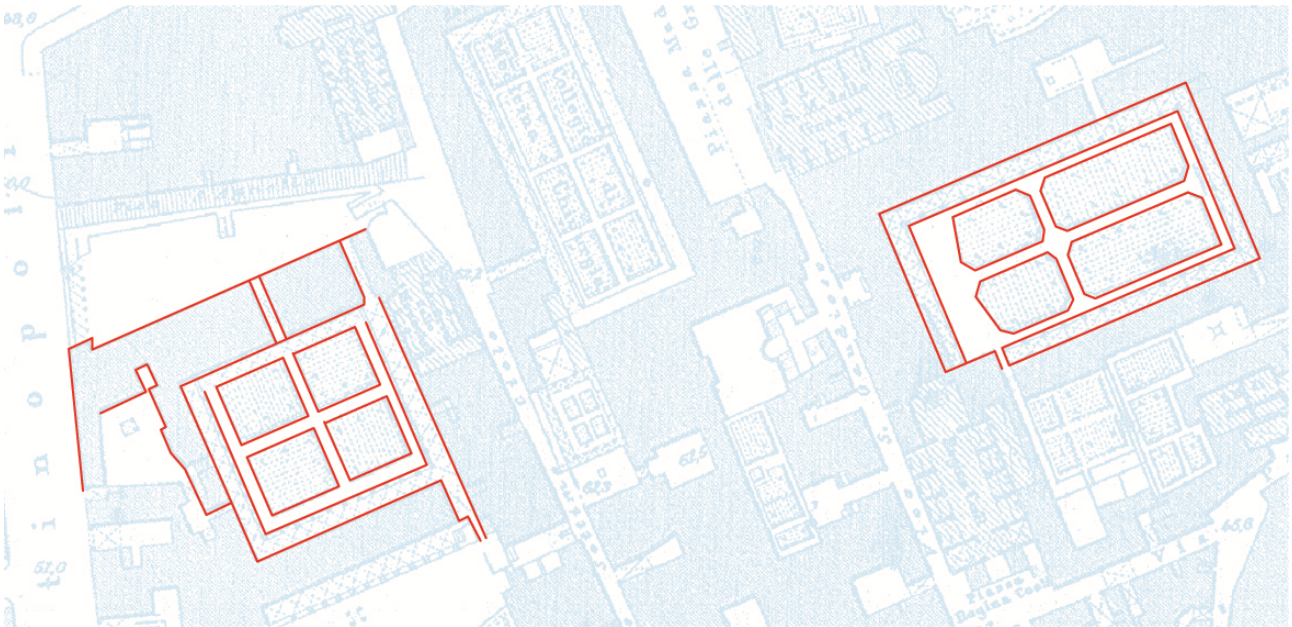

Fig. 3: Drawing ancient layout of cloister

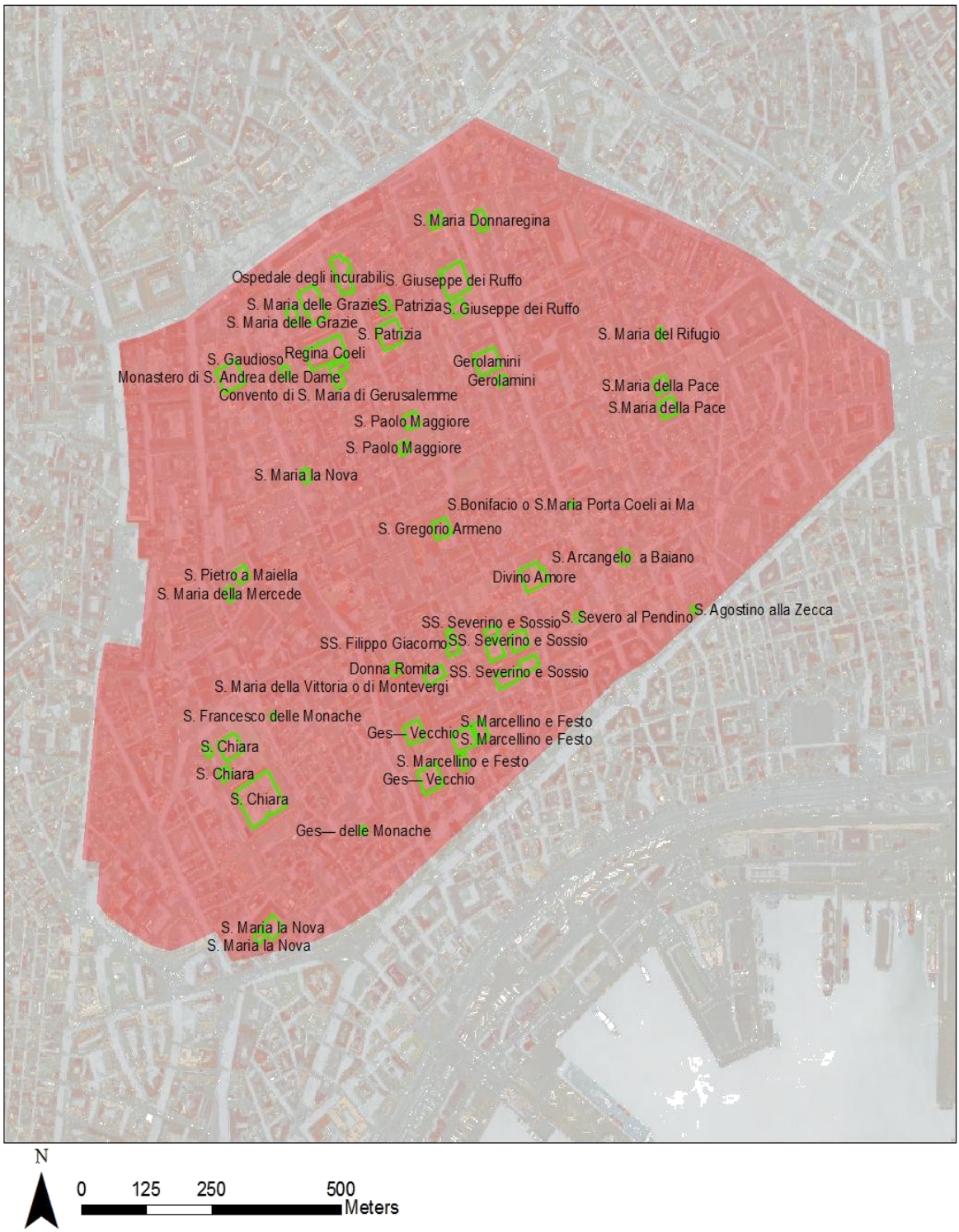

Fig. 4: Zoom on historic Center of Naples and cloisters on Ortophoto of Region Campania

In this research is possible notice the most of the buildings that host cloisters in Naples historical city centre have been adapted for a new specific use.
Some examples are university faculties, high schools or council dependencies. Therefore, some of them are totally close to the public, or open only during specific days or after having asked for permission. Some of them, more focused on tourism, require an entrance ticket, as it is the case of the Cloister of Santa Chiara, the most famous in the city.

1.4 Conclusions

The territory is the synthesis of evolutionary processes whose knowledge can direct its management and strategic decisions for optimal modification. Reading a comparison of the processed images from satellite data shows that the measurement and comparative analysis of data collected from different platforms can lead to a process of deeper knowledge of man-made and natural territory.

The Drawing and Survey can help provide a powerful tool to urban design of recovery and transformation. The analytical urban survey is translated in maps of a city or in the representation of a horizontal section of its masses built, as the outline of the blocks as distinct forms the background of the open space.

Cloister	Area
S. Maria Donnaregina	621
Donna Romita	347
Gesù Vecchio	2609
Regina Coeli	2683
S. Agostino alla Zecca	89
Monastero di S. Andrea delle Dame	1832
S. Arcangelo a Baiano	447
S.Bonifacio o S.Maria Porta Coeli ai Ma	66
Divino Amore	1690
S. Chiara	6883
Gerolamini	1822
S. Francesco delle Monache	121
S. Gaudioso	273
Gesù delle Monache	611
Gesù delle Monache	126
S. Giuseppe dei Ruffo	2941
S. Gregorio Armeno	897
Ospedale degli incurabili	1649
S. Maria del Rifugio	197
S. Maria della Mercede	341
S.Maria della Pace	1498
S. Maria delle Grazie	2614
Convento di S. Maria di Gerusalemme	860
S. Maria della Vittoria o di Montevergi	785
S. Maria la Nova	1178
S. Maria la Nova	298
S. Paolo Maggiore	1010
S. Patrizia	2211
S. Pietro a Maiella	539
S. Severo al Pendino	203
SS. Filippo Giacomo	655
S. Marcellino e Festo	2392
SS. Severino e Sossio	3826

Fig. 5: Cloister Table of attributes

Metaphorically the survey is more radiography that photography.
It is one of the drivers of change in the city as in representing it stimulates a consequent fate project, suggests arrangements congruent or discordant, preserves the product and affects the transformation.
The research aims to integrate the observations made on the comparison of satellite images with historical maps, with additional images available on-line as those of the Landsat satellites.
In this perspective it aims to test the integration between the survey and design traditionally understood with the modern techniques of remote sensing.
The goal is to operate a cross-disciplinary methodology that is a cultural orientation that use for the study of the territory of his study traditional integrated and consolidated with the data obtained from historical maps and digital images and remote sensing.
The search continues for a testing methodology to shaping the representation of a model from which you can extract all the information embedded-abstract object.
The territory is thus no longer represented by the method "Mongiano" projection on horizontal and vertical but as a living organism.
Discretization and extent are two actions that interacting allow the transition from a natural to a cultural knowledge.
The measure is related to a physicality that must be measured at all, to know the true depth of investigated object.
At the end of the research it has been possible to know approximately an comparison between the cloister area (in m²) and area (in m²) of total historic center of Naples (drawing according cardo-decumani layout). So you can notice that the area of cloister is only 3,3 % of the total area of the historic center of Naples.
In this historical city centre the dense concentration is especially noticeable, enhanced by the important presence of strong anthropic activity like to bars, shops, small open-air markets. Additionally, in the areas in which the traffic is not totally restricted, it is desirable some intervention to get better life situation.
The research wants integrate the information obtained by this study with the information contained in satellite image for study the evolution of the green area in this particular center.

Name	Area
Historic Center of Naples	1326954

Fig. 6: Cloister Table of attributes

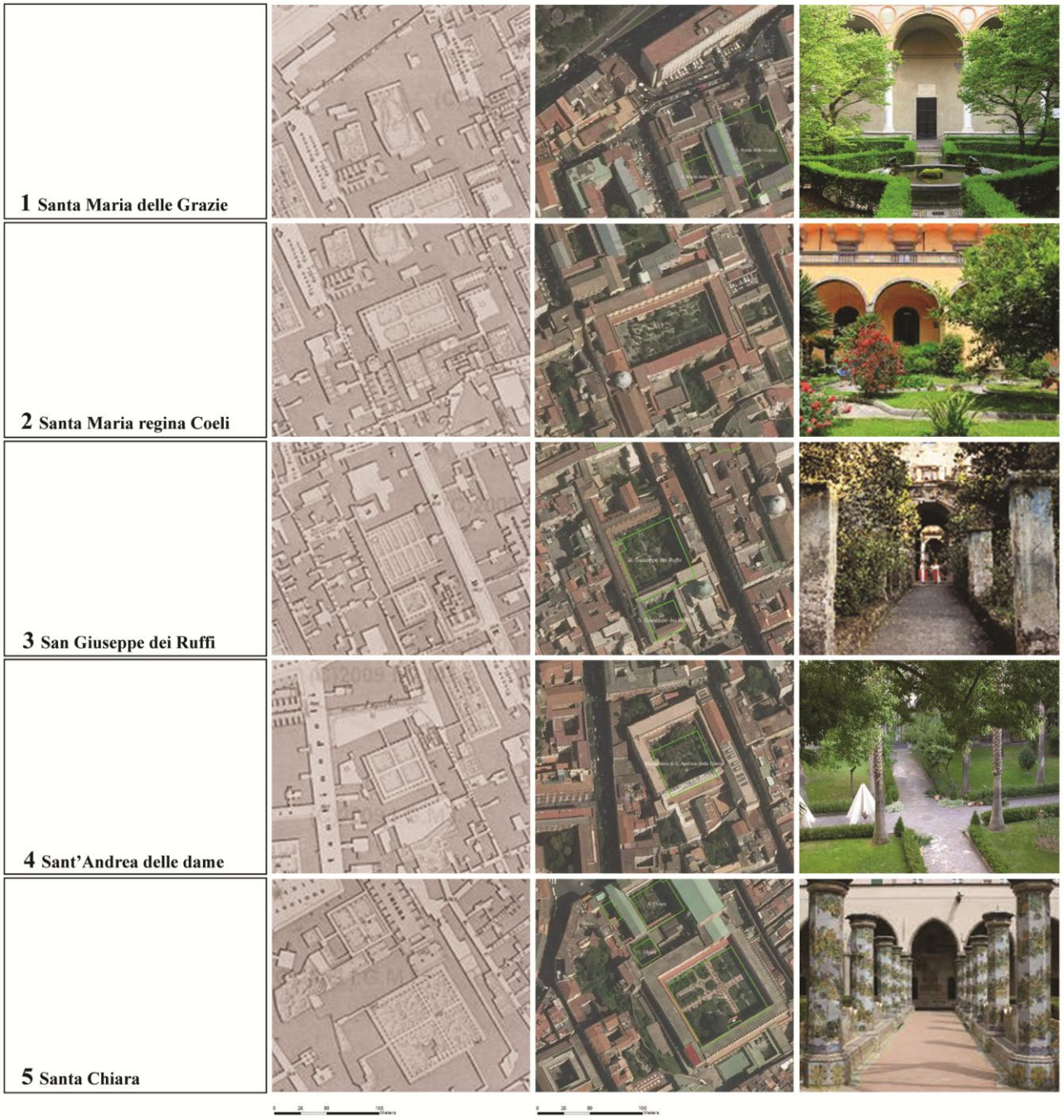

Fig. 7: Five Cloisters in the Center of Naples

Bibliographical References

[1] GAMBARDELLA, C. (a cura di), *Atlante di Pompei*, La Scuola di Pitagora, Napoli 2012.

[2] GUAITOLI, Marcello (a cura di). *Lo sguardo di Icaro. Le collezioni dell'Aerofototeca Nazionale per la conoscenza del territorio,* Campisano Editore, Roma 2003.

[3] BORENGASSER, M. (a cura di), *Hyperspectral Remote Sensing: Principles and Applications*, CRC Press 2007.

[4] SHAN, J., TOTH, C. (a cura di), *Topographic laser ranging and scanning*, CRC Press 2009.

[5] M. Borengasser (a cura di), *Hyperspectral Remote Sensing: Principles and Applications*, CRC Press 2007, Boca Raton FL

[6] J. Shan, C. Toth (a cura di), *Topographic laser ranging and scanning*, CRC Press 2009, Boca Raton FL

[7] C. Gambardella (a cura di), *Atlante di Pompei*, La Scuola di Pitagora, Napoli 2012

[8] C. Gambardella, N. Pisacane, A. Avella, P. Argenziano, S. Bastoni, G. Casbarra. *Technical and scientific protocol for the multitemporal airborne surveying*, in C. Gambardella, *Best Practice in Heritage, Conservation, Management form the World to Pompei, XII International Study Forum Le Vie dei Mercanti*. La Scuola di Pitagora Editrice, Napoli 2014.

[9] C. Gambardella, A. Avella, P. Argenziano, N. Pisacane, S. Bastoni, G. Casbarra *Attività di telerilevamento aereo multisensore per l'analisi multidimensionale del Paesaggio* Mediterraneo, in *Costruzione dell'Atlante del Patrimonio Mediterraneo*(RICERCA PRIN 2009-2011). *in corso di stampa*

[10] G. GAMBARDELLA, Ecogeometria in Venafro: identità e trasparenze. Napoli: ESI, 2001

[11] BUONDONNO A, CAPRA G F, GRILLI E, PARENTE R.,PISACANE N, ODIERNA P, ERRAGLIO R (2014). The "Agri+cultural" Heritage of "Two Sicilies" Borbone House. The Vineyard of "San Silvestro" farm in San Leucio (Caserta, Italy). In: Fabbrica della Conoscenza, XII International Forum Le Vie dei Mercanti. best Practice in -Heritage, Conservation, Management From the World to Pompei. Aversa, Capri, 12-14 giugno 2014, NAPOLI: La Scuola di Pitagora, vol. 46, p. 1397-1405, ISBN:978-88-6542-347-9.

[10] Referring Web Pages Web: http://www.igmi.org/, http://www.comune.napoli.it

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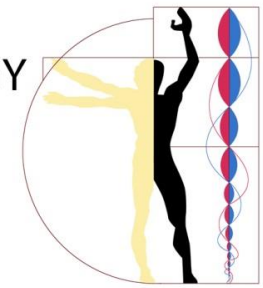

Digital Invasion at the Royal Palace of Caserta
Telling a story/Telling your story

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Abstract
In recent years there has been an evolution of cultural tourism from more traditional forms, based on the visit to museums and monuments, towards more dynamic and participatory forms, such as the tourism of territory, of landscape, the urban and training tourism, which led to a substantial change in the demand for cultural tourism. Abandoned the standardized model of research of the big event, the cultural tourism today is characterized by much higher levels of sophistication, information and empathy with the place, destined to a type of "cultural consumers" capable of entering into a virtuous connection with a wide range of urban and functional synapses.
In this context, the complexity of a place and its proposals can become a factor of tourist attraction if it is appropriately communicated through an information infrastructure that makes it usable, putting individuals in conditions of differentiate their experience, customize the paths and rebuild independently a dynamic identity.
The experience presented here was carried out in collaboration with the *Wandering* team of Tel Aviv, as an example of application of the web platform of cultural promotion entitled *Idio project*, which they presented in the paper ID 051 of these proceedings.
The application concerns the Royal Palace of Caserta, and was carried out with the participation of students at the Laboratory in *Multimedia Graphics*.

Keywords: Heritage, Communication technology, Interactive platform, Mapping, Sharing experience.

1. Interactive communication for cultural heritage
Within the large debate around the issues and the challenges about the management of our immense Cultural Heritage, an aspect now appears clearly: it is essential a sensitive displacement of the 'point of view' from which you need to look at the complex issue of cultural heritage.
A point of view that in recent years has produced interpretations - even the most attentive to the changes of scenery derived from the introduction of the new 'knowledge economies' - almost exclusively tied to a vision so to speak 'patrimonial' of cultural heritage, but not always focused on the essential role that heritage can play in its own dimension of *heritage*, namely of inheritance, with the whole meaning of identity that encompasses the beautiful English term when referring to the culture of a people. Instead, there is another way in which the cultural heritage can be interpreted as a factor of development: intending it as an extraordinary engine, which is essential to expand the 'mental infrastructure' that make people able to access new experiences, creating new values and, therefore, new economies related to culture. In this perspective, the Cultural Heritage is really able to "build a sense of belonging and identification; to stimulate the demand for consumption of culture by a market that is defined internal; to turn a 'private' idea of the cultural property into a 'relational' idea; to create the conditions for which should be determined the interweaving between cognitive and emotional relationships, that scholars of French heritage suggestively define patrimonial emotions" [1] in a process whose purpose cannot be limited to economic enhancement, but should seek the enlargement through the relationship with the cultural heritage, of the 'mental space', that is the necessary condition for it to build a society that is really oriented to the production of knowledge.

In this way seems to be directed the recent evolution of the concept of cultural tourism, from the more traditional forms, based on visiting museums and monuments, towards more dynamic and participatory forms, such as the tourism of the territory, of landscape, the urban and training tourism, which led to a substantial change in the demand for cultural tourism. [2]. Abandoned the standardized model of research of the big event, the cultural tourism today is characterized by much higher levels of sophistication, information and empathy with the place, destined to a type of 'cultural consumers' capable of entering into a virtuous connection with a wide range of urban and functional synapses.
The emerging model of Creative Tourism is based on the interaction even more than on the cultural context of visits, which is still relevant. The user must feel a real part of the cultural dynamics of the community, like a resident (and sometimes he can be!), so it is necessary to connect the new demands and the new awareness of the public with the peculiar cultural expressions of the territory. [3].
In this context, the complexity of a place and its proposals can become a factor of touristic attraction if it is appropriately communicated through an information infrastructure that makes it usable, putting individuals in conditions of differentiate their experience, customize the paths and rebuild independently a dynamic identity.
The experience of crossing and walking is central at this regard for the definition and sharing of the experience of visiting the city and its heritage, in the broadest sense of the term. "Si ha uno *spazio* dal momento in cui si prendono in considerazione vettori di direzione, quantità di velocità e la variabile del tempo. Lo spazio è un incrocio di entità mobili. [...] insomma, *lo spazio è un luogo radicato.* Così la strada geograficamente definita da un'urbanistica è trasformata in spazio dai camminatori. Allo stesso modo la lettura è lo spazio prodotto attraverso la pratica del luogo che costituisce un sistema di segni - uno scritto." [4].
In this context, the theme of exploration and crossing places, acquires a special significance in which it is possible to see today the meaning of some of the most common practices of territorial re-appropriation, carried out more and more often in effort to counteract the critical and homogenizing issues of globalization, through the urban exploration in its various forms. A scope that touches the issue of the use of cultural heritage. These are, in fact, tactics for re-appropriation of the identity values of places, that take place through a mapping, a practice somewhere between critical cartography and maps of the community, but also through immersive crossings, for the purpose of investigation, intervention, pure symbolic appropriation of the urban environment. These are deconstructions of the identity of places, seen as interweaving of complex relationships, perceptual and emotional experiences of the urbanized space, new 'maps' or new 'visions' through which hypothesize a sort of sense making, a new attribution of meaning to the places of the urban environment. Because exploring (on foot, by car, motorbike, bicycle, camper...) is at the same time a perceptive act and a creative act that takes shape through a 'path'. The meaning of this latter word encapsulates at the same time the idea of the physical act of crossing (the path as action), the idea of the trajectory, that is the line along which you cross the space (path as a route), and finally the idea of telling a story about the crossed space (the path as narration). In this sense, many points of reflection are offered to scholars of representation. Because just the idea of the path as a route and a story is evidently connected to complex action of the territory mapping. But the idea of the 'map' contains in itself wider narrative results, that today, interweaving with the development of new technologies, are declined in 'cross-media' forms of representation, where the new digital languages are intertwined with the new practices of participation, documentation, and with the widespread habit of leaving a trace of our passage in the atopic dimension of the Network. Through new routes of transmedia storytelling, today are put in scene collective urban representations on multiple and open platforms in which the contents are crowded, added together, overlapped, shared, confused.
The advent of the second informatics age, the web 2.0 (and even more 3.0), which corresponds to an unrestrainable process of capillary diffusion of new technologies and a substantial democratization process through the Internet, has produced a proliferation of territorial representations, in the form of maps, static and dynamic images, patterns, hybrid information "joined by the persistent need for a reference to the land, the geographic data, the space traceability to an idea vague and polysemy of place". [5]. It is a topic of great innovation and interest in the representation field, "whether we interrogate on the ability to define and describe the emergence of 'new visual languages', whether we reflect on the increasing need of translation and simplification of disciplinary knowledge in an optic of dissemination and citizen participation in the construction of their own identity, drawing their territory and constructing shared transformation scenarios". [6]. After all, the novelty is just this: the emergence of new subjects, users and consumers of territorial images, able to interact directly, although non-technical, with the process of production and exchange of new forms of representation of urban space. [7].
Thanks to the simplification of web-based tools, it is now easy to build maps, produce information, generate and share representations of places, especially of those to which you are devoted, linking it closely to the physical and emotional experience. Scholars have named this collective phenomenon as 'Neo-geography' [8] and the scale of the phenomenon is enormous not only if you look at this form of participatory mapping as a tool for shared administration of the territory (that is if you imagine to use these new maps as an effective,

intuitive and persuasive medium for the definition of processes of public action), but also and perhaps especially when you consider the significance of these practices in the use of the shared cultural heritage and landscape, in a dynamic that is intertwined with the more general theme of reflection about the role of ICT (Information and Communication Technology) increasingly engaged in the definition of 'social areas', as well as cultural horizons of collective and shared responsibility, in which to explore the increasingly close relationship between new media and use practices, involved around the idea of cultural heritage as a 'common good'.

In the definition of cultural paths, is in fact the information that builds a territory, representing the material and cultural resources that makes it special, as well as the user, choosing between several options, builds and expresses his identity. [9]. For cities thus it becomes important to try to root somehow their cultural events to make them irreproducible in other contexts. Basically it is to think in terms of building a place instead of marketing it.

The relationship between tourism and communication is strong and unbreakable, and this is especially true with regard to the cultural tourism. In this case, in fact, the creation of an offer includes the construction of an identity whose communication is an integral part of the product that you are going to define. The communication combines aspects of the real dimension (environmental, historical and cultural factors, infrastructures, services) and aspects of the perceptive dimension, namely the image that an individual or a community has about a territory.

The image of an area can be defined as the set of opinions, ideas and impressions related to a geographic location. In conclusion, the image is the result of a mental process of simplification and synthesis of huge amounts of data related to a territory. Walking through the streets connects reading a road map to living your life, the individual microcosm with the public macrocosm; it gives a sense to the labyrinth that is around. [10].

The imaginary of a city becomes a factor of attraction when the space described from literature or filmography builds a 'myth', a 'legendary city', where the visitor feels the desire to retrace with his own eyes itineraries lived through the narration of others and his own imagination.

Very often, the indirect communication, without promotional purposes, deriving from books, commercials, movies, music videos, sports or cultural events, is perceived as more reliable and persuasive by potential visitors. In particular, the movies can make reread many times a symbol city, or discover a place with a previously unknown power, a pervasiveness and potentially synesthetic involvement.

The perception of the identity of a place goes through three integrated phases: before the visit, through the direct or indirect advertising, the web sites and the comparison with the experiences of other travelers; during the visit, through the real contact with the peculiarities of the place; after the visit, in the memory of the experience, which will be the starting point for other visitors. [11]. In each of these stages, the experience is the key element on which to focus communication strategies, amplifying the perceptive horizons through the cultural exchange and the sharing of the memory, the uniqueness of the experience, the emotional aspects linked to a place, that lead us to talk about it involving other subjects.

2. An application in the Royal Palace of Caserta

A precious opportunity to test on the field the implication of the process just outlined, which is more a cultural and critic process than a technological one, has offered thanks to the collaboration of "The Wondering" [12], a company formed by a team of researchers based in Tel Aviv, that for some years promotes in different national and international institutions the use of its platform *Experiencity,* in order to encourage processes of social learning and construction of collective identity through mobile systems and clouds technologies.

In collaboration with Idit Goldfisher, Partner & Italy Country Manager, responsible for the dissemination of the system in Italy, and Shani Ziv, co-founder and visionary of the platform in terms of information and system technology, we organized a workshop which was attended by students of the Laboratory of Multimedia Design of the bachelor degree in Design and Communication in the Department of Architecture and Industrial Design of the SUN.

It was clear since our first contacts that we shared an identical attitude to consider the cultural heritage as an experience to live and as a valuable opportunity for cultural growth through the new methods of social learning and game with collective participation. The idea was therefore to use the Wondering platform to build a data system about the royal palace of Caserta, considered as a case study on which to test the system's potential in terms of activator of processes of collective re-appropriation of a place or a cultural heritage. In this sense, the choice of the royal palace of Caserta has not been done to the case. The wonderful architecture by Vanvitelli, the park, the numerous treasures it holds, are an extraordinary heritage which however suffers from a lack of connection with the city of Caserta, where the circuits of visits are very old-fashioned and unimaginative as, in its set, the whole communication strategy.

The Workshop was articulated in five days, in which students were able to understand the dynamics of the IT platform, to interact with it, to build data through personal experience and to share it with others. [13]. During all the activities of the workshop, which ended with a collective experience of interactive gaming in the park, the magnificent spaces of the Palace became a place to dive with their senses and emotions, and where to

try to activate strategies of using space and playing that allowed the magnificent spaces of the Palace to be inserted in a circuit of 'possible experience', of places to touch and interact with.
The experience, made possible by the organizational collaboration of the 'Friends of the Palace' and the dr. Anna Maria Romano, head of the Historical and Artistic institution, has offered in terms of teaching as an interesting opportunity to test processes of social learning, not usual in the academic educational paths.
It has been interesting to lead the students to think about problems of concept and process, rather than about a specific multimedia product. In order to use an existing platform and verifying its potentialities and weak points, it has been an interesting critical exercise for both teachers and students. Useful considerations about data flows, cognitive processes and communication strategies were shared in a useful way, providing a good experience of cooperation between the Wondering and the Department of Architecture and Industrial Design of SUN, that we hope can continue.
The final product, which is a prototype, provides valuable indications on how the process of collective narration, constructed by individual pieces of shared experience, can be effective from the point of view of learning and enjoyment. Infinite are the 'applications' of the information assets that could be generated following the experience of the Royal Palace, customizing applications for different visitors targets and different outcomes. There is only to hope that the experience will continue on specific projects linked to the current guidelines of the Ministry of Culture, that leads all the actors of the cultural process to act in the direction of greater participation and sharing of experiences related to Cultural Heritage.
The following images show the realization of the prototype.



ExperienCity

strole around the garden

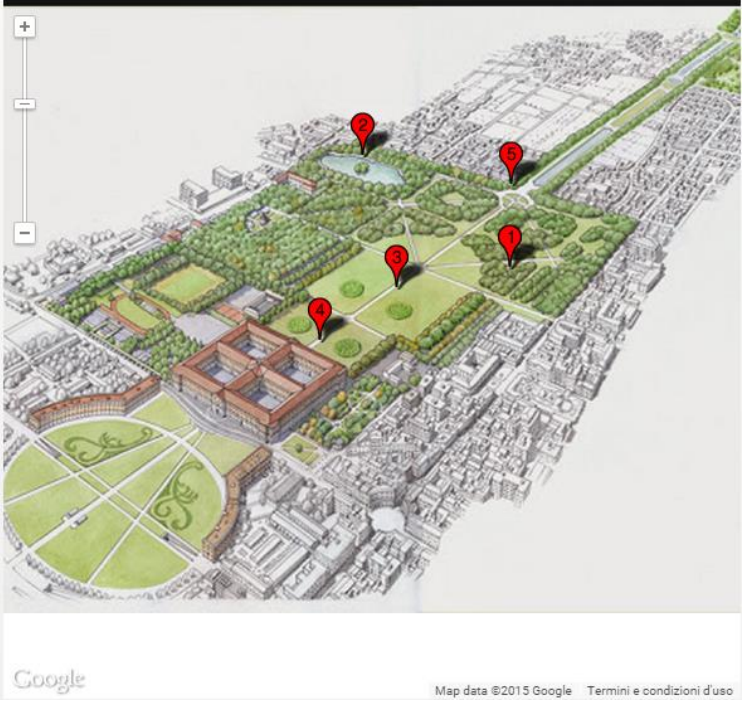
great places to look for



Filters by tags

- Caserta
- street
- passante
- passerby
- bystander
- invite
- vasca
- fontana
- pesci

Stations



ExperienCity

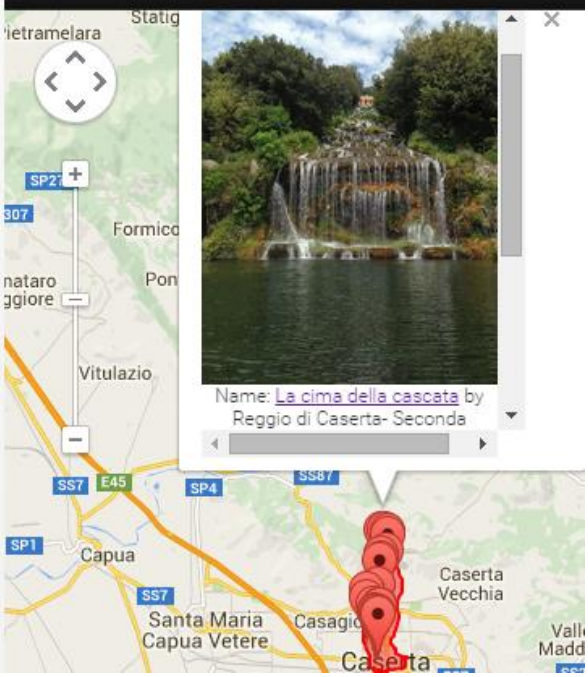
event Reggio di Caserta

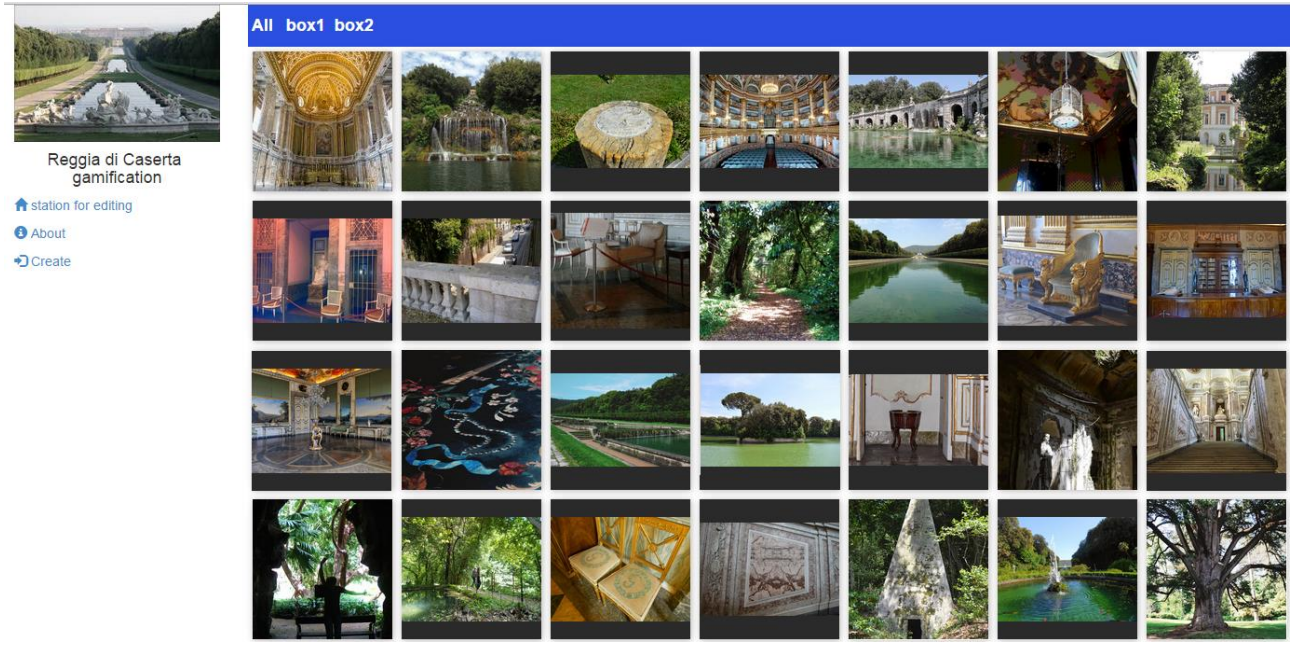
time to meet



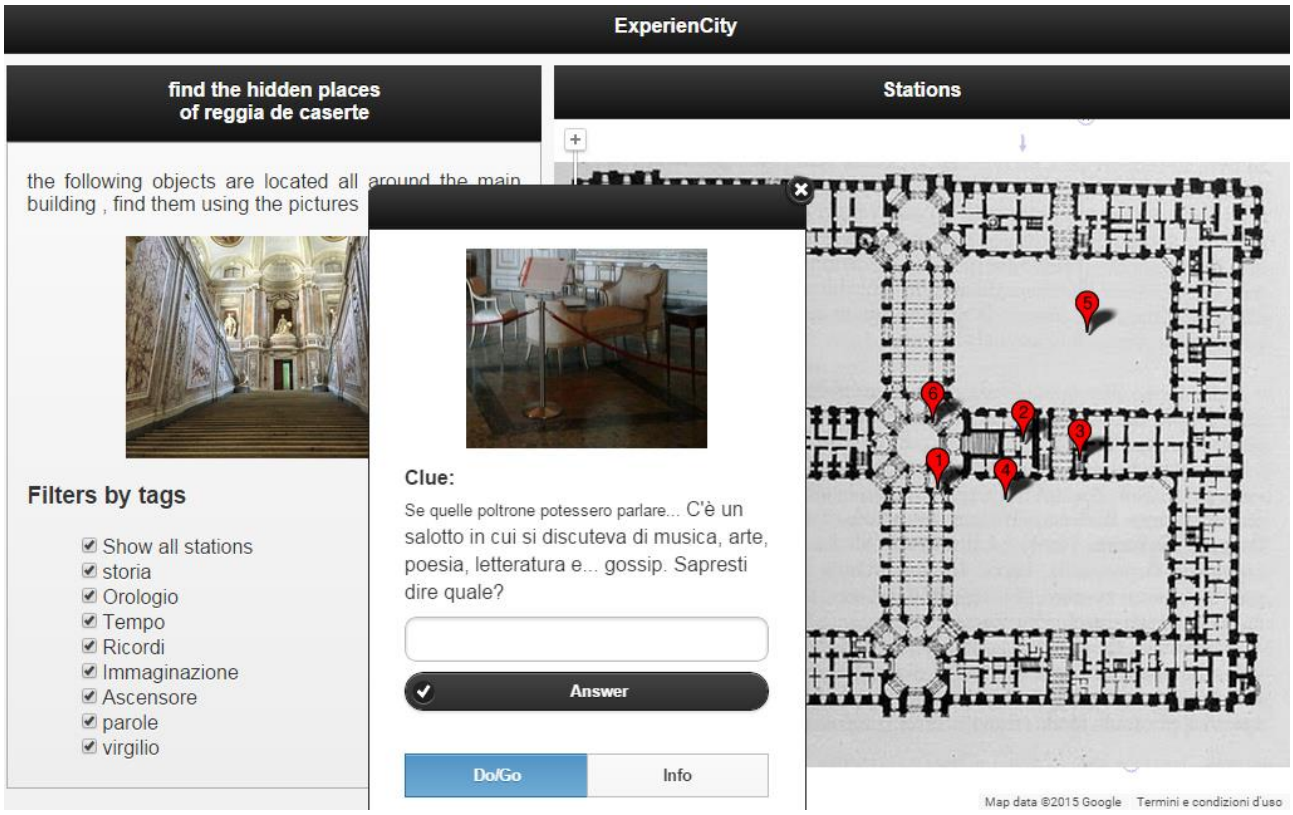
Filters by tags

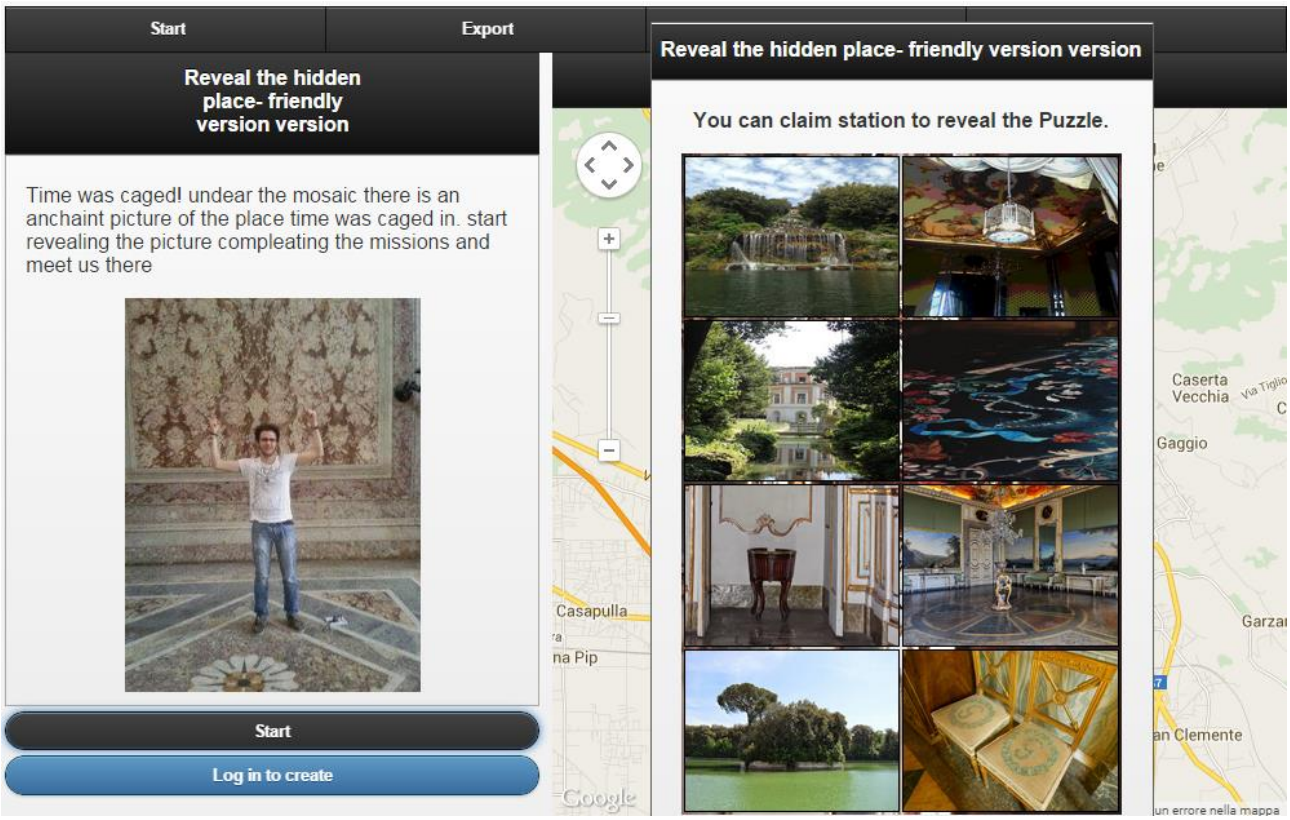
Stations




Reggia di Caserta
gamification
station for editing
About
Create
All box1 box2




ExperienCity
find the hidden places of reggia de caserte
the following objects are located all around the main building , find them using the pictures
Filters by tags
Show all stations
storia
Orologio
Tempo
Ricordi
Immaginazione
Ascensore
parole
virgilio
Clue:
Se quelle poltrone potessero parlare... C'è un salotto in cui si discuteva di musica, arte, poesia, letteratura e... gossip. Sapresti dire quale?
Answer
Do/Go
Info
Stations
Map data ©2015 Google
Termini e condizioni d'uso


Start
Export
Reveal the hidden place- friendly version version
Time was caged! undear the mosaic there is an anchaint picture of the place time was caged in. start revealing the picture compleating the missions and meet us there
Start
Log in to create
Reveal the hidden place- friendly version version
You can claim station to reveal the Puzzle.
Casapulla
Caserta Vecchia
Gaggio
Google



Notes and Bibliographical References

[1] CIRAFICI, Alessandra. *Dal valore astratto al valore condiviso. Misura e identità nella comunicazione per i beni culturali*, in GAMBARDELLA, Carmine, PISCITELLI, Manuela, IANNOTTA, Fabio (a cura di), *Misura e Identità*, Napoli: La scuola di Pitagora, 2007, p. 226.

[2] CUSIMANO G., GIANNONE M., *Turismi culturali: dai macroprodotti ai segmenti di nicchia*, in: *XV rapporto sul turismo italiano 2006/2007*, Rubbettino Editore, 2007.

[3] PISCITELLI, Manuela. *Comunicazione visiva e grafica per un "turismo creativo" nei centri storici.* In: (a cura di): Gambardella C, Le Vie dei Mercanti. SAVE Heritage. Aversa, Capri, 9-11 giugno 2011. Napoli: La Scuola di Pitagora, 2011.

[4] DE CERTEAU, Michel. *L'invenzione del quotidiano, L'invention du quotidian. I Arts de faire* (1990); trad. it. *L'invenzione del quotidiano*, Roma: Edizioni Lavoro, 2001, p. 176.

[5] VILLA, Daniele. *La rappresentazione del territorio fra vecchie carte, nuovi strumenti e nuovi soggetti* in SALERNO, R. (a cura di) *Teorie e tecniche della rappresentazione contemporanea*, Milano: Maggiolo, 2011, p.140.

[6] Ivi, p.139.

[7] This is the final and astounding step of this process: the introduction of the concept of database updateable in real time, and thus the birth of the idea of 'collaborative map'. This is the last frontier of the cartographic representation derived from the silent, but sensational revolution due to the introduction of the Web 2.0, that has changed again, and not only in the field of cartography, the dynamics of creation, use and

sharing of information, opening definitively to what is now commonly known as the season of the sharing economy.

On this topic, see also: *Mappe e dintorni. Geografie della comunicazione* in SALERNO, R. (a cura di) *Teorie e tecniche della rappresentazione contemporanea,* Milano: Maggiolo, 2011, pp. 129-138.

[8] The definition by the geographer Michael Goodchild as 'Geographic Information Voluntary' (VGI) defines its meaning even better. GOODCHILD, M.F. *Citizens as Sensor: the World of Voluntareed Geography*, in "GeoJournal" 69 (4) Springer 2005.

[9] URRY, J. *Lo sguardo del turista*, Roma: Seam, 1995.

[10] SOLNIT, Rebecca. (2000). *Wanderlust. A history of walking*. Trad. it. *Storia del camminare*, Milano: Bruno Mondadori, 2002, p. 11.

[11] AUGÉ, Marc. *Rovine e macerie. Il senso del tempo*, Torino: Bollati Boringhieri, 2004.

[12] The Wandering team is composed by several experts, mainly based in Israel where the project was started, continuously developing and operating a platform built to exploit location based studying and teaching, using mobile and cloud technologies. Wandering is a technology knowledge platform, generating engaging activities for learning, training, team building, research and fun. Users can practice, comment, create, share, rate, organize and certify experiences generated by others. Activity related content is the core essence of the platform that brings people back to the community as active players and builds a vibrant community over the platform.

[13] Knowledge is created around physical locations called "stations" - points of interest, social hubs, historical sites, public attractions - and is retrievable and usable all over the world. Station based content is where people can meet to create and share experiences over the Wandering platform. The platform leverages advanced mobile cloud technologies and network applications to connect individuals, groups and communities in collaborative and productive experience. With more members participating and creating on the platform over time, a universal repository of knowledge, experiences and relations grows in the virtual space for current and future use by individuals and communities.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Charles and Georges Rohault de Fleury illustrators and historians of the medieval architecture.

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Abstract
At the end of the XIX century Charles and Georges Rohault de Fleury published, in Paris, *Les Saints de la Messe et leurs Monuments*, a work made of ten volumes based on the principles of the medieval architecture with a Christian matrix, founded on the themes of the neo-liturgism, ecclesiology, and the history of the architecture of the early-Christian period and of the medieval age. Artists, architects, archaeologists and historians, examined and recreated the origin and the spread of places of worship connected to specific figures of Saints, highlighting religious, cultural and structural influences. The text of the volumes is part of a great research work started by Charles and continued and completed with excellent graphic tables realized by the son Georges. Some of these tables were made of real drawings, while others were realized on the basis of historical sources. In the various volumes of the work the authors examine places and architectures including historical, liturgical, archaeological and architectural themes, providing informations not always comprehensible. Maybe the volume structure, that is the study of the examined monuments starting from the figures of the Saints which are dedicated, makes the syntax of this work hard to comprehend especially for the history of the medieval architecture to which they furnish rich and articulate informations. Especially the graphic tables, unfortunately devoid of an adequate critical apparatus, if conveniently correlated to cartographic and documentary sources can be an incredible instrument for the historicization of the architectural structures of the Middle Ages.

Keywords: architecture, Middle Age, drawing, XIX century.

1. Life as research: Charles and Georges Rohault de Fleury
Charles Rohault de Fleury, French architect, author of many buildings in the Paris of the nineteenth century, and of formidable volumes about archaeological and religious themes, was born in Paris in 1801, son of the architect Charles Hubert Rohault de Fleury (1777-1846) [1], author of a *Voyage*, handwritten notes about his trip in Italy, equipped with small drawings[2].His uncle, the Baron Hubert Rohault de Fleury, was a military engineer[3].
Charles began his studies at the l'École Polytechnique in Paris[4], initially focusing on the sculpture and later on the architecture[5] as an apprentice of the architect Louis Hippolyte Lebas, at the School of Belle Arti (Fine Arts). In 1823, after the conclusion of his studies, he was appointed as inspector of police stations in Paris and in 1827 he won an award for the project of the Palace of Justice in Lille. In 1832 he was appointed as architect of the Museo di Storia Naturale in Paris (Museum of Natural History in Paris), for which, between 1832 and 1838, he designed the Galleria di Mineralogia e Geologia (Gallery of Mineralogy and Geology) and the "palazzo delle scimmie" ("palace of the monkeys"): using, in an original manner, glass for the construction of greenhouses that became a reference model for later buildings made of iron and glass[6]. In the meantime, he continued his activity of architect in the city of Paris for the construction of hospitals and hospices. His fame grew up to exhibit at the Salon of Paris in 1837. In 1861 he became an official of the Legion of Honour, of which he was nominated knight in 1843. He realized many infrastructural works and was the author of many projects, only partly realized, of hippodromes, hotels, theaters, zoological gardens, urban residences and non-urban areas especially in Paris, but also in Marseille, Brussels, Poitiers. Numerous drawings, plans and manuscripts documenting his intense and varied activities as an architect are currently stored at the Canadian Centre for Architecture in Montreal and at the Bibliothèque nationale de France[7]. Simultaneously at the activity of architect, he began to devote his time to erudite research

publishing, in chronological order, *Mémoire sur les instruments de la passion de N.-S. Jésus-Christ* (Paris,1870), *L'Évangile: études iconographiques et archéologiques* (2 voll., Tours, 1874); and his other texts as *La Messe. Études archéologiques sur ses monuments* (8 voll., Paris, 1883-1889) and *Les Saints de la Messe et leurs monuments* (10 voll., Paris,1893-1900) were completed and published by his son Georges. His sons, Hubert Rohault de Fleury, became a painter and was decisive in the construction of the Basilica of the Sacre Coeur in Paris[8], while Georges Rohault de Fleury, who trained as an architect, specialized in archeology and art history. The collaboration of Charles Rohault de Fleury with his young son Georges lit, starting from the sixties of the nineteenth century, the interest of the latter for archaeological and religious studies: it will be, as already mentioned, his son to take care of the publication of some works of his father[9]. Charles Rohault de Fleury died in 1875.

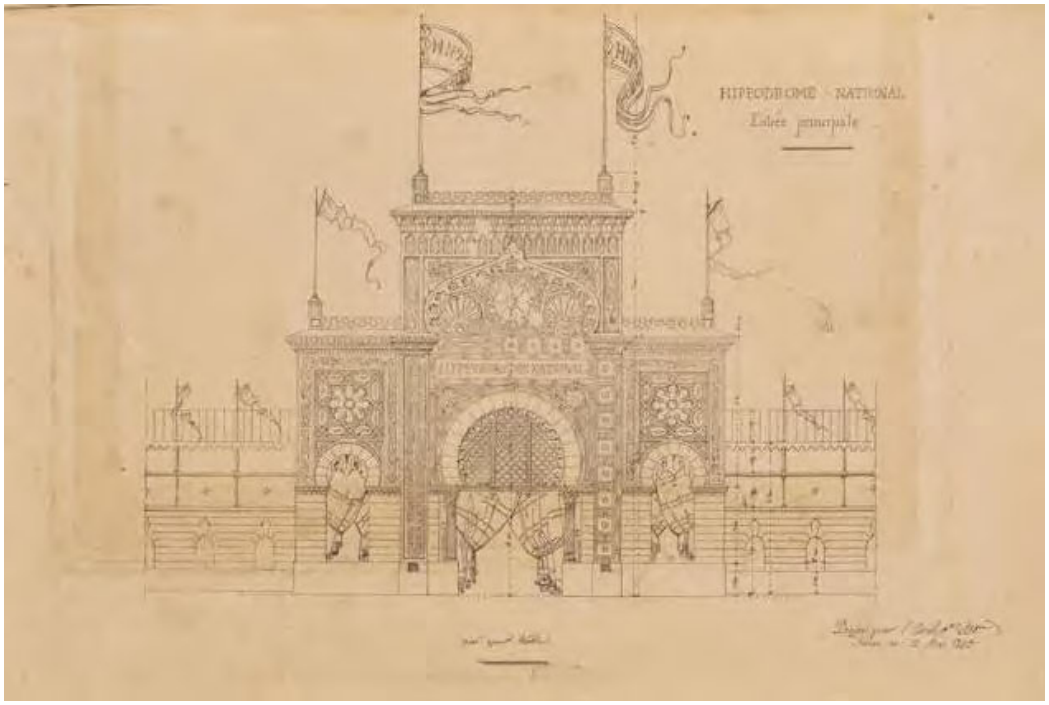

Fig. 1: Charles Rohault de Fleury, Hippodrome national de Paris, elevation for the principal entrance, 12 May 1845. Collection Canadian center for Architecture, Montreal.



Fig. 2: Charles Rohault de Fleury, Project for an opera house for the Théâtre Imperial de l'Opéra, cross section throught the auditorium showing the interior decoration (1859-60). Collection Canadian center for Architecture, Montreal.

Georges Rohault de Fleury was born in Paris in 1835. He inherited his taste for art from his grandfather and his father, Charles, both architects. He accompanied his father on his travels through Europe and was with him in London in 1851 for the *Exposition Universelle*. He attended courses in Architecture at the School of Fine Arts in Paris, even if he did not follow the career of his ancestors, preferring to pursue his interest in the history of art: he studied the late-Gothic art in France. Thanks to some scholarships, he went many times in Italy, which became the main object of his studies. He spent long periods in Florence and Rome. Decisive in his education was the father Charles, of which he continued the work, using the research of the father as a documentary base to build his artistic interests, mainly focused on the Middle Ages. The beginnings of the medieval art, analyzed through the biographical reconstruction of the lives of the Saints, are illustrated by Georges in a "catalog raisonné" about places of worship, with a singular approach linked to the themes of the nascent history about religious architecture, which, during the nineteenth century, as a result of the rediscovery of the Middle Ages by the Romance, recovers *memoriae christianae* as a fundamental factor of national identity, in the wake of European revivals[10]. It is no coincidence that among the sources that the author mentions there is also the contemporary Giovan Battista de Rossi, pioneer and founder of the Christian archeology, as well as an archaeologist and an expert epigraphist[11]. In particular, monuments and arts of the medieval Tuscany and of the city of Pisa were the subjects of his first publications, which he dedicated the volumes *Èdifices de Pise: reléves, dessinés et décrits* (Paris, 1862), *Le monuments de Pise au Moyen âge* (Paris, 1866), *La Toscane au Moyen âge: architecture civile et militaire* (Paris, 1870) [12]. Later he enlarged his interest at later ages, but remaining faithful to his main passion. All his activities and his researches were always accompanied by sketches, drawings, miniatures, characterized by great attention to detail and a true reproduction of reality, how it was usual for travelers. Even his grandfather, Hubert Rohault de Fleury had made a trip to Italy in 1804 creating a manuscript, *Voyag*e, to which Georges inspired to complete and equip its works with drawings made by his grandfather, who, having gone to the Peninsula to visit the main cities, as was custom, he came into contact with prominent figures of the cultural world of the time[13].

In 1893 Georges Rohault de Fleury published ten volumes of *Les Saints de la Messe et leurs Monuments*, a work created by the father Charles, but completed and equipped with the drawings of Georges. The work, compared to his other works, is still little known in Italy, so as not to be even in the biographies of the author or in specific studies relating to its activity, despite the significant historiographic interest of the researches and the documentary value of the rich iconographical equipment, made of drawings included in the text or in its margin and numbered tables and attached at the end of each volume. Georges Rohault de Fleury died in Paris on November 12, 1904.

2. Les Saints de la Messe et leurs Monuments

Les saints de la Messe vivent non seulement en Dieu, mais aussi parmi les hommes. Ils ont conquis le monde et rappelé leurs conquêtes immenses sur les autels qu'ils ont marqués de leurs noms dans les innombrables lieux où leur patronage s'est établi. Cette vie est celle qui vibre dans l'âme des peuples, de sorte qu'il faut, pour l'écrire, montrer leur vénération et en suivre les phases glorieuses. Or la vénération s'exprime par les monuments qui nous en conservent le témoignage, et les monuments doivent être exposés ici comme les meilleurs documents de cette histoire" [14].

The first volume of the work begins with an introduction on the objectives of the ample publication, published in ten volumes. The author's desire is to continue his father's work analyzing the buildings of the early Christian period to preserve their memory, by intersecting the history with the hagiography of the saints to which they are dedicated, because: *On peut* falsifier *un manuscrit, dont l'original a presque toujours disparu; mais un édifice, tant qu'il est debout, reste un témoin incorruptible ; on peut le mutiler, couvrir les vieux murs de stucs, on peut même le défigurer sous les trop habiles restaurations de nos jours, mais les mutilations demeurent visibles, les stucs tombent et l'habileté moderne se trahit souvent elle-même. Un édifice de pierre est, plus que les riches reliquaires, à l'abri de la cupidité humaine, il traverse mieux les siècleset nous offre un des jalons les plus sûrs de notre exploration.* The objectives of this project are already clearly expressed in the introduction: starting from Rome and from places of worship dedicated to the first Saints, continuing through streets and itineraries of the cult with the analysis of the buildings in Italy, France, Germany, Netherlands and in the countries of the Mediterranean, following the routes of the transfer of the relics, to build a sort of geography of Christian devotion. In short, the proposal of Georges Rohault de Fleury is to build a monumental history of art and architecture, starting from the Saints who have inspired it. At the basis of the history of architecture, mainly built through the characters and not only by places and monuments, there is an axiom: the cult linked to a figure born in the place in which it operates; The movement of men facilitates the movement of ideas and, when it happens, these ideas take root even at distant places. As Georges Rohault de Fleury affirms: *"Les translations de reliques déterminent aussi les progrès de ce culte ; elles déterminent les routes qu'il a suivies, les conquêtes qu'il a faites. Le long des routes que les saintes châsses ont parcourues, nous observons des églises en l'honneur du titulaire, à peu près, si l'on nous permet la comparaison, comme les chariots qui reviennent de la moisson laissent de leurs gerbes tomber,*

sur les bords du chemin, des graines bientôt fécondes" . The places examined in the work are places visited by Charles and Georges Rohault de Fleury in their travels and, before, by the grandfather Hubert. Rome, capital of the terrestrial kingdom of God, is the reference point identified by the author as a center that elaborates and makes official the Christian cults, in the name of which many people move great masses of ground and stone and build monuments suitable to exalt the life of the most devoted servants of the Lord. From Rome, the official cults return to the places of origin and expand in other European nations, especially France, Germany and England. This criterion is adopted by our author looking for monuments associated to various sacred figures. The realization of this ample work was possible thanks to the numerous contacts that Georges Rohault de Fleury had with various erudite persons from all over Europe, which sent him information, documents, sketches, drawings and prints of the monuments object of his study. Among his sources he mentioned Ferdinando Ughelli and Ludovico Antonio Muratori, but also his contemporaries Giuseppe Cappelletti, author of *Le chiese d'Italia dalla loro origine sino ai nostri giorni* (1844-1879) and Georg Heinrich Pertz, german historian and archivist, expert philologist of medieval documents, director of the work *Monumenta Germaniae Historica*.
So this is a work that could be called choral, because, without the support of this network of friendships and acquaintances, it would be impossible to propose a synoptic view of the monuments associated with the cult of Christian saints examined. But beyond the hagiographic and historical value, the most interesting part of the work for the study of the history of architecture, is made up of the numerous drawings and reliefs, included in the tables attached at the end of each volume, tables realized by Georges de Fleury Rohault himself, also proposing critical reconstructions of the analyzed monuments. The historical education and the passion for archeology allows him to use bibliographic and iconographic sources with a great documentary importance, and to formulate interpretative hypothesis of the ancient religious buildings with a great interest. The first book, dedicated to the Sante Vergini, opens with a treatise of the monuments associated with the Vergine Maria, and continues with Santa Celilia and Sant'Agnese. In the second volume are examined monuments consecrated to Sant'Agata, Santa Lucia, Sant'Anastasia, Santa Perpetua, Santa Felicita, San Crisogono and Santi Giovanni e Paolo. The third volume is dedicated to Santi Lino, Cleto, Clemente, Alessandro, Cornelio, Cipriano and Sisto. The fourth, instead, is entitled to Santi Ignazio, Marcellino e Pietro, Lorenzo. Santo Stefano and the Santi Cosma and Damiano are the subject of the fifth volume. The sixth volume is only about San Pietro, to whom is also dedicated part of the seventh volume which illustrates the monuments of Santi Paolo, Filippo, Giacomo Minore. The eighth volume is about San Giovanni Evangelista and San Giacomo Maggiore. San Bartolomeo, San Matteo and San Tommaso occupy the ninth volume; Finally, the tenth volume is dedicated to the Saints Andrea, Simone and Giuda, Mattia, Barnaba, Giovanni Battista and a brief discussion of the iconography of the Lamb of God.

3. The Kingdom of Naples

In the volumes of *Les Saints de la Messe et leurs Monuments*, Georges Rohault de Fleury records the presence of numerous buildings in the Kingdom of Naples, some of these accompanied by a description, other illustrated by a table made up of summary sketches or of detailed technical drawings, particularly interesting for the study of architecture and for the reconstruction of the original configuration of the structures. Often, in the tables are included details of decorative, sculptural and pictorial elements, which, however, are beyond the interests of the present study. In some cases, the tables contain excerpts of cartography, representations taken from ancient codex and manuscripts of monastic archives no longer existing, as well as details and information provided by scholars correspondent with Rohault de Fleury and by the consultation of some of the best known guidebooks of the city; the most frequently mentioned are the *Descrittione dei luoghi sacri della città di Napoli* by Pietro de Stefano (1560), *Napoli sacra* di Cesare d'Engenio Caracciolo (1623), *Napoli città nobilissima, antica, e fedelissima* by Domenico Antonio Parrino (1700), in addition to the historical and archaeological research by Francesco Savoia di Cangiano and by Gennaro Aspreno Galante. In particular, one of the most used cartographic sources for the city of Naples is the *Neapolis urbs to verissimam effigiem* designed by Carlo Theti and engraved in 1560 by Sebastiano del Re, consulted by Georges at the Bibliotheque Nationale de France, but found and brought to the knowledge of the scientific community in 1990[15]. The planimetry is used as an iconographical source to furnish proves about the existence of a church of Sant'Agata in the city of Naples, which, he sustains, is no longer indicated in the later planimetries[16]. The cult of Santa Agata in Naples is also proved by the presence of her images in the Catacombs of San Gennaro, reproduced with an accurate drawing in the Table IX. In the city of Naples the author noted relics and chapels dedicated to Sant'Agata in various churches, as, for example, the chapel of Sant'Agata in the church of San Paolo Maggiore. Near the town of Aversa, Rohualt de Fleury indicates the presence of a church dedicated to Sant' Agata, of which he reconstructs the documentary traces in the Norman diplomas of XI and XII century. In fact, the historiographical sources indicate the presence of a "borgo di Sant' Agata" ("village of Sant 'Agata"), outside the original walls of Aversa, in which there were a monastery and a church dedicated to the Saint, no longer existing since the mid-nineteenth century[17].

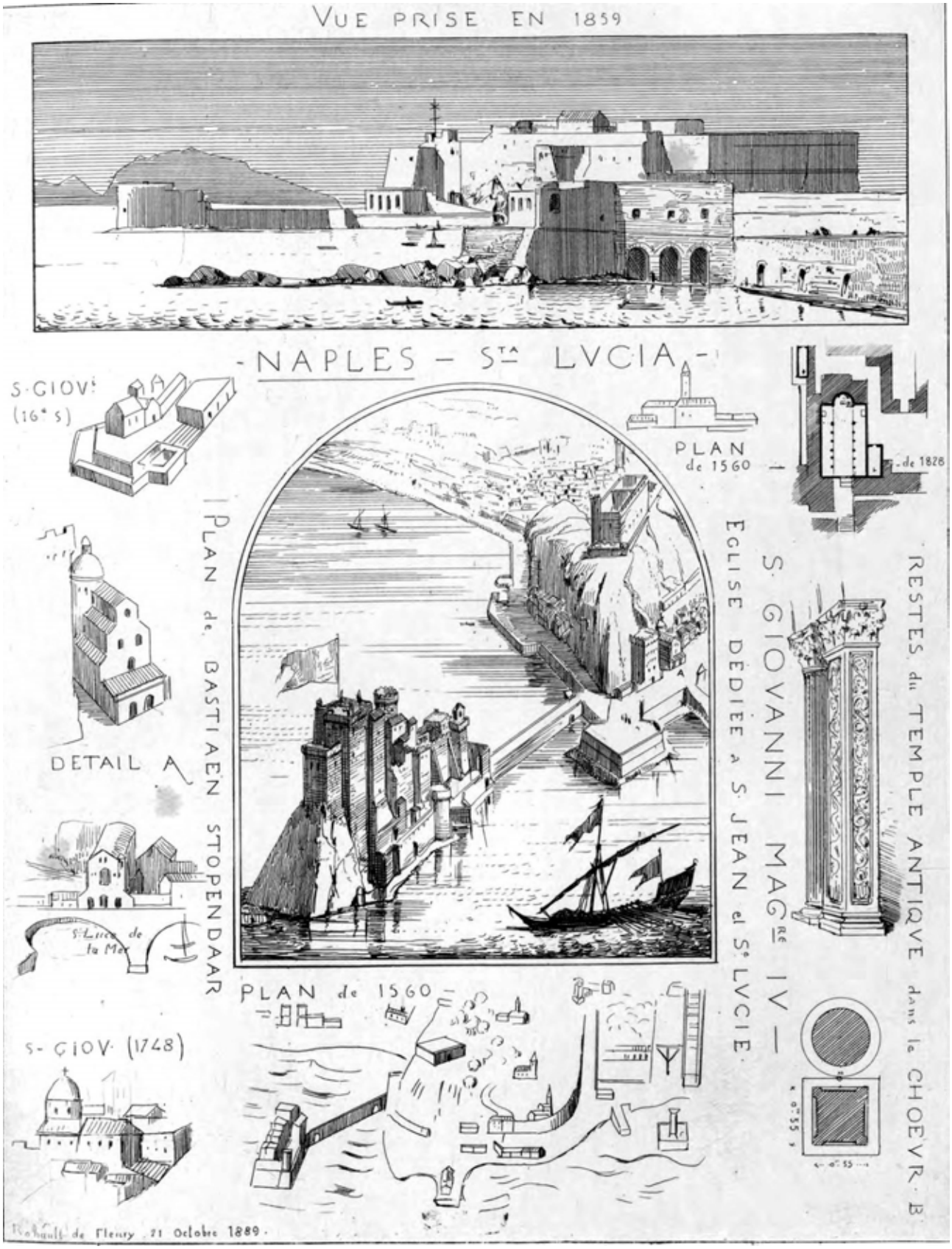

Fig. 3: Naples, Santa Lucia (by C. and G. Rohault de Fleury, Les Saints de la Messe et leurs Monuments…) vol. II, tav. VII, p. 152.

In the same volume, in the section destined to the examination of the monuments dedicated to Saint Lucia, Rohault De Fleury indicates the presence of four ecclesiastical buildings dedicated to her in the city of

Naples, sign of the devotion of the people of Naples: Santa Lucia a Mare, Santa Lucia del Monte, Santa Lucia in via S. Antonio Abate and Santa Lucia in via Olivara[18].
The Table VII is dedicated to the church of Santa Lucia a Mare, originally a small building dating back to the ninth century: here the author includes details taken from historical cartography, obtaining informations from the maps of Carlo Theti for the design of the original church of the IX century, on which in 1588 was built a new church, in turn buried with the work of the nineteenth-century of the building in via Chiatamone[19].
At the center of the table leads the view of the Castel dell'Ovo copied from the original one made by Bastiaen Stopendaal in 1653 e inserted in *Theatrum Civitatum nec non Admirandorum Neapolis et Siciliae Regnorum*, published in Amsterdam by Joan Blaeu (1596-1673). The image is a beautiful derivation of the prototype of Baratta (1627) [20]. Around the central frame, George Rohault de Fleury includes individual details of the buildings present in the area taken from the planimetry of Carlo Theti dating back to 1560, as the particular of the *Castrum Lucullanum* and of the east coast. The engraving of Carlo Theti shows an unprecedented image of Naples at the time of the author, but that belongs to the tradition of the *Neapolis* of Mũnster, both for the setting of the view and for the graphic writing[21].
At the top of the table there is a view of the maritime village, directly drawn by Georges and dated 1859: *Enfin un quai et tout un quartier de Naples portent son nom. De S. Martino la vue est splendide: on a le Castello Nuovo à gauche, la ligne brillante de la Marinella derrière et enfin, au fond du tableau, les hauteurs vésuviennes qui dessinent leur silhouette sur l'azur. Nous avons fait en 1859 un dessin que nous donnons (pl. VII) avec un ancien plan où figure l'église S. Lucia a Mare.*
The exposition of the works dedicated to Santa Lucia moves, then, in the church of San Giovanni maggiore, originally consecrated to Santi Giovanni Battista e Lucia, which foundation is related to Constantine, who would have erected a Christian church on the site of an ancient temple. The author confers to the original structures some remains found in the choir of the church during the compilation of the work and visited with Gennaro Aspreno Galante who had signaled it. In particular a pillar of marble adorned with leaves, with a ribbed column that Rohualt de Fleury designs in detail in the table. In the fourth and in the fifth volume of the opera, Georges Rohault de Fleury examines the cults dedicated to the Martyrs of the Kingdom of Naples, attaching to the text some tables of drawings and sketches of the monuments dedicated to them. Particularly interesting are two tables dedicated to San Lorenzo[22].

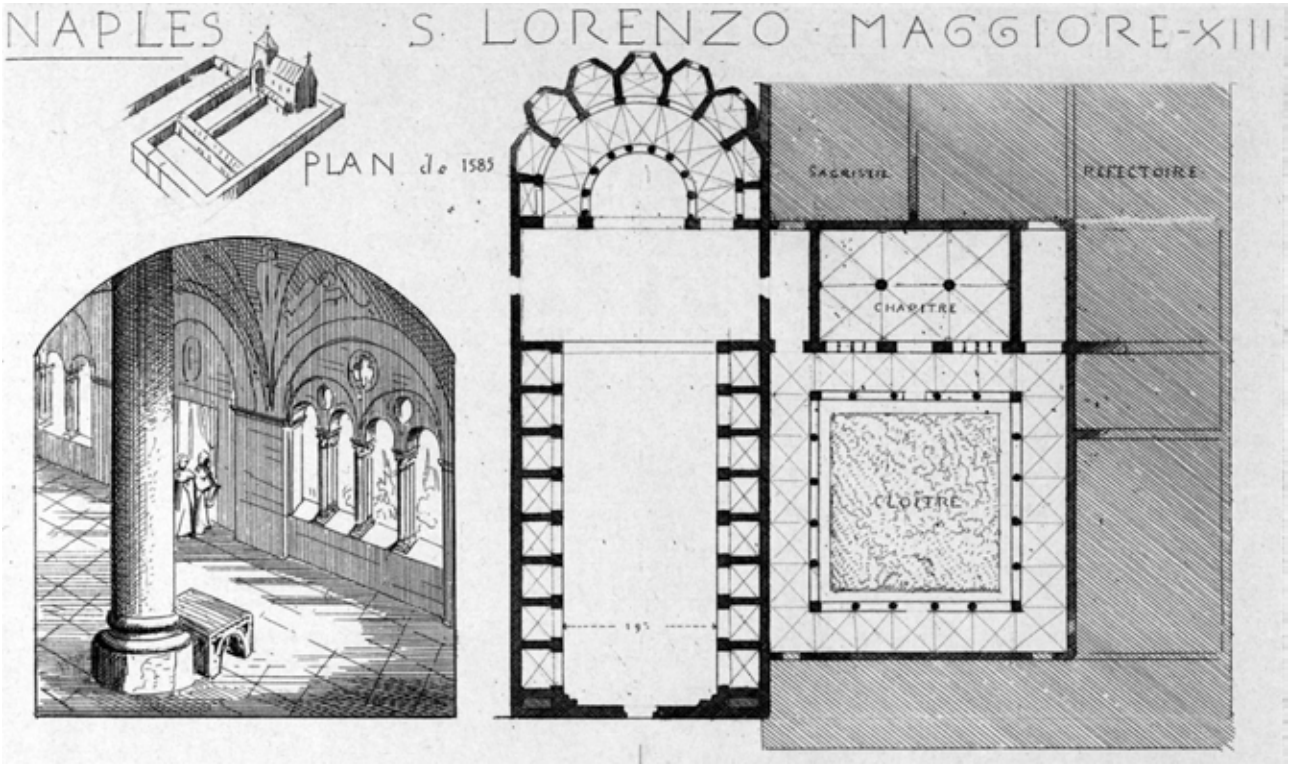

Fig. 4: Naples, San Lorenzo Maggiore (by C. and G. Rohault de Fleury, Les Saints de la Messe et leurs Monuments…) vol. IV, tav. XIX, p. 367.

The first illustrates the church of San Lorenzo Maggiore in Naples: about this building there is an accurate structural description, noting the different interventions suffered by the church and by the nearby convent. The table, necessary patrimony of the architectural study of De Fleury, is dated December 24, 1891, and offers a small detail with the drawing of the building extrapolated from the planimetry *La città di Napoli Gentile* engraved in 1585 by Claudio Duchetti, grandson of the famous Antonio Lafrery; furthermore, there are a map and a inner perspective view, realized by his grandfather Hubert Rohault de Fleury in 1804 - as you can read on the same table. In the second table, which is also dedicated to the examination of the buildings dedicated to San Lorenzo, there is a drawing of the church of Aversa in its original articulation, before a series of instabilities that occurred in the late nineteenth century that caused the collapse of the upper part of the façade, causing the breakage of one of the lions on the sides of the main entrance[23].



Fig. 5: Aversa, San Lorenzo (by C. and G. Rohault de Fleury, Les Saints de la Messe et leurs Monuments…) vol. IV, tav. XII, p. 360.

The design, as reported in the caption, is taken from Schulz who published it in 1860, with the detail of the main portal in support of his monumental work about the architecture of southern Italy [24]. In the drawing, the facade has three entrance portals finely decorated: the main portal framed by a prothyrum with spiral columns and column-bearing lions; the two sides are simply lunettes. The central partition of the façade is framed by thin vertical pilaster strips, which erected in correspondence to the inner naves, and by pensile small arches crowning the tympanum. Above the main door opened a simple rose window. The table published by de Fleury assumes, then, in order to historical researches, particular significance because it provides documentary evidences about the arrangement of the facade and about the church before its partial collapse.

In the seventh volume of *Les Saints de la Messe*, dedicated to the Apostles, the author examines, with a detailed description and with a detailed table, the presence of the cult of San Paolo in Naples[25]. On the ruins of a pagan temple of the imperial age, the so-called Tempio dei Dioscuri of the first century AD, was, in fact, built between the VIII and the IX centuries the Christian church dedicated to San Paolo. The attached table shows at the center the relief of the façade of the ancient Tempio dei Dioscuri, based on *I quattro Libri dell'Architettura* by Palladio with the map of the pronao (portico o porch) and the measures of the wheelbase of the columns. To the right of the temple, in a frame, there is a view of the church based on an engraving of 1637, taken from the edition of 1601 of *Historia* by Giovan Antonio Summonte, which furnished proves about the state of the façade before the collapse in 1688. In the drawing are still recognizable pagan structures though incorporated in the additions of the second half of the '500. In the left margin of the table are designed architectural details of the column with the architrave, and of the base of the column, including its measures. At the center of the table there is a map of San Paolo Maggiore dated 1805, carried out by his grandfather Hubert Rohault de Fleury; Finally an image of San Paolo in the Catacombs of San Gennaro is confronted with the image of the Saint reported on a golden glass. The caption on the side of the coin quotes *Rome Verre dore* and refers to a well-known glass painted in gold now preserved in the Vatican Museums.

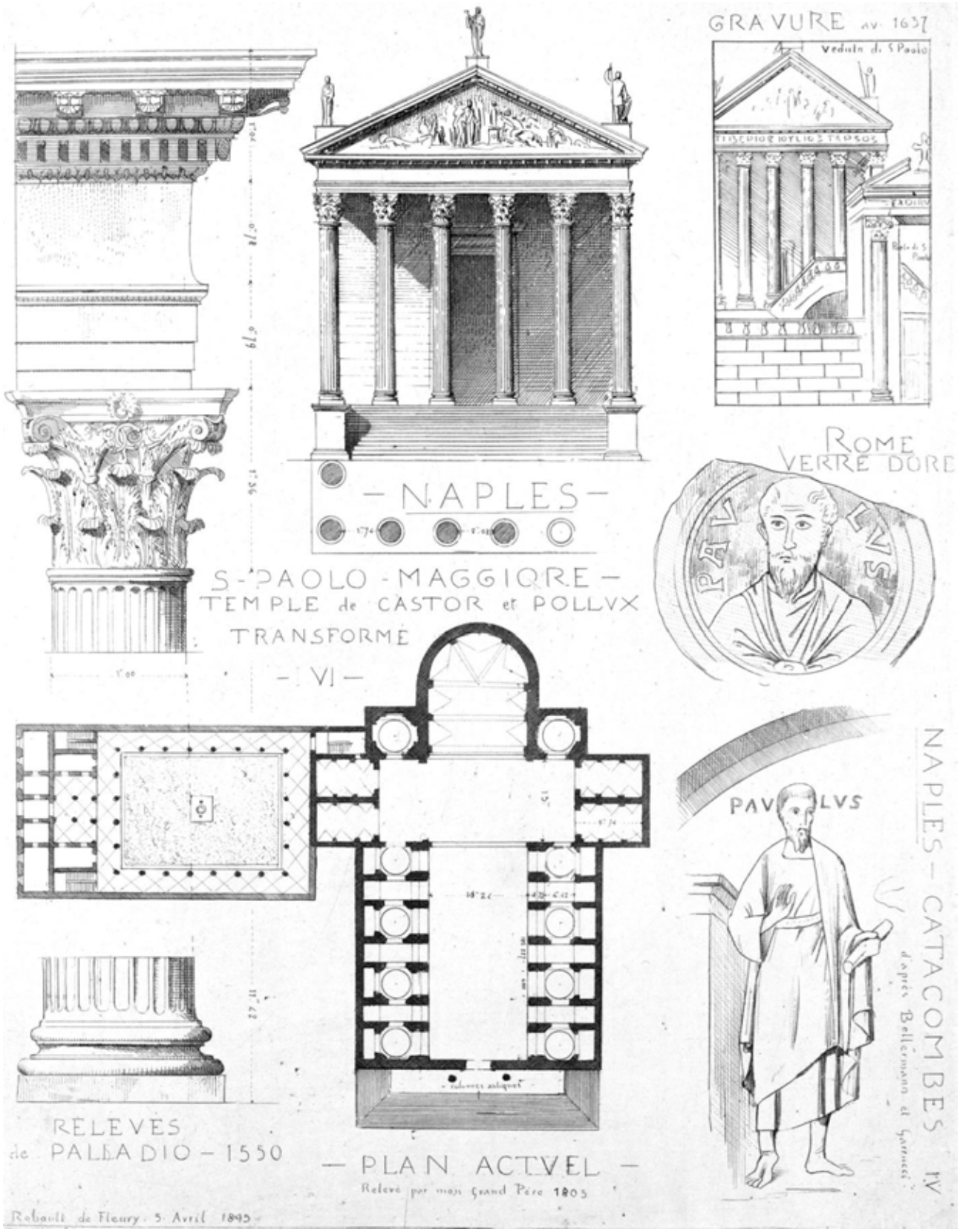

Fig. 6: Naples, San Paolo Maggiore (by C. and G. Rohault de Fleury, Les Saints de la Messe et leurs Monuments…) vol. VII, tav. X, p. 695.

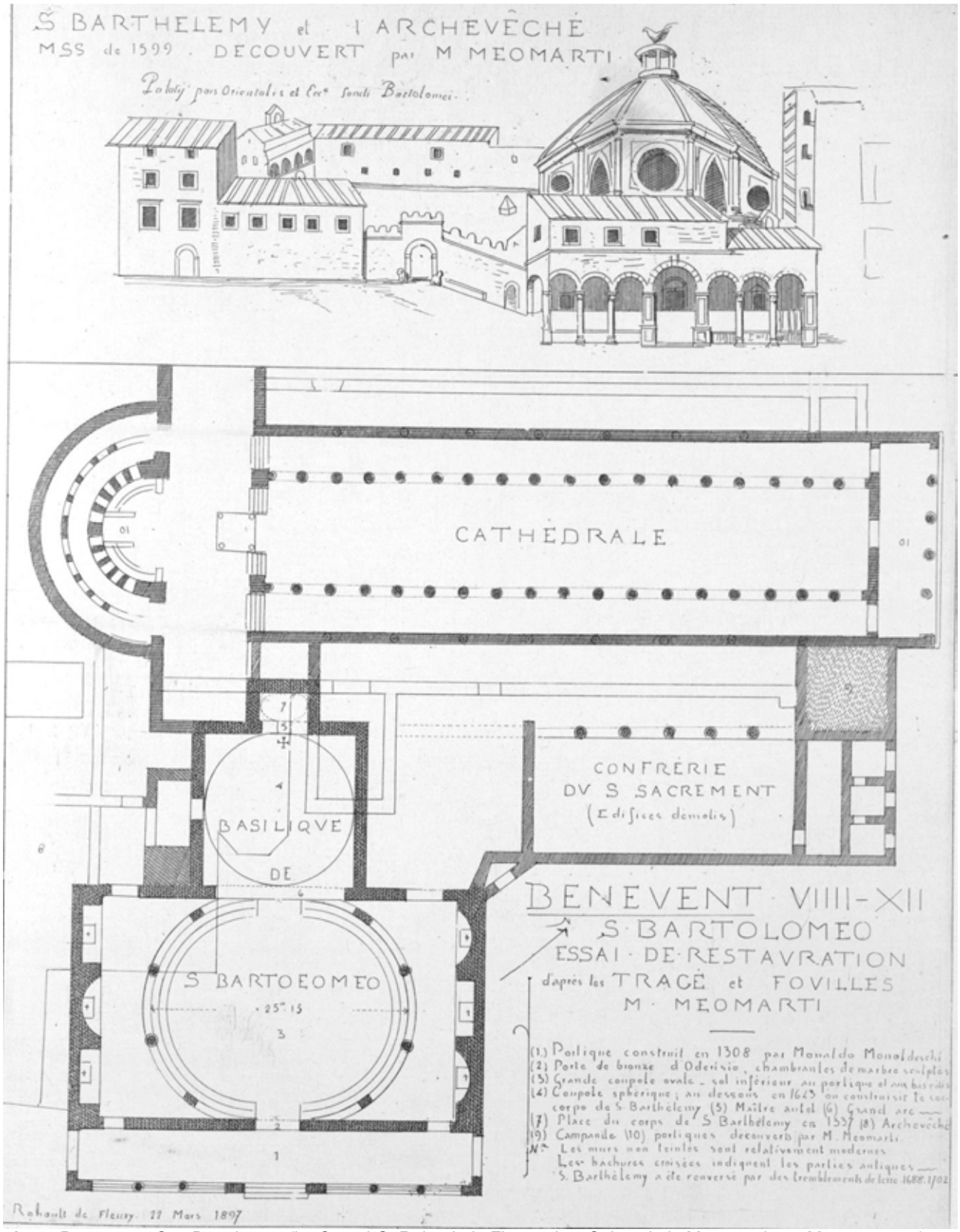

Fig. 7: Benevento, San Bartolomeo (by C. and G. Rohault de Fleury, Les Saints de la Messe et leurs Monuments…) vol. IX, tav. IX, p. 858.

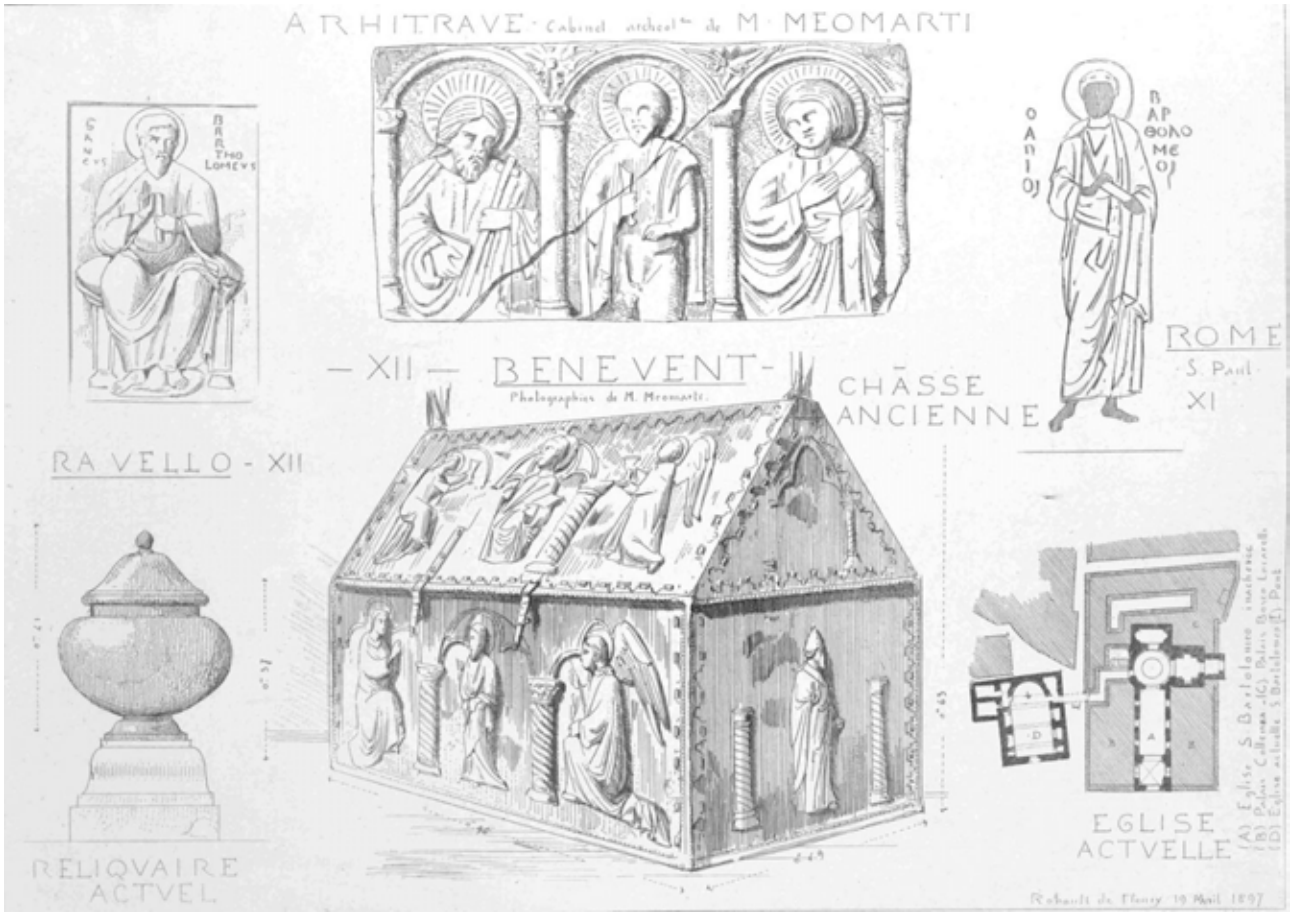

Fig. 8: Benevento, San Bartolomeo (by C. and G. Rohault de Fleury, Les Saints de la Messe et leurs Monuments…) vol. IX, tav. X, p. 859.

In the ninth volume, where Georges Rohault de Fleury follows the traces of the cult of San Bartolomeo, whose relics, after the destruction of Lipari by the Saracens in 838, were transferred to Benevento, where was erected a small *sacellum* next to the cathedral, to keep the remains[26]. In 1112 a new building was erected in honor of San Bartolomeo; a structure with a central map, decorated with mosaics and a fine cosmatesque floor, completed in the XV century with the construction of a large central elliptical dome, preceded by a smaller hemispherical dome, which collapsed with the earthquake of 1688. The relics of the Saint were therefore transferred to the Cathedral, where they were still kept at the time of Rohualt de Fleury. Georges Rohault de Fleury affirmed that the remains of the ancient sanctuary, at his time, still existed and had been identified by Meomartini in the modern church of San Bartolomeo. The well-known historian and archaeologist of Benevento, a correspondent of our historian, had communicated with a letter in 1897 about the finding, documenting with photographs the remains of the reliquary. The reference to the documents reported by Meomartini to the French archaeologist, return in the six tables dedicated to the cult of San Bartolomeo in Benevento. The first table shows, at the top edge, a perspective view of the *insula* of San Bartolomeo found out from Meomartini in the archives of the Cathedral, which shows the archbishop's palace and the church of San Bartolomeo in 1599, before the destruction caused by the earthquake. At the bottom of the table there is the supposed image of the map of the Cathedral of Benevento and of the Church of San Bartolomeo based on the excavations of Meomartini, accompanied by explanatory caption. The second table shows the drawing of an ancient architrave, found during the excavations and guarded in the archaeological Cabinet of Meomartini, the drawing of an ancient gold box, probably the reliquary of the Saint in the hypothesis formulated by the author, reproduced from a photograph sent by Meomartini; Finally, in the right margin, the map of the ancient and modern church in relation to the surrounding buildings (palazzo Collenea and palazzo Bosco Lucarelli).

In the tenth volume, the concluding one of the entire work, Georges Rohault de Fleury describes the Cathedral of Amalfi dedicated to Sant'Andrea, adding to the description a graphic board[27]. The table shows a relief of the facade and of the access staircase and, at the right margin, a perspective of the interior space, both taken by Schultz. In the text the author harshly criticizes *Le mauvais génie modern* that in the 18th century led to the renewal of the original medieval structures. Then, he reports of a recent restoration

that has led to the reconstruction of the facade and of the windows, that Rohault Fleury prefers to document by the design of Schultz.

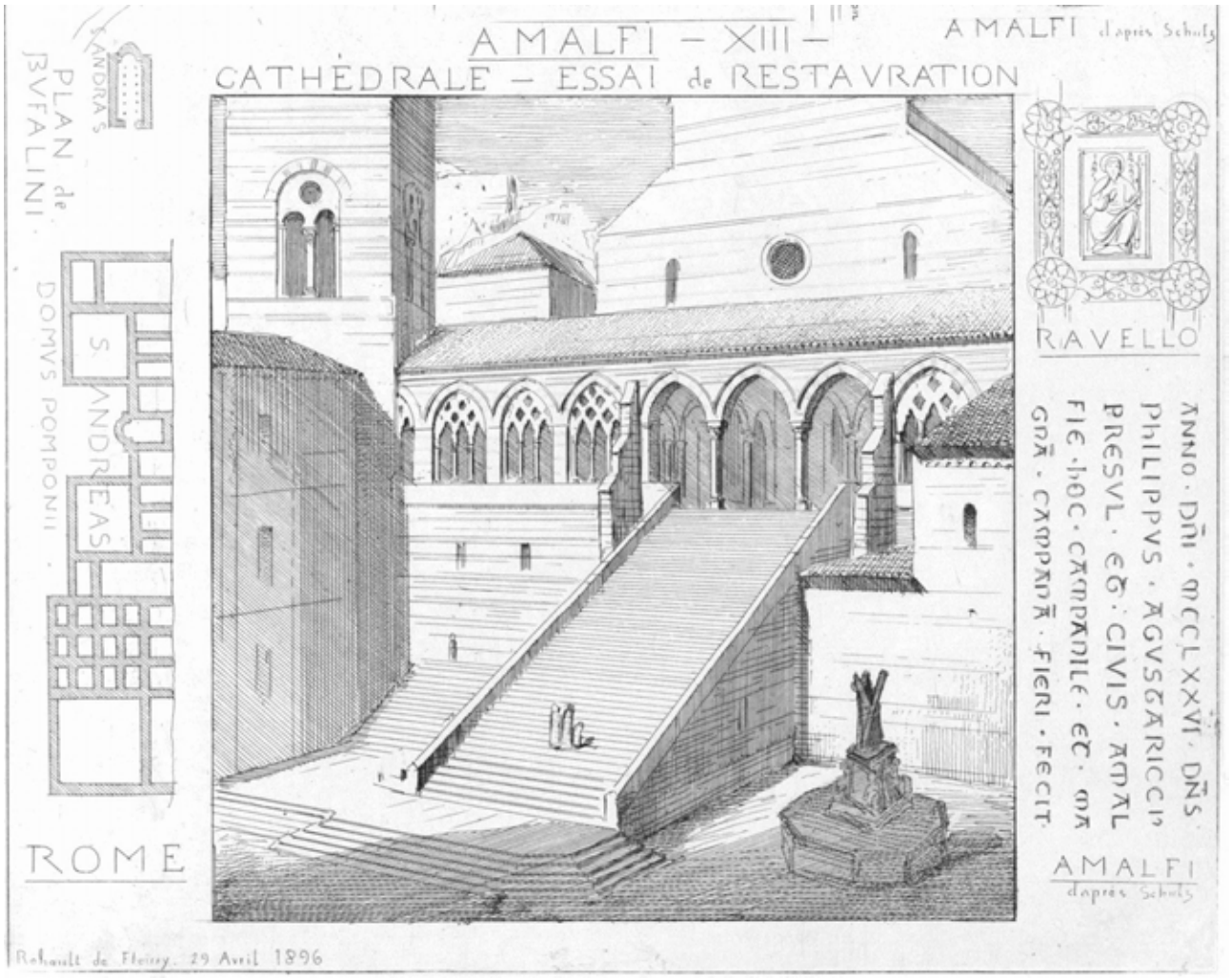

Fig. 9: Amalfi, Sant'Andrea (by C. and G. Rohault de Fleury, Les Saints de la Messe et leurs Monuments…) vol. X, tav. XII, p. 967.

The analysis of the volumes of *Les Saint de la Messe* and of the graphic tables attached, has made possible to reconstruct the complexity of the data collection that Charles and Georges Rohault de Fleury have used. Ancient and modern archival and bibliographical sources, but also manuscripts and drawings found in libraries and archives across Europe, as well as data from archaeological excavations and details directly observed, are the basis of the construction of an imposing historiographical work. The analysis of the text has sometimes been difficult, as the authors do not always provide details about sources. But, indirectly, it can be rebuild the circuit of historians, archaeologists and scholars connected with the two French scholars, such as, among the others, monsignor Gennaro Aspreno Galante, distinguished scholar of ecclesiastical history and Christian Archaeology, or the archaeologist "Explorer of the catacombs" Giovan Battista de Rossi, founder of the *Bullettino di Archeologia Cristiana* in 1863*,* and influential leaders of the Christian Archaeology. The research done by Charles and Georges Rohault de Fleury for the drafting of the work are not, of course, free from controversy: in line with a reconstruction of an architectural history almost exclusively oriented to the study and the "rediscovered" in the nineteenth century of the medieval art, the authors explicitly complain in text about the difficulties to recognize in the few remains of the surviving buildings, the richness of the original monuments.

Bibliographical References

[1] BELLIER DE LA CHAVIGNERIE, Émile. AUVRAY, Louis. *Dictionnaire général des artistes de l'École française depuis l'origine des arts du dessin jusqu'à nos jours.* Paris: Librairie Renouard, 1885, p. 408.

[2] ROHAULT DE FLEURY, Hubert. *Voyage de l'architecte Rohault de Fleury en Italie*, *1804-1805*. Manuscrit, Bibliothèque nationale de France, NAF 23696-23700.

[3] WILLESME, Jean-Pierre. *Hubert Rohault de Fleury, (1777-1846) «l'économie jointe aux convenances».* In *Livraisons d'histoire de l'architecture*, 1er semestre 2003, n°5, p. 95-105.

[4] BAUCHAL, Charles. *ouveau dictionnaire biographique et critique des architects francais*. Paris: Libraire Générale de l'Architecture, 1887, p. 719-720.

[5] WEBER, Nicholas. *Rohault de Fleury*. In *The Catholic Encyclopedia.* New York: Robert Appleton Company, 1912, vol. XIII, p. 117.

[6] NARDI, Guido. *Percorsi di un pensiero progettuale.* Santarcangelo di Romagna: Maggioli Editore, 2010*,* p. 141*;* SQUICCIARINO, Nicola. *La Great Exhibition del 1851: una svolta epocale nella comunicazione.* Roma: Armando Editore, 2014, p. 114.

[7] DE BENGY-PUYVALLÉE, Maurice. *Inventaire de la collection Rohault de Fleury*. In *La Correspondance historique et archéologique*. Paris: 1907, p. 163, 212 et 361; 1908, p. 102, 161.

[8] BENOIST, Jasques. *Le Sacré-Coeur de Montmartre. De 1870 à nos jours*. Paris: Editions Ouvrières, 1992, p. 62.

[9] TALENTI, Simona. *L'Histoire de l'Architécturen en France. Emergence d'une discipline (1863-1914)*. Paris: Picard, 2000, p. 130.

[10] PALOMBI, Domenico. *Rodolfo Lanciani, l'Archeologia a Roma tra Ottocento e ov ecento.* Roma: L'Erma di Bretschneider, 2006; GHILARDI, Massimiliano. *Giuseppe Gioacchino Belli, mons. Vincenzo Tizzani e l'archeologia cristiana*. In *Belli e l'archeologia.* Atti delle Giornate di Studio (Roma, 4-5 dicembre 2009), edited by CONSALES, Ilde. SCALESSA, Gabriele. Roma: Aracne Editrice, 2011, p. 29-54.

[11] Cfr. DE' ROSSI, Giovanni Battista. *Inscriptiones christianae Urbis Romae septimo saeculo antiquiores*. Roma: Officina Libraria Pontificia, 1857-1888, vol. 2; EADEM. *La Roma sotterranea cristiana descritta e illustrata.* Roma: Cromo-litografia Pontificia, 1864-1877, Vol. 3; EADEM. *Mosaici cristiani e saggi dei pavimenti delle chiese di Roma anteriori al secolo XV*. Roma: Libreria Spithoever, 1888. BARUFFA, Antonio. *Giovanni Battista De Rossi. L'archeologo esploratore delle catacombe*. Città del Vaticano: Libreria Editrice Vaticana, 1994.

[12] GARRIC, Jean-Philippe. *Recueils d'Italie. Les modeles italiens dans les livres d'architecture française.* Hayen: Pierre Mardaga éditeur, 2004, p. 253-260.

[13] PIOZZI, Hester Lynch. *Observations and reflections made in the course of a journey through France, Italy and Germany,* edited by Barrows,Hebert. Michigan: University Press, 1967; VERHOEVEN, Gerrit. *L'influence des guides imprimées aux Pays-Bas sur la construction et l'évolution de l'espace touristique européen (XVIIe et XVIIIe siècles)*. In *Revue Belge de Philologiè et d'histoire*, 2005, 83/2, p. 399-423; *Voyages et conscience patrimoniale Aubin-Louis Millin (1759-1818) entre France et Italie*, edited by D'ACHILLE, Anna Maria. IACOBINI, Antonio. PRETI-HAMARD, Monica. RIGHETTI, Marina. TOSCANO, Gennaro. Roma: Campisano Editore, 2014.

[14] ROHAULT DE FLEURY*,* Charles and Georges. *Les Saints de la Messe et leurs Monuments.* Paris: Librairies des Imprimeries Réunies, 1893, vol. I, p. 1-5.

[15] MARIN, Brigitte. *Le Plan de Naples de Carlo Theti. Gravé par Sebastiano Di Re en 1560. Un neuveau document pour l'étude de la cartographie et de la topographie napolitaines*. In *Melangés de l'Ecole Français de Rome.* Roma: 1990, *CCII,1*, p. 163-189.

[16] ROHAULT DE FLEURY, Charles and Georges. *Les Saints de la Messe et leurs Monuments.* Paris: Librairies des Imprimeries Réunies, 1894, vol. II, p. 20.

[17] PARENTE, Gaetano. O*rigini e vicende ecclesiastiche della città di Aversa.* Napoli: tip. di Gaetano Cardamone, 1858, vol. II, p. 7 e ss.

[18] ROHAULT DE FLEURY, Charles and Georges. *Les Saints de la Messe et leurs Monuments.* Paris: Librairies des Imprimeries Réunies, 1894, vol. II, p. 97.

[19] GALANTE, Gennaro Aspreno. *Guida sacra della Città di Napoli*. Napoli: Stamperia del Fibreno,1872, p. 381.

[20] DE SETA, Cesare. BUCCARO, Alfredo. *Iconografia delle città in Campania, Napoli e i centri della provincia.* Napoli: Electa 2006, p. 134 e ss.

[21] VALERIO, Vladimiro. *Cartography in the kingdom of Naples during the Early Modern period.* In *The History of Cartography*, edited by WOODWARD, David. Chicago: 2007, vol. III, p. 954-956. DE SETA, Cesare. *Napoli fra Rinascimento e Illuminismo.* Napoli: Electa, 1991, p. 22-23.

[22] ROHAULT DE FLEURY, Charles and Georges. *Le Saints de la Messe et leurs Monumentes*. Paris: Librairies des Imprimeries Réunies, 1896, vol. IV, p. 88 e ss.

[23] JACAZZI, Danila. Aversa. *S. Lorenzo ad Septimum. Facoltà di Architettura*. In *Dimore della conoscenza. Le sedi della Seconda Università degli Studi di Napoli*, edited by AMIRANTE, Giosy. CIOFFI, Rosanna. Napoli: Edizioni Scientifiche Italiane 2010.

[24] SCHULZ, Heinrich Wilhelm. *Denkmäler der Kunst des Mittelalters in Unteritalien*. Dresden: 1860, p. 189.

[25] ROHAULT DE FLEURY, Charles and Georges. *Le Saints de la Messe et leurs Monumentes*. Paris: Librairies des Imprimeries Réunies, 1899, vol. VII, p. 60.

[26] ROHAULT DE FLEURY, Charles and Georges. *Le Saints de la Messe et leurs Monumentes*. Paris: Librairies des Imprimeries Réunies, 1899, vol. IX, p. 13.

[27] ROHAULT DE FLEURY, Charles and Georges. *Le Saints de la Messe et leurs Monumentes*. Paris: Librairies des Imprimeries Réunies, 1900, vol. X, p. 10

HERITAGE and TECHNOLOGY
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Modern churches in the province of Caserta

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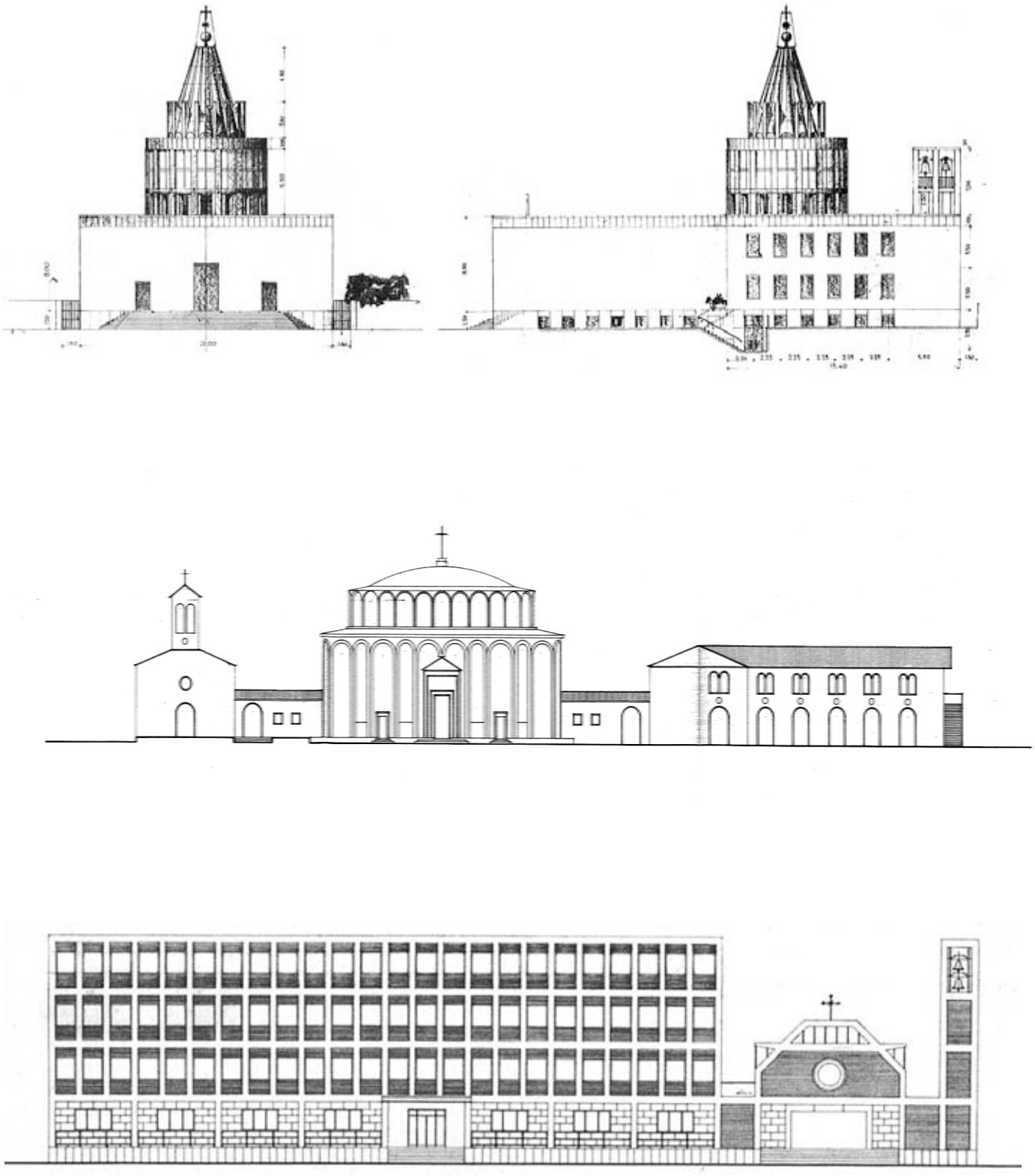
Abstract
The present text forestalls the first results of a study, currently underway, about the ecclesiastical architecture of the twentieth century in Campania. In particular, have been examined some religious buildings built in the 1950's-1960's in the province of Caserta, designed by excellent architects, known at national level: the church of San Pietro in Cattedra in Caserta designed by the Neapolitan Marcello Canino; the churches of San Nicola and San Rufino, realized in Mondragone and designed by the Sicilian Gaetano Rapisardi; the complex of the Colonia Estiva Elisa Fernandes in Mondragone with the church of Santa Maria dell'Aiuto, designed by the Neapolitan Ferdinando Chiaromonte. These architectures are precious assets for a territory that, in spite of everything, could still find the strength to regenerate itself through a path of redemption of its moral and material values.

Keywords: cultural heritage, ecclesiastical architecture, twentieth century, Caserta.

1. Introduction
The common feeling tends to associate the social decline and the environmental decay in the province of Caserta to the urban disorganization and to the poor quality of the buildings of those areas. In fact, the analysis about the heterogeneous settlement areas involved in the territory of Caserta gives back, in most cases, difficult scenarios, because of the functional inadequacy of the infrastructures, the shortage of the public buildings and the failure to comply with zoning laws.
Evidently, the present essay does not expect to offer practicable and efficient solutions to these grave and complicated problems. This contribution lays its foundations on the certainty that the rebirth of those territories – which identity has been compromised by the alteration of historic centers, by interventions of abusive urban speculation, by the widespread phenomenon of unauthorized development in the peripheral areas, by environmental crimes – must include, along with other socio-cultural initiatives, the promotion of the architectural heritage, which, despite everything, is still conspicuous.
The conferment of the historical and artistic value to the most ancient architectural structures by the administrators and by the population is relatively simple, because the old age of a building is usually considered as a sufficient reason to acknowledge its value. Instead, to confer an analogous recognition to edifices built during the twentieth century becomes difficult because, on the contrary, to the "modern" constructions is usually uncritically assigned a negative judgment. However, it must be remembered that the our old research activity in the territories of Caserta in the recent past led to the acknowledgement of remarkable architectural and urban structures, conceived and achieved in the first half of the twentieth century, previously neglected or underestimated by the researchers[1]. The chronological extension of the studies about the architecture of the province of Caserta to the years of the post-conflict reconstruction and of the "economic miracle" is now leading to the identification of some constructions characterized by remarkable architectural qualities, achieved in the 50's-60's in the urban centers near Caserta, such as the ecclesiastical buildings that are subject matter of this research.



Figg. 1-3: Project drawings of the churches of San Nicola in Mondragone, San Pietro in Cattedra in Caserta, Santa Maria dell'Aiuto in Castel Volturno.

2. The Church of San Pietro in Cattedra in Caserta by Marcello Canino

Marcello Canino (Naples, July 3, 1895 – October 2, 1970) professor of architecture from 1930 to 1969 and dean of the Faculty of Architecture in the University of Naples from 1943 to 1952, he flanked an intense professional task to his academic work. During his successful career he designed and built, in addition to various public and residential buildings and city plans, some interesting ecclesiastical buildings. His first job in this trade dates back to 1932, with the winning participation in the competition for the church of the Maddalena in Messina. The project of Canino, not carried out, proposed an original interpretation of the basilical space, in which the reinforced concrete structure defined the volumes of the building, drawing a vivid game of cylindrical and hemispherical elements, relatable to the spatiality of the Sicilian Arabic-Norman cathedrals[2]. Twenty years later, in 1951, Canino took part in the competition for the church of San Giovanni Bosco in Rome, organized by the Pontifical Commission for the Holy Art obtaining the third prize among one hundred and one competitors, with the project of a church with a basilical plan, covered by a great dome and characterized by a great trefoil transept[2].

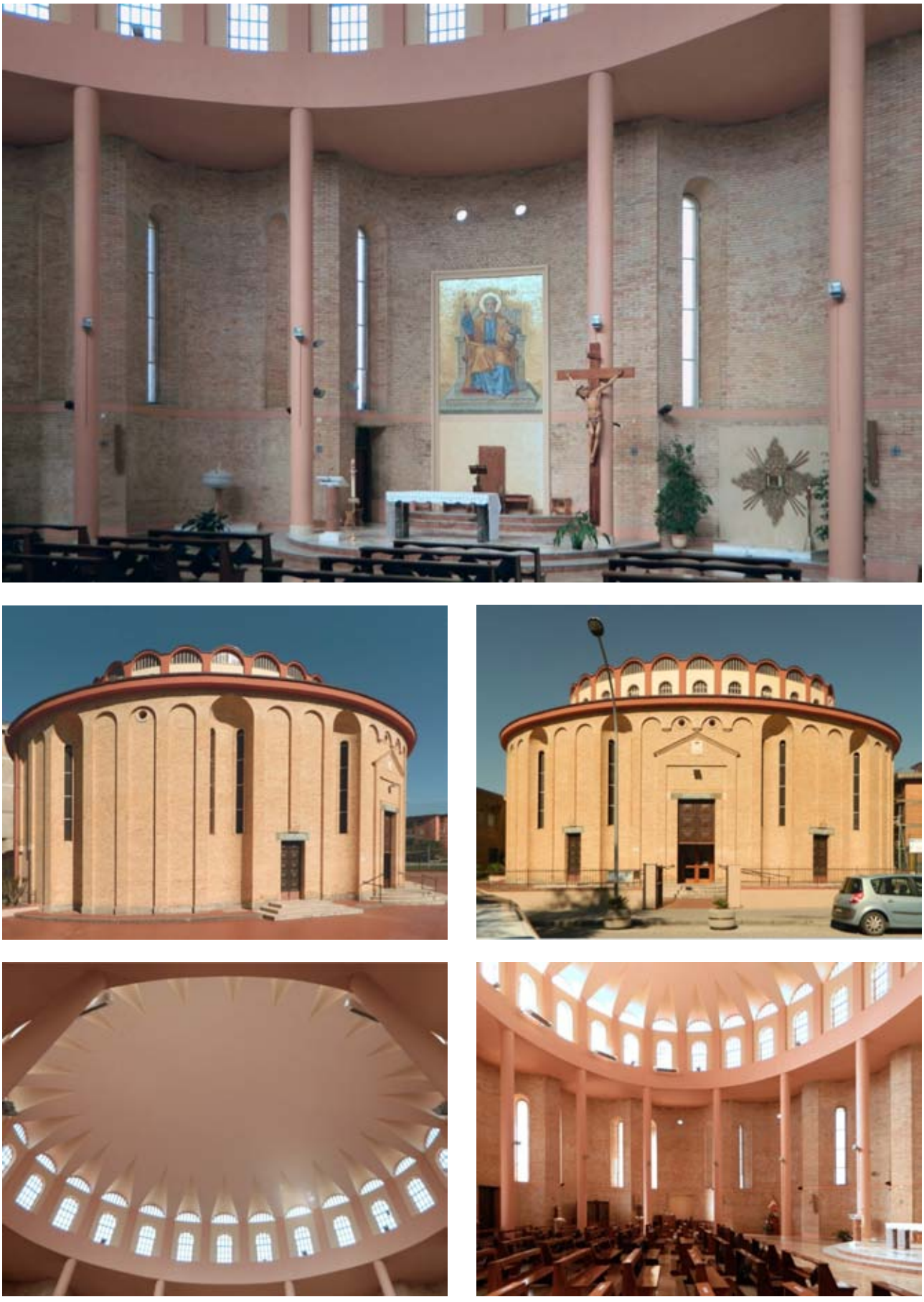
The architect, during that important competition, experienced composition themes; solutions then adopted in the churches built in the fifties-sixties in Caserta and in the province of Benevento. In fact, in the structure of San Biagio in Limatola (1954-60) and in the church of Santa Giuliana in Frasso Telesino, built in 1958 after the demolition of the preexisting eighteenth century church, Canino proposed again the same elements from the Renaissance – arches on the facade, ribbed vaults, modular scanning of the wall surfaces with duotone divisions, etc. - already presented in the projects for the church of the Maddalena in Messina and for the Basilica of San Giovanni Bosco. Referring to future opportunities to study in depth the mentioned churches in the province of Benevento, will now be analyzed the church of San Pietro in Cattedra in Caserta that, with the one of San Giovanni Battista in Naples, can be considered the ecclesiastical architecture of greater significance made by Canino.

The building, inexplicably indicated as "not built" in the monograph on Canino in 2005, is actually located in via Vescovo Natale in Caserta, in accordance with the design. However, there is an evident inconsistency between the dating within 1940 and 1958 attributed to the project in the monograph and the dating of technical drawings preserved at the Technical Office of the Diocesan Curia of Caserta, approved by the Pontifical Commission for the Holy Art during the assembly of May 25, 1966 and by the Civil Engineering of Caserta on October 18, 1968 [3].

It seems unlikely the dating of 1940, perhaps when Canino elaborated the project of an unidentified church in Caserta. It is probable, however, that the design of the new parish structure took place simultaneously with the one of the district Tescione, started from the Technical Office of the Institute Independent Public Housing of Caserta in 1956-57, while its construction can be traced back to the late sixties, when the realization of the new district was in the final phase. In fact, compared to the graphics project [3] and to the image of the three-dimensional model published in the monograph [2] the bell tower, the baptistery and some other rooms are missing in the parish structure, so that only the construction of the church could be attributed to economic problems, that would justify even the ample time period between the design and execution of the work.

An authentic manuscript preserved in the private archive of Canino, justifies the choice of the elliptical drawing, which allowed him to place the presbytery in order to have good visibility from every point of view of the church. Other observations by the designer described the articulation of the wall structure, configured by a series of niches, and vaulted with lunettes, supported by 12 circular pillars, leaning against the interior perimeter of the church [2].

Apart from the chronology of the building and the reshuffle on the original project, the ecclesiastical building results very interesting because it shows a singular interpretation of the planning theme of the elliptical structure, experimented by Canino himself during the contest of the Auditorium of Rome (1935) and by Marcello Piacentini, with whom he attended since 1920's, in the church of Divina Sapienza in Rome (1947-48). The comparison with the Auditorium's project could seem forced, both for the different functions and the size of the two buildings, and because, by his own admission, in that occasion Canino had commensurate to the German architecture of 1920-1930, contemplating most of all the Totaltheater of Gropius. However, beyond the clear difference of the languages, the theater of Canino was different from the model of Gropius because it inverted the orientation, arranging the stage on the short side of the ellipse, as he would have done later with the Caserta's church's altar. Then, the dialectical relationship between empty space and full space of the Auditorium's prospectus – established by radial pillars, that sustain the roofing, alternated to recesses built in the masonry – remembers, even if with different expressive ways, the game of recesses and pillars along the curved perimeter of the building to obtain a chiaroscuro effect. The jointed wall register of the church of the quarter Tescione represents, in fact, the successful conjugation of an architectural concept of Canino's poetry and recurring in his buildings, which always show wall surfaces very articulate. The comparison with the Divina Sapienza moves, instead, the interpretative speech on Canino's historical flair, never ended, who would get inspiration, as Piacentini did before him, from the roman baroque architecture, at least in the geometrical shape chosen. Indeed, the harmony between the two buildings seems to be very evident in the features of the architectural space, with the insertion of the major altar at the end of the short axis and the enlargement of the long axis farther the ellipse's perimeter, as well as in the



Figg. 4-8: Views of the church of San Pietro in Cattedra in Caserta.

covering of the bricks in view of the outside. Canino, however, looked for a bigger joint in the treatment of the walls, illuminated and overshadowed at the external by a blind sequence and inside the ecclesiastical hall by the theory of the recesses squared by the slim circular pillars which sustain the dome. About the dome, with its reduced curvature and placed on a proportioned tambour totally windowed, it completes the balanced volumetric composition of the building, interesting for the almost metaphysical nature which seems to alienate it from the surrounding setting.

3. San Nicola and San Rufino churches in Mondragone by Gaetano Rapisardi

Gaetano Rapisardi (Siracusa, 1893 – Roma, 1988), personality of great importance among the architects, active in the central decades of 19th century, he distinguished himself for the high number of commissions received for the planning of ecclesiastical buildings throughout of his long professional experience. Influenced in the years of his formation by the historicism of the Sicilian School and then by the magniloquence of the fascist architecture, he developed a research characterized by a reasonable modernity, conscious of the meaning that the heritage of tradition had to maintain in the new Italian architecture. His projects about the churches of 50's, were far from the innovative research of some realizations in Italy during that time, but they revealed aesthetic features heritage deriving from the fascist architecture. The link with the classicist architecture of 30's appears very clear in the Basilica of San Giovanni Bosco in Rome, his most famous work, characterized by the imposing central dome, inferior for dimension only to the one in the Pantheon and to the one in the Basilica of San Pietro, and for the character of continuity with the surrounding buildings, due to the master plan of Rapisardi of the full urban sector [7]. The imposing building, characterized by the tidy stereometry of the volumes that compose it, was the prototype of the churches built in province of Caserta, in which the author iterated the composing features of the architectural structure realized in Rome from 1952 to 1964. Besides the temple dedicated to the founder of the Salesian order, Rapisardi created *ex novo* (entirely new) and restored churches and convents in various Italian regions and maybe the design of the churches of San Nicola and San Rufino in Mondragone is related to his activity in the area of the Lower Lazio (Castelforte , Minturno, Scauri) not far from the city[5].

The church of San Nicola was built from 1954 to 1959 on the initiative of Monsignor Adelchi Fantini, who wanted to equip the districts of San Nicola and Principe Amedeo of an adequate parish center, because at that time the religious assistance addressed to the populous local community took place with many difficulties in the small chapels of the Congrega del Carmine (Congregation of Carmine) and San Biagio. Once obtained a building area of about 5000 square meters placed at the edge of the residential area and collected the funds required to build the church, thanks to the donations of citizens of Mondragone and of the emigrants in the United States, the work began the October 18, 1954 and officially ended with the opening ceremony celebrated the May 3, 1960 [8].

The architect, in the building of Mondragone, re-elaborates, in small size, the architecture of the basilica of San Giovanni Bosco in Rome, designing a parallelepiped in which is grafted, in the middle, the large cylinder of the lantern, which marks the external volume and the inner space of the building. Differently from the Roman basilica, which main front is characterized by the continuity of the travertine copper, in the church of San Nicola the connection with the urban roads is done through the filter of a portico juxtaposed to the body of the church, which supports the choir overlying the entrance. The ecclesiastical hall, divided into three bays and ending with a rectangular apse, is characterized by the essentiality of the structural elements and the central dome, which reproduces, in small size, the one of the Roman prototype. The lateral facades, articulated by the regular rhythm of the windows, denounce the partition of the inner locations, while the rear façade is characterized by the reinforced concrete trestle of the bell tower, moved to the eastern side, which recalls - but with different dimensions and proportions - the bell towers of the mentioned church of San Giovanni Bosco in Rome. Oral informations, not supported by documents, report about the enlargement of the entire ecclesiastical structure at the end of the sixties, with the addition of the edifice including the rectory and the parish places behind the church. Finally, in 1995 were carried out interventions aimed at the elimination of architectural barriers [8].

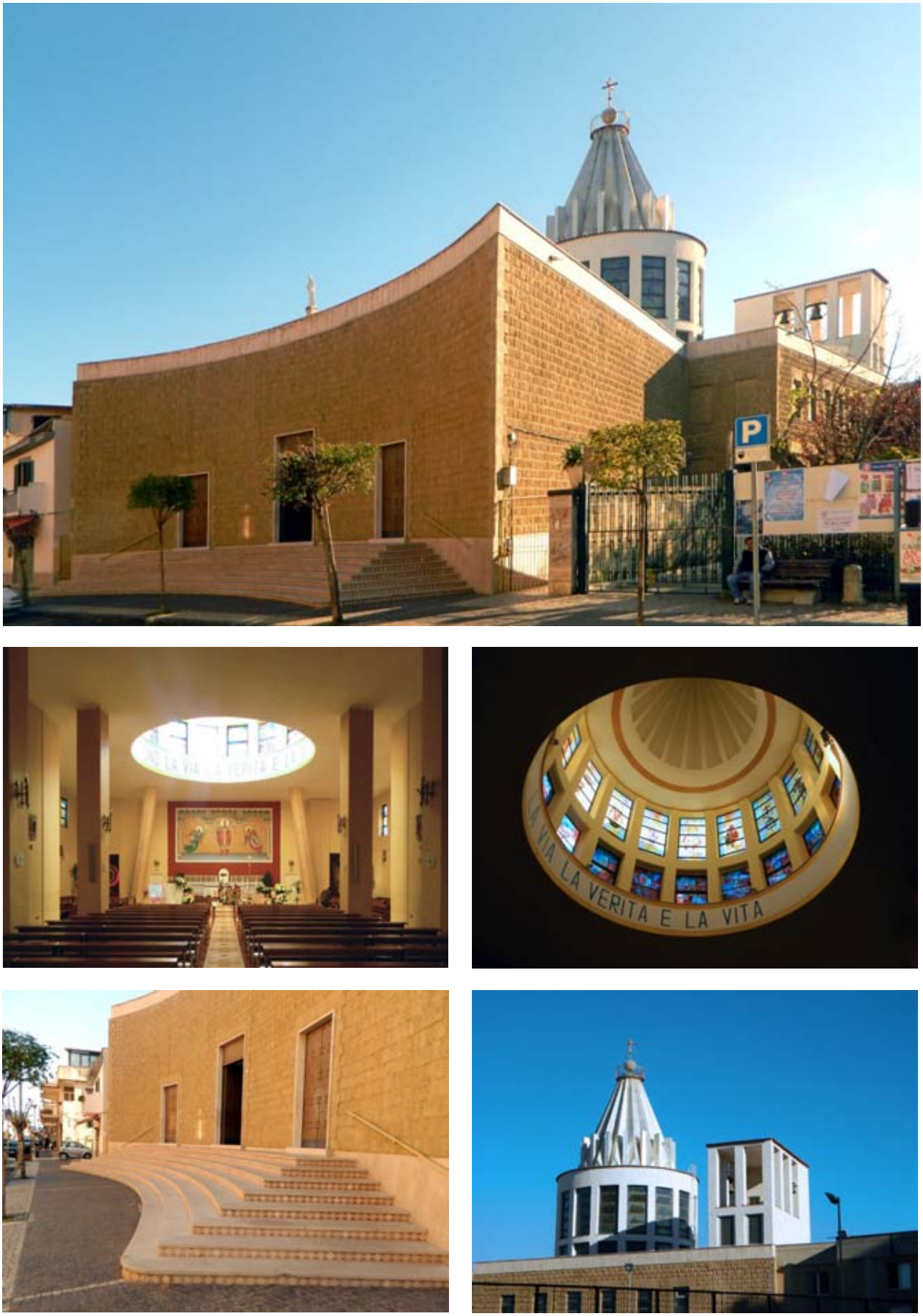
In 1958, when the work of San Nicola's church was in the final phase, Rapisardi was commissioned by Monsignor Salvatore Razzino to design, in an area near via Domiziana, a new church dedicated to San Rufino, which was inaugurated with a solemn ceremony on August 6, 1962. In this building are recognizable similarities in the planimetric and volumetric composition and in the definition of architectural elements with the basilica dedicated to Don Bosco; however in this case the architect showed a greater autonomy from the Roman model elaborating an interesting project, documented by copies of the original graphics preserved in the parish archive. The planimetric structure of the church, originated from the intersection of a trapezoid – corresponding to the ecclesiastical hall - and a rectangle - corresponding to the presbytery - returns a complex spatiality, characterized by the concavity of the external façade and, in the middle position, by the volumes emerging from the cylindrical tambour and by the conical lantern. The interior space, however, is characterized by the convergence of the perimetral walls towards the altar, accentuated by the brightness of the tambour, drilled by a double order of windows. A concave staircase, ample as the church's facade, connects the building to the opposite street. The lateral asymmetric façades denounce the arrangement of







Figg. 9-11: Views of the church of San Nicola in Mondragone.



Figg. 12-16: Views of the church of San Nicola in Mondragone.

the utility areas, concentrated on the eastern side of the building, while the rear façade is marked by the bell tower, moved to the west side, which, as in San Nicola's church, reiterates the bell towers of the Basilica of San Giovanni Bosco. Some old images show the changes dating back to the seventies-eighties years, made at the openings of the imposing cylindrical tambour, which in Rapisardi's drawing appears entirely windowed, while now the openings of the higher order are partially or completely walled-up. However, we do not have documents that can precisely describe the changes which happened regularly over time, both in the elements of the dome and in other parts of the building. The necessity to enlarge the church structure, adding new settings, and the need to adapt the structure with the rules for the elimination of architectural barriers, required a substantial renovation, carried out in 1992 [9]. Consequently, it has been realized a new building, in continuity with the pre-existing structure, behind the church. The new structure, unfortunately, has absorbed the valuable bell tower, debased even by the partial infilling of the exposed frame of beams and reinforced concrete pillars. Other invasive interventions have been operated by the restoration within the ecclesiastical hall, which currently shows a tonality not pertaining to the authenticity of Rapisardi's architectural language.

4. The Church of Santa Maria dell'Aiuto in Castel Volturno by Ferdinando Chiaromonte

Ferdinando Ferdinando Chiaromonte (Naples, September 1, 1902 - December 11, 1985) was, like Marcello Canino, one of the most renowned Neapolitan architects of the twentieth century[10]. His professional diligence is proved by a register of one hundred works and projects, produced from 1927 to 1975. Equally intense was his activity as a professor at the Faculty of Architecture of the University of Naples, where he taught the disciplines of design and technology from 1928 to 1977. Among his many works, there are eight churches (seven placed in Naples), of considerable interest for the variety and the quality of the architectural solutions adopted[10]. Although his ecclesiastical buildings are considered secondary compared to some public and residential buildings, evaluated as his best works, the linguistic evolution recognizable in the churches designed by Chiaromonte, clearly distinguishable over a period of about twenty years, reveals a path of planning experimentation absolutely interesting. He started from the stylistic exercise of the church of the nuns Carmelitane Scalze of Santa Maria dei Monti ai Ponti Rossi (1939-48), built exactly like an eighteenth-century church at the request of the client, to the historicism of the church of San Vitale Martire in Viale Augusto (1939- 1963), which construction, designed and launched at the end of the thirties during the urban renewal of Fuorigrotta, was completed in the fifties[10]. While the church of the Carmelitane depends on the deepened knowledge by the designer of the Neapolitan Baroque architecture, the church of San Vitale, certainly the best known among the churches of Chiaromonte, reveals the author's adhesion to the principles of the architectural culture promoted by the fascist regime, already successfully tested in the palace of the Provincia, designed with Marcello Canino[2, 10]. Conceived in the late thirties as part of the recovery plan of Fuorigrotta, but completed in the fifties, the Church of San Vitale, located next to the gallery of Posillipo between the two roads of Via Giulio Cesare and viale Augusto, characterized by the presence of historicists elements, inspired by the characters of the architecture of the Renaissance and the Romanesque one, assembled in a modern composition, reflecting the monumental imprint typical of the fascist architecture in its large portals made of travertine cashed in masonry and in bands crowning suspended arches. From the architectural solutions tested in the church of San Vitale depend the most modest churches of Santa Maria delle Grazie in via delle Brecce (1950) and the one of Santa Maria del Buon Consiglio in via Santacroce (1952-56), in which the architect proposed again the motif characterizing the high large central empty space, generated through the moving back of the entrance portals[10].

The churches designed in the early sixties in Naples are absolutely different: here the concrete structure becomes protagonist of both external volumes and in the internal space of the buildings. The church of Santa Maria della Rotonda in via Altamura (1961) is an interesting variation of the theme of composition of the circular plan, bordered by a sequence of load-bearings, clearly visible from the inside and from the outside of the building, that curve the geometric network of beams on which rests the umbrella dome [10]. The church of Santi Giovanni e Paolo in square Ottocalli (1961), however, elaborates in an original way the theme of the cross plan with the longitudinal walls open towards the cross vault, in order to expand the central space of the ecclesiastical hall [10]. In this case, even more than in the Rotonda, the particularity of the work is the three-dimensional system of the concrete structure, in which alternate the gaps of porticos and balconies and the fullness of the brick infill walls. Ultimately, these two buildings, realized by Chiaromonte, probably inspired by the famous Roman churches of Nicolosi (San Policarpo) and Paniconi and Pediconi (San Gregorio VII), built a few years earlier, express architectural clarity and sincerity in the use of materials that in his poetry rise up to become real aesthetic values. Definitively, both churches are successful interpretations of that simple and essential language, characterized by the perceptibility of the concrete structure and of the infill brick on sight, which was a procedure amply widespread in the Italian ecclesiastical architecture of the sixties.

Strictly related to these two churches is the church of Santa Maria dell'Aiuto in Castel Volturno, built in the structure conceived to host summer camps for children from poor families, made by the Neapolitan businessman Roberto Fernandes, the main buyer of Chiaromonte, in memory of his daughter Elisa, who







Figg. 17-19: Views of the church of Santa Maria dell'Aiuto in Castel Volturno.

died at a young age [10]. The structure, situated along the via Domitiana on the edge of a blooming pine wood, has a simple arrangement, made up of a large block of three floors with a parallelepiped shape which joins the ecclesiastical building, distinguished by two symmetrical bodies of lesser height from the compact volume of the colony and from the terminal bell. The continuous geometry of the structural system in view, which is the main feature of these works, guarantees the composition unity of the building, revived by the central portico and by embossed platforms in correspondence to the entrances. The exterior of the church shows a greater articulation, generated by the moving back of the entrance, which creates an empty space in the lower register of the main façade; by the mixtilinear shape of the façade, which follows the contour of the roof, underlined by the bending and by the intersections of the bearing elements made of reinforced concrete; by the sequence of composite windows delimited by the beams of the roof, that light from the top the ecclesiastical hall; by the bell tower side, where the trestle, free from the infill of the terminal level, defines an open belfry. The interior of the church offers an articulated spatiality, defined by the compositional clarity of the intersected beam system that supports the roof, which inner wavy surface was perhaps obtained using a corrugated sheet as formwork. The parietal paintings on the inner sides, depicting episodes of the life of emigrants from Africa and Eastern Europe, thanks to their genuineness, not clash with the entire structure. Even the clumsy plaster Ionic capitals affixed on the pillars emerging from the perimetral walls are in this context acceptable, because they are expression of a sincere spirituality. Actually the Center, renovated after years of neglect following the donation of the heirs Fernandes to the Archdiocese of Capua in 1996, is refuge for people in need, such as the non-European immigrants. However, at the time of the survey carried out by the writer (April 19, 2015) was functioning only the church, which hosts church services, in original language, for the various foreign communities stabilized in the centers of the Litorale Domizio, while the accommodating structure was momentarily closed.

References

[1] SERRAGLIO, Riccardo. *Architetture per i lavoratori tra Napoli e Caserta. Progetti e realizzazioni dal XVIII al XX secolo*. Napoli: La scuola di Pitagora, 2012.

[2] STENTI, Sergio. *Marcello Canino 1895/1970*. Napoli: CLEAN, 2005.

[3] Archive of the Ufficio Tecnico Edilizia di Culto della Curia di Caserta.

[4] BENEDETTI, Sandro. *La Cappella della "divina sapienza" nella città universitaria di Roma*. Roma: Gangemi, 1998.

[5] BIZZOTTO, Renata. CHIUMENTI, Luisa. MUNTONI, Alessandra. *Cinquant'anni di professione*, Roma: Paolo Kappa, 1983, pp. 121-124.

[6] LIMA, Antonietta Iolanda. *La palazzata di Messina e i suoi architetti*. In DOCCI, Marina. TURCO, Maria Grazia. *L'architettura dell'"altra" modernità*. Roma: Gangemi, 2010, pp. 594-607.

[7] CIUFFETTI, Ruggero. *La Basilica di San Giovanni Bosco in Roma*. Roma: Litotipografia Istituto Salesiano Pio XI, 2009.

[8] Archive of the Church of San Nicola in Mondragone.

[9] Archive of the Church of San Rufino in Mondragone.

[10] DI LUGGO, Antonella; CASTAGNARO, Alessandro. *Ferdinando Chiaromonte Disegni opere progetti*. Roma: Officina Edizioni, 2008.

HERITAGE and TECHNOLOGY
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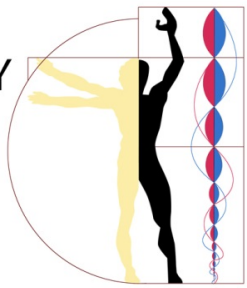

IMAGES OF POSSIBLE FUTURES. Representing changing landscape

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Abstract
The spread of new technologies, including those from Information and Communication (ICT), has deeply changed the way of the learning transmission, increasing the possibility to create knowledge and using digital technologies oriented to a fruition of the cultural heritage landscape as an emotional experience. Innovative communication strategies are based on the use of digital technologies for the construction of images that convey cultural content, and oriented to fruition as a visual experience, which is lived, told and shared, to catch the attention, expand knowledge and create a sense of identity and belonging.
The cultural heritage landscapes are often occupied by construction site that need to be continuously maintained and simultaneously used. The construction site is the place of the transformation, characterized by environmental and energetic impacts; however, it is also the place where communication flows are generated. No place, more than a construction site, can interpret the dimension of transience and temporariness, generally perceived as a perceptive degradation. No place better than a construction site can be interpreted as an occasion to test innovative technologies and useful strategies in order to manage the cultural landscape valorising its fruition also during construction site phase: cultivating imaginaries, activating the pleasure dimension, reinterpreting the mode of use, through a new assignment of sense to their direct experience.
The contribute illustrates strategies, methodologies and purposes of an on-going research work about the innovative communication tools in order to manage the construction site phase of the Cultural Heritage.

Keywords: Communication, Identity, Participation, Sustainable construction site

1. Introduction (by A. Cirafici)
The "Europe 2020" Program continues the policy outlined in Lisbon, pointing on Innovation, Research, Digitalization and ICT detailed implementation on Cultural Heritage. The widespread of new technologies, included those from Information and Communication (ICT), has deeply changed the way of learning transmission, increasing the possibility to create knowledge.
The aim of this paper is to illustrate examples of enhancement of cultural heritage, broader meaning that the term can assume today, through new communication strategies based on the use of digital technologies for the construction of images that convey cultural content, and oriented to fruition as a visual experience, which is lived, told and shared, to catch the attention, expand knowledge and create a sense of identity and belonging.
The change of the internal dynamics in the contemporary society requires the need to tell the cultural heritage according to new logics and ways. In fact, we are living in times in which a cultural good can be enjoyed in every moment, in every part of the world, with a mass of different technologies and various motivations and purposes: times in which virtual reality superimposes on material reality, and the Image converts and evolves his components. Times in which also temporal, spatial and sensorial dimension can be modified, transformed and implemented beyond every awareness. [3]
The multiple forms of today communication lead to consider how appropriate and useful is to look at the so-called new media, capable of reaching large audiences with no limits of space and time. New technologies,

enabling to communicate through the building and sharing of images, may, in fact, allow the user to increase the chances to experience the cultural heritage by providing a set of virtual tools able to change substantially the relationship between the cultural resource and who holds them.
In this perspective, the results reached by Augmented Reality (AR) – that actually experiences his own new language, able to model original stories that develop our experience, supplying to our senses a large spectrum of information otherwise unapproachable - are significant. However, is the sharing of the Visual Heritage on digital platforms that contributes most to the construction of a “Collective Identity”.
A recent international research lead between Italy, France, USA and Japan has revealed the incredible spread of a new social avant-garde: the “Cultural Creatives”. This is a social miscellaneous group, bounded by the common will to pursue the positive values of ecological sustainability, the recovery of own history and tradition and human ethics: they have a perspective on quality of life based on “unique experiences” of personal growth, on critical and conscious access to knowledge and the consumption of more cultural than material products. “Creatives” because of the fact that – acting in a discerning way regarding information, operating in a selective manner and elaborating their own awareness form – they act on culture, producing culture on their turn.
The observation of the emergence of this social phenomenon suggests that communication projects for the cultural heritage, that are ready to follow the evolution of these processes, can really change the relationship that the citizen has towards 'own' territory and can have a great impact on the perception of his property, on the sense of mutual belonging and identification, on the construction of a cultural identity to live, share and respect. A so determined approach, which aims to build a direct relationship with the good through the experience that the user makes of it, can help to create new culture and to form a society oriented to the production of knowledge.
The previously described scenario has an interesting – and not studied – application in the case of the particular phenomenon represented by the pervasive presence in the fabric of the city, especially the history and foundation, of numerous sites that are often not marginal episodes as well as temporally not insignificant of the urban scenario. "In the urban cultural landscape, the construction site is Both the place of transformation and conflict, but also of productivity and the attractiveness of resources" [4] .
The concepts of Identity and Integration, Communication and Participation effectively interpret the dynamic process of improvement and conversion, which is not only functional, but also perceptive-fruitive of these open spaces, waiting to identity and needy of creative incentives and practices of re-appropriation.
The aim of this paper is to define the critical outline and method of this particular area of reflection and to illustrate examples of the application of new communication strategies based on the use of digital technologies for the construction of images that convey cultural content, and oriented to fruition as a visual experience, which is lived, told and shared, to catch the attention, expand knowledge and create a sense of identity and belonging.

2. Images, imaginary and construction building site: The contemporary challenge of communication (by A. Cirafici)

“Sustainability”, in the scenario of contemporary culture, is now considered an essential condition for any action aimed at modifying the structure of the city and territory. A concept, that of sustainability, widely investigated in the contemporary cultural scene, but that has unusual aspects in the particular case of the relationship between the city and places of its transformation: construction sites. They are often open wounds in the urban fabric, without the choice being shared or the need with the communities that will suffer the inevitable disruption and that, in most cases, live the experience of the construction site as a loss, a deprivation, a limitation. In Italy, the culture of participating in the fate of the city is still in its infancy, with virtuous cases such as those represented by the history of the immense construction site of the Halles of Paris around which an intense dialectic of collective participation was enabled right from the decision of the project and continued throughout all the stages of the implementation of the construction site with the activation of specific and sophisticated communication strategies, aimed at giving an account of the work and continuous interacting with the functioning of the city are very rare. The aspects upon which the theme encourages consideration are manifold. On the one hand, the construction site is shown in the urban landscape, as an “ephemeral object” which is primarily interested in investigating from a perceptual point of view. The construction site changes the structure of the city, its fluxes, and its perceptive landscapes for a period of time that sometimes cannot be foreseen. They are places considered as “awful” and without any identity.
No place, more than a construction site, can interpret the dimension of transience and temporariness, generally perceived as a perceptive degradation. No place better than a construction site can be interpreted as an occasion to test useful strategies of intervention in the management of the public space: working nearby, cultivating imaginaries, activating the pleasure dimension, reinterpreting the sense of places, through

a new assignment of sense to their experience. These are all actions that can find in the construction site management their own expression, able to increase their sustainability in terms of collective experience.
The aim should be that one to activate communication and enjoyment dynamics, able to let the construction site interpret not as a shape but as an event. An event we can participate to, finalizing its experience, also in its negative aspects, considering a collective advantage. Activating devices, able to let the construction site live as a possible experience, and accessible in some way, increasing the sense of familiarity and participation with what happens beyond the enclosure, cancelling the sense of exclusion and lack that is accompanied to it, is one of the strategies that is possible to carry out, especially if you consider the potential poetical strength closed in the construction site, imagined as an incredible “machine with a fantastic reaction”, a contemporary and a little bit surreal version of the “festival machines” of the baroque city.
In such a sense, it is possible to interpret the construction site as a “close” space in an affectionate sense of the word, within which producing further ephemeral actions turned into spatial and figurative disposals, mediated through opportune storytelling strategies by sight, storytelling, involvement of the one who lives that space and works there. Therefore, the construction site shows to be able to cultivate imaginaries and activate those actions of poetical disorientation, creating paths of either rediscovery or re-appropriation of the places.
Not lastly we must consider that, as it happened for the fittings of the “festival machines”, offered as a precious occasion of experimentation for the architectural language, also the contemporary construction site in its ineluctable ephemeral condition could be offered as an occasion of experimentation for those who work in reinventing the image of the contemporary city and reconfiguring urban landscapes.
The impact of some “inventions” and the figurative result of planning actions in the context of the urban tissue could be judged and shared by the society, in the advantageous condition of the provisional fittings, starting a new phase of participation to the choices about the destiny of the city and its image.
They are operations aimed at reinventing the construction site, simply putting it within a value system, which seems not to be of its interest, imagining communication and participation ways able to interpret its strength of impact in terms of perceptive sustainability, in order to make it really “accessible” in the sense that it is perceived as a “possible experience” [5] in the identity dynamics of an urban community.
The issue becomes all the more interesting in those cases where the opening of the construction site coincides with the realisation of historical and artistic structures that somehow offer the community, in an unprecedented temporality, sometimes limited for procedures of detection by the Superintendency, or even more so in those cases in which the interventions are in exhibition areas whose desired use is possible even during the construction phases. It is worth considering the complex work conditions in archaeological sites like Pompeii that would be an interesting pilot study of the organization of a construction site where through the use of communication strategies supported by new digital technologies, such as augmented reality or video mapping, experience storytelling techniques of places through the construction of images that document such places as the valuable work that is being carried out on them, make it possible to build new forms of knowledge and understanding through a direct experience and interaction with cultural patrimony under new and stimulating participatory conditions.

3. Construction building site: place of transformation generating flows (by A. Violano)

In a resilient and regenerative future vision, the construction site must be the place of a participated and shared transformation, so that, in the future vision of the urban setting, the transformation was not only the change of the physical area, but also that one of the way to use it. [4]
Currently, the construction site is the place of production of the construction process, a complex system of actions and relationships that are at the same time, a verification of the design phase and the premise of the management phase, in which a multitude of people with different roles and tasks operate independently, but also act together for the realization of the architectural works in perfect synergy.
The factors, which characterize a construction site, can be summarized in three main categories:
1. *men*, the active people that prepare, coordinate and carry out the operations,
2. *machines*, tools and means of work that allow the execution of operational procedures,
3. *environment*, the physical location of processing, but also the context, natural and anthropogenic, into which is placed the shipyard.
The first macro-category consists of individuals, decision makers, who are called in order to intervene directly or indirectly in the construction process. They play an important role both in the design and coordination phase (as the designer, the site manager, technical director of the contractor, the security officer, the energy manager) and in the construction work phase ("labor" performed by specialized, skilled and common workers).
The equipment and work vehicles are, in most cases, the main elements of production of the impacts; in this case, it is necessary to intervene upstream in the design phase, defining, in regulatory terms, the performance standards that, as was the case with the EC Directive 89/106, constitute an obligatory reference for industries production of tools and machines.

The environment is both the place of production and the receptor of the impacts. In the place of production, it is possible to take appropriate mitigation measures in order to minimize damage on the natural and man-made environment; as receptor, it is affected to varying degrees depending on the type, location, extent and duration of the implementation phase.

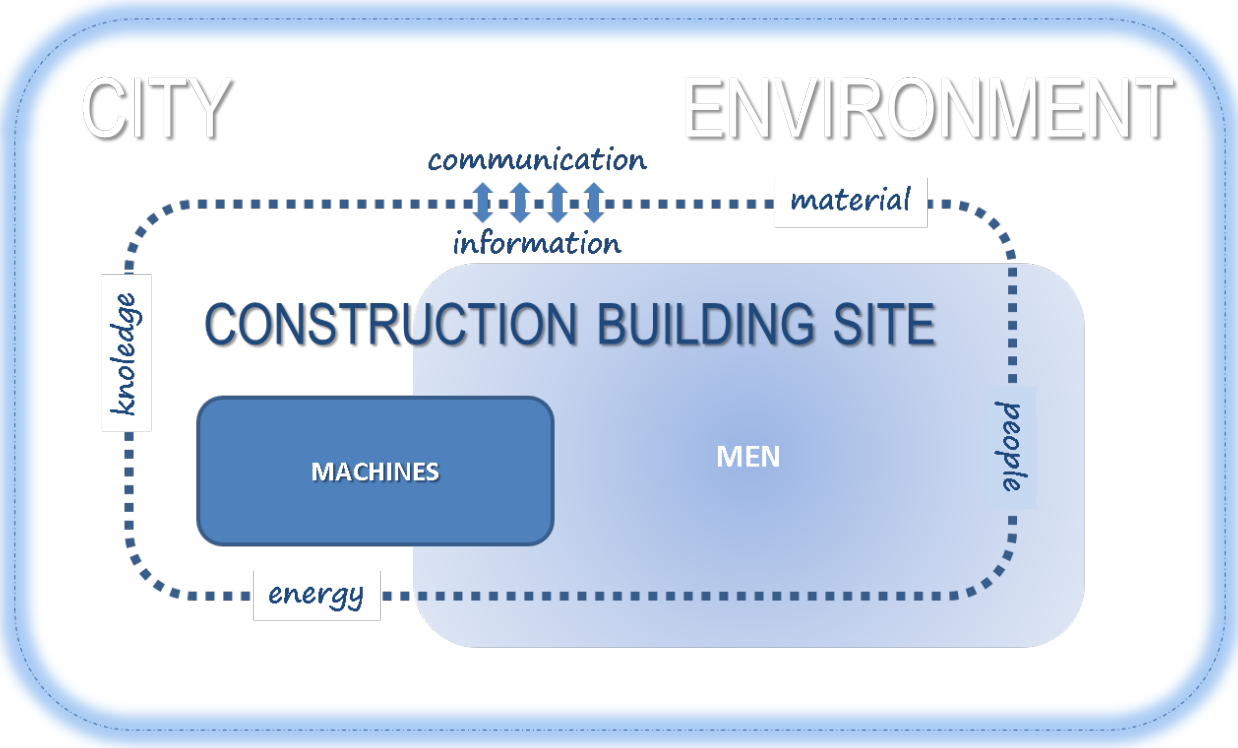

Fig. 2: Factors characterizing a construction site.

Each construction site is "unique" because its characters are closely dependent on synergies and conflicts arising between the three main categories.
In urban areas with high population density, the delicate mechanisms that regulate the activities of the inhabitants can be easily disturbed by the opening of building sites for the construction of works of public or private interest. Size of the construction site and the scale of works to realize may cause discomfort and negative consequences for a very variable number of people; but also the smaller renovation work often causes negative impacts on the immediate around and on the inhabitants who are involved.
In order to analyse the different types of impacts, several case studies have been selected in relation to their different structure and spatial conformation, but especially to the implemented strategies mitigation of environmental impacts.
The deduced reflections arise as part of a research work in progress on the issue of the impact caused from construction on the environment, in order to define decision-making tools that can address the choices related to the execution phase, transforming the construction site from social cost in opportunities, “well to positive utility”. The objective is aimed at creating a new way of managing the urban construction site, which converts the socio-economic costs and environmental impacts in social and energy-environmental benefits.
The research focuses on the presence of construction sites in large cities, considering the construction site no longer as a temporary impediment, or as concentration of temporary impediments, but as a chance that cleverly use in order to retrieve the identity of the urban landscape.
However, a construction site is sustainable not only if it is able to manage its negative environmental impacts on the surrounding urban system.
The concept of sustainability applied to the building process, and in particular to the implementation phase, draws attention not only on the relationship between the type of work and around the environment (understood as the physical place where the effects of the work should be analysed), but also on the need to analyse all the potential factors of change in dynamic and evolutionary terms, with a systemic and multidimensional. [3]
However temporary, the construction phase influences the quality of the use of common areas, continuously affected by the presence of shipyards cyclically open and close.
Assuming that the construction site is a production complex place, it produces different impacts on the environment and on the direct and indirect beneficiaries, particularly significant concerns areas of particular historical and artistic.

In these cultural contexts, the construction site can be an opportunity to develop strategies for promoting them. The research work, after analysing the different types of flows of matter and energy into and exit from the construction site with their social and environmental impacts generated, focuses, in particular, on the frontier of the construction site.

	OPERA	SITO	DURATA	ARCHITETTO	OBIETTIVI	
1	One World Trade Center	Manhattan NY	2006 - 2013	•Daniel Libeskind •David Childs	• Cantiere sostenibile • Compostaggio rifiuti • Impalcatura dinamica • Risparmio di suolo • Ottimizzazione dei tempi	CANTIERE VERTICALE
2	Ministere de la Culture et de la Communication	Parigi	2004 2006	•Principale progettista: Francis Soler •Architetto d'interni: Frédéric Druot •Paesaggista: Michel Desvignes •Consulente: Patrick Blanc	• Impalcatura dinamica • Risparmio di suolo	
3	Green green screen	Tokyo	2003 2006	•Klein Dytam	• Parete verde • Schermatura dinamica • Raffrescamento naturale • Parco lineare • Giardino verticale	SCHERMATURA VERDE VERTICALE
4	Kaiser-Wilhelm Gedächtniskirche	Berlino	2011		• Integrazione percettiva • Fasi di lavorazione h24 • Minimizzazione impatti percettivi sul contesto urbano	INTEGRAZIONE PERCETTIVA
5	New Hall of Messe Basel Exhibition	Basilea	2010 2013	•Herzog & de Meuron •Stefan Marbach •Wolfgang Hardt	• Ottimizzazione dei tempi • Fasi di lavorazione h24 • Condivisione con la comunità • Industrializzazione del processo costruttivo	CONDIVISIONE CON LA COMUNITÀ
6	The development at King's Cross	London	-----		• Partecipazione dei cittadini • Nuova geografia emozionale • Fruibilità immediata spazi aperti • Cooperazione pubblico - privato	PARTECIPAZIONE DEI CITTADINI
7	The king's Cross Skip Garden	London	-----		• Cantiere sostenibile • Paesaggio • Integrazione sociale • Ecologia • Sperimentazione	LUOGO DI SPERIMENTAZIONE

Fig. 2: Significant examples of urban construction sites that mitigate their environmental impacts (Immagine elaborated in collaboration with L. Melchiorre).

In fact, the fence of construction site, which is a physical and immaterial that can filter and select the flows of matter and energy, people and information, can fulfil the role of technological "smart" element in order to mitigate the negative impacts and create integration, communication and participation.
In the construction site as thought at Ersilia, the city of Calvin, "in order to establish the relationships governing the life of the city, the inhabitants stretch strings from the corners of the houses, white or blacks or grey or white-and-blacks depending on whether they mark a relationship of blood , trade, authorities, representation. ... webs intricate relationships seeking a form. "[2]
The smart construction site can be an important node of this web of relationships that are relational links and information flows. The goal is to ensure that the architectural and urban planning are shared, that does not stop the communion of amorous feelings between cultural heritage and its users and that the place of the transformation will become the site of social and perceptive involvement.
This is even more evident in the case of construction sites concerning cultural heritage (architectural and archaeological). In these cases, the primary requirement is to protect the good, but at the same time ensure its continuity of use, avoiding interference or risks for both workers and visitors.
This requirement can be met through the development of methodologies and strategies for the valorisation of "cultural heritage", based on a multi-model approach, which includes actions diversified (geography of space, observation points, paths fruition, interaction modes , information flows) by type of users (direct and indirect).
The spread of new technologies, including information and communication (ICT), has profoundly changed the way we transmit knowledge, increasing the possibility of using digital technologies oriented towards use of cultural heritage interpretable also as an emotional experience.
Innovative communication strategies are based on the use of digital technologies for the construction of images that convey cultural content, and oriented to the use as a visual experience that is lived, it told and shared, in order to expand knowledge and create a sense of identity and belonging.
The cultural heritage has the particular need to be constantly maintained and simultaneously enjoyed. No place, more than construction site is able to interpret dimension of transience and temporariness, generally perceived as physical and perceptive degradation. Instead, we want to say that a construction site can be

interpreted as an opportunity to test innovative technologies and useful strategies to manage cultural heritage, emphasizing its material and immaterial knowledge.
The planning process, based on development and improvement of socio-cultural, environmental and economic relationships/synergies, acquires connotations of transparency, participation and flexibility, according to social rules, ecological principles and efficiency criteria [1].

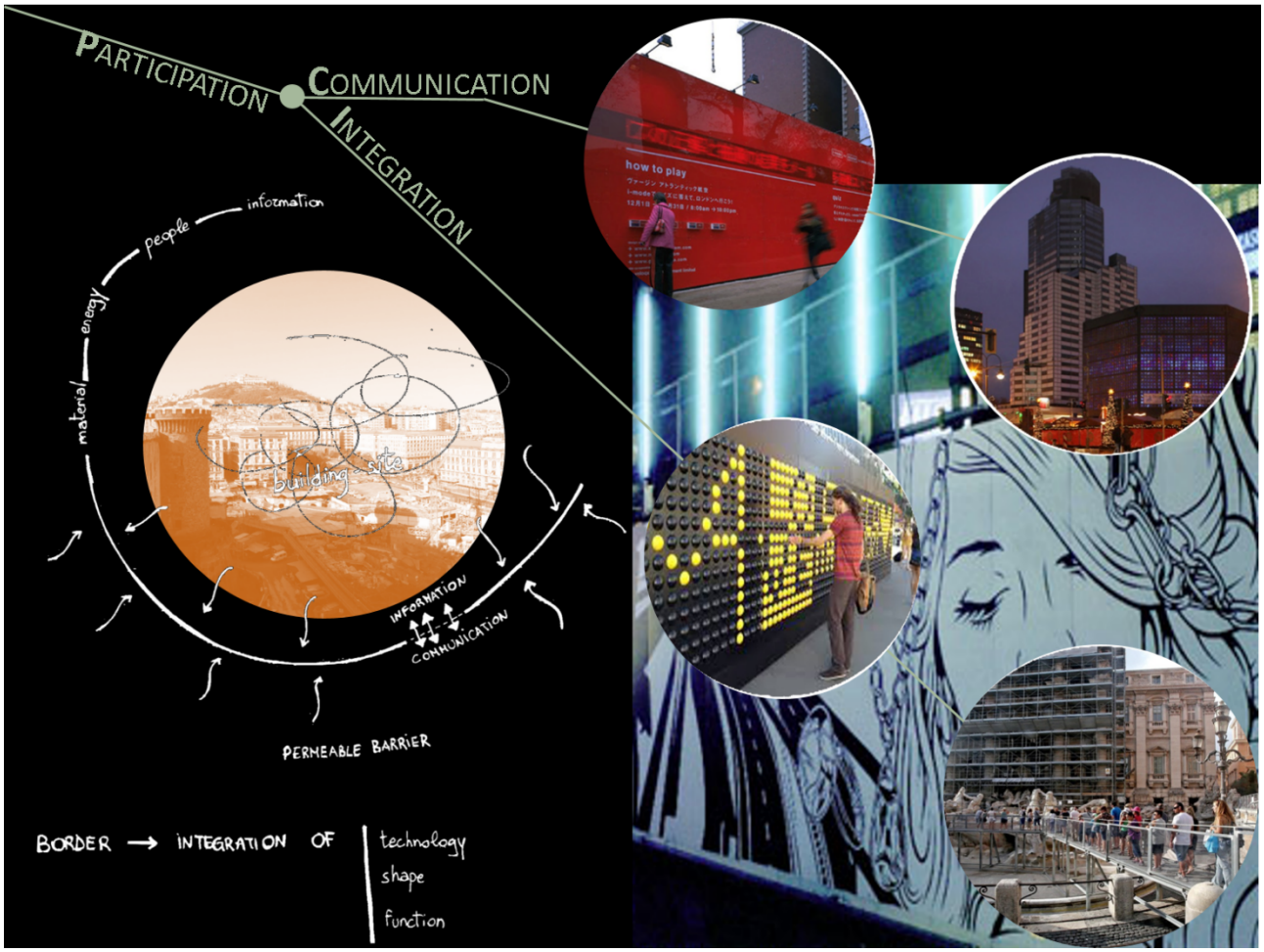

Fig. 3: The technological "smart" element in order to create integration, communication and participation.

That is neither for trend, nor to satisfy effective slogans, nor because they are a prestigious status and worth indicator, but for conviction, awareness and knowledge. Nevertheless, you need courage, boldness and vision ability of future setting. The construction site represents an opportunity to orientate such a vision towards a culture of regenerative and inclusive transformation and its technological footprint.
The communicative and permeable construction site is in direct relationship with the changing city, offering new technologies for managing and monitoring itself. It has the ability to interact positively with the city if it is conceived and designed with meta-temporal approach. The choices must be made before the opening of the construction site, even before the transformation becomes physical ... then become future space.

4. The technological footprint of a building site (by A. Maio)

The continuous effort to bring more and more people in the world of culture (understood in its various forms) and cultural heritage has expanded their formative effect for the direct beneficiaries but also and above all emphasized that such Heritage is an economic driver.
However, the rules of fruition have changed: at micro systemic level, function and objective can no longer be limited to observation or knowledge of the Good; it is placed in a larger context that includes the technological process that is the protagonist and producer of Good itself.
Between Good and the user, therefore, it must establish a highly communicative and participatory relationship.
In the construction phase, the activity of fruition becomes collateral and requires additional complementary activities and standards that meet and ensure precise levels of quality and safety.

The government, owner and operator of a large part of this heritage must therefore restore its cultural heritage by ensuring the fruition. This means raising the quality of its offer and integrate it with additional services that have the capacity to meet a complex question, including through participation of private entrepreneurs.
A privileged way in order to enhance the safeguard and the local economy through the re-appropriation of their identity territorial is to enhance and possibly restart the technological processes that led to the very culture of heritage.
A construction site able to offer users information about the activities of the restoration project, the construction characteristics of the building being restored, the consolidation methods and the future cultural offer after restoration has, in fact, an Added Value.
Through a critical analysis of experiences, research verifies the feasibility of the implementation of the "network of flows", of local authorities, of tangible and intangible assets, of natural and man-made resources, fixed capital accumulated in infrastructure and facilities and relational goods.
Therefore, with deductive method, the experimentation starts with the identification of an archaeological heritage to be restored, having in essence the said potentialities and needs. The restoration project is not only conservative, but also oriented to the optimization of technological processes underlying the nature of the asset, significant elements of a "cultural identity" connected to its' "technological footprint".
The experiment showed that the preservation without the dynamic process of development has been consolidated as mere preservation of the "matter", linked to a collective and individual memory that has, in a short time, created maintenance and conservation problems. Instead, the material restored and returned to the collective memory, in case there was the reactivation of the technological process, which underlies the nature of the product itself, has become small attractor.
Analysis and experimentation also showed the relationship between the social and technological determinism; the latter combines the "contemporary" and the changeability of technological culture, influencing the consumer society, imposing requirements and directing needs.
The relationship between fruition and conservation of cultural heritage and the need to regulate their "consumption" tying market rules, already appears in embryo in the Code of Cultural Heritage in 2009.
The bond that is regulating between those who exercise supervision and the private user, who may benefit, is evident. We must increase these benefits.
Therefore, the goal is to re-enter the cultural heritage in the vital circuit, to the attention of "consumer", as an opportunity to increase knowledge.

Bibliographical References

[1] BIRKELAND, J.. *Design For Sustainability: A Source Book of Integrate Eco-Logical Solution*. London: Earthscan Publishing, 2002

[2] CALVINO Italo. *Le città invisibili.* Torino: Einaudi, 1972

[3] CIRAFICI Alessandra, AMORETTI V., DI FRATTA V., DI NATALE I., LALLONE D., *Rethorics through Images. New strategies to communicate, valorise and share the Cultural Heritage.* In: Conference Proceeding VSMM 2014 Hong Kong 9th 11th decembre 2014.

[4] CIRAFICI Alessandra, MELCHIORRE Lucia, MUZZILLO Francesca, VIOLANO Antonella. *Public space and contemporary city: the places of transformation*. In: HOPUE n. 2/2015

[5] RIFKIN Jeremy. *L'era dell'accesso. La rivoluzione della new economy.* Milano: Mondadori, 2000.

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Urban farming as an eco-oriented tool for the redevelopment of urban contexts

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Abstract
Urban farming is configured as an effective tool for redevelopment of urban spaces which represent nodal elements able to perform the delicate function of link between the urban and the natural surrounding system. This process of improvement takes on a role of particular importance especially when the open spaces are in a compromised ecological-environmental state, because their transformation corresponds to a real regeneration of the urban context. In this regard, the aim of this research is essentially to analyze the potential of urban farming not only for its capacity to allow an improvement of the general conditions of anthropised spaces, but especially, to the possibility of consenting the implementation of an urban network, structured as a multi-purpose system both of spaces and connecting corridors. To put in a system different urban areas, through ecological/functional links, aids to increase the overall environmental quality of the anthropised contexts as well as represents an important opportunity for social and economic development, which is fundamental in urban regeneration processes. Considering the significant features of urban context as well as the concepts outlined above, the case study of the Scampia district of Naples will be illustrated as an interesting application.

Keywords: Urban farming, urban redevelopment, environmental and technological issues.

1. The urban farming for sustainability cities (Rossella Franchino)
"Managing urban areas has become one of the most important development challenges of the 21st century. Our success or failure in building sustainable cities will be a major factor in the success of the post-2015 UN development agenda," said John Wilmoth, Director of United Nations DESA's (Department of Economic and Social Affairs) Population Division [1].
In many areas, there is the need for citizens to re-appropriate the old relationship with agriculture that urban growth has unfortunately changed over time. This is so as to find a solution to issues related to the economic crisis which have led to the search for less expensive solutions than those offered by industrialization agriculture, but also to respond to needs related to the safety and quality of food that moves towards finding solutions in cultivating urban areas that can be more easily "controlled". This need, however, is in contrast with the model of urbanization that has emerged over the last hundred years and kept agriculture outside the urban environment, giving it a role only in the context of remote rural areas.
A renewed environmental consciousness has led to reclaiming wasteland by "urban farmers", along with the diffusion of social experiences such as vegetable gardens, small crops in greenhouses, on the balconies and roofs of the buildings, colliding with an urban structure that, in most cases, unfortunately, is not prepared to receive them. Alongside these initiatives, especially related to individual or small communities, considerably more important, sometimes only as projects, have been created, but in many cases as experiences already activated and implemented within the metropolis.
Among the numerous cases, it is worth mentioning the experience of China, with an urbanization characterized by a depopulation of the countryside and a very rapid and disorganised urban growth. For example, in the Jiangbei District that belongs to the metropolis of Chongqing, the most populous in the world (8 million inhabitants) in south-central China, extended urban crop fields can be found at the foot of

skyscrapers, thus demonstrating how some Chinese companies are almost self-sufficient in foodstuffs [2] [3].
To intervene on the development of the urban territory in order to find an alternative to the model that emerged over the last century, consolidation interventions need to be orientated towards sustainability.
The challenge is therefore the following: can cities become capable of self-regulation in environmental, social and economic terms?
Consequently, the contribution from the conversion of urban open spaces is particularly important, since they constitute nodal elements capable of performing the delicate function of linking the urban systems with the surrounding natural ones, while assuming a strategic role in the transformation of anthropized areas.
It is important to not only bring nature into the urban areas, but use the best technologies available in order to enable those processes that use the principles of nature as a model of sustainable management and stimulate the natural potential of the inherent and undeveloped natural resources caused by mass anthropisation.
In this context *urban farming* can make a valuable contribution as an effective instrument for the renewal of urban open space because offers significant possibilities from an environmental, economic and social perspective.
Urban farming offers significant possibilities since it allows for the improvement of the environmental quality of these spaces, the achievement of both social benefits, with its responding to the needs of aggregation, thus implying a collective use of the land by the inhabitants, as well as economic ones, with its being" configured as an innovative business model (the self-production of food products at km 0), which can be easily extended to other related activities such as catering.
Urban farming, through the valorisation of agricultural areas, can also represent an interesting opportunity in both retrieving and restoring degraded urban areas as well as improving them from an ecological point of view. Obviously these areas, once suitably upgraded, can be networked with the green spaces in the city so as to achieve an ecological connection with the rural and natural peripheral areas.

2. Urban farming: ecological issues (Raffaela De Martino)

The city is an artificial ecosystem with complex interactions similar to those found in a natural ecosystem, but in contrast, it is made up of both natural and artificial elements, whose mutual influences are conditioned not only by natural factors, but also cultural, political, economic and social ones.
The city, like any other ecosystem, is made up of habitats with different degrees of naturalness: artificial habitats (buildings, industries, infrastructures), semi-artificial habitats (gardens, avenues, urban gardens), semi-natural habitats (large parks, forests urban parks, agro-ecosystems) [4].
The uncontrolled growth of cities, with the consequent settlement, infrastructure and production phenomena, has led to profound changes in the ecological urban structure, profoundly transforming the semi-artificial and/or semi-natural spaces. Nature is often reduced to isolated fragments, poorly connected and highly compromised in their ecological functions. In recent years the concept of ecological network, as a system of interconnected habitats that protect biodiversity, though usually applied to vast territories, has been proposed for the reorganization of open spaces in urban areas.
These areas include in addition to large parks and equipped green areas, small gardens, squares, unbuilt areas, open spaces as well as non-green and agricultural areas.
The considerations that follow are specifically concerned with the role that agricultural areas and, more generally, agro-ecosystems can have as part of an urban ecological network.
Recent studies have shown that urban agriculture is an integral part of the ecological system of the city due to both the considerable environmental improvements derived from its use as well as the areas involved helping to improve the stability of the ecosystems and therefore the implementation of their diversity.
The ecological policy dimension refers to types of urban agriculture with a multifunctional character, in addition to providing food and generating income, they play a role in environmental management and provide other services demanded by urban citizens: decentralized composting and reuse of organic wastes and wastewater, including nutrients; urban greening and improvement of the urban climate (shade, oxygen, dust reduction, etc.); landscape management (parks, buffer zones, areas that are flood- or earthquake-prone, or ecologically valuable and that should be kept free from construction), providing opportunities for leisure and recreational activities, water storage. In order to allow such a combination of functions, multi-functional agriculture should adopt agro-ecological production methods linked with eco-sanitation/ sustainable waste management, as well as with the planning and management of parks, nature and recreation areas [5].
As previously mentioned, in highly anthropised environments, there is less chance to favour the colonization and spread of many animal species, with consequent danger on the biodiversity. The implementation of agricultural areas in the city can therefore contribute to increasing urban biodiversity. If this statement is to be considered generally correct, it is however necessary to make some further clarifications.
From an ecological point of view, agricultural practices make ecosystems very fragile. Ecologists believe that there is a relationship of proportionality between the degree of diversity in species and the stability of the

environment: this means that the stability of a system, namely its ability to react to possible external disturbances of natural or man-made origin, grows with an increase in diversity, which expresses the richness and homogeneity of the species present in a given area. In agro-ecosystems, elements with different degrees of ecological stability can be recognized: the field, for example, destined to agricultural production constitutes the least stable element. Strips, rows, hedges, are highly important elements from an ecological point of view: even if their presence is not specifically related to agricultural production, however, it contributes to increasing the overall stability of the ecosystem [6].
The biodiversity of agricultural ecosystems has been greatly reduced in the past decades, not only due to the extreme specialization of crops, but also to the abandonment of traditional farming enclosures, such as hedges and trees, that were important ecosystems for many animal and plant species [7].
Hedges and rows are, in fact, an oasis of shelter and survival for all those species that can no longer find a suitable place to reproduce in the fields [8]. They also serve as biological corridors connecting, on a local scale, and encouraging an exchange of genetic material, both plants and animals, through the connection between otherwise isolated natural areas [9].
Based on these considerations, it is clear that in the design and/or redevelopment of a farm, regardless of its type-techno-morphological characteristics these ecological aspects, should be taken into account. In the arrangement of an open agricultural urban space, it is necessary to prepare the inclusion of vegetation strips at the edge of fields and agricultural areas as well as the ecotonal separation areas between them, paying particular attention to details such as the length, width and height of the hedges and presence/amount of trees.
Finally, for the urban ecological network, of which agro-ecosystems are part, to function properly, it is not only necessary that the areal elements (nodes) that make it up have an adequate environmental quality but they must also be connected to each other. It is therefore necessary to realize an ecological connection between the open ecological urban spaces and the offshoots of the rural territory present in the marginal areas of the cities in order to permit territorial movement of numerous animal species.

3. Green areas and quality of life (Caterina Frettoloso)

As part of the European policies of urban regeneration in a sustainable perspective, one of the parameters to measure the quality of urban life to the status quo, and with a focus on specific interventions, is the greenery. This highlights the key role that it can play from both an environmental and social point of view. The urban green areas, in fact, improve the inhabitants' quality of life, especially the air quality. Apart from being places where citizens can enjoy leisure time, squares, gardens and parks help to make up a well-balanced city, where the natural spaces mitigate the building and pollution effects [10].The presence of greenery, however, does not ensure an increase of quality, it represents an important factor but it is, above all, the level of connection between the different green areas and type of vegetation present in reference to the context which gives this parameter a greater or lesser significance.
In order to get tangible benefits on the quality of life, it is especially important to work on the connection between the environment and people in physical, perceptual and ecological terms, as explained in the previous section. A connection that involves inserting a series of suitable infrastructures, so as first of all to allow for the achievement, and then the fruition, of the areas created.
Urban agriculture, whose origins in Europe some studies have dated back to the edict issued by Charlemagne in the eighth century AD [11], is not set out as a traditional green space but retains some important characteristics. For example, the ability to increase or not the environmental quality of the context in which it is inserted and with which there is a two-way relationship: the external environment interferes with the growth of the vegetation, urban agriculture in turn changes the balance of its surroundings.
Some studies have distinguished between intra-urban and peri-urban agriculture in relation to the different location. In the first case, the place of production is within the city where plentiful vacant and under-utilized land areas, including areas not suited for building, public or private lands not being used that can have an interim use, community lands and household areas. In the case of intra-urban businesses, the types observed are mainly the community gardens (formal and informal), home gardens, institutional gardens (managed by schools, hospitals, prisons, factories), nurseries, roof top gardening, cultivation in cellars and barns (e.g. mushrooms, earthworms). Research data seem to indicate that intra-urban agriculture tends to be more small-scale and more subsistence-oriented than peri-urban agriculture, although exceptions can regularly be found (e.g. vegetable production and production of mushroom or ornamental plants).The experiments carried out so far in different parts of the world seem to indicate that the second type, called peri-urban due to being in the suburbs, tends to be larger and more strongly market-oriented [5].

3.1 Focus on the urban network

Going over the different locations that urban farming can have, it would be interesting to work on their functional fruition and eco-environmental connection with other strategic municipal points (public/private), exploiting the potential offered: production and green, green and social sharing, green and well-being.

The size differences that can somehow be associated with the intra-urban and peri-urban types can suggest different ways of disseminating and organizing the urban territory: from a more widespread and capillary model to a more accurately designed one characterized the farm as a landmark .
Urban farms can become nodes of a wider and more articulated system of open spaces, a predominantly natural character, and play a leading role, supporting the creation of new activities to support and integrate food production oriented towards maintaining and increasing the quality level of public spaces. In the Leipzig Charter and later in the Toledo Declaration, 2010, reference is also made to the need to make greater use of points related to the integrated urban development policy, which promote, among other things, the creation and consolidation of quality public spaces, upgrading infrastructure networks and improving energy efficiency as well as the development of efficient and affordable public transport systems [10].
Especially when working on urban contexts in the Mediterranean area, it would be interesting to be able to recover the systemic nature that has historically qualified our cities. The historic Mediterranean city created a blend of compactness and complexity from the medieval period facilitating communication as well as the exchange of goods and services among citizens on a pedestrian scale. Today, we still retain the best features of the Mediterranean city; it is possible to go by foot from home to the market or to businesses, to take children to school or even allow them to go alone. The compact and complex city not only provides mobility and accessibility, but also enables the commitment of more time to social or personal activities [10].
By sharing what was previously discussed, namely that the promotion of isolated cases of urban agriculture, without the establishment of ecological and productive networks, does not allow for the possibility of creating food systems based on closed ecological cycles within the city and its territory. It is believed that this is one of the aspects upon which it would be interesting to work with regard to how to map an urban farm within the built environment and, in particular, within the areas identified as significant nodes of the network.
Thus, regarding the connection as a sequence of environmental and spatial units characterized by different functional, ecological-environmental, fruition levels. The ways of connecting can be oriented, depending on the specific conditions of the intervention context, to mitigate situations of discomfort, to strengthen areas of the territory characterized by a good level of quality, but also to indicate innovative ways of growth and development on an urban scale in an attempt to systematize the many aspects involved in defining the quality of life in urban areas.
This methodological and planning opening is necessary when wanting to make sure that the experiences conducted so far are not limited to the testing of unconventional production, marketing and management techniques of urban and peri-urban areas, but would amount to real solutions to address the critical environmental and functional issues, while including the users in the decision-making processes [12].

4. A didactic experience: an *urban farm* for Scampia (NA) (Rossella Franchino)

The following is an example of a didactic application carried out during the course of “Design of Environmental Systems” held by prof. Rossella Franchino in the academic year 2013/14 as part of the degree course in Architecture at the Department of Architecture and Industrial Design “Luigi Vanvitelli” of the Second University of Naples, with an urban farm in the particularly urbanized context of Scampia, a areas situated at the extreme northern edge of the city of Naples .
The object of this didactic experience was the upgrading of the central sail of Scampia and its reuse as a vertical *urban farm*, with the aim of converting the structure from a negative icon throughout the hinterland of Naples into an awarding eco-sustainable and environmental project.
The redevelopment plans for a large part of the structure included the elimination of all the interior walls and perimeter in favour of transparency and the use of the spaces, the elimination of balconies, interior walkways and several floors, so as to increase the height of some environments.
Wide terraces for the construction of green roofs for grazing of small animals (north) and growing of crops (south) were also prepared. The system was also equipped with a recirculation system that reused rainwater for irrigation purposes. The large uncultivated flowerbeds at the base of the building were transformed into rain gardens to collect rainwater and tanks for the treatment of waste water.
On the south-facing façade, photovoltaic systems were installed so as to create self-sufficient energy. The car parks were located in the basement and the shops on the ground and first floors.
Several homes located in the northern part were used for temporary and social housing while those in the southern part as offices. In the upper southern part, finally, it is positioned a vertical greenhouse.

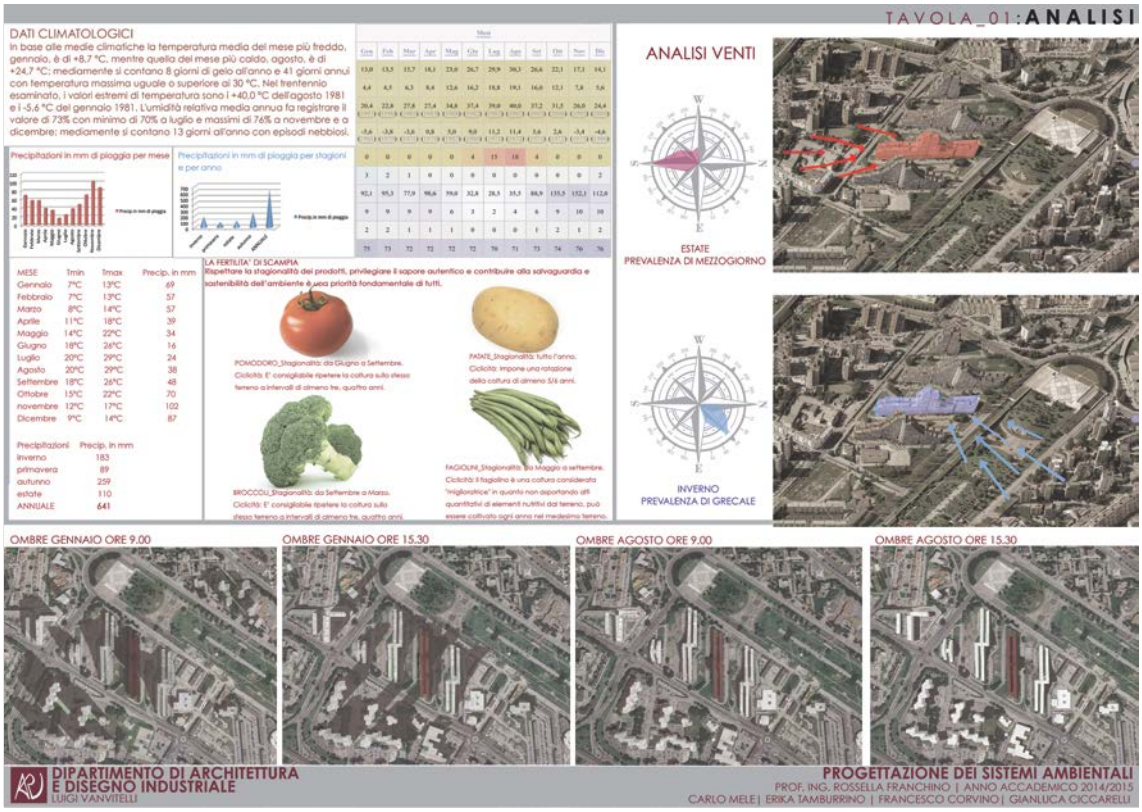

Fig. 1: Analysis phase - case study of an urban farm for Scampia in Naples (Elaborated by students Carlo Mele, M. Erika Tamburrino, Francesco Corvino, Gianluca Ciccarelli)

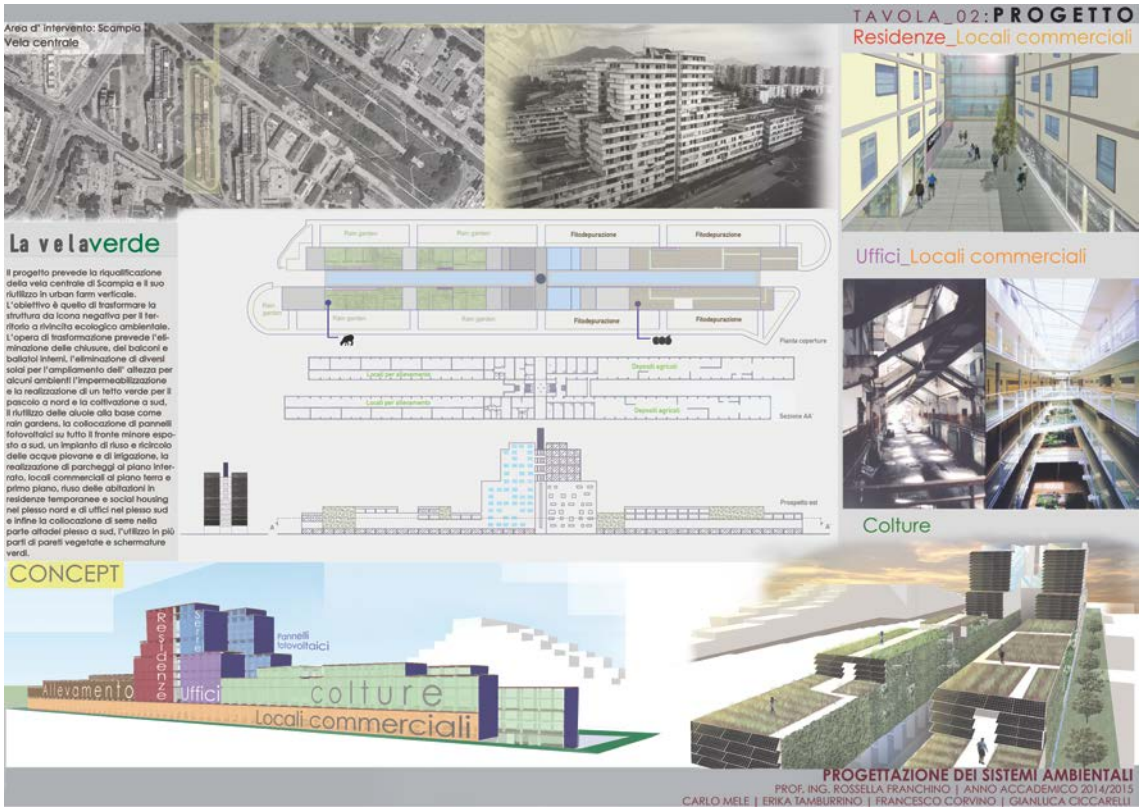

Fig. 2: Concept phase - case study of an urban farm for Scampia in Naples (Elaborated by students Carlo Mele, M. Erika Tamburrino, Francesco Corvino, Gianluca Ciccarelli)

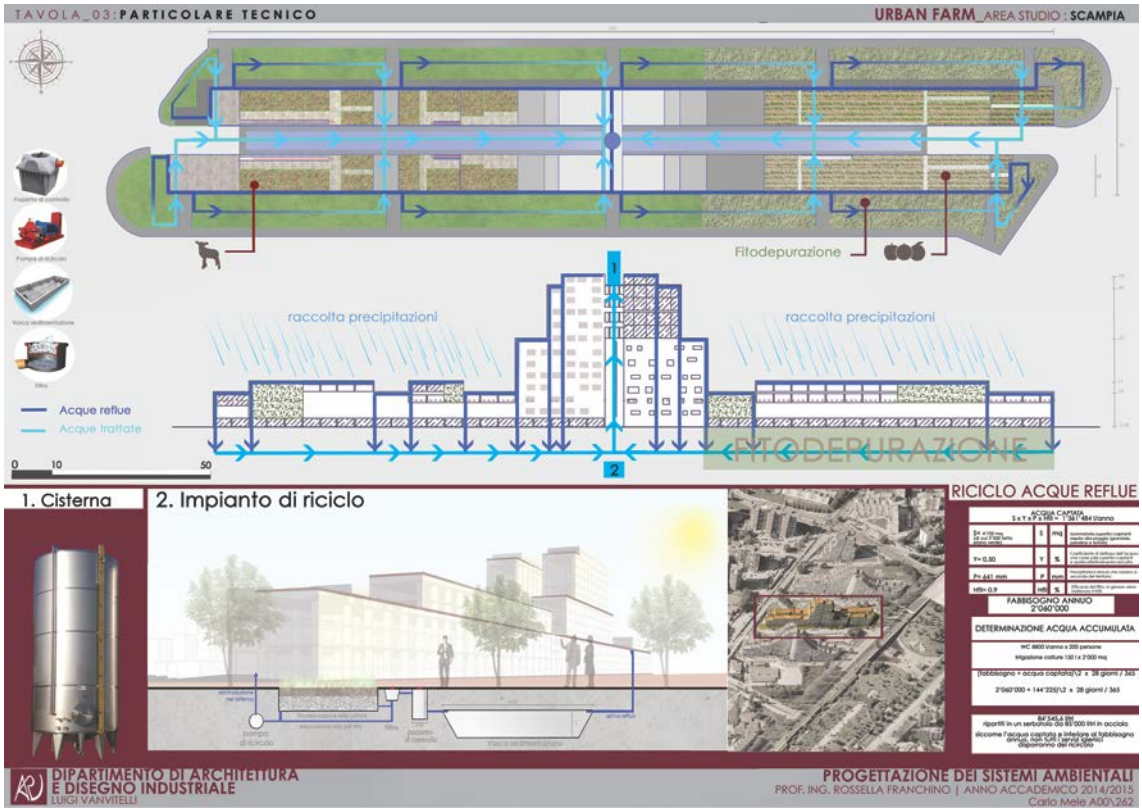

Fig. 3: Water recycle system - case study of an urban farm for Scampia in Naples (Elaborated by student Carlo Mele)

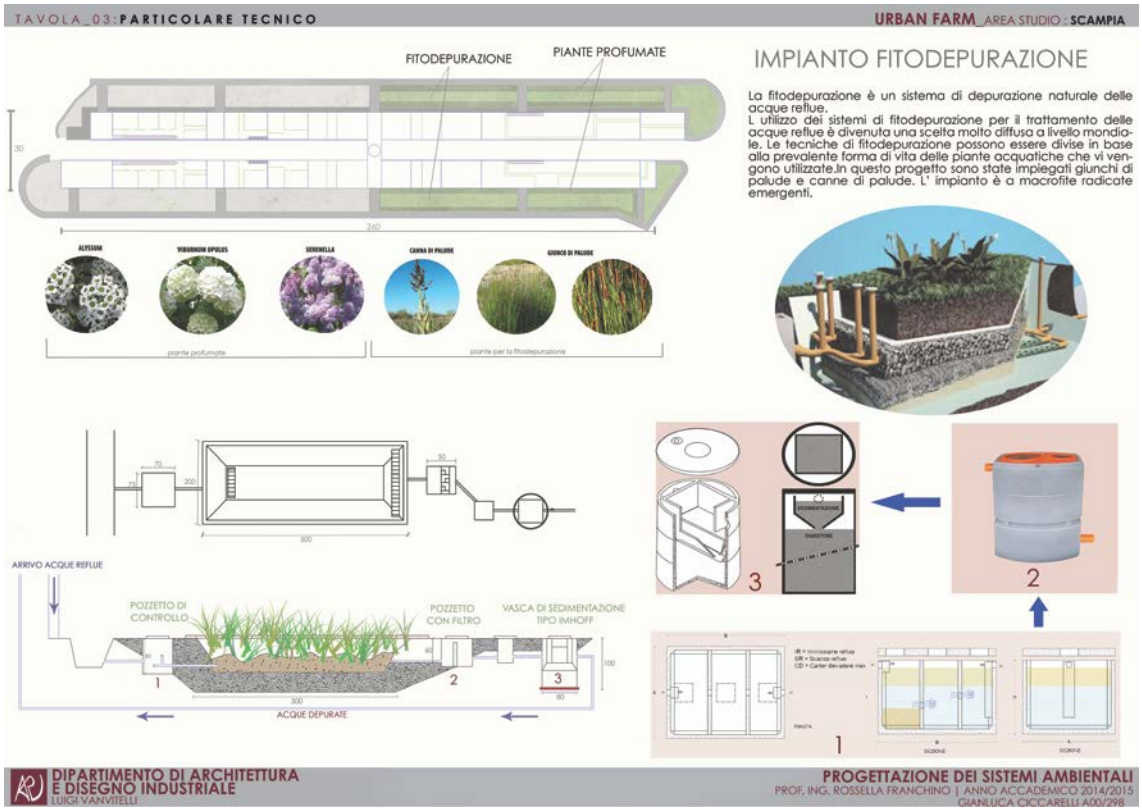

Fig. 4: Phytodepuration system - case study of an urban farm for Scampia in Naples (Elaborated by student Gianluca Ciccarelli)

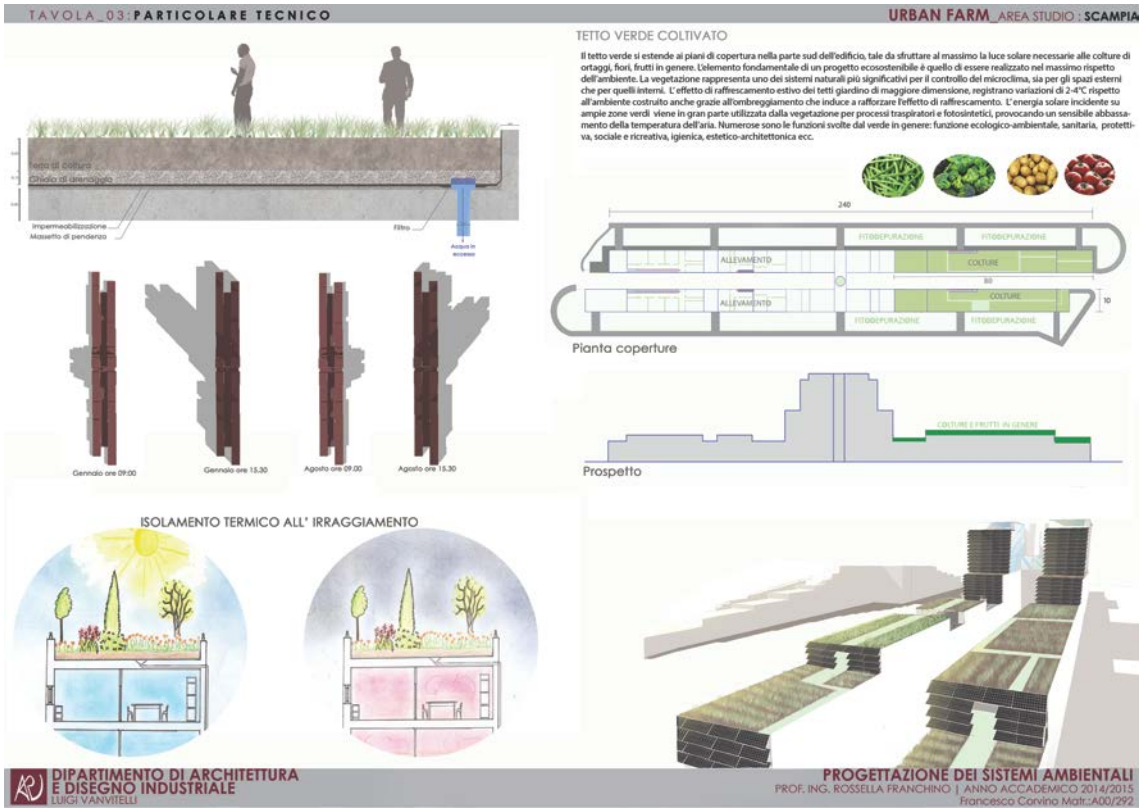

Fig. 5: Green roof - case study of an urban farm for Scampia in Naples (Elaborated by student Francesco Corvino)

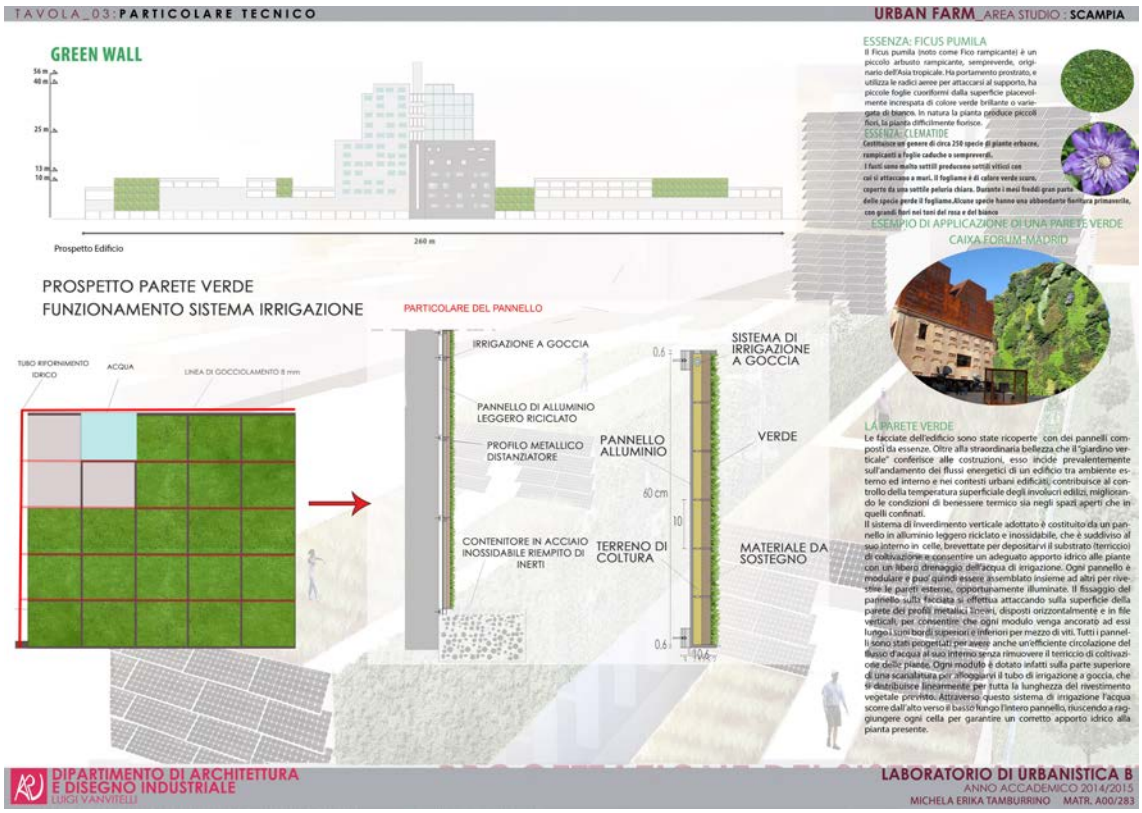

Fig. 6: Green wall - case study of an urban farm for Scampia in Naples (Elaborated by student M. Erika Tamburrino)

Bibliographical References

[1] http://www.un.org/en/development/desa/news/population/world-urbanization-prospects.html

[2] http://www.architetturaecosostenibile.it/green-life/green-economy/urban-farming-cina-299/

[3] http://www.timfranco.com/china/photographer/professional/shanghai/blog/2014/5/2/urban-farming-in-china-chongqing-series

[4] MININNI, Mariavaleria. *Ecologia urbana*. In: AA.VV. *Costruire sostenibile*. Firenze: Alinea editrice, 2000.

[5] AA. VV. *Profitability and sustainability of urban and peri-urban agriculture.* Roma*:* FAO, 2007. Agricultural management, marketing and finance occasional paper, 19.

[6] FABBRI, Pompeo. *Principi ecologici per la progettazione del paesaggio*. Milano: FrancoAngeli, 2007

[7] LEGAMBIENTE. *La nuova agricoltura. Manifesto per un agricoltura sana e sostenibile*. Download from (2014): http://www.legambiente.it/la-nuova-agricoltura-manifesto-%20

[8] LORENZONI, Giovanni Giorgio, ZANABONI, Alberto. *L'importanza delle vegetazioni relitte e delle siepi nell'agroecosistema della Pianura Padana e nella ricostruzione dinamica della vegetazione.* Università di Padova,1988.

[9] MASSA, Renato Ignazio, BAIETTO, Marco, BOTTONI, Luciana, PADOA-SCHIOPPA, Emilio. *Conservazione della biodiversità nei paesaggi culturali.* In: XIV Congresso della Società Italiana di Ecologia, Siena 4-6 ottobre 2004.

[10] AA.VV. *CAT-MED Sustainable urban models Work methodology and results.* Dipartimento dei Programmi Europei del Comune di Malaga – Osservatorio dell'Ambiente Urbano – OMAU, Istituto del Mediterraneo, GR 2150-2012.

[11] SMIT, Jac, NASR, Joe, RATTA Annu*. Urban Agriculture: Food Jobs and Sustainable Cities.* Washington: The Urban Agriculture Network, Inc., 2001.

[12] DJALALI, Amir. *L'agricoltura urbana come spazio della produzione comune*. http://www.crepeweb.net/wp-content/uploads/2009/12/intervento_amir.pdf

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Nisida: integrated and transdisciplinary survey for interpretation of sources

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Abstract
The island of Nisida houses the Institute Criminal juvenile, located in a building of the thirties of the last century. Below this building are preserved ancient local Bourbon, recently the subject of excavation conducted by the current prison administration. The Memorandum of Understanding for cultural activities and research signed in March 2014 between the Department of Architecture and Industrial Design "Luigi Vanvitelli" of the Second University of Naples and the Department of Juvenile Justice of the Ministry of Justice (Italy) has the aim to promote studies to analyze the material sources and to propose the scientific survey of some buildings recently brought to light. The disciplines of the survey and the representation of the built and natural environment have provided an opportunity for knowledge and documentation of reality. This documentation assumes importance as a valuable starting point for any proposed enhancement and it allows architecture to reveal otherwise unknown to most. The survey campaign of the building housing the juvenile Criminal Institute was launched in March 2014 with the correlation of scientific scholars of the history of the island. To date they have been brought to light some rooms below and a staircase leading to the courtyard. This will allow structural and architectural survey will allow to understand whether the current foundations rest on a convent or a Roman villa.

Keywords: Nisida, architectural and environmental survey, structural identification, texture wall.

1. Interpretation of sources and architectural survey (Ornella Zerlenga)
In March 2014, a Memorandum of Understanding between the Studies and Research Office of the Department of Juvenile Justice of the Italian Ministry of Justice and the Department of Architecture and Industrial Design “Luigi Vanvitelli” of the Second University of Naples was signed (under the scientific responsibility of the writer). This agreement has made it possible to carry out studies and research in order to valorise the environmental and architectural heritage of the island of Nisida as well as further the knowledge of the places. Access to the island of Nisida is limited since it houses a Juvenile Detention Centre. The signing of the agreement has therefore given supervised access to the island and its architecture so as to valorise the nature trails of the island as well as carry out the objective interpretation of the historical sources about the existence of a Roman villa and a Benedictine monastery on the island. On the basis of existing historical knowledge as well as the architectural-environmental site inspections and on-site surveys [1-7], a thorough investigation of archives was carried out and a multimedia communication project realised, along with a new architectural and structural survey campaign, which is presented in this paper.

1.2 The paths of Nisida
The multimedia project for the valorisation of the natural paths of Nisida was inspired by a previous study: the creation of literary and nature walks along the paths on the island. Taken from the book “Tales for Nisida and the unification of Italy” [8] and the datasheets of the vegetation on the island (drawn up by the Onlus “VIV-Vivara”, Association of Friends of the small islands) panels containing information and data were placed on along the now disused paths. This project was recently re-evaluated in terms of teaching and learning by the Director of the Juvenile Detention Centre of Nisida. The Director, dr. Gianluca Guida, has enthusiastically

involved the young detainees in rediscovering and maintaining the paths that were hidden by thick vegetation. This has given rise to a new project aimed at valorising the wildlife and environment of the island of Nisida, with the idea of offering guided tours to the public, with the cooperation of the young detainees, who are the key players of this project in a rehabilitative and professional perspective. To this aim, in agreement with the aforementioned director and under with the scientific coordination of the writer, Claudia Cennamo and Ciro Scognamiglio also participated in the project. The task of this team was to interpret and update the sources as well as design a visual communication campaign for a possible usability of the paths of Nisida by the public [9].

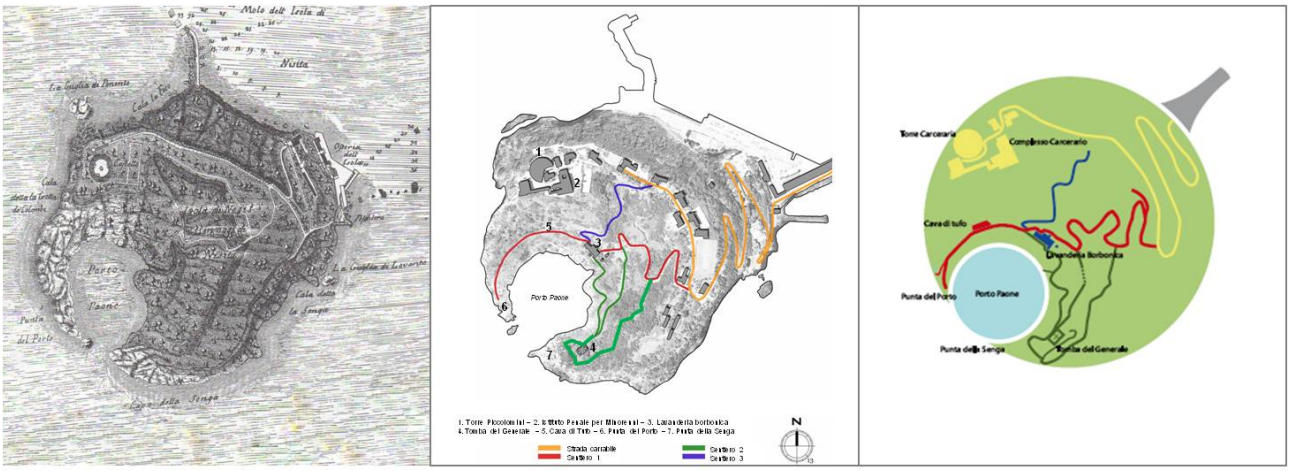

Fig. 1: The island of Nisida: Giovanni Carafa Duca di Noja, 1775 (A); Current planimetry (B). Tourist map (C).

Currently, three nature paths have been unearthed on the island. Methodologically, the paths were mapped out comparing them with historical maps (Fig. 1). The first path (in red), entitled to Homer in the project of literary walks, can be accessed from the side of one of the residential halls, located along the driveway and leading to the prison complex (in orange). Along this path, there is the “Bourbon washhouse” (3), the tuff quarry (7) and Punta del Porto (8). Punta del Porto leads to the sea turtles reserve. The second path (in green) leads to the “Tomb of the General” (4), with it currently being blocked due to a landslide. An alternative path was unearthed. This route, more rugged, passes through the highest point of “Punta della Senga”, a remarkable scenic vantage point, by the “Tomb of the General” (4) and rapidly descends down to the “Bourbon washhouse” (3). Following the inner curve of Porto Paone, it rejoins the main path (in red). The third path (blue) can be accessed, like the second, from the side of one of the residential halls located along the driveway and joins the first at the “Bourbon washhouse”. All this information is set out in a map of the island of Nisida, which includes a didascalia of the architecture present as well as the roads and pedestrian paths. The historical understanding of the places and the direct knowledge of the natural environment (through the current mapping of the paths and the photographic survey to valorise the landscape and highlight the existence of several panoramic viewpoints scattered along the route) were the logical and emotional basis for a media communication project aimed at restoring the primary characteristics of the island of Nisida by building a visual identity.

The starting point for the construction of the visual identity of Nisida was the design of a logo that was able to communicate the particularities of the island. Starting from the conceptual idea of “island”, the study of the morphology of the island of Nisida allowed to observe several elements that were particularly relevant for the graphic project. The Neapolitan island is, in fact, of volcanic origin and has the form of a crater that, over time, has been changed by the atmospheric elements and has created the natural bay of Porto Paone. Furthermore, the volcanic nature of the island has characterized the topography and, subsequently, the prevailing trend of the natural paths that, leaning on the almost circular contour lines, were connected through the use of bends. Finally, another significant characteristic of the island is its connection to the mainland by an artificial pier that has been provocatively defined by the writer as “ Neverland”, due to both the inconsistency in the definition of “'island” as well as it not being accessible to the public [6]. In this sense, the circular perimeter of the island and its harbour, the prevailing circular bends of the road and the artificial connection to the mainland inspired the design of a graphic symbol (logo) that conceptually recalls the morphological identity of the island of Nisida.

The geometric-figurative matrix of the logo of the island of Nisida consists of only circumferences (Fig. 2). Seven of these circumferences are tangent in a point that belongs to the diagonal of the square that inscribes the limit circle of the circular perimeter of the island. Whereas, the smaller radius defines the bay of Porto Paone. This circle, however, does not respect the true dimensions of the bay but magnifies it so as to highlight the concept of a volcanic crater. The circular paths and their bends recall arcs with the remaining

interior rings. The circumference outlining the perimeter of the island and the larger radius define the field in which alludes to the existence of artificial pier connecting the island to the mainland, whose initial section is located along the diagonal of the square. Designed in this way, the development of the geometric paths is a simplification and conceptual synthesis of the real development, along with the roads and pedestrian paths. In fact, a single line accesses the island from the pier and, through a circular development made of bends, it climbs to the summit where there is the Juvenile Detention Centre, then dropping in altitude, passing in front of the “Tomb the General” and the “Bourbon washhouse”, finally reaching Porto Paone.

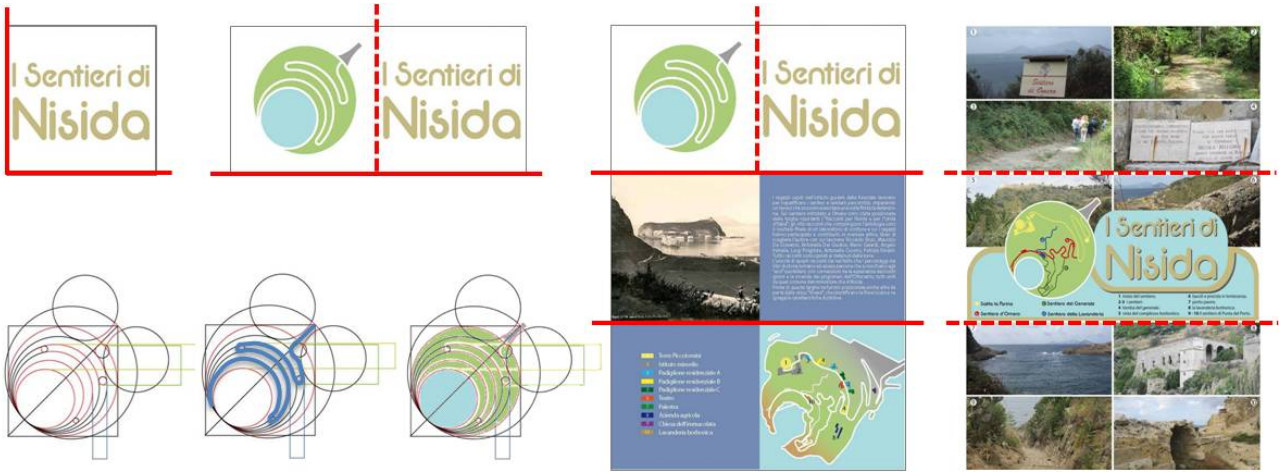

Fig. 2: Conceptual genesis and geometry of the logo of the Island of Nisida (down) and graphic design of the brochure advertising “The Paths of Nisida” (up and right) | (by Ciro Scognamiglio).

The colours chosen for the logo of Nisida are: green, representing the island (not very urbanized and mainly characterized by shrubs and Mediterranean bush); light blue, representing the waters of Porto Paone; white, for the paths (a design solution that separates them from the background and makes them more evident since they are the main subject of the communication); grey, for the asphalt of the pier that artificially connects Nisida to the mainland. There is also the colour ochre, which refers to the presence of natural paths paved in tuff on the island (perhaps dating back to Bourbon). It is used for the “naming” associated with the logo, “The Paths of Nisida”. For this naming, a font “Neon '80” typeface was used, whose curvilinear style conceptually recalls the circular paths.
The next stage of the multimedia communication project was the realization of a brochure (Fig. 2). The brochure was designed to inform the public of the project on the valorisation of the footpaths through the creation of literary and nature walks as well as the participation of the young detainees in the retraining programme for the redevelopment of the nature paths of Nisida. Graphically, the brochure was designed on both sides a portrait A4 sheet. It was folded to a square size (equal in height to the third part of the longitudinal development of the A4 format), showing the naming on the front and the logo on the back. Upon opening the brochure, a small written text (placed next to a photo of the island from the pier connecting it to the mainland) provides information on the project to valorise the nature paths of Nisida, while on the other side, there is a map (with a didascalia) showing the location of the buildings on the island along the paths. Once fully opened, it contains photographs of (and from) some of the views of the nature paths.



Fig. 3: Videographic project for the advertisement “I Sentieri di Nisida | L’isola che c’è!” (by Ciro Scognamiglio).

The multimedia communication project ended with the realisation of a video to advertise the paths of Nisida on websites dedicated to the organization of nature and literary excursions in parks such as, for example, the websites of the “Regional Park of Campi Flegrei” or “Vivara”, that offer guided tours in the Flegrei area as

well as to the islands of the Gulf of Naples (Fig. 3). The video is short (20 seconds) and opens with the still image of the logo and naming of the island of Nisida and an animation of the paths, which gradually goes from the harbour to Porto Paone. Once the first animation finishes, a second one dissolves the logo into a stylized map with the right proportions of the bay compared to the island. At the same time, the background passes from light blue to photographs, synchronized with the animation of the unfolding of the mapped paths, dissolving into one another (from the panel "Path of Homer" to the Juvenile Detention Centre, into a series of panoramic sights of rare beauty).
When the animation ends with the presence of all the mapped paths, the background becomes light blue again and the naming "The Paths of Nisida" appears. The last animation once again dissolves the naming and in its place, next to the map, a white text appears that is the message of the valorisation project: "The island that is!". To make sure that this message remains fixed in the visual memory of those watching the video, while the map of the island fades, the light blue of the background becomes black in which, for maximum contrast, the final message written in white stands out. The short video is accompanied by an electronic percussion song ("chill-house") with an enveloping rhythm and relaxing sound, which is mixed with the squawking of seagulls. This further audio suggestion refers to the idea of the sea but, above all, recalls the presence of this species on the island of Nisida that lives and nests here in abundance.

1.2 Architectural survey: Roman villa or medieval monastery?
A press conference presenting a work of knowledge and restoration carried out in synergy between the Juvenile Detention Centre, the Manufacturers Association of Naples, INAIL and the Department of Architecture and Industrial Design "Luigi Vanvitelli" of the Second University of Naples was held in Nisida on the 4th December, 2014. The presentation was also attended by the Supervisory Judge and Assessor for Work of the Campania Region. This occasion was clearly demonstrated how through a synergy between public institutions and business, it was possible to create a virtuous example of knowledge and restoration of the landscape and the monument as well as promote an active ethic of re-education and professional training to build a better future for the young detainees of Nisida. The project consisted of an integrated activity of excavating, dicovering and restoring of some buildings, recently unearthed and located in the architectural complex which houses the Juvenile Detention Centre [10].



Fig. 4: The Island of Nisida today (by Mattia Venza, 2015).

The architectural survey was based on the previously mentioned Memorandum of Understanding, signed in March 2014 between the Department of Architecture and Industrial Design "Luigi Vanvitelli" of the Second University of Naples and the Department of Juvenile Justice Ministry of Justice of the Italian State to promote cultural activities and research on the island of Nisida. The specific objective of the architectural survey was (and still is) the geometric and structural knowledge of some buildings, recently brought to light, in order to formulate a more objective interpretation of the historical sources about the existence on the top of the island of

a Roman villa and/or medieval monastery. From a natural perspective, the plateau, upon which the tower and Juvenile Detention Centre stand, is the highest point of the island, therefore not only with the most panoramic views but also with a 360° control over the entire area (Fig. 4). At the same time, it is also the most suitable defensive site due to its orographic configuration. In fact, the considerable height difference to the north and west has created rugged slopes overlooking the sea. This confirms the good choice of building the walls for a Roman villa, a medieval monastery, a tower and, subsequently, also justifies a change of intended use to a prison. The survey campaign, started in March 2014, was scientifically coordinated by the writer and carried out in teams with Salvatore Petrillo Domenico Pignata and with the disciplinary correlation of Claudia Cennamo, for the structural aspects, and the scientific advice of Vito Cardone, noted scholar of the history of Nisida [11].

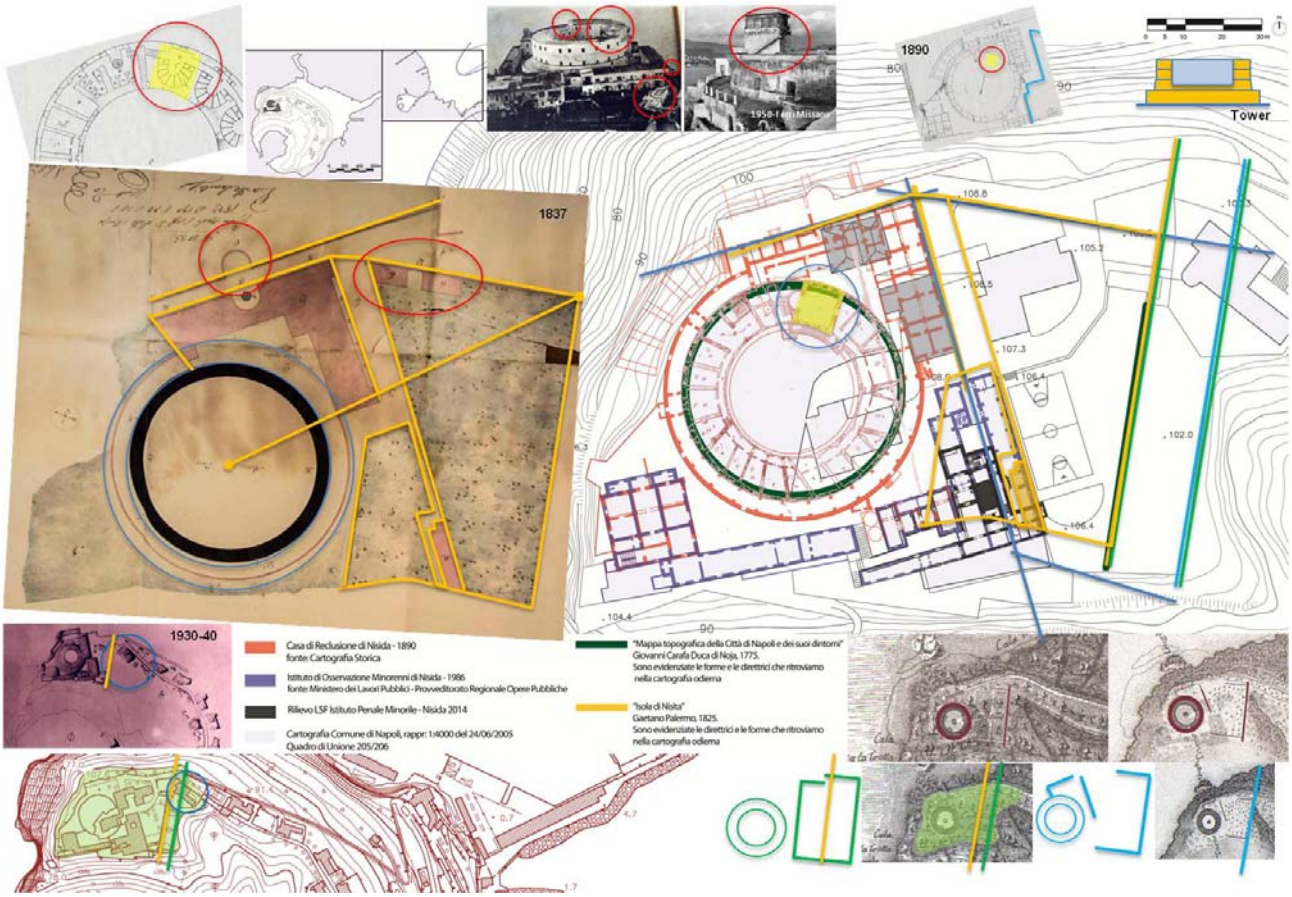

Fig. 5: Comparing historical sources and a current architectural survey.

Currently, on top of the island and near the remains of the imposing cylindrical tower (initially called Piccolomini, subsequently becoming a prison), there are the different buildings that make up the Juvenile Detention Centre. As reported by Cicero in his letters to Atticus, in Roman times, the island of Nisida housed the villa of Brutus, the theatre of the conspiracy against Caesar and tragic backdrop to the suicide of Portia, wife of Brutus [4, p. 15]. Based on the discovery near the former prison tower of the remains of a wall in *opus reticulatum* of considerable size, such as to belong to a Roman villa, Amedeo Maiuri assumed that the main building of the villa of Brutus could be located on the top of the island, in a strategic and panoramic location [12]. In the Middle Ages, however, rather confused historical sources report the existence of a monastery in the eleventh century on the island of Nisida, called “Monastery of St. Archangel the Saviour " or “Benedictine Monastery of Saint Nicholas”, as reported by Antonella Ferri Missano [3, pp. 25-27]. Based on these sources, Ferri Missano suggests that the monastery (like the villa of Brutus for Maiuri) was located on the highest point of the island with her identifying it as one of the buildings that makes up the Juvenile Detention Centre. This building has a rectangular, oblong plan as well as a square courtyard, called “courtyard of the schools”. This fascinating hypothesis is based on the fact that the facades of the courtyard recall those of the cloister of a convent, since in the second order of the court in question, there is a visible trace of an arcade, now buffered. In order to objectively verify the hypothesis, she concluded that only an integrated and transdisciplinary survey would answer these questions [3, pp. 27, 46-49]. This position was also supported by Vito Cardone, who, in the absence of any objective documentation stated that «the experimental verification is the specific subject of a careful survey that - through a thorough investigation of textures and movements of what remains of the wall mass, the materials used and their combination, of building

technologies - capable of detecting any parcelling or, conversely, penetrations or recasts of several buildings and, more generally, to grasp the relationships between the different parts of the building» [4, pp. 22-24].
On this basis, the research team started an integrated and interdisciplinary architectural survey, with the aim of verifying the aforementioned assumptions. The survey campaign was methodologically divided into several stages: 1) analysis of cartographic sources; 2) procurement of earlier architectural surveys; 3) relevant architectural and structural areas recently unearthed by the excavations.
The analysis of the iconographic sources started from the cartography of the City of Naples in scale 1:4,000 (union n. 205-206 of 24 June 2005). It included the ruins of the ancient tower, the different buildings that make up the Juvenile Detention Centre and the access roads (current and historical) on top of the island (102 to 109 metres above sea level). This was compared with the first topographic maps of the island of Nisida, in particular, those of Giovanni Carafa, Duke of Noja (1775, “Topographic map of the City of Naples and its Surroundings”) and Gaetano Palermo (1825, “Island of Nisita”); the Survey of the Court of Appeal of Naples by architect Gaetano Forte (1837, State Archive of Naples, found in 2014 by Salvatore Petrillo and Domenico Pignata); the project for the “Juvenile Detention Centre of Nisida” dating back to the Fascist period; zenith views taken from Google Earth (“Show historical imagery”: 12/31/1943 and 2004-2014). In addition to the cartographic sources, information from survey drawings and architectural scale projects of the tower and Juvenile Detention Centre, in particular: “Juvenile Detention Centre of Nisida" (updated in 1890 and 1896; source Director of the Centre) and “Institute of Juvenile Observation of Nisida” (1986; source Ministry of Public Works, Superintendency of Public Works, with the exception of buildings under publication ban), as well as some historic photographs of the tower taken from the Istituto Luce and the work by Ferri Missano (Fig. 5).
Although the research is still ongoing, a cross-analysis of the data contained in the aforementioned maps, surveys and projects shows the presence in all the sources of two particular straight lines to the east of the tower, significant enough to speculate on the condition of the places and construction events. The first line goes in a north-south direction and starts with the contour lines to the east of the plateau, that become thicker. This direction identifies the outer limit of the current playgrounds and is, with a perfectly parallel trend, in line with the height difference (about 4 metres) between these two playgrounds. The second, in a north-west, south-east direction is identified with the longitudinal plug walls of two buildings: one that contains the “courtyard of the schools” and another a “L” shaped plan, demolished over time. In addition, this direction identifies an internal road of the Juvenile Detention Centre.
Comparing the current cartography with those of the Duke of Noja and Palermo, it is possible to easily identify the plateau, the tower (a single building on the plateau in the historical maps) as well as the access road, different from today. In particular, in the map of the Duke of Noja, the current tower is called “Castle”, while in Palermo’s it is called, “Tower”. In addition, in the map of the Duke of Noja, to the east of the tower, there is a garden lined by a rectangular oblong, divided into four parts by avenues perpendicular to each other. The same area is also present in the map by Palermo, where neither the inside roads nor the western side of the fence of the garden are indicated. On the contrary, in the vicinity of the tower, there is a marked rectilinear running parallel to the one that leads to the tower. Comparing the current situation with the historical maps of the Duke of Noja and Palermo, the Survey of the Court of Appeal of Naples, signed in 1837 by the architect Gaetano Forte, the fascist era project of the “Rehabilitation Home for Minors of Nisida”, project drawings for the “Prison of Nisida" updated in 1890 and 1896, it is possible to make the following hypothesis. Between 1825 and 1837, several buildings (referred to by the letters “D”, “G”, “R” in the drawing accompanying the Survey) were built next to the tower, thus reducing the size of the garden with fruit trees. Among these buildings, the building known as “D” (with a higher planimetric development, next to the tower and a “L” shape plan) is present in the surveys dating from 1890 and 1896 as well as in the project for the “Rehabilitation Home for Minors of Nisida” dating from the Fascist era. In the late nineteenth century, this building housed deposits, barracks and housing for prison guards, as indicated in the didascalia to the project drawings dated to 1890-96. This “L” shaped building, with a front porch on the ground floor on the east and a terrace on the first, can be seen in a photograph of the prison complex before the demolition of top two floors of the tower (1950?). It also includes the two small buildings mentioned in the 1837 survey with the letter “G”. Besides the presence of new buildings, the survey dated 1837 also marked the fence of the fruit tree garden, whose eastern orientation refers to that found in the maps of the Duke of Noja and Palermo. By reducing the three iconographic sources and overlaying them with the current map (despite the obvious inconsistencies due to differentiated relief techniques and reproduction methods), the direction in the 1837 survey overlaps the avenue inside the garden in the map of the Duke Noja as well as the limitation that in the modern map marks the height difference (about 4 metres) between the two playgrounds. The eastern boundary of the garden fence, present in the cartography by the Duke of Noja, overlaps the one shown in the map by Palermo. The direction, which defines the top side of fence of the garden to the north and is present in both the historical maps of the Duke of Noja and Palermo, coincides with the upper limit of the garden party represented in the survey of 1837. Along this direction, there are the two small buildings called “G” which can be seen in the aforementioned photograph. The direction, present in Palermo and parallel to the direction of access to the tower, coincides with the orientation of the front porch of the “L” shaped building (“D” in the 1837 survey).

In the drawing attached to the 1837 survey, the building characterized by the presence of the so-called “Courtyard of the schools” is not indicated. In its place, there is a trapezoidal shaped garden and a small building called “R”. From the overlay between the 1837 survey drawing, the late nineteenth century project drawing, the survey of the Juvenile Detention Centre (1986) and the current map (2005), the eastern boundary of this part of the garden coincides with the aforementioned second direction, which is relevant to the study since it refers to the common longitudinal direction of the buildings “D”, “R” as well as the one containing the "courtyard of the schools". In addition, this longitudinal direction also marks the eastern limit of the latter part of the building.



Fig. 6: An architectural survey of the basement (by Salvatore Petrillo and Domenico Pignata, 2014) in comparison with a survey of the floors above ground (by Ministero Lavori Pubblici, Provveditorato Regionale Opere Pubbliche, 1986).

Regarding the discussion of the importance of the areas recently brought to light by the Director of the Juvenile Detention Centre, they confirm the permanence in the wall structure of this second direction (Fig. 6). The plateau, upon which the building in question stands, slopes towards the south. Therefore, the unearthed rooms, surveyed by Salvatore Petrillo and Domenico Pignata, are placed below the floor of the so-called “courtyard of the schools” but are at the same level to a building (today on two levels) already visible in the late nineteenth century (1890 and 1986) project drawing. In detail, the architectural survey of the excavation has highlighted not only the existence of an internal connection between these two levels (previously connected through an external staircase) but also two different solutions that presume different moments in time. The first connection consists of a stairway, a single ramp with vertical continuity, leading to the service corridor to the kitchen and the dining hall, which connected the courtyard directly with the floor below. The second solution, older, connected the two levels through the current double staircase between the ground and first floors. The excavations have brought to light the existence of two additional ramps to this staircase, leading down to a level below, but intermediate, giving access to the rooms discovered so far. Additional steps, placed in the compartment walls of the staircase with a single ramp (with the excavation conserving the orientation), then linked the courtyard to the lower one. The rooms, excavated and surveyed so far, are covered and confirm the vertical continuity of the walls along the aforementioned north-west, south-east longitudinal direction. They have a number of elements (scarp walls, double wall thickness, internal stairs, air vents, buffered windows, etc.) that lead to a number of assumptions, with only further excavations, along with architectural and structural surveys allowing to make more reliable speculations. From the current situation of the architectural surveys carried out so far and overlaying the different levels of architectural significance, it is possible to make an educated, rather credible, guess of a possible configuration of the original architecture. The building in question had a southern facing front with three floors (instead of two), before the construction in the east-west direction of the oblong body of the building intended for workshops in front. Moreover, this front was a little further back than that of the current ground floor, in line with the projection of the first floor. Therefore, although not reported in the late nineteenth century (1890, 1896) survey, it is possible to state that the building in question (i.e., the one containing the “courtyard of the schools”) and the body of the building (already present in the late nineteenth century survey on the ground floor and attached to it) were all on the same level.

A final consideration relates to the cylindrical tower (Fig. 5), whose current configuration is significantly different to that of the late nineteenth century (1890, 1896) survey. In fact, in addition to the demolition of the “L” shaped building (referred to as “D” in the 1837 survey drawing), part of the planimetric development, the

ring concentric to the “Ground floor” as well as the two last floors (“Second Floor in correspondence to the screen"; “Third floor”) were demolished. The current “turret” is evidence of the height of the tower, whose location on the plan was identified by the writer. It was the vertical placed on the first of two groups of punishment cells, that are still there today (characterized on the plan by an orientation to “C”) and that in the aforementioned survey drawings floor accommodated the school and the chapel on the top. Moreover, this source also shows that the ceiling of the top floor was not the same height. Obviously, both the structural configuration of the “turret”, along with the entire tower will be further investigated in additional architectural survey campaigns.

2. The marvelous and indecipherable structures into the subsoil of Nisida (Claudia Cennamo)

The survey of the area below the Institute of Nisida has highlighted a number of realities to which a structural approach can give a further contribution of clarity. The hypothesis is the subsequent aggregation of various structures in time succession. To confirm this, some surveys on the structure are proposed, starting from direct observation and analysis of the relief. Needless to reiterate the importance in this first phase of an accurate relief, to the aim of a correct interpretation of the whole structure from the constructive, historical and typological point of view.

From the individuation of the different masonry typologies presents under the building of the Institute, the Authors try to rebuilt the history of the construction, so that the real origin of the marvelous environments that the work of Nisida's Boys has brought to the light, could finally be revealed.

The works are still in progress, therefore the cases that will be described in the follow, must be considered as study hypothesis.

Talking first about the point (1) evidenced in the Figure 7), the barrel vault shows, on the down floor, a masonry wall positioned longitudinally at the center of the environment, so that to create, for the observer who looks up from below, an effect like "once gooseneck". In fact, looking carefully at the upper floor, the vault is a regular barrel vault that unloads on the lateral wall. Alongside it, on the left, there is another masonry wall, and therefore it would seem a double wall structure where, the presence of air vents in the environment with the cross vault on the left, suggests a subsequent aggregation of the two structures between them. And it suggests also that the whole structure on the left is more ancient than the other.



Figure 7: a) The individuation of the different masonry typologies in the survey of the plan considered -until now- the first level for the structures indicated with red and violet; b) photo of the vault indicated in the planimetry on the left as point (1).

As can be seen from the table in the figure a), the masonry of the part in blue reaches a thickness of approximately 100 cm. For these thicknesses we cannot speak more than masonry with "n heads", but the composition of these wall typologies is made from external tuff blocks machined accurately, whose better face is placed outside, while inside, the masonry is variously filled with the "sac" technique, whose resistance varies according to the material that was introduced (eg. a sac masonry with flakes to tuff stones is capable of a better distribution of the stress respect to another one, where the material to inside is different) [1].

The masonry found in (1) is supposed taken from tuff quarries on the island, though only specific tests on the material will provide the real characterization of it. In fact the next step of the research will be the chemical analysis on the ancient tuff, that will be able especially to provide an exact dating, as already occurred in [2].

About the point (2), in green are noticed some chains aimed to counteract the pressures.

As it is known, the insertion of such chains indicates the need to counter the horizontal thrusts probably worsened at a later time. This confirms the hypothesis of the subsequent elevation of the upper floor respect to the original built (Fig. 7a).



Figure 8: a) The area in which there are the chains; b) The environment with the low vaulted room and the walled semicircle.

In fact, the hypothesis that an arcade was subsequently transformed into a floor upstairs, is accredited by the presence of chains, whose purpose is to absorb the horizontal stresses coming from the decomposition of the vector resultant by the vault loads. As it is known, the morphology arched or vaulted manages to transform the onset of tensile stresses, in compression stress, and manages to do in manner that the structure works exclusively to compressive, transforming the oblique thrust coming from the curve, in a vertical component, absorbed by the piers, and in an horizontal component, absorbed by the thickness of the wall or from the buttress.
In the case where, for some reason, the horizontal component of the force exceeds the expectations of the structure (precisely in the case of successive elevations), it is necessary an elastic element that absorbs the horizontal stress and restores the box behavior of the macro-element "arcade" inserted in the behavior of the whole structure.
The "keys of head" of these chains are not still brought to light, because probably they are drowned in the masonry, that is another evident sign of the subsequent manipulations of the structure (i.e. first the chains were placed, and then a new part of the structure realized).
As the table in Figure 6, in the area (2) the masonry varies from a thickness of 50 cm until to 60, achievable with two heads tuff blocks.

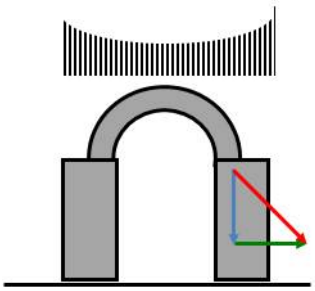

Figure 9: In red the vertical loads and own weight reconverted in oblique forces thanks to the arcuated structure, in blue the vertical component absorbed by piers, in green the horizontal component by thickness, buttresses or possibly chains.

At the point (3) in the Figure 7b) appears an extremely interesting environment, that is a vaulted room. Going into, the sensation is to enter in a wrongly dimensioned space, with a too important ceiling for that plan. With a more careful observation, the studier can understand that in origin the room had to be higher than now, and the current is not the real height.
This fact gives the confirm that the actual shares of the structure aren't the real ones, and the ancient manufact was more complex than the one that can be seen now.
In the same environment a wall panel in which appears a buffered semicircle that most likely is not a true arch, but a semicircle that does not come down to the ground, can be noticed. It because the below tuff blocks appear intact (if it was been closed before, along the vertical development, the blocks would be cut along the line of the piers). In all probability this is a semi-arch useful for taking light, originally placed at a height superior to that of man, while today is visible at eye level.
Also in this case, as in the previous, those that originally were air vents to the outside, if they were open at present, they would look out on other closed environments.

Finally, on one side of the floor a parallelepiped of masonry can be noticed. From some surface essays it would seem masonry full... the only explanation could be that it is a foundation beam, but this is not in accordance to what above hypothesized, i.e. with the original major height of the environment.
As above demonstrated, all these structural clues constitute a situation still very uncertain, but also very charming, that it is worth continuing to investigate.
Traced back to the ancient origins of the structural connection, or the various connections over the centuries, through inter-disciplinary collaborations with items like relief and history, aims among others, the restore of the old box-like behavior of the original structure, which would suffered interference from static character because of the subsequent interventions.

Acknowledgments: The authors thank the Director of the Studies and Research Office of the Department of Juvenile Justice, Dr. Isabella Mastropasqua, for signing the Memorandum of Understanding with the Department of Architecture and Industrial Design 'Luigi Vanvitelli', so initiating a relationship of collaboration and cooperation to promote the site of Nisida through research topics with architectural and landscape character.
The Authors thank the Director of the Juvenile Detention Centre of Nisida, Dr. Gianluca Guida, whose great interest in Culture, History and Architecture of the Island has allowed the realization of the Understanding Protocol with Department of Architecture and Industrial Design “Luigi Vanvitelli” of the Second University of Naples and the subsequent studies on the heritage.
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Bibliographical References [O. Zerlenga]

[1] CROCE, Benedetto. Nisida. In *Napoli Nobilissima*, 1894, III, II, pp. 17-23.
[2] DE LORENZO, Giuseppe. Il cratere di Nisida. In *Reale Accademia delle Scienze Fisiche e Naturali*. Napoli, 1915.II, XVI, n. 10.
[3] FERRI MISSANO, Antonella. *Nisida*. Napoli: Edizione Circolo Nuova Italdider Bagnoli, 1987, pp. 23-24.
[4] CARDONE, Vito. *Nisida. Storia di un mito dei Campi Flegrei*. Napoli: Electa Napoli, 1992. ISBN 88-435-4218-4.
[5] DISCEPOLO, Bruno. *Nisida, l’isola. L’ambiente, l’architettura, i progetti*. Napoli: Graffiti, 2001. ISBN 888698340-9.
[6] ZERLENGA, Ornella. Il rilievo architettonico e ambientale. In DISCEPOLO, Bruno. *Nisida, l’isola. L’ambiente, l’architettura, i progetti*. Napoli: Graffiti, 2001, pp. 147-177. ISBN 888698340-9.
[7] ZERLENGA, Ornella. CENNAMO, Claudia. Nisida, the memory of a myth. In GAMBARDELLA, Carmine. *Best practise in Heritage Conservation Management from the world to Pompeii | Le vie dei Mercanti*, *XII Forum Internazionale di Studi*. Napoli: La scuola di Pitagora, 2014, n° 46, pp. 1583-1593. ISBN 978-88-6542-347-9.
[8] FRANCO, Maria. *Racconti per Nisida e l’Unità d’Italia*. Napoli: Guida, 2011 (fuori commercio).
[9] SCOGNAMIGLIO, Ciro. *I Sentieri di Nisida. La riscoperta di paesaggi storici, naturalistici e letterari*. Seconda Università degli Studi di Napoli: Dipartimento di Architettura e Disegno Industriale ‘Luigi Vanvitelli’, 2013-14. Tesi di laurea in “Design e Comunicazione”. Relatore: Ornella Zerlenga. Correlatore: Claudia Cennamo.
[10] MAIETTA, Carmela. “Il carcere? Era un monastero. La scoperta dei baby detenuti. Nisida, progetto educativo svela una storia sconosciuta”. In *Il Mattino*. Napoli: 5 dicembre 2014, p. 43.
http://www.architettura.unina2.it/ITA/eventi/img/Nisida_ilmattino.jpg
[11] PETRILLO, Salvatore. PIGNATA, Domenico. *Nisida. Rilievo integrato e transdisciplinare per un’interpretazione delle fonti*. Seconda Università degli Studi di Napoli: Dipartimento di Architettura e Disegno Industriale ‘Luigi Vanvitelli’, 2013-14. Tesi di laurea magistrale in “Architettura”. Relatore: Ornella Zerlenga. Correlatori: Claudia Cennamo, Danila Jacazzi. Referee, Vito Cardone.
[12] MAIURI, Amedeo. *Passeggiate Campane*. Firenze: Sansoni, 1950, p. 35.
[13] ZERLENGA, Ornella. Il disegno della natura napoletana fra mimesi e icona nelle piante topografiche dal XVIII al XIX secolo. In MARGIOTTA, Maria Luisa. BELFIORE, Pasquale. *Giardini storici napoletani*. Napoli: Electa Napoli, 2000, pp. 89-96, 98-99. ISBN 88-435-8525-8.
[14] ZERLENGA, Ornella. Regola e trasgressione nell’impianto claustrale. In MARGIOTTA, Maria Luisa. *Il giardino sacro. Chiostri e giardini della Campania*. Napoli: Electa Napoli, 2000, pp. 73-79, 179-190. ISBN 88-435-8538-X.
[15] GAMBARDELLA, Alfonso. *Itinerari storico-artistici per le fondazioni benedettine dopo la riforma cluniacense*. Napoli: Edizioni Scientifiche Italiane, 2003, p. 224. ISBN 88-495-0852-2.

Bibliographical References [C. Cennamo]

[1] CERONI F., MANFREDI G., MARCARI G., VOTO S., PECE M. Analisi e caratterizzazione meccanica di murature di tufo, *15° Congresso C.T.E.* Bari, 2004.
[2] CENNAMO C., CHIAIA B., MASOERO E. Optimization of cutting process for ancient masonry: the greek gymnasium in Naples, 2009. *International Journal of Architectural Heritage*, vol. 3, p. 235-257, ISSN: 1558-3058, doi: 10.1080/15583050902731049.

HERITAGE and TECHNOLOGY
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Architecture and material culture: the construction of the working-class neighborhood of the new Pompei

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Abstract

The present contribution describes the realization of the working-class neighborhood in Pompei between 1887 and 1890, commissioned by Bartolo Longo and designed by the Neapolitan engineer Giovanni Rispoli. The structure, composed by the union, as a checkerboard, of five buildings, had to be the generating element of the urban system of the new city, since was predicted the repetition of residential units similar to the prototype, in the area included among the sanctuary, the new railway yard and the archeological sites. The building, for which construction Rispoli was inspired by the contemporaneous working-class houses in Berlin, had to guarantee conditions of healthiness and public health that, at the time, were considered as the main requirement of the new residential structures. Moreover, the acquisition of the material concerning the construction of the building, which contains the payments already in progress of the various typologies of structures, allows to examine in detail the used techniques and building materials, giving a detailed picture about the old material culture.

Keywords: working class neighborhood, material culture, Bartolo Longo, Giovanni Rispoli, New Pompei.

1. A new "working class" city

The urban form of the New Pompei, founded by Bartolo Longo in 1870 around the Santuario della Vergine del Rosario (Sanctuary of the Virgin of the Rosary), deducible from historical cartography, shows a small settlement aggregated on the basis of an orthogonal urban system along the Via Sacra, around the church and the building of the working class district. In a few decades, in the area surrounding the church, was organized the new road network and were built numerous buildings: two railway stations, low-cost houses, some schools, a post office, a pharmacy and even an observatory of meteorology and volcanology. It would seem that the new city has been achieved without a general design, because of later works of construction of community buildings, provided by Bartolo Longo to the new population. In fact, contrary to the thesis of a spontaneous development, it can be said that the construction of the New Pompei is not the result of extemporaneous moments, but it was regulated, at least in the initial phase, by a global and a rational vision. Even if the creator and the founder is considered Bartolo Longo, the design of the new urban structure it must be attributed to the Neapolitan architect Giovanni Rispoli. He designed the Basilica, the Case Operaie (Working-class houses), the new square, the church of the Santissimo Salvatore and other buildings, arranged on the basis of rationality and decorum virtues, typical of the architectural culture of that time [2]. The contemporaneous documents, preserved in the archive of the Sanctuary, have allowed to identify the generating element of the new city in the district of the working-class houses, built between 1887 and 1890 in the west of the road between the church and the new railway station of Valle. Bartolo Longo affirmed that to the construction of the first district of working-class houses should have followed the construction of a series of identical buildings, starting from the area surrounding the new square.

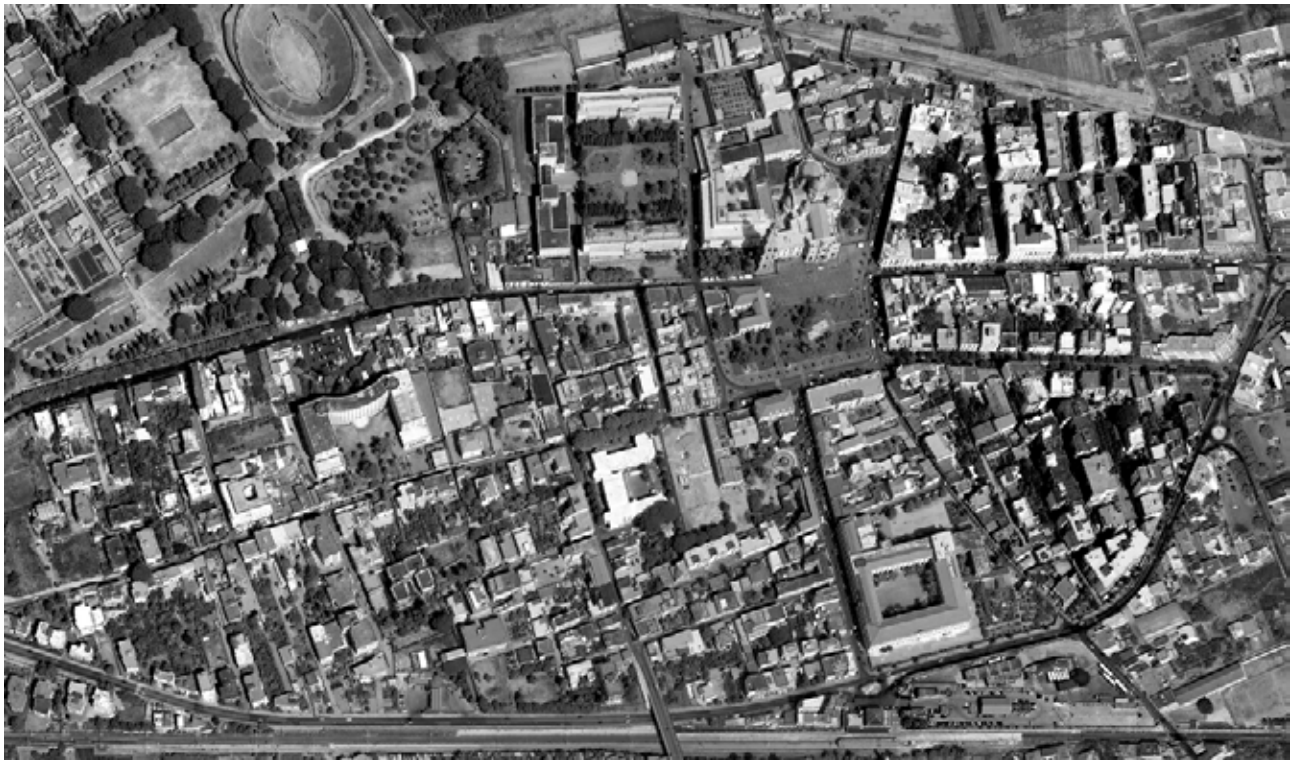




Fig. 1: Aerial ortho-photo of Pompei.
Fig. 2: Graphic reconstruction of the initial project of Bartolo Longo.











Fig. 3: A building for the children of prisoners.
Figg. 4-6: The buildings for public transportation.
Fig. 7: The church of the Santissimo Salvatore.

To achieve this purpose, he financed the building of the first residences and left the entire project file available to those who wished to build the same type of residences.
We believe, therefore, that, in the intent of Longo and Rispoli, the city would have to expand according to an orthogonal allotment, conceptually similar to the one shown in a plan published in 1885 in the «Bollettino del Collegio degli Ingegneri ed Architetti di Napoli», of which Rispoli was the editor, in which is outlined a system of residential buildings adaptable for subsequent interventions, effectively similar to the neighborhood of Pompei. Moreover, it should be noted that architectural and urban characteristics, central in this research, are strictly related to the achievement of a new social organization, based on the introduction of advanced technologies, on the economic independence and on the setting of moral standards of the workers. The countercheck that the purpose of Bartolo Longo was to establish a real working colony is provided by correspondence with Alessandro Rossi, senator of the Kingdom and known wool industrialist, founder of the working class village of New Schio in 1873, to who the lawyer requested the “Statuto di Organizzazione della comarca operaia” (Statute of Organization of the working class comarca). However, while the realization of the social experiment continued with positive results, the planning program was interrupted after the completion of the first residential unit[6].

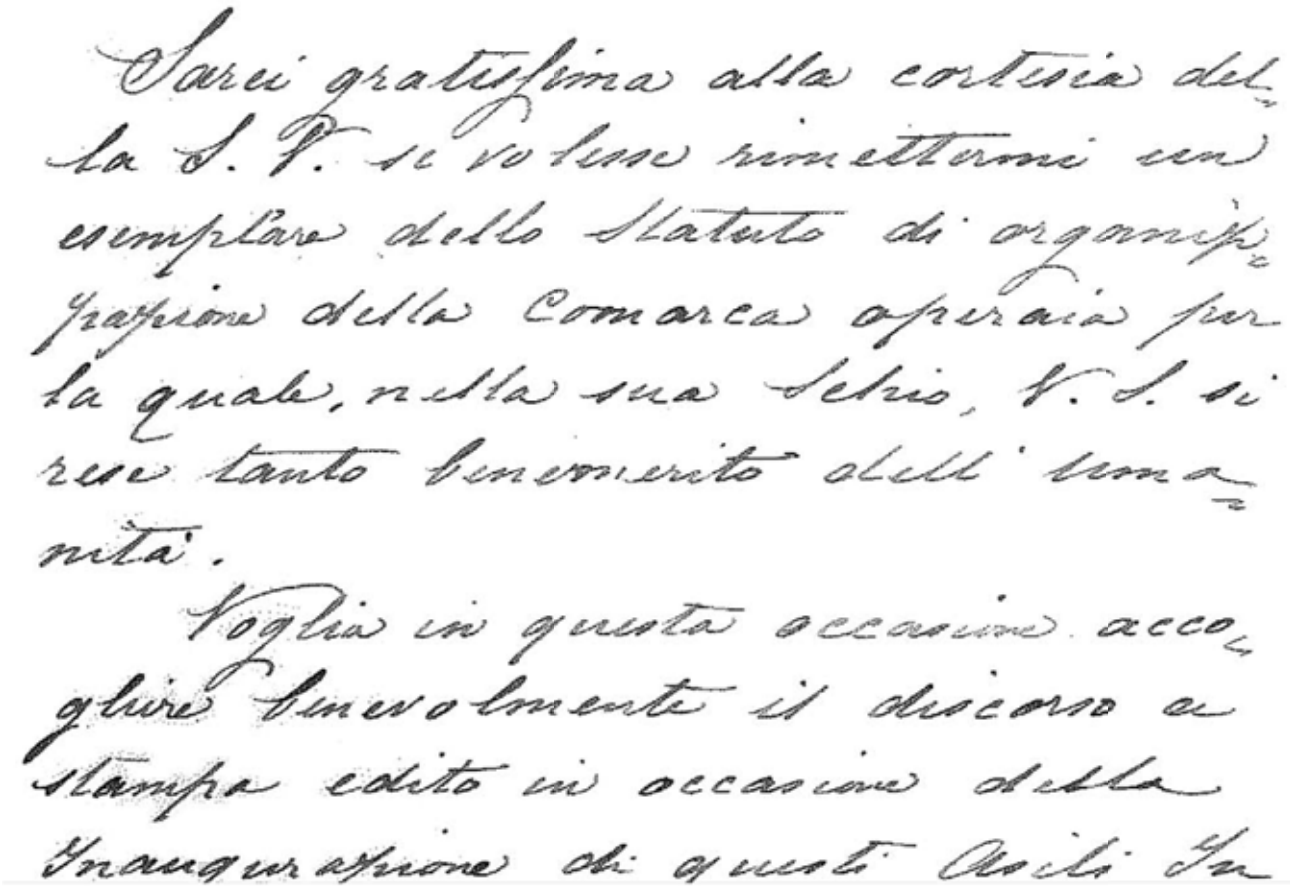


Fig. 8: Bartolo Longo, letter sent to Alessandro Rossi.

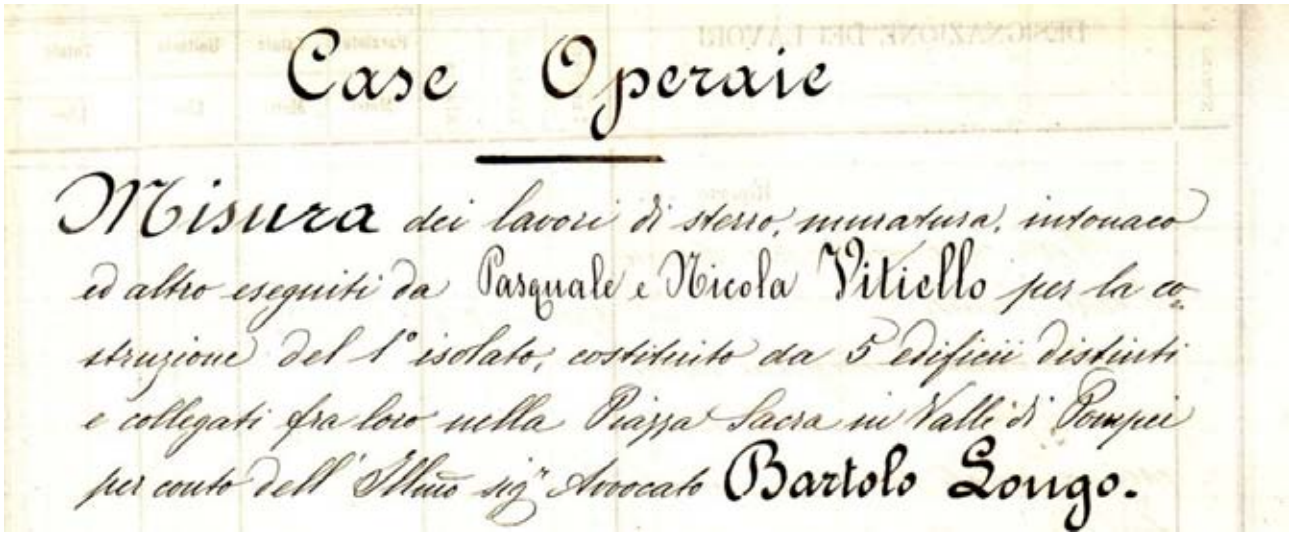
2. The district of the working class houses

2.1 The construction yard

The excavation works for the construction of the working class houses, which began in December 1886, were soon interrupted because of the discovery of a building of imperial age, probably a *fullonica*. This discovery, however, did not prevent the construction of the new building, whose structures were resting on the preexisting ones. The work of integration of the new building to the old walls structures is evident from the analysis of the current foundations, in which the walls of the nineteenth century rest, in some parts, on the ancient ones, specifically cut, while other portions are arranged on uneven levels placed at different heights. The building works were entrusted to the contractors Pasquale and Nicola Vitiello from Scafati, who had already participated in the construction of the Sanctuary. The Vitiellos carried out works of excavations, masonry and finishing (plaster and stucco). The works of painting of walls and windows were made by Paride and Luigi Langella, to whom later was entrusted the interventions of maintenance. The works in glass and the finish of the hydraulic system were made by Domenico Celotti. Pasquale Romanelli achieved the joinery works. The metalwork was entrusted to the mechanical workshop of the brothers Antonio and Giovanni Battista Alfano and Giuseppe Di Antonio, placed in Naples at the Istituto Casanova di San Pietro a Maiellai. All these processes are documented by account books composed by the architect Giovanni Rispoli, who reports the measurements of the various types of constructions and the payments perceived by the executors[5].

2.2 Archaeological finds

During the excavation works for the construction of working class houses, it was discovered an ancient building, identified as the extension of a rectangular body of the building, recognized by Ludovico Pepe, as a part of a *fullonica*. The segments of the underlying masonry to the foundations of the new district were incorporated into the new constructions, however, the later archaeological excavations managed behind the new building revealed a large construction, characterized by reshuffles following the eruption of 79 AD and by the presence of fragments of crocks, a waterproof material used to upholster tanks and cisterns. On this occasion was called the archaeologist Antonio Sogliano, who, in 1887, inspected the structure and wrote a report describing the findings. The hypothesis that it was a Pompeian *fullonica*, used for the cleaning and the painting of fabrics, depended on the discovery of coloring substances, tanks, ducts and water tanks are very similar to those found in *fullonica* discovered inside the archaeological area. The Pompeian structure, observed by the architect Rispoli, was constituted of residential locations and a factory, probably used for the production of fabrics, modified in the early Middle Ages. The walls were made with the technique of the *opus incertum*, with elements of calcareous and lava stones, and showed parts made with greater accuracy in the corners[2]. The composition of the building, showing transformations probably dating back to the immediate period subsequent to the volcanic event, indicates a continuity of use which reinforces the hypothesis of the constitution of a farmhouse called Valle just after the destruction of Pompei[1].


Case Operaie

Misura dei lavori di ferro, muratura, intonaco ed altro eseguiti da Pasquale e Nicola Vitiello per la costruzione del 1° isolato, costituito da 5 edifizii distinti e collegati fra loro nella Piazza Sacra in Valle di Pompei per conto dell'Illmo sig.r Avvocato Bartolo Longo.

Fig. 9: Archivio Bartolo Longo, account books of work's measurements.






Figg. 10-13: Interiors of the working class houses.



Figg. 14-17: Flor tiles of the working class houses.



Fig. 18: 3d model of the working class houses, initial project of the Architect Giovanni Rispoli.

2.3 Typological, architectural and executive features of the working class neighborhood

The working-class neighborhood, made up of five buildings, called "islands", aggregated as a chessboard, developed a useful area of about 252 square meters per floor, for a total of 1260 square meters. Initially, every island consisted of three apartments per floor: a larger one, of about 75 square meters (two rooms, a kitchen and a bathroom) and two smaller ones, about 45 meters (a room with a bathroom and a kitchen); they could be accessed from the entrance room on the first floor, and from the staircase to the first floor. The two smaller dwellings were served by a shared bathroom. Two wells of water coming from the river Sarno, placed in the squares to the south and to the north of the structure, satisfied the water needs of the working-class families. The inner locations were, by the standards and for the building typology, wonderfully spacious and comfortable. Each room was illuminated by direct sunlight; the built-in kitchens were equipped with hoods and sinks; the bathrooms, well-aired, had drain systems connected to the wells located in the exterior courtyards. The attic of the central building was directly served from the staircase, while those of the four lateral buildings were reachable from small hatches open in the lofts. The basements, used as depository such as the attics, were reachable by stairs which was accessed by the entrances or directly from the intermediate gardens. The building acquired a decent look from the balanced composition of the architectural elements extremely simplified (the mouldings and the straight cornices that framed and protected doors and windows and the bossage finish of the stucco coating). The materials used, documented by notes of payment to the companies of the various categories of construction works, were all of good quality[4]. The bearing walls, cut off upwards (from the thickness of about 1 meter of the walls of the basement, to the 60 cm of those of the intermediate levels, up to the 40 centimeters of those of attics) consisted essentially of blocks of stone of the Vesuvio, assembled in yards and tied with a mix of lime and pozzolan. Horizontal partitions were made of lowered rib vaults at the basement and of level lofts at the highest levels. The vaults of the basement floor, resting on the perimeter walls of the underlying rooms and three meters high, were made of blocks of volcanic stones and were lightened by a filling of pumice. The small barrel vaults of the landings showed similar structural characteristics. The stairs connecting the ground floor and the first floor were supported by rampant barrel vault; the steps were made of stone and covered with marble slabs. The flat lofts were made with metal beams formed as double T, placed at a distance of about 70 centimeters, on which rested a wooden panel and above was placed the screed with the floor. To the floors were hooked false ceilings of reeds, covered with plaster, placed at a distance of about 60 centimeters from the extrados of the lofts. The roofing was made of pitched roofs, supported by chestnut trusses resting on floors, measuring about 1,20 meters, which reached a height of about 3,80 meters at the ridge lines. The roofing consisted of Marseille tiles. The exterior doors were made of solid wood in American pine while the interior ones are made of spruce. The floors were originally made of Neapolitan terracotta tiles but they were later replaced by grit cement tiles. Gates and railings were made of forged iron of good quality[5].





Fig. 19: Case Operaie facade on the square.
Fig. 20: Case Operaie interior courtyard.

Bibliographical References

[1] JACAZZI, Danila. *Pompei e la "valle diruta". Tracce e memorie della città antica nelle fonti medioevali e moderne*. In GAMBARDELLA, Carmine, *Atlante di Pompei.* Napoli: La Scuola di Pitagora Editrice, 2012.

[2] SERRAGLIO, Riccardo. *Le "comode, nette, belle ed igieniche" Case Operaie della Nuova Pompei*. In GAMBARDELLA, Carmine, *Atlante di Pompei.* Napoli: La Scuola di Pitagora Editrice, 2012.

[3] DI VIRGILIO, Michele. *Preesistenze archeologiche nel sito delle Case Operaie*. In GAMBARDELLA, Carmine, *Atlante di Pompei.* Napoli: La Scuola di Pitagora Editrice, 2012.

[4] SERRAGLIO, Riccardo. *Architetture per i lavoratori tra Napoli e Caserta. Progetti e realizzazioni dal XVIII al XX secolo*. Napoli: La scuola di Pitagora Editrice, 2012.

[5] ARCHIVIO BARTOLO LONGO. Misure delle opere edilizie per la costruzione delle Case Operaie di Pompei, sez. II.

[6] BIBLIOTECA COMUNALE DI SCHIO. Lettera di Bartolo Longo ad Alessandro Rossi., sez. Giornali e Giornalisti.

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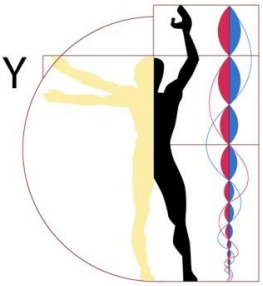

Beyond the Visible
Remote Sensing and Photo Interpretation

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Abstract
The use of sensors, multispectral and hyperspectral, in terrestrial observation missions is increasing continuously. The possibility of acquiring the same image at different frequencies in the electromagnetic spectrum - from infrared to ultraviolet - and the capability to detect specific markings of elements otherwise not observable only in the visible region, make these tools particularly effective, innovative and applicable in various fields: from agriculture to mineralogy, from physics to civil and military surveillance and they confer success stories behind it in terms of saving time and resources, especially in the early stages of scientific investigations.
The evolution of multispectral sensors and the perspective development of hyperspectral sensors in the field of optical remote sensing offer new perspectives in the detection of the territory and renew the need to redefine the potentiality, limitations and accuracy of traditional techniques. In the case of hyperspectral images, in particular the very high spectral resolution, opens new possibilities for the development of physically-based models to correlate radiometric quantities with physicochemical indicators, characteristics of the surfaces observed.
Taking into account also the acquisition of hyperspectral data is not without attributable criticality, most of the times, to the the operational complexity and the strong sensitivity to atmospheric noise, particularly in the proximity of the stronger molecular absorption bands that make up the atmosphere.
Driven by an interest primarily methodological, this work offers a brief introduction on the topic of remote sensing offering also an overview of the different passive sensors, with particular reference to those that are multispectrally and hyperspectrally airborne, and proceeding with the discussion of the concept of digital image and the most common improvement techniques.
The last part is devoted to the analysis of the techniques of classification, supervised and not, and their possible applications in the investigation on a regional scale.

Keywords: Hyperspectral Sensors, Photo Interpretation

1. Remote Sensing
Remote sensing is definable as the bonding of techniques, tools and means of interpretation, that allow the reception of both radiometric and geometric information from an object without direct contact with the object itself. More generally, with this term one understands the study of the earth's surface from a distance in order to identify or to control a series of phenomena whose acquisition or knowledge of which may be useful for humans. Remote sensing encompasses the entire process of detecting and recording the energy of the electromagnetic radiation emitted or reflected, treating and analyzing information, and then implementing this information. Remote sensing is a discipline of detection which has as its object the production of thematic maps or however the extraction of a certain type of information on the area from a "remote" position in respect to that territory. It also allows you to extend and improve the capacity of perception of the eye, providing the observer qualitative and quantitative information on objects positioned at a distance, and therefore on the surrounding environment. The main advantage in performing this type of analysis is that the data detected from a distance allows the capability of analyzing a much larger area than that done on-site,

highlighting phenomena otherwise difficult to identify. Remote sensing allows studies with diagnostic and investigative purposes of which many are in the environmental field:
- Atmosphere Monitoring: composition, weather profiles, precipitation, wind, input models for forecasting and nowcasting (forecasting weather in the very short term equal to the successive three hours), and ocean (including activities in the sea and coastal areas): marine/ocean circulation, waves, sea level, temperature, marine biology, water pollution;
- Climatology: understanding and assessment of climatic processes (i.e. desertification);
- Glaciology: types and movements of sea ice and land;
- Geology, geomorphology, geodesy: faults and anomalies, tectonic movements, unstable slopes, identifying rock types; Topography and Cartography: maps and basic issues (i.e. land cover);
- Agriculture, forestry, botany: mapping, phenological and health state, humidity, estimates of production, cultivation indications;
- Hydrology and Hydrogeology: water resources, rainfall, run-off input models, vapor-transpiration;
- Forecast and catastrophic control, risk assessment: fires, floods, instability, inaccessible area control;
- Land management: inventory resources, planning support, assessment of environmental impact;
- Archaeology: with the polarimetric SAR (Synthetic Aperture Radar) technique.

In order to understand what the principles are that underpin the processes related to the techniques of remote sensing, we must start from the crucial element, the electromagnetic energy (EM), which already the name highlights the interaction of electric and magnetic energy. EM is also known as radiant and therefore it is correct to speak of electromagnetic radiation, a wavy phenomenon that does not require any medium material to propagate, and that in the open, travels at the speed of light. Electromagnetic radiation is a form of energy propagation in nature, the shape that results most familiar to us is that perceived as visible light by the human eye, which constitutes only a small (but very important) portion of the complete electromagnetic spectrum. The radiation has been recognized by physicists as the wave phenomenon, related to electricity and magnetism (electromagnetic optics).
The wave theory for which the EM radiation propagates in space as a harmonic wave that swings on 2 orthogonal levels between each other and in relation to the direction of propagation, represents as shown in Fig.1 by the electric and magnetic field, generated by the radiation itself.
The waves transport energy and are classified according to their frequency; the higher the frequency, and the higher will be the energy associated with such wave. Visually we can perceive wavelengths between 390 and 700 nanometers (nm) to which we give the name of visible light. The shorter wavelengths correspond to ultraviolet rays, X-rays and gamma rays that all have frequency above the visible light and therefore more energy.
Infrared radiation, radio waves, and microwaves have instead larger wavelengths of light and transport lower energy. Our eyes cannot see electromagnetic radiation beyond the violet end of the spectrum and the area below the red zone. It is precisely the segments of this spectrum, located outside of the human field of vision, that require more of our attention because they do not fall into visual experiences belonging to our everyday visible radiation. We have said that the light is only a small part of the electromagnetic radiation, the one defined visible by man. The representation of all forms of existing radiation graphed on an axis divided into regions is the electromagnetic spectrum Fig.3.
Visually we can perceive wavelengths ranging between 390 and 700 nanometers (nm) to which we give the name of visible light. The shorter wavelengths correspond to ultraviolet rays, X-rays and gamma rays that all have a frequency above the visible light and therefore more energy.
Every electromagnetic radiation that hits any surface generates three fundamental phenomena:
1. reflection
2. absorption
3. transmission

Such phenomena are reflected in different proportions, depending on the characteristics of the surface and the radiation. But regardless, there is the principle of conservation of energy for which it does not create itself nor destroy itself thus it is possible to write: The proportions between energy reflected, absorbed and transmitted, vary according to the type of material which constitutes the surface: equaling the surface, then, the amount of energy reflected, absorbed and transmitted, varies in function of the wavelength. This implies that the two surfaces may be indistinguishable from a spectral point of view in a certain wavelength and perfectly discriminable in another. However, of these three coefficients, the one of most interest to remote sensing is the reflected radiation that assessed in function of the wavelength coincides with the reflectivity (spectral reflectance).Depending on the type of surface, we will have trends spectral of different reflectivity, then we will talk about spectral signature, distinctive characteristic, because the identifiable of the surface material. The observation of different spectral signatures associated with different elements, allows us to choose the spectral bands (windows) most appropriate to better interpret the images and differentiate its elements in them.
In summary, what provides a system for remote sensing is the measurement of a distance, of a reflectivity and a combination of temperature and emissivity. To get more information, you need to make a different combination of variables that we provide other data. For example carrying out

measurements at different temporal instances, and at different wavelengths (spectral bands), and also with different polarizations of the radiation. In doing so we are operating under these domains:
• Spectral
• Spacial
• Temporal
This allows us to evaluate the changes and then relate them to the desired information. Remote sensing is the study of the radiation emitted and reflected from the Earth's surface. If we talk about radiation, then the object itself is the source of radiation; when speaking of reflected radiation, the source can be the sun, the atmosphere (by scattering solar radiation) or artificial radiation (like radar images). We can recognize objects and features on the Earth's surface considering the very values of energy reflected and/or emitted by them. The sensors of remote sensing provide us the brightness of objects in different ranges of wavelengths. These observations or measures are a model of spectral response, called the "spectral signature" of an object. The detailed knowledge of a model of spectral response could allow us to identify the characteristics of interest, such as different types of crops, woods, or minerals. Everything in nature has its own unique characteristic of reflected radiation, emitted and absorbed. These spectral characteristics can, if cleverly exploited, be used to distinguish one thing from another or to get information on the shape, size and other physical and chemical properties (Parker and Wolff, 1965). Of course, the spectral responses are affected by time factors and may provide different data even though equal species are investigated, but there is no doubt of the greatness of the utility of study of the spectral properties of objects in remote sensing. Sometimes, though it results difficult to define a univocal spectral signature for a specific vegetation, you can still gather important data for the study of the ground and spectral models that are useful and unique to the specific characteristics of the site under investigation are defined. Generally the trend of the reflectivity of a surface is included in spectral regions ranging between UV and IR spectral range that is $\lambda = 0.4 \div 2.5\mu m$. The spectral reflectance is a function of the geometric characteristics, the nature and composition of the body itself. For example the amount of water contained in a body, tends to lower the reflectance value, the presence of chlorophyll results in a absorption of the radiation in the red spectral range and a strong reflection in that of the infrared nearby. We can therefore analyze the value of the spectral reflectance of a body in relation to the various wavelengths of the spectrum, producing a curve in a diagram the ordinate axis shows the reflectance and on the abscissa, the wavelength.
By analyzing the diagram in Fig. 5, we can notice that the vegetation, for example, assumes high values of reflectance in the spectral region of about 0,8 μm which is equivalent to the area of the infrared nearby. Another peak is around the value 0,55 μm which is equivalent to the area of the green. It is possible also to make considerations by comparing surfaces of a different type and be able to then identify the spectral region that mainly allows us to discriminate two different surfaces. In the case depicted, imagining that we want to discriminate vegetation from the moist soil, we should position ourselves in the spectral region where the spectral reflectance difference between the two surfaces is maximum, that is, at around 0,8 μm. Understanding the spectral signatures is critical in the field of remote sensing and photo-interpretation in order to be able to understand and interpret the images produced by the sensors. All radiation used for remote sensing must necessarily cross the Earth's atmosphere. If the sensor is moved from a plane at low altitude, the effects of the atmosphere on the quality of the images may be negligible.
On the contrary, the energy that reaches the sensors located on the satellites of the Earth must go through the entire depth of the terrestrial atmosphere. In this case, the atmospheric effects can have a significant impact on the quality of the images on the data that the sensors generate. We can distinguish two types of sensors used for remote sensing. In the case of remote sensing where the energy source is the sun, we'll talk about passive remote sensing, the sensor can detect the electromagnetic radiation emitted or reflected by the object in the analyzed scene. When it is the same sensor to emit radiation and to receive in return the part of energy reflected, we speak of active remote sensing. Then, regarding the passive, we distinguish those sensors that record the reflection of solar radiation from the terrestrial surface from the sensors that operate mainly in the thermal infrared, which collect the radiation emitted directly from the Earth's surface. It is clear that to measure the reflected energy it is possible only in the presence of the main source of energy, that is, the sun that illuminates the object under observation, this is not necessary for the detection of the emitted energy, for which instead, the recovery can be made equally well during the day or night, as in the case of sensors operating in the thermal infrared. Active sensors, however, detect the electromagnetic radiation reflected from an object irradiated by a source of energy generated artificially by them. The emitted radiation reaches the object under observation and its reflected fraction is detected and measured by the sensor, following interaction with the surface. The systems for active remote sensing are divided into systems of scattering, such as lidar, which operate in the visible and in the infrared, and in radar systems operating in the microwave range. The hyperspectral remote sensing was born in the mid-80’s and was initially used mainly to study geological minerals and rocks, but recently its

use has been extended to the monitoring of the environment, in particular the study of the atmosphere, vegetation, water and forest fires, and the classification of land cover or support and monitoring of agriculture. Initially the hyperspectral remote sensing was carried out through the use of sensors on aircraft: AVIRIS (Airborne Visible Infrared Imaging Spectrometer) sensor was the first to produce images of the Earth's surface with 224 spectral bands. The hyperspectral sensors used for remote sensing of the Earth's surface are mounted on airborne or satellite platforms. The most famous airborne sensors are MIVIS, AVIRIS and CASI-1500. The multispectral images represent the largest category of images captured by the sensors of remote sensing. Unlike the panchromatic images, which for each pixel only one value is stored, the multispectral images divide the electromagnetic spectrum into many bands (or channels) assigning to each pixel a value belonging to these bands. These values make up the Space Feature of a multispectral image. The multispectral images were created with the task of storing more information than the panchromatic images, extending information stored in the individual RGB channels. The first uses of these images took place in the space field and archaeological heritage, for the study of artifacts and documents, difficult to analyze with the naked eye. The Hyperspectral and Multispectral Imaging both belong to a larger family of techniques of image representation, that of "Spectral Imaging" or "Spectral Analysis". In hyperspectral images, as in those multispectral, each image element (pixel) is not constituted by a simple monochrome value (panchromatic images or grayscale), or by a triplet of values (RGB color images), but by a set of values belonging to the electromagnetic spectrum. The distinction between multispectral and hyperspectral imaging is based on the number of bands that is stored, and the frequency spectrum represented. The sensors are hyperspectral imaging spectrometers with more than 16 bands. The high spectral resolution allows a detailed representation of the spectral signature of each pixel. "The fundamental difference compared to multispectral sensors is not in the technology of the sensor but in the methodologies for digital processing of the data with an appropriate selection of the bands according to the applications for which they must be used". [M.A.Gomarasca] In particular, the first possess a limited number of bands and are not required to store frequency bands contiguous. It is possible that within a same picture there are some bands of the visible spectrum, and other bands related to that of the infrared, and that the frequency space between them is not totally covered by the remaining bands. The hyperspectral images instead possess a high number of bands, which represent discrete intervals of the electromagnetic spectrum, and produce a continuous spectrum for each pixel in the portrait scene. A hyperspectral image can therefore be regarded as a data cube, consisting of as many levels as there are bands that make up the remotely sensed spectrum, and with a width and height equal to the size of the area captured. Ideally you can consider the two spatial dimensions as if they were portrayed resting on the surface and the third dimension (spectral) perpendicular to them. If you move along the spectral direction, different values and colors are obtained, and if a band of remote sensing it revealed, a monochrome image is obtained. Gathering information about a single point in the image, you get the continuous spectrum of that pixel. Often the spectrum associated to each pixel is a "reflectance spectrum," which can contain up to a few hundred monochromatic values. At the end of the acquisition phase and before making elaborations for analysis, photo interpretation and integration with other geographic data in a GIS, the data that are in a so-called “raw” format require a series of operations of correction of the radiometric and geometric type. The reason for these errors depends on the distortion due to the acquisition system (platform and sensor), the means of signal propagation (atmospheric distortions), the angle of shooting, and the effect of the curvature of the earth for satellite imagery. Each image remotely sensed "raw" is thus affected by a number of defects and errors, dependent on its type and resolution, which would prevent its correct use in mapping applications. All the operations of preparation of data for the obtaining of the images are defined operations of pre-processing. Clearly, the end user will request, depending on the type of analysis to be performed, a pre-processing which, for example, can also include a Orthorectification that as a geometric correction also allows a perfect correspondence with cartography. Corrections to which remotely sensed images are generally subjected can be divided and grouped into two main types:

• radiometric correction or calibration: elimination of distortions of the signal due to the influence of external conditions at the time of acquisition (climate, lighting, topography) and to the malfunction of the sensors (sensor calibration), this may mean that for example the radiance measured by the sensor is altered because of the value not exactly corresponding to the pixel displayed;
• geometric correction: elimination of spatial deformations of both systematic type (curvature and rotation of the earth) and of a non-systematic type (speed, variations in trim and altitude of the platform on which there is the sensor) introduced in the image by the camera system.

The sensors for remote sensing provide a significant amount of data that due to processing operations are translated into images of the Earth's surface at different levels of detail and in almost all regions of the electromagnetic spectrum. In order to gain information from the images, they need to apply a set of analytical techniques defined as photo interpretation. Clearly photo interpretation and remote sensing are closely related disciplines, in the sense that the techniques of remote sensing are

necessary in order to understand how images are generated, structured and processed and made ready for the phase carried out by the photo-interpreter. The observation of any photo and the ability to identify its contents, and then transmit the information obtained, represents the operation of photo interpretation. We, in fact, almost unknowingly do so daily when our eyes view our surroundings. In the case of remote sensing, however, these are shots taken from above; images are unfamiliar compared with those made from ground level. The photographic interpretation consists of two phases, the first consisting in the observation of what is represented in the image (recognition and measurement); the second phase, a little more focused on inductive and deductive reasoning, is still linked to observations with the aim of reaching an outcome related to the topic of study. In both phases the experience of the photo-interpreter has important value. Much is also linked to the quality of the images which depends on the spatial resolution (pixel size for which at a higher resolution corresponds to a pixel of smaller dimensions), spectral (number of bands, the higher it is, the more is the number of spectral windows in which to observe the image) and radiometric (number of gray levels). The photo interpretation offers the advantage of allowing the study of areas on Earth that are not accessible both for natural reasons and for security reasons, and although in these areas is not, however, possible to compare the data resulting from the photo interpretation with those verified on the ground, it still represents an added value compared to the alternative of not having any given for those areas. Photo interpretation inevitably has a component negligible of subjectivity, two photo-interpreters might come to different interpretations for the same investigated area. This happens for two main aspects, allocation and placement. For example, in regards the allocation, they may not agree on the type of crop (citrus or olive), but they certainly will have to agree on broad terms (distinction between tree crops and grasses). This problem may also occur for positioning, for example in not agreeing on a limitation of the homogeneous zone.

The photo-interpreter has a number of elements available as an aid to the interpretation process:

• Spectral elements (color tone and spectral signature)
• Geometric elements (shape, size, texture, pattern, shadows)
• Spatial elements (location and association)
• Temporal elements (time-varying)

The tone is definitely among the most important elements, directly observable on the image, expresses the spectral response of objects to the incident radiation. The differences in tone allow us to define the boundaries between different objects.

Clearly the analysis of the same image in color, will allow easier recognition of certain objects in the scene.The same image shown in false color as in the following example, it is convenient to have an immediate perception of the areas where there is vegetation (in red) and also allows us, depending on the brightness of the color red, to learn the state of health or stress of the plants. Another important element is the texture, that is, as the interpreter visually perceives a surface that may be more or less rough or smooth. The leaves of the trees return certainly a coarser texture than a grassy meadow. The model (pattern) instead concerns the spatial distribution of objects, such as an orchard differs by a natural forest. The shadows then can sometimes represent a disturbing element since they decrease considerably the value of the reflected energy, but also a very effective means to assess the shape and the height of the objects (think of a shadow projected body that helps us to understand the shape). The location allows us, for example, instead of being able to discriminate an orchard, differentiating an apple orchard (for example if the scene is in an area of the Trentino) by citrus trees (but if we are in Sicily). The time elements are important to choose the best time to shoot, I think, for example, the state of phenological development of crops, as planned for the experience made during the period of doctorate carried out in Albania, for which the choice of the months from June in September were those suitable in view of the phenological development of crops investigated. All operations of photo interpretation with the relevant information, serve to achieve geographic and cartographic databases. It is therefore necessary from the beginning to organize a flow chart that must include a number of basic steps.

1. A definition of objectives
2. Choice of the basic parameters and a legend
3. Choosing Images evaluating the parameters of resolution and the time of shooting
4. Collection of ancillary data and their evaluation
5. Definition of interpretation keys
6. First check on the ground
7. Interpretation of the images and the construction of the database
8. Second check on the ground for data validation
9. Review and completion

Define your goals is the first step and this obviously depends on the type of investigation required and the desired result. You must then choose the basic parameters including the tolerance for which there is a rule that establishes a reference value (graphic error). The legend should include all items that are needed to be able to classify the different areas in the area of study. For example, the CORINE

project represents the creation of a database of land used for Europe as a whole. Since the content of the legend must be established in the initial stage of work, we must equip a legend of a dynamic character for eventual changes during construction. The collection of ancillary data (maps, campaigns on the ground, and raster or vector data) is an introductory photo interpretation. Its usefulness is greater if this data is geo-referenced to be consulted in a GIS environment. Very important is the realization of interpretative keys through the analysis of samples carried out on site. This allows us to have a certain number of points on the ground, each belonging to a class. The main phase carried out by the photo-interpreter, for the image interpretation and construction of the database, it is processed with the help of the legend, the ancillary data and knowledge acquired as a result of checks on the ground. At the end, following a second and more careful campaign on the ground, there is the review stage, validation and completion, in which the photo-interpreter revises total themes created during the work of interpretation, making more accurate corrections where necessary. As an example a letter explaining the photo interpretation activities is drafted, through the comparison of hyperspectral images.

1.2 Photo Interpretation

Hyperspectral scanning, taken as an example, summarizes the geographic and orographic composition typical of the Mediterranean. A little dense urban fabric is facing a stream, characterized by low depth and surfacing vegetation along the banks and in outcrops apart from the obvious areas of stagnation; a road network section and variable surface serves the built up area and the farm in the suburbs. Over the waterway, the land is steeper marked by natural vegetation and barren areas with rocky outcrops and is dotted with an urban settlement in close dependence on the road network. The selective analysis of the spectral data acquired from a sensor plane, allows multiple representations of the land remotely sensed in relation to targeted processing from electromagnetic segments scanned between 407.9 nm and 954.4 nm divided into thirteen bands of variable width between 2.4 and 4.8 nm. The first performance is possible in 'true colors' (Fig. 10) that synthesizing bands 649.1 (Red) 544.5 (Green) 407.9 (Blue) allowing a 'photorealistic' reading of land remote sensing. This will be the main yardstick for comparing the photo interpretation of the subsequent processing. The RedVeg representation enhances in shades of red the vegetated areas in comparison to the uncultivated areas that fade in shades of green; while the representation NDVI enhances with tones the gray that fade to white the most active chlorophyll vegetation. These two representations obviously have a quantitative relationship that properly accessed for comparison can highlight the suffering state of the vegetation and the variable nature of the species of trees or grasses. In relation to data concerned, in fact, it is possible to highlight that all 'green' zones (agricultural or spontaneous) are actually characterized by vegetation and that also have good chlorophyll activity in line with the biological activities of the season (summer) when the scan was acquired. The outcrops in the river, however, despite having varying colors of green are characterized by large, inert clods (dirt or sand) on which limited clods of vegetation have taken root (A). In the southern wetlands, on the contrary, not all areas of color in shades of green appear to be emerging or floating with vegetation: it's the case of suspended material at point B that despite the 'green' result, in the image 'true colors' results as 'black' in RedVeg and NDVI representations. Therefore in that point there is no plant activity. The comparative reading of this area with the Principal Component Analysis (PCA) (bands 4 (638.4 nm) 5 (649.1 nm) 6 (684.7 nm), Fig. 13 explains the phenomenon: in point B there is an element suspended identified with the nuances of bright red in this drawing that looks 'light green' in the visible. To be noted is how this 'element' in suspension has its highest concentration at the point B and goes degrading towards the bodies of water nearby. The direct sampling of the suspended material and the chemical characterization will clarify the nature of the material. Other material in suspension, represented by shades of red to magenta, is identifiable in the center of the major water flow and along its banks. Focusing on the built area, the comparative reading of the four images allows you to accurately identify the road network, the scope of the houses and courtyards of the covering material; in particular, the latter being equal color in the 'visible' results to be of different material surface as evidenced in the details processed by PCA. Turning our gaze to the north over the river, you can see two particular points labeled as C and D.

In point C there is a clear concentration of green lush forests as demonstrated by the bright red processed by RedVeg and NDVI but is not reflected in the elaboration of PCA which has two color variations of very different and divergent shades of light green and dark purple. This divergence of color may postpone two tree species or to a plant suffering localized only in certain plants of the same species. In point D, however, the calculations 'true color' and PCA have a close analytical relationship which is indistinguishable in other images from RedVeg and NDVI. With the 'naked eye' you can distinguish an area of wasteland next to a rocky area; at the same point the PCA image demonstrates two different materials, while the RedVeg and NDVI images classify the area simply as not vegetated, as already evident in the visible. Reading the draft, by comparison, the four processed images beginning from hyperspectral data shows that the measurement and comparative analysis of data

collected over the visible range may lead to a deeper knowledge and makes you aware of the natural, man-made landscape.

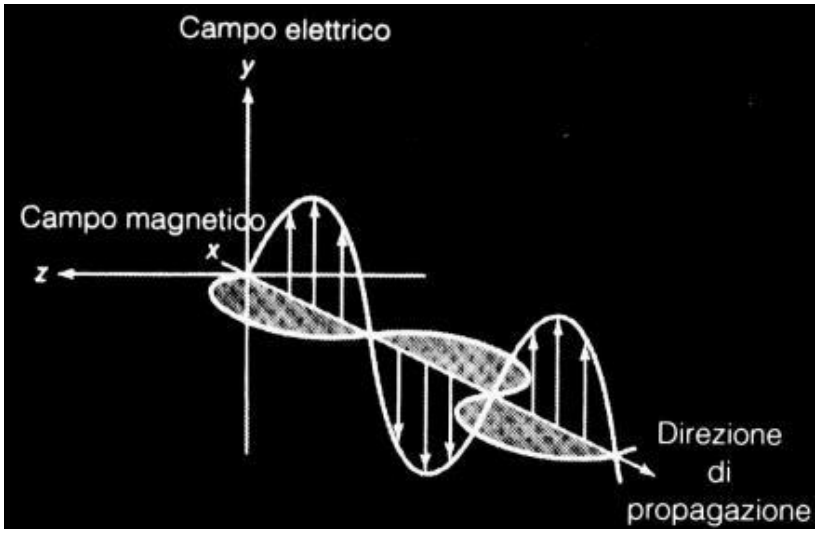

Fig.1 Composition of the Electromagnetic Wave

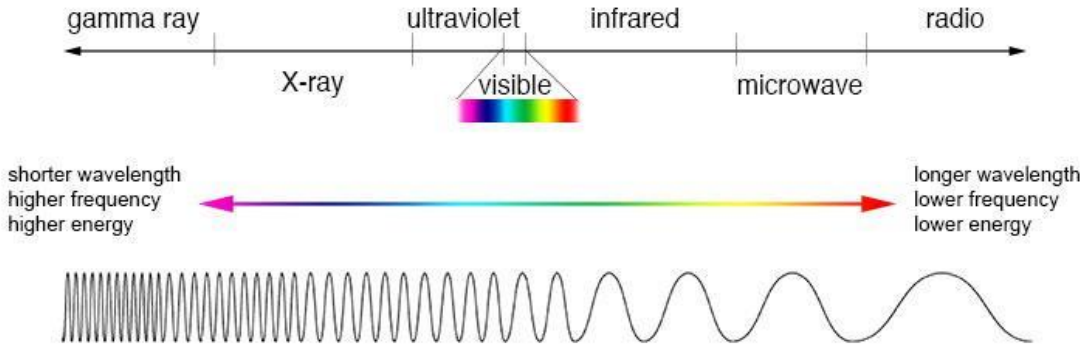

Fig.2 Wavelength

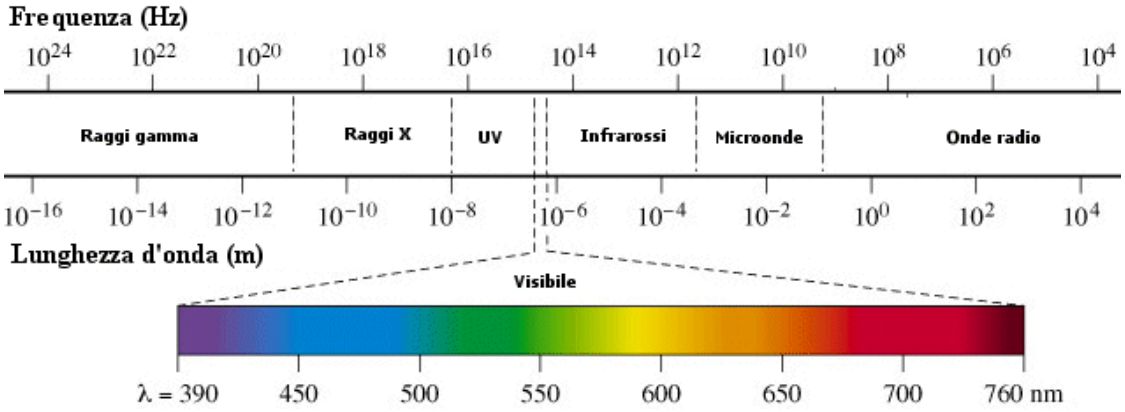

Fig.3 Electromagnetic Spectrum

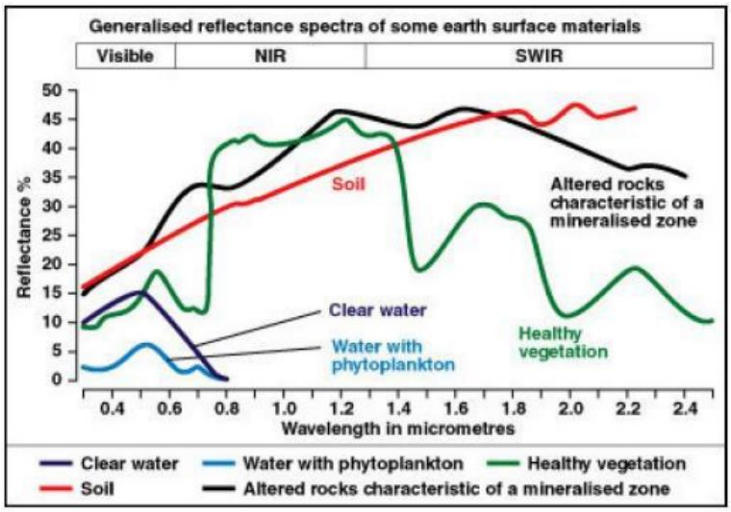

Fig.5 Spectral signatures of some natural surfaces



Fig.7 Grayscale representation



Fig.8 True color representation



Fig.9 False color representation

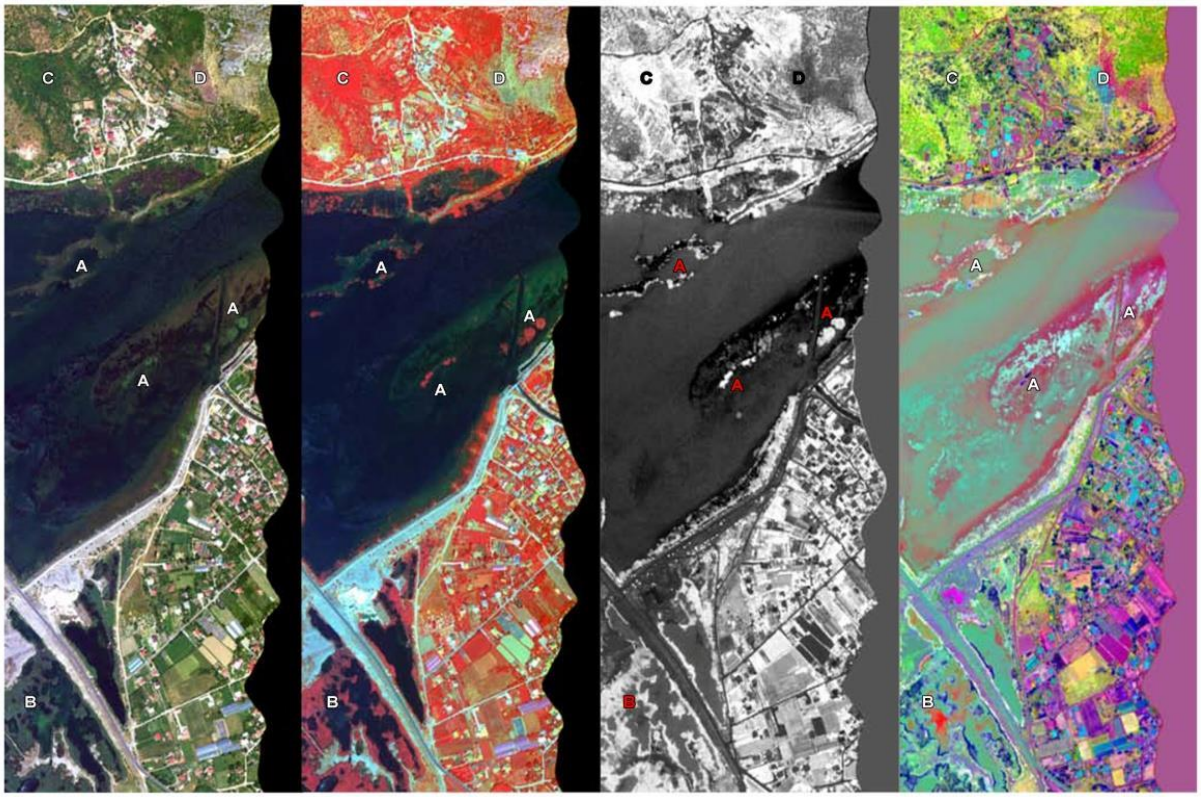

Fig.10 Representation 'true color' (Red 649,1 Green 544,5 Blu 407,9).	**Fig.11** Representation 'RedVeg' (R 954,4 G 649,1 B 407,9).	**Fig.12** Elaboration 'NDVI' (R 684,7 NIR 851).	**Fig.13** PCA representation

Comparison of processing images (true color, Red Veg, NDVI, PCA)

Bibliographical References

[1] GOMARASCA, Mario A. Elementi di Geomatica. Edizione 2004. Associazione Italiana di Telerilevamento.

[2] CHEN, C.H. Frontiers of Remote Sensing Information Processing. World Scientific, 2003.

[3] HALLIDAY, D., RESNICK, R., WALKER, J. Fondamenti di Fisica. 3a Edizione. Milano: Casa Editrice Ambrosiana, 1995.

[4] CARDER, Lee Z., HAWES, K. L., STEWARD, S. K., PEACOCK, R. G., DAVIS, T. G. Model for the interpretation of hyperspectral remote-sensing reflectance, “Applied Optics”. 1994.

[5] BRIVIO, P. A., LECHI, G., ZILIOLI, E. Principi e metodi di Telerilevamento. Città studi Edizioni, 2006.

[6] HALL, D.L., LLINAS, J. An introduction to multisensory image fusion. Proc. IEEE, 1997.

[7] LABEN. Process for enhancing the spatial resolution of multispectral imagery using pan-sharpening. United States Patent. 2000.

[8] POHL, C., VAN GENDEREN, J.L. Multi-sensor image fusion remote sensing: Concepts, methods and applications. Int. J. Remote Sensing, Vol. 19, no. 5. 1998.

[9] DUDA, R.O., HART, P.E., STORK, D.G. Pattern Classification. 2nd Edition. John Wiley & Sons, Inc., 2001.

[10] BHATTACHARYA, B., KALLER, D. Reference set thinning for the k-nearest neighbor decision rule. 14 ◦ IEEE International Conference on Pattern Recognition. Vol.1. 1998.

[11] TINTRUP, F., DE NATALE, F., GIUSTO, D. Compression algorithm for classification of remotely sensed image. Proceedings of IEEE International Geoscience and Remote Sensing Symposium. Vol.4. Luglio 1998.

[12] LANDRGREBE, D. Hyperspectral Image Data Analysis. IEEE Transactions on Signal Processing Magazine. Vol.19. January 2002.

[13] NIEMEYER I., CANTY M., Pixel-based and object-oriented change detection analysis using high-resolution imagery.

[14] CHEIN-I CHANG. Hyperspectral Imaging: Techniques for Spectral Detection and Classification.Springer, 2003. ISBN 978-0306474835.

[15] Itres CASI-1500 Manual, Vol. 3. 2005.

[16] Itres TABI-320 Manual, Vol. 3. 2005.

[17] LILLESAND, Thomas, KIEFER, Ralph W., CHIPMAN, Jonathan. Remote Sensing and Image Interpretation. John Wiley & Sons, Inc., 2007. ISBN 978-0470052457.

[18] BORENGASSER Marcus, HUNGATE William S. WATKINS Russell, Hyperspectral Remote Sensing. Principles and Applications, CRC Press 2008.ISBN 9781566706544.

[19] DENT Borden, TORGUSON Jeff , HODLER Thomas, Cartography: Thematic Map Design, McGraw-Hill 2008 ISBN 978-0072943825

[20] GAMBARDELLA, Carmine. Atlante del Cilento. Napoli: ESI, 2009. ISBN 978 88 495 1836 8.

[21] HAMLYN G Jones, VAUGHAN Robin A. Remote Sensing of Vegetation: Principles, Techniques, and Applications. Springer, 2010. ISBN 978-0199207794.

HERITAGE and TECHNOLOGY
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A methodical approach to knowledge the sacred heritage of Aversa

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Abstract
Over the centuries the city of Aversa, in the province of Caserta, had several dominations: Norman, Swabian, Angevin and Aragonese. The city of Aversa, first Norman county was founded in 1030 by Ranulf Drengot , the first Duke of the city . The system of settlement of origin was circocentrico of Norman inspiration. The city was defense from ditches and tall hedges that arounded her. The reasons for the foundation of the city were political; the aim of Duke Sergio IV was mitigate the clashes between Naples and Capua. The first plant was formed from the Church of St. Paul , near the ancient byzantine castle where Rainulfo settled his residence , to underline the union existing between ecclesiastical and political power .
In the story of AVERSA, it remembered as city of hundred churches. The research has the aim to identify and to know the position and the dynamics of transformations of sacred buildings inside a very stratified urban frame, but very recognizable (Fig.1). In order to concretely obtain a cognitive summarize of the case and to understand the reason of a lot of sacred structures is necessary to realize of a geographical database in which are contained the information on year of foundation of each sacred building, its typology, collocation, the cult and its conservation.

Keywords: sacred heritage, church, Aversa



Fig. 1: Cataloguing of churches on Catasto storico di terra di lavoro image (1875)

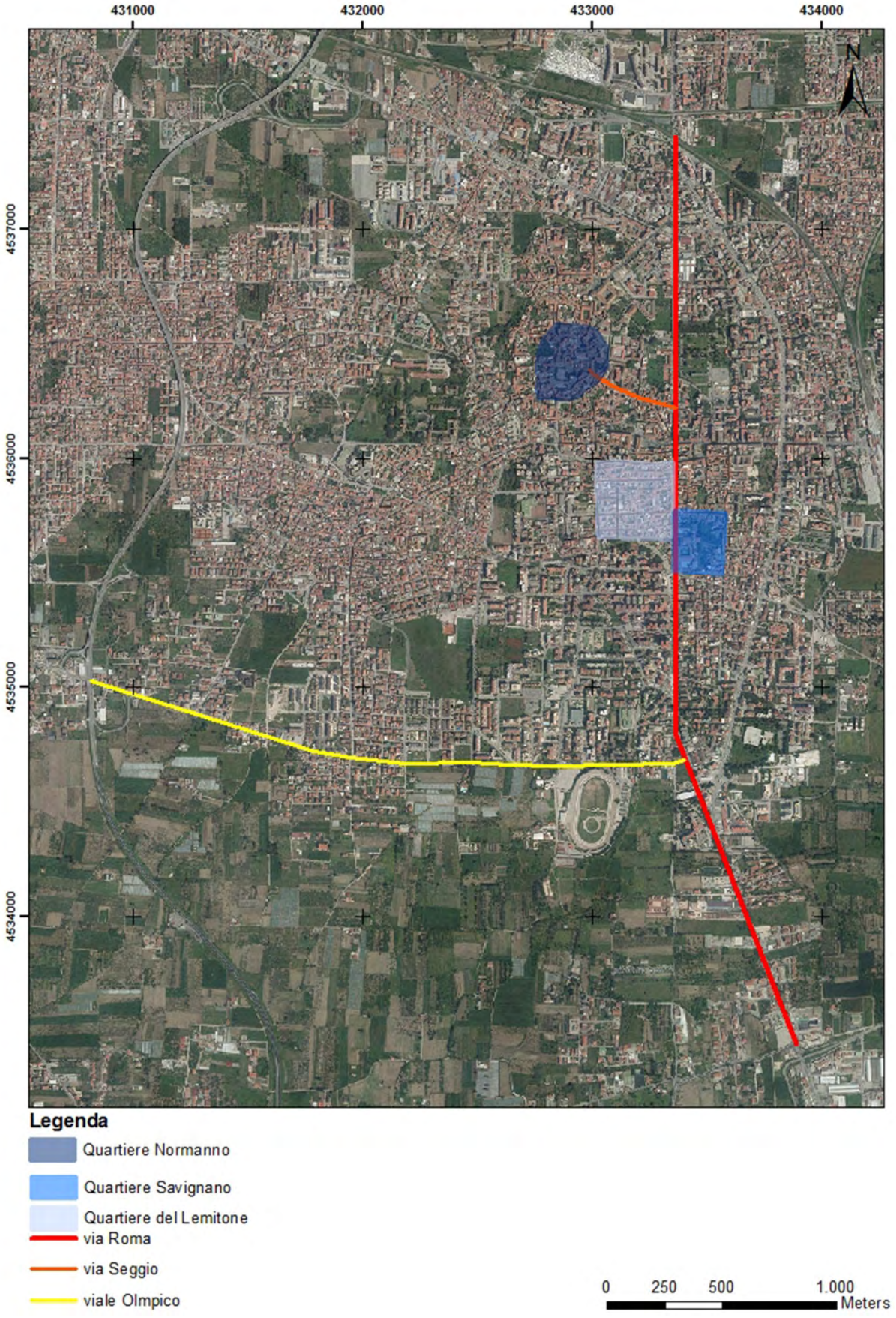

Fig. 2: The territory of Aversa on Ortophoto 2011 (Regione Campania).

1. Introduction

The knowledge of an area is a preliminary and essential action to the proper management of the territory itself. The research is a necessary tool for the knowledge; it is a kind of relief not only “geometric-descriptive”, but it is an instrument for the real knowledge of the building or the area under investigation. In this we want to build a model from which it is possible to extract all information about a portion of the territory. The design is an arbitrary convention that once accepted it is able to communicate with the observer and it is also a great element of communication. One cross marked on a map can indicate the presence of a sacred building. In the our study, the crosses drawn on the Catasto Storico di Terra di Lavoro helped in reading of the map; in fact the recognition of several sacred building was possible. This approach is not easy with the ortophotos, because an expert eye is necessary. Every method of representation communicates a particular message with the most appropriate means and every observation is also the product of an individual way of perceiving and communicating.

2. Aversa: an brief historical overview

The ancient town center of Aversa is located inside of a lot of Roman centuriation, and this includes a segment of Via Pietro Rosano and Via di Porta San Giovanni to north, a portion of via Presidio and Via Marchione to south, a part of Via Fuori le Mura to west and a portion of Via Roma and Via Filippo Saporito. Also, the ancient town in constituted by the sacred area of Cathedral and this was built up on an ancient Chapel of Sanctu Paulu ad Aversa. The Normans, gave the particular circular form to the city including old and new settlements inside four circular and concentric city walls. In 1030, command Rainulfo Drengot, founded the first town center and his home was the preexistent byzantine castle. The entrance to the city was through the doors S. Andrea, Castello, St. Maria and S. Nicola placed at the connections with the consular roads. The Benedictine monasteries of S. Lorenzo (1000-1030) and of S. Biagio (after 1030) were out first city wall. They were the focus around which born the first *extra moenia* settlements. The next development of Aversa was subject to the presence of the four Normans Parish outside the walls of Rainulfo: S. Maria a Piazza, S. Nicola, S. Giovanni Evangelista e S. Andrea. These were incorporate inside the second city walls. This coincides with the actual via S. Maria della Neve, via S. Francesco di Paola, via S. Francesco d’Assisi, via Orto dei Bagni and via S. Agostino.

Ruggiero II, around 1156, was responsible for the construction building a new defensive structure, the castle. He chose the village of Mercato Vecchio out Porta S. Andrea. The site was strategic for the control of Via Atellana. Later, Federico (1269-1283) II used the castle of Ruggiero and the Castle of Casaluce for the military reorganization of the Reign and for the defense of Terra di Lavoro.

The Angevin, in 1266, had a new aspect to the city. They built a new road so called Strada Nuova (today Via Roma). Strada Nuova improved connections with Napoli and Capua and it determined the abandon of ancient consular road near the village San Lorenzo. The Castle of Ruggero II became a new focus of Aversa through the building of this new road. The Castle, also connected with the Cathedral through Via Seggio. A third city wall (1382) was created and it incorporated the northern village of San Biagio and the south-eastern expansion of Borgo Vecchio, creating a new linear development of Aversa. In 1382 originated new orders in addition to Benedectines: Franciscan, Augustinian, Dominicans, Celestinian and Benedectines of Montevergine [4]. The Angevin walls originated by Porta S. Giovanni and they connected to walls of Ruggero II. The presence of several monastic order was the reason for the birth of numerous religious buildings. The new monastic Orders had an important role for the urban development of the city. The sacred building were placed outside the Norman walls and near the doors. Several churches were also built outside the Angevin walls: the Maddalena (after 1279) near Porta San Nicola; the Monastery of Carmine (1315).

3. GIS: a tool for Knowledge

Leon Battista Alberti, in his *De Re Aedificatoria*, declared that the perspective representation is typical of painters. Alberti also criticized the work of architects that represented the structures with extrusion of single parts of them: for example terraces. This research wants to give a greater emphasis to design in plan drawing of city of Aversa: this is useful drawing for the knowledge. The peculiarity of a GIS (Geographic Information System) is its capability of simultaneous processing of two components of complex informative valuables: spatial and alphanumeric data. So we proceeded with the creation of shapes (Fig. 2). The first shape shows churches dislocated on territory of Aversa and they are on Carta del Catasto Storico del 1875 (Fig. 3); the second shape shows the sacred buildings on ortophoto of 2011 (Fig. 5). An attribute table was realized for the two shapes. The tables contain several information about sacred buildings (Fig. 4).

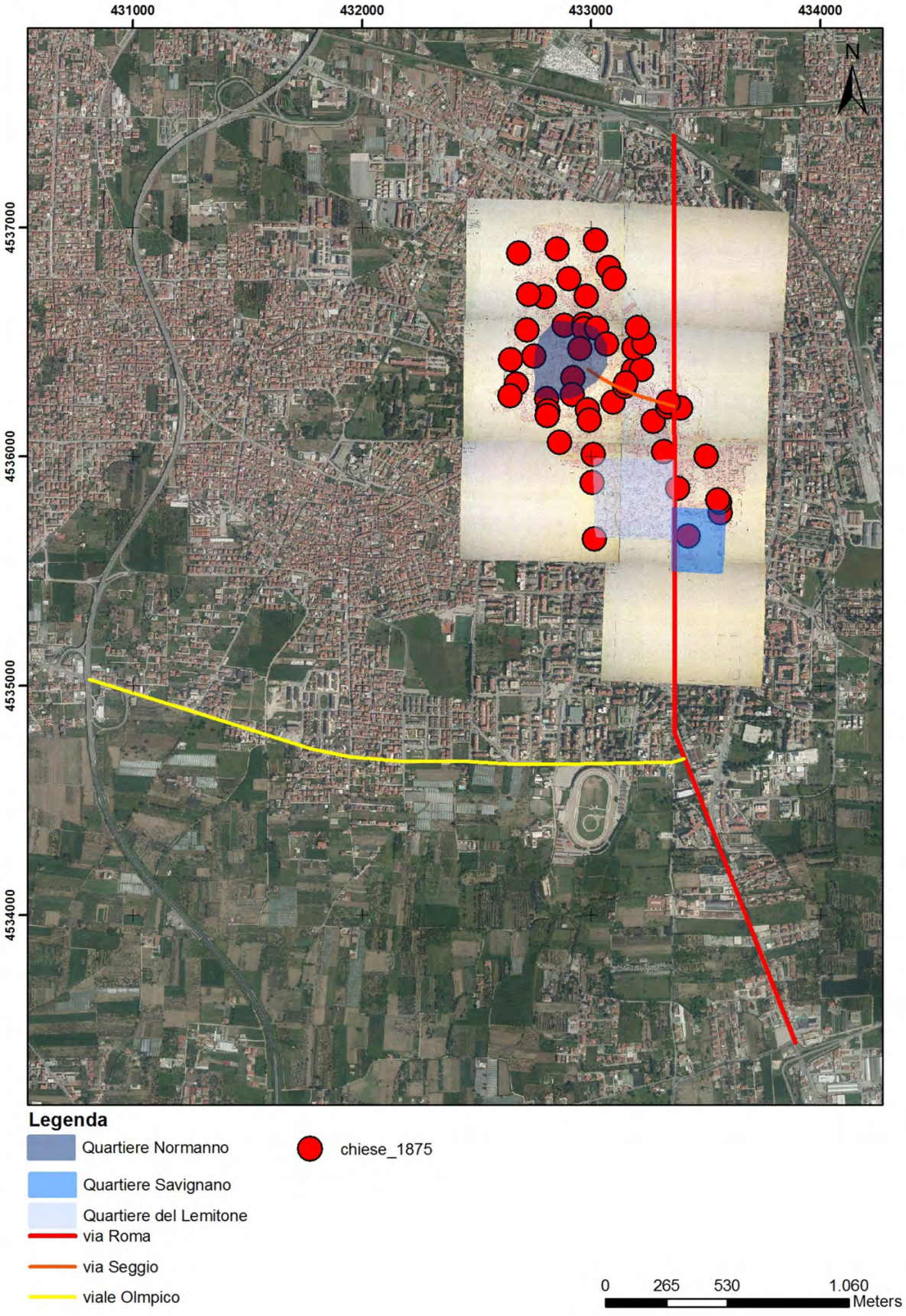

Fig. 3: Sacred building identified on Carta del Catasto di Terra di Lavoro (1875)

Nome	Ubicazione
Santa Maria a Piazza	Via Santa Maria a Piazza n 21
San Giovanni Evangelista	Via San Giovanni
San Lorenzo	Via San Lorenzo n 8
Chiesa Sant Audeno alla Trinità	Via C.Golia
Parrochhia San Nicola	Via San Nicola
Chiesa di San Paolo Apostolo	P.zza Duomo
Chiesa Santa Anna	P.zza Francesco Crispi
Chiesa Convento Sant Antonio	P.zza Lucarelli
Chiesa di san Francesco d'assisi	Via S.an Francesco d'Assisi
Chiesa della Madonna di Casaluce	Via Roma
Chiesa Santa Marta	Via Santa Marta
cappella Saporito	Via Rainulfo Drengot
Chiesa dell'Immacolata	Via San Nicola
Chiesa dell'Annunziata	Via Roma
Chiesa di Maria di Costantinopoli	Via Mancone
Chiesa di Santa Teresa bambino Ges¨	Via Luca Giordano
Chiesa di San Michele	Via Armando Diaz
Chiesa Santa Maria delle grazie	Via San Giovanni
Chiesa Santa Maria della Neve	Via Santa Maria della Neve
Chiesa Santa Maria Monserrato	Via Monserrato
Chiesa Santa Marta Minore	Via Santa Martella
Chiesa Santa Maria la nova	Via San Biagio n 51
Chiesa San Francesco alla Villa	Via San Francesco da Paola
Chiesa di S. Spirito	Via Roma n 103
Chiesa San Giovanni Battista	P.zza Savignano n 3
Chiesa di San Giuseppe Operaio	Via Filippo Saporito
Chiesa di San Filippo e giacomo	Via Roma n 249

Fig. 4: Table of shapefile about sacred buildings

The possibility of management of different kind of data allows to increase the processing efficiency and to achieve satisfying results in the territory management and of its transformation, within the same platform. In fact, is possible to analyze, to compare and to ask what are the churches and how many are the churches that are placed in a specific area and the distance between two sacred buildings. All this is possible because it is able to operate on information entities are associated complex information in which the information component and the spatial component consisting of descriptive attributes. The research aims to gather in a systemic manner the large amount of religious buildings to assess the actual changes that have occurred in the territory Aversa. The first step will be to study the actual reason of the birth of such a large number of churches. This operation will only be possible through a careful study of historical sources and archival, a study done not only on the identification of the building itself but the context in which it is placed or of the tracks and signs changed over time. The zenithal airborne relief is an important tool for the examination of territory and for the visual individuation of archetype up to its decomposition into parts.

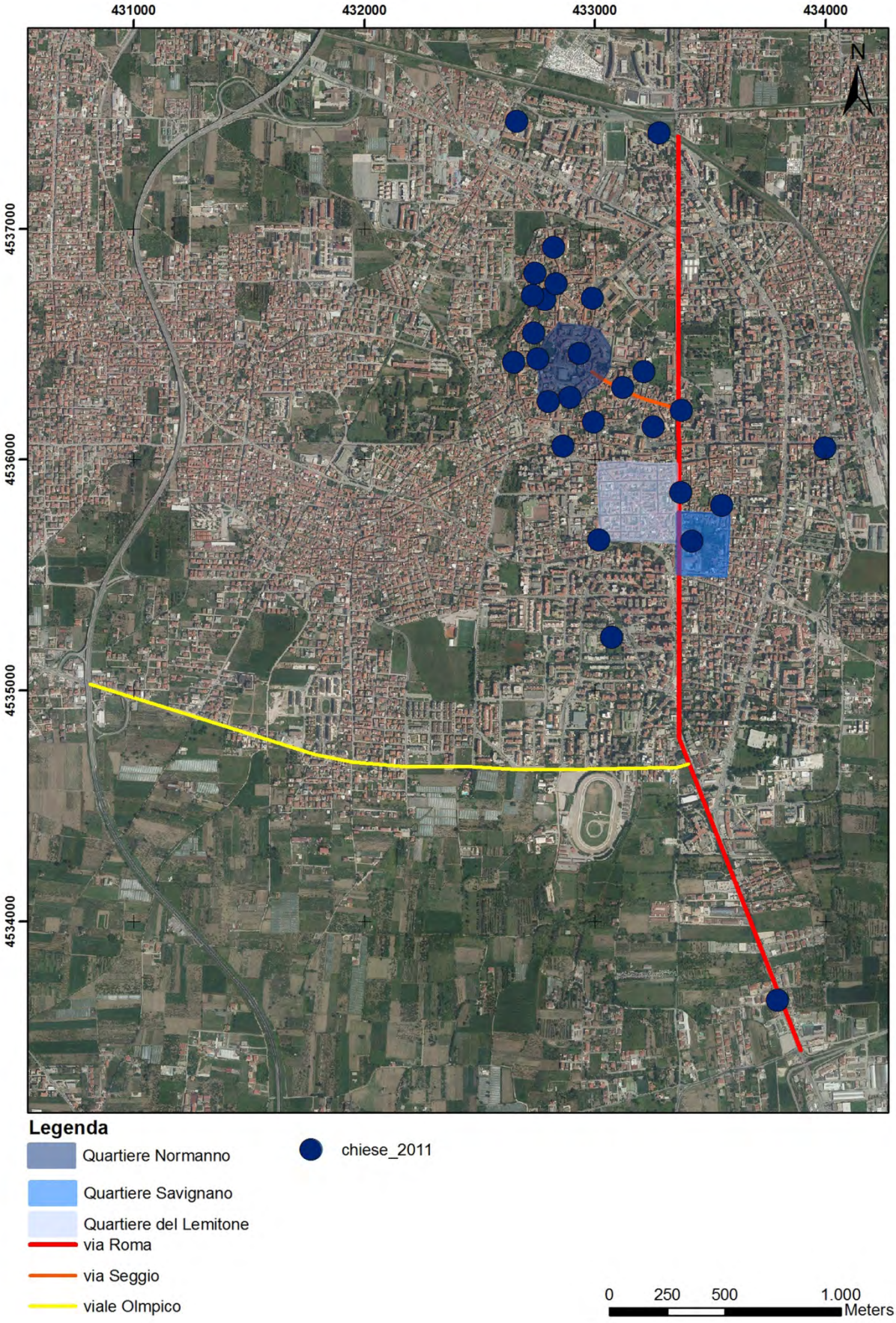

Fig. 5: Sacred building identified on Ortofoto 2011 (Regione Campania).

4. Conclusions

We used GIS For the georeferencing of the map of the Catasto. This activity allowed the detailed comparison between the map dating from 1875 and the most recent production of ortophotos. The phase has essentially concerns the recognition of points actually present on both the old paper which on the current one so as to allow the software to make the right overlap. For this reason we identified some points remained unchanged over time, this activity was particularly interesting because it has been possible to verify the actual changes undergone over time through traces left in time. It was therefore an opportunity to recognize the value inherent in the memorial maps can pass roads, building types and urban areas and thus preserve a snapshot of a place in a particular moment. Among the various points easily recognizable was identified as the Piazza Vittorio Emanuele. Through a recognition of the first points on the cadastral map and then on the ortophoto, we did the georeferentation spline getting a good result of overlap. This operation was essential for the creation of the shapefile and for setting the research work. You can do this spline operation if you can recognize ten points on old map and then on ortophoto image. In our case of study we recognized about 30 points to obtain a good result for overlapping. In particular, for the map “Aversa sezione urbana foglio 3 e 10” there was several difficults for the georeferencing.

In fact those maps represent an extra urban area of Aversa where there isn’t recognizable points like building or streets. So we had some difficult to mark points for the georeferencing.

At last the church have been recognized on Carta del Catasto Storico through the drawing of square and then they have been verified on the ortophoto of 2011. The sacred buildings are 50 on Carta del Catasto Storico (1875) and 27 on the ortophoto of 2011 (Fig. 6). The area of all churches is 9 km². The work of "census" of the churches of the city of Aversa was aimed to provide a method of cognitive approach to the sacred heritage of the city and allow a method of divulgation of the same heritage.

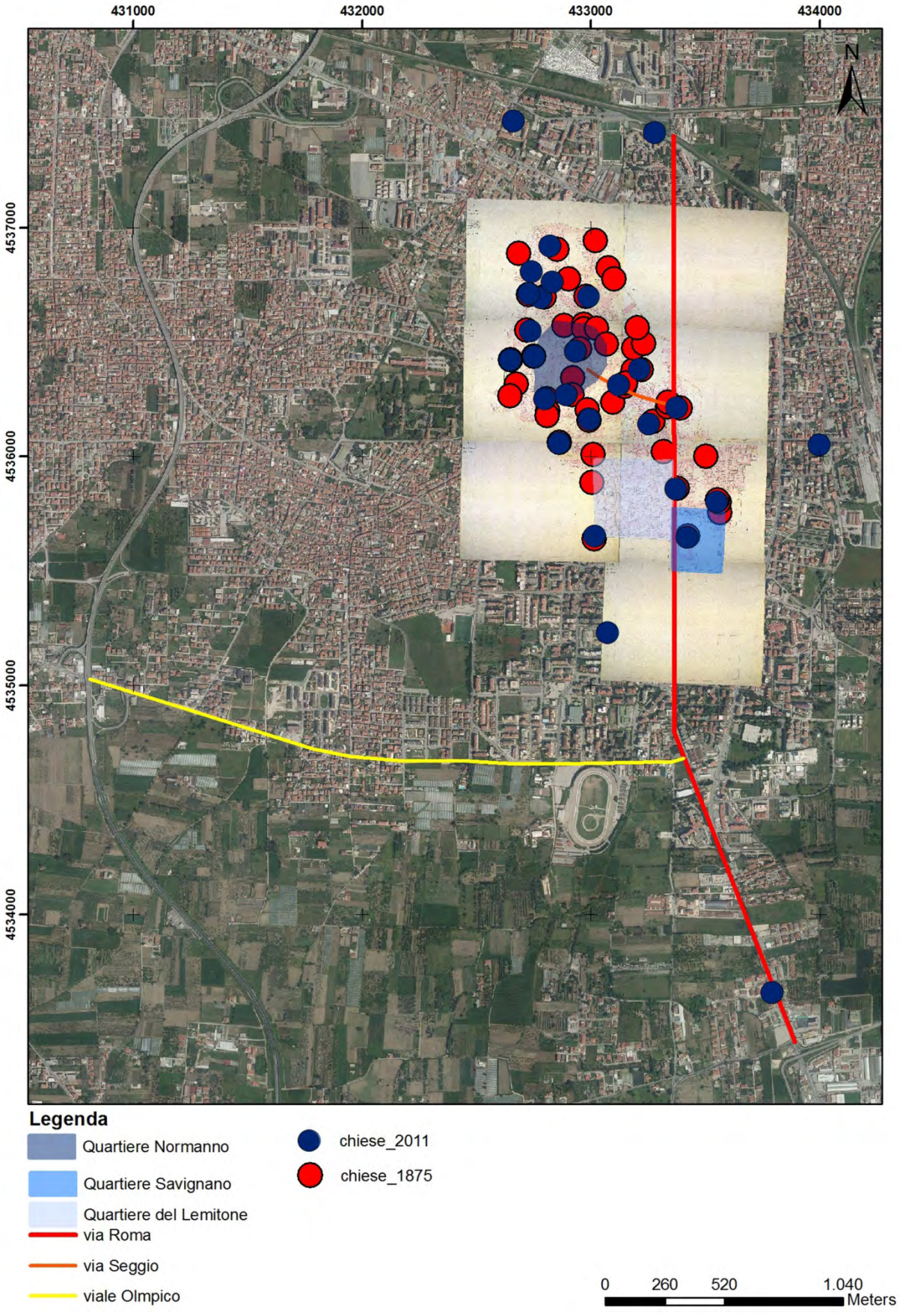

Fig. 5 – Comparison between churches of 1875 and 2011.

Bibliografical References

Atltante dei catasti storici di Terra di Lavoro, a cura di M. Borrelli, responsabile della ricerca S. Polito

ACKERMAN, S. James. *Architettura e Disegno. La rappresentazione da Vitruvio a Gehry*. Electa, Milano, 2003.

AMIRANTE, Giosi. *Aversa. Dalle origini al Settecento*. Edizioni Scientifiche Italiane, Napoli, 1998.
CECERE, Tiberio. *Aversa la città consolidata*. Edizioni Scientifiche Italiane, Napoli, 1998.

CUNDARI, Cesare. *Quaestio studi e ricerche per il disegno e l'la documentazione dei beni Culturali.* 21-22, anno XII – Ottobre 2010. Roma, Edizioni Kappa, 2011.

FABOZZI, Ferdinando. Istoria della fondazione della città d'Aversa. Napoli, 1770.

GAMBARDELLA, Alfonso. *Considerazioni sullo sviluppo urbano di Caserta*, in *Caserta La Storia*, Paparo Edizioni, Foggia-Napoli 2000.

IOANNILLI, Maria, SCHIAVONI, Ugo M. A..*Fondamenti di Sistemi Informativi Geografici*. TeXmat, Roma, 2002.

LIBERTINI, Giacinto. *Documenti per la città di Aversa*. Napoli, Istituti di Studi Atellani, 2002.

ZERLENGA, Ornella. *L'informazione territoriale nella rappresentazione della linea di costa*, in *Atlante del Cilento,* a cura di GAMBARDELLA Carmine, Edizioni Scientifiche Italiane, Napoli 2009.

HERITAGE and TECHNOLOGY
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Perception and fruition of open spaces in the historical centers

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Abstract
The identity relation with the places of living is related to the perception of spaces, that is to the way in which the objective world becomes part of the experience of people, not only with regard to material objects, but also with regard to immaterial values well established in the collective memory of the community settled. Urban spaces are perceived by people in relation to their shape, proportion, location in a visual route. These characteristics affect both the spatial orientation and the way of use of the spaces themselves.
The contemporary towns are progressively losing their connotation as spaces with precise functional characteristics, to become fluxes (of people, exchanges, relations, etc.), and are completely plunged into the development of a thick network of planetary communications, which make unnecessary and obsolete the traditional meeting spaces designed for various activities.
On the contrary in the historical centers the square, often characterized by buildings of historical and artistic value, has preserved its function as a physical place of aggregation, circulation and exchange.
Objective of the paper is to analyze the relationship between perception and fruition of squares in historic centers that have maintained over time their main function, or to highlight if the change of characteristics such as accessibility, focal points, visibility within a path, sunshine, artificial lighting etc. corresponded to a change in the functions, for the redevelopment of abandoned or rarely visited and used spaces.
Understanding the functions that today the square still performs can be of valuable support for the sustainable enhancement of the urban environment while respecting the historical identity of places and the needs of citizens.

Keywords: Perception, urban space, path, historical squares, artistic lighting

1. Perception of urban space (M. Piscitelli)
Numerous psychological studies have shown that the space assumes a precise meaning to the eyes those who live it, influencing also their emotional state.
Urban spaces are perceived by people in relation to their shape, proportion, location in a visual route. These characteristics affect both the spatial orientation and the way of use of the spaces themselves.
We tend to associate the physical distance not only to the degree of intimacy of our relations, but also to what we feel about a space rather than another: walking through a narrow street in an old town gives us a feeling of intimacy, while among monotonous residential buildings, always identical and far among them, we feel an unpleasant sense of disorientation and insecurity.
The distance of a path is not an objective parameter, since its articulation makes subjective the perception of its length, in relation to its variety, richness, and points of interest that are encountered.
Even if the view has a major role in the perception of space, beside it the other senses also play an important role: the olfactory, tactile and sonorous dimensions contribute to the recognizability of places, as it is evident especially when you consider the street markets or the fairs and festivals.
The perceptive and relational system, through which man interprets the urban reality where he lives, is therefore influenced by aspects of physical and socio-cultural nature. There are dimensional aspects in the anatomical measure of the human species that determine the proportion between the movements of man

and the space in which he moves. There are, at the same time, also cultural and psychological aspects that, because of the composition of the environmental context, influence the perception of space: light and darkness, isolation or overcrowding, orientation, saturation of space for the presence of other elements, clarity of information that the city is able to transmit.
The image of the city is multiple and in constant transformation, as in a work of kinetic art. In this sense, when the observer moves through the streets, squares and traffic routes, the perceived image is a sum of mental photographs collected in the memory along the way. The result of this perceptive process is a kind of summarizing image formed by a sequence of shots, and the perception of the moving image of the city will be comparable to the vision of a film sequence.
This perception depends on the times and rhythms of sequence duration, reflecting the perception of the passage through the spaces of the city. Obviously, the rhythms are different depending on the means used to move: the slow time of walking allows you to capture details that escape the perception in a quick pass on mechanical means of transport. The clear differentiation between fast and slow paths, between paths that use public or private transport, and pedestrian paths at an individual level, and the continuing need for interchange between them, allow to reflect on the concept of travelling through the city and on the perception of the routes in urban areas.
From this point of view, the evolution of technology, allowing the access to a wide range of possibilities for moving, has while decreased some key issues for the welfare of human life: the reduction of space per person, the loss of contact between the man and the urban open space, the decrease of the walkable parts of the city, and consequently the loss of the bond of identity between the man and the place of living, intended as the part of the city where you feel safe under the bonds of neighborliness that generate relatively protected social structures.
People tend to prefer frequented areas to desert ones; this behavior is already described from Jane Jacobs, who attributes it to the fear that leads to prefer the routes and places where we feel a greater sense of security. Designing a space that encourages people to live it then generates a virtuous circle that will lead others to stop there. (Jacobs, 1961).
According to Rebecca Solnit, democracy is the possibility to move physically in a city, not as vehicles but as bodies, among other known and unknown individuals. The city is the place where meeting is always possible and free from risks, and where locals and foreigners, residents and visitors meet each other without fear but also without an apparent purpose. (Solnit, 2005).
Also Lynch, in his study about the *imageneability* of the city - the ability to understand the city through the clarity of its routes and its margins, the presence of knots and landmarks and recognizability of the districts - considered which places in the city were more lived, which less or not. (Lynch, 1960).
From modern age, within the city, regarding the public space, the streets have become organs of circulatory distribution. The opening of the streets to welcome the circulation or become parking, and the intensity of vehicular traffic, have systematically transformed the urban space in an inhospitable place for pedestrians. (Choay, 1969).
The most significant consequences for the urban space are the tendency to the extinction of the human scale, and the corresponding loss of life quality. The saturation of urban centers due to the excessive increase in car traffic and the willingness of communities themselves to take back the control of the quality of urban spaces, often found as a solution the pedestrianization of city centers and the exploitation of the human dimension.
The pedestrianization of streets may allow you to turn them into public spaces where you can walk peacefully, stop and socialize, organize events, in other words, experience the city. “Walking is first and foremost a type of transportation, a way to get around, but it also provides an informal and uncomplicated possibility for being present in the public environment”. (Gehl, 1987, p. 133).
An example in this regard is Time Square in New York. When it was closed to traffic assumed again the value of square as a meeting place for people.



Fig. 1 Times Square, New York with crowd in 1945; with cars in 1977; with green chairs in 2009.

2. Fruition of open spaces in historical centers (M. Piscitelli)

While contemporary towns are progressively losing their connotation as spaces with precise functional characteristics, to become fluxes (of people, exchanges, relations, etc.), and are completely plunged into the development of a thick network of planetary communications, which make unnecessary and obsolete the traditional meeting spaces designed for various activities, on the contrary in the historical centers the square, often characterized by buildings of historical and artistic value, has preserved its function as a physical place of aggregation, circulation and exchange.

The welfare that we often feel in historic cities depends on the confirmation of our sense of proportions of human beings, from the possibility to move without the use of mechanical means, from being suitable for humans.

The spaces resulting for example from the space modeling in the cities of medieval origins show a quality which is still appreciated, so much that these cities are simultaneously tourist destinations, models of urbanization and provide a high quality of life for citizens. Usually these spaces are characterized by the utmost attention to orientation, shading and irradiation, offer seating for passersby, overhangs to shelter from the rain, and show detail solutions that make them more attractive and useful.

According to Mumford, the culture of the city was the human experiment of living together, in Greek polis as in Renaissance seigniory, a culture of exchanges, relations between spaces and people, which was extended until the dawn of cities like New York and Chicago. (Mumford, 1938).

In contemporary cities, instead, social life has shifted to shopping centers and anonymous spaces, while the cities of the past preserved material remains but not primary functions. Meanwhile sometimes the need of meeting spaces powerfully emerges through the request for public space, that is manifested in the great events of square, from Gezi Park to Occupy wall Street. (La Cecla, 2015).



Fig. 2 Taksim Square, Istanbul, during the protests against the edification of a shopping center in the place of Gezi Park, 2013.

Much cue for reflection at this regard are contained in the documentary film *The Human Scale* of 2012, filmed by the Danish director Dalsgaard and focused on the research of the architect Jan Gehl about the main problems of some cities in the world taken as examples for his studies, for which he proposed solutions always focusing on people and their needs.

On the basis of observation of Siena since the 60s, Gehl began to set a method of analysis of human behavior, observing the ways of life and social relations of the people; modes of relationship between people and environment; modes of travelling within the city; modes of distribution of activities. The conclusions

taken from his analysis were that the cities to be livable, must be provided with public spaces that can hold and stimulate human relations.
In his study, published in 1971, identifies different types of outdoor activities: “necessary activities” as moving to go to work, and “optional activities”, such as stop, sit on a bench or at a bar. The first are independent from urban quality, while the latter are closely related to it. “People only engage in optional activities when the place and the circumstances are right, when the settling into squares and spending time in the city is distinctly pleasant”. (Gehl, 1996, p. 59).
The following images show a work done by the students of the *Laboratory of Design, Perception and Visual Communication* in the bachelor degree of Design and Communication, academic year 2014-2015, taught by the writer at the Department of Architecture and Industrial Design at the Second University of Naples. The aim was to analyze the perceptive characteristics of squares intended as urban spaces of aggregation, to identify the predominant activities at different times of the day or in different months of the year, including holidays or special occasions, and prevalent users for different types; to put in relation the prevalent uses with the accessibility and perceptive characteristics: lighting, focal points, visual elements, etc.
Analyses were carried out in the historic center of Naples, which has preserved a strong vitality and many traditional activities, and especially in the pedestrian areas has kept the function of place of meeting and exchange between different physical entities, residents and tourists.



Fig. 3 Napoli, Piazza Bellini, analysis of distribution of activities and users, for day and typologies.

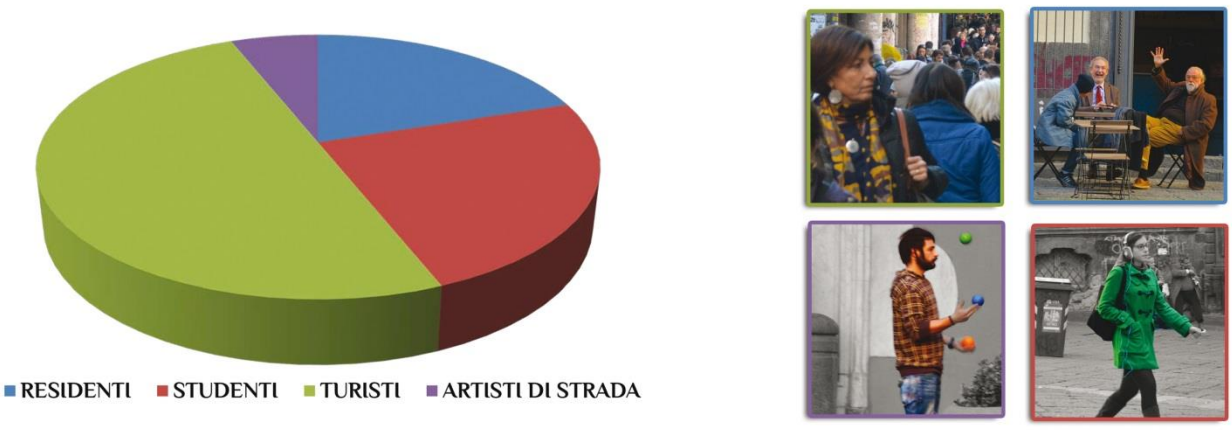

Fig. 4 Napoli, Piazza San Domenico, analysis of distribution of activities and users, for day and typologies.

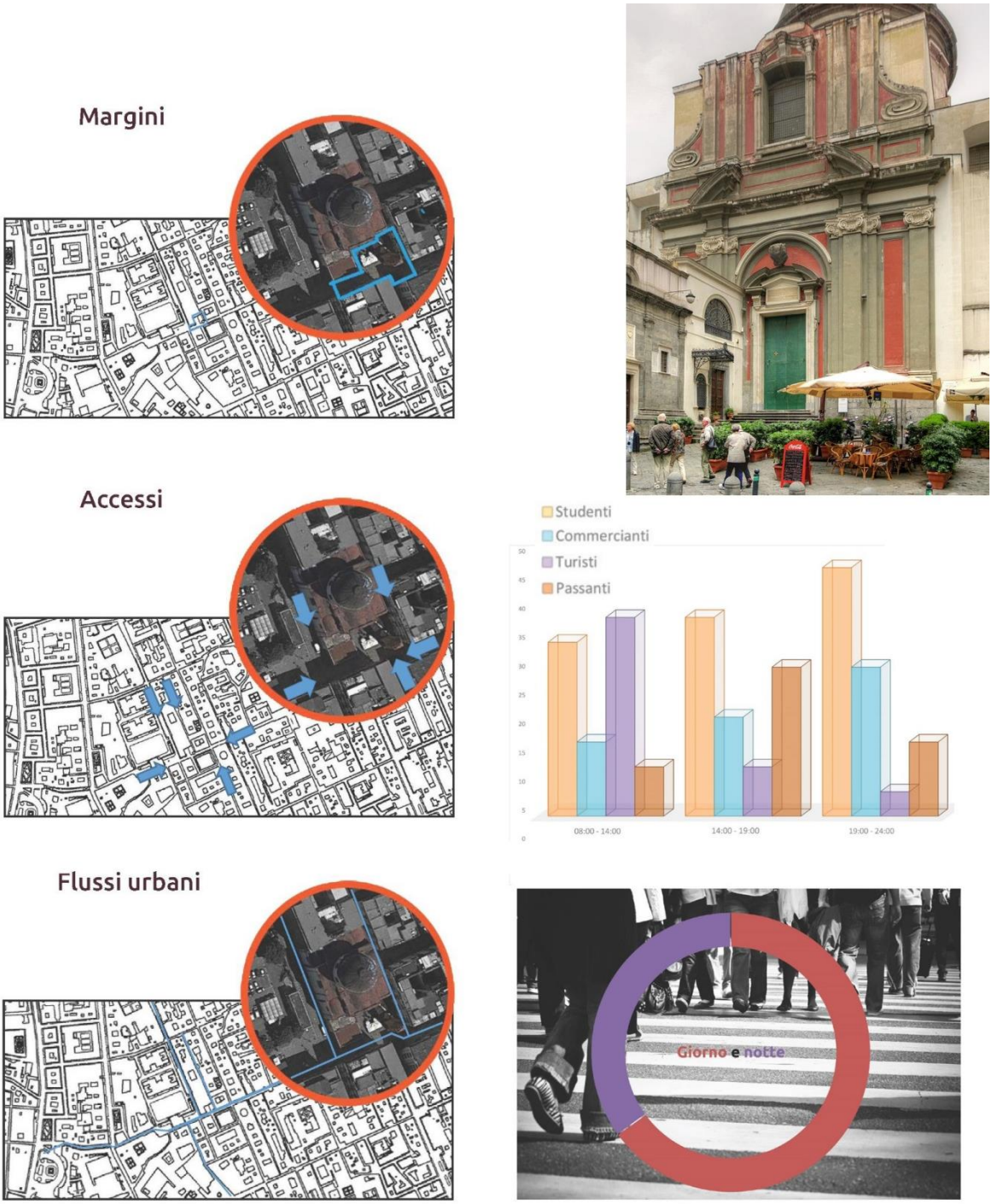

Fig. 5 Napoli, Piazza Pietrasanta, analysis of distribution of activities and users, for day and typologies.

3. Artistic lighting in open urban spaces (M. Kichekova)

The city is not a set of infrastructures governed by an aseptic plan, but a living organism that needs to be articulated more in line with the needs and tastes of its inhabitants. For this purpose, should be encouraged all the practices of re-appropriation of public space restoring the relationship between city and citizenship.
Many redevelopment projects in historic centers, with the introduction of meeting places, bars, restaurants, shops, have shown how people have returned to attend and experience areas left in a state of neglect.
Among the strategies for the redevelopment of the urban space, an interesting case is represented by the artistic lighting, intended as a factor of attraction creating a pleasant and welcoming atmosphere.
The use of artificial light for illuminating the exterior objects reveals and highlights notable architectural sites, historic and public buildings and landscapes.
The use of artificial light to illuminate the exterior architectures is an important element of aesthetic lighting layout of urban space in the dark hours of the day. Artistically lighting of the city achieves more attractive and remarkable open spaces, where citizens and visitors receive a relaxed, comfortable and safe environment.
Monitoring buildings at different times of day, we can note that exists a light moment when the object most successful shows its architectural and artistic qualities and has a maximum expressiveness.
Getting light with a spectral composition similar to natural light, is not difficulty for modern lighting equipment, but it is virtually impossible to obtain analogue qualities of daylight, especially to illuminate the exterior objects.
The ultimate goal is then to complete and expressive disclosure of the form and content of the site by artistic lighting and its connection with the environment. Architect standing in front of an interesting creative task, using artificial light to create a new evening artistic image, in which the architectural form does not retain daily view, but is modified, especially regarding its overall impact on the viewer.
Artistic lighting plays an important role in the fruition of a city during the night. An illuminated monument is not isolated in the public space. Its role is to provide light, enhance safety, facilitate moving and orientation, spark communication.
Artistic interventions in city lighting can overturn the perception of the urban space, creating new paths and new landmarks that are not perceived with the daylight. The concept of ephemerality, which is closely intertwined with light as an art, leads to interventions that creatively reinvent the relationship between the citizen and their city.

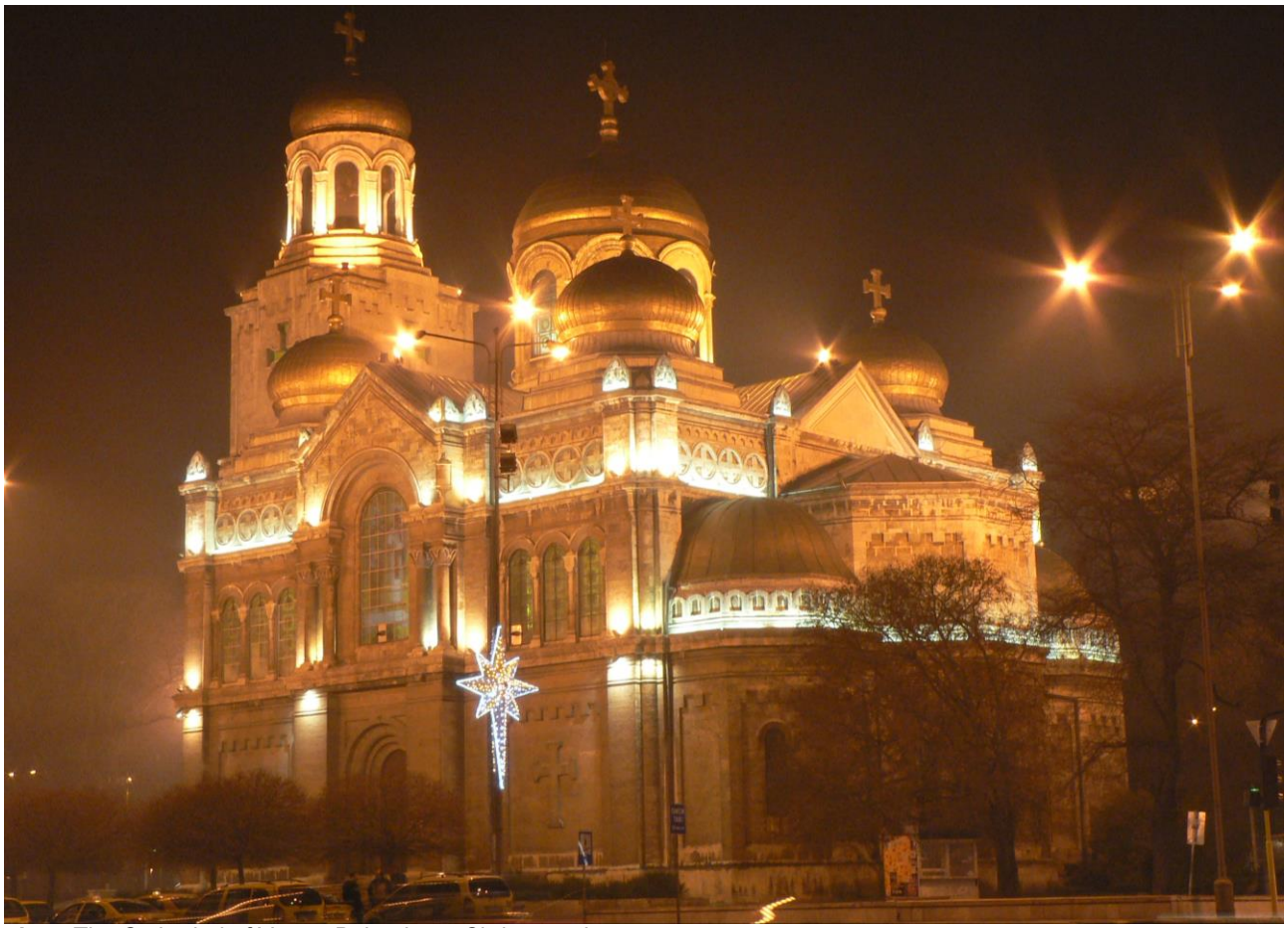

Fig. 6 The Cathedral of Varna, Bulgaria, at Christmas time.

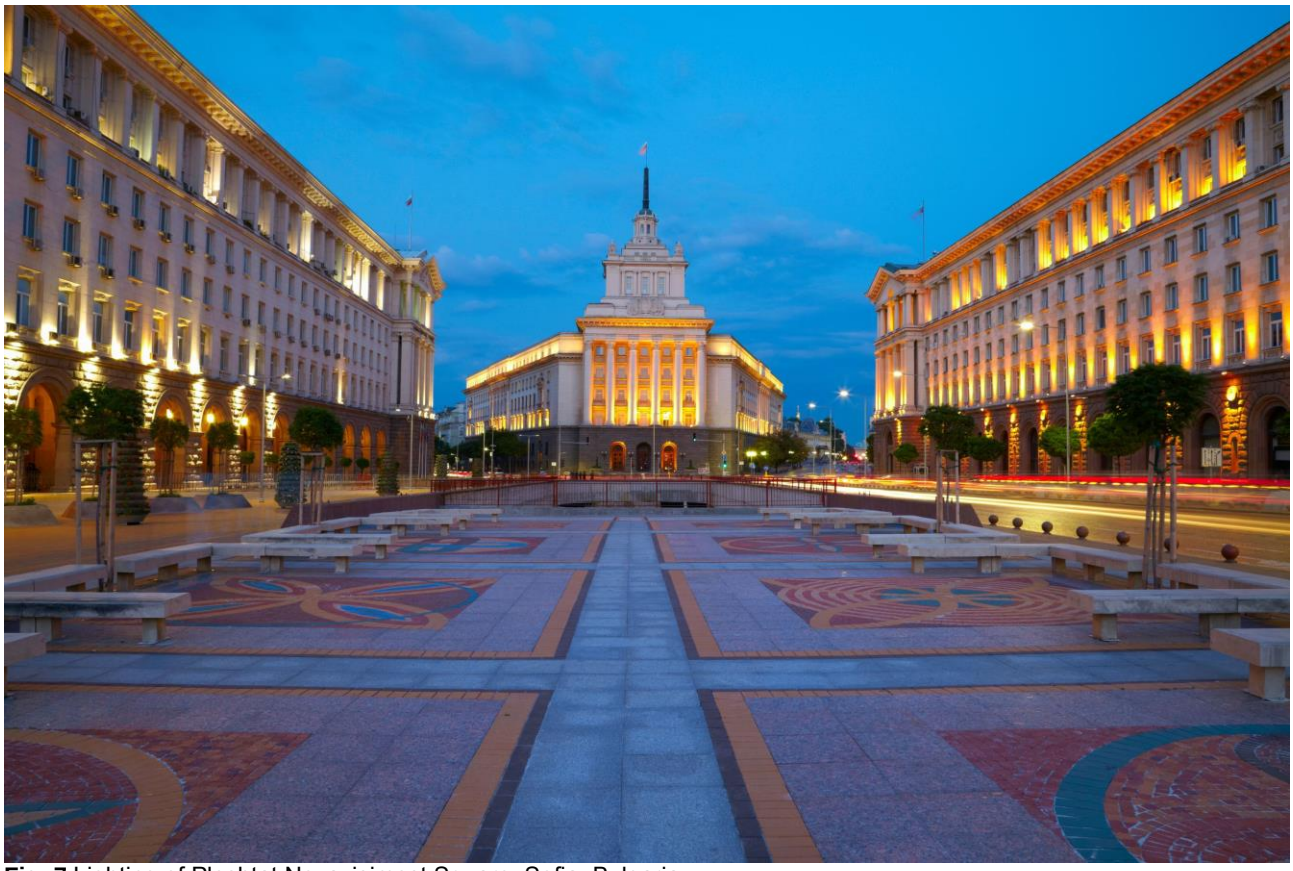

Fig. 7 Lighting of Ploshtat Nezavisimost Square, Sofia, Bulgaria.

Urban lighting is a determining factor, both to safety and to the city's particular identity, contributing to its recognition by tourists and visitors. Moreover it contributes to the residents' free and equal access to public space, supporting environmentally friendly mobility. Interventions in open public areas also create a challenge of residents' engagement, as the passive spectator's role is gradually replaced by participation and interaction with the final visual result.

Also the color is a significant part of visual perception. It is not visible without natural or artificial light. The combination of lamps and filters allows a wide range of creative possibilities, able to highlight or to modify the color light effect of space and objects.

White light reflected from a colored surface acquires the color of this surface, becoming the predominant colored light throughout the environment. In case of colored lighting of a colored wall may be strengthened alienate or reverse the effect. Desired colors can be obtained with the metal halogen, fluorescent and sodium lamps, LEDs with different color light or by using color filters.

Applications in this direction were made possible in Bulgaria thanks to the achievements of technical progress, enhancement of the technical and material possibilities of society, improving the standard of living.

Quality nocturnal lighting of the objects of cultural heritage in our country in order to emphasize their architectural and artistic advantages to the observers, is an extremely significant task for Bulgarian architects and engineers. It is a result from the new scientific attitude to our rich cultural heritage.

Lighting monumental or historical sites aims to attract the eyes of the people on them, to emphasize and enhance the artistic value and aesthetic impact, by highlighting the characteristics and beauty of the whole facades and their individual compositions and details.

A new and increasing use of artistic lighting are the lighting festivals, with the production of night landscapes to communicate a particular event.

An experiment in this direction is the Music and Light show in Veliko Tarnovo, a medieval town in the center-north of Bulgaria. Through the power of music and spectacular lighting you are taken on a journey through the history of Veliko Tarnovo and Tsarevets.



Fig. 8 - 9 The festival of light in Veliko Tarnovo, Bulgaria.

Bibliographical References

[1] BUCHANAN, Colin, *Traffic in Towns*, London: Penguin Books, 1964.

[2] CHOAY, Françoise, *Espacements. Figure di spazi urbani nel tempo*, Ginevra: Skira, 1969.

[3] GEHL Jan, *Life Between Buildings. Using Public Space*, Washington, Covelo, London: Island Press, 1987.

[4] GEHL, Jan & GEMZØE, Lars, *Public Spaces Public Life.* Copenhagen: Danish Architectural Press, 1996.

[5] GEHL Jan, *Cities for People*, Washington, Covelo, London: Island Press, 2010.

[6] JACOBS, Jane, *The Death and Life of Great American Cities*, New York: Random House, 1961.

[7] KICHEKOVA, Milena, *Colore e luce nell'illuminazione artistica ed architettonica di siti di interesse storico*, International Conference, il colore nel costruito storico. Innovazione, sperimentazione, applicazione, Lerici, 13 Ottobre 2011, Italy.

[8] LA CECLA, Franco, *Contro l'urbanistica*, Torino: Einaudi 2015.

[9] LYNCH, Kevin, *The image of the city*, Cambridge Massachussettes: MIT Press, 1960.

[10] LYNCH, Kevin, *Site Planning*, Cambridge Massachussettes: MIT Press, 1962.

[11] MUMFORD, Lewis, *La cultura delle città* (1938), a cura di M. Rossi e P. Scrivano, Torino: Einaudi, 2007.

[12] PISCITELLI, Manuela (2010). *Senza limiti. La dissoluzione della città. / Without limits. The dissolution of the town.* In: La freccia e il cerchio, vol. 2-2011, p. 271-295.

[13] SOLNIT, Rebecca, *Storia del camminare*, Milano: Mondadori, 2005.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
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Multisensor and multiscale surveying into Pompeii's archeological site. Three case studies.

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Abstract
Within the wider Campus Project, this study focuses on the definition of the geometric multiscale layer, essential for the planning of the multidimensional research activities on the Pompeii area and on archaeological site, particularly. The orography between the Vesuvius and the Castellammare Gulf, and the morphological complexity of the ancient and contemporary cities of Pompeii, guided the application of remote sensing multiple sensors (photo and LIDAR), from the satellite altitude to the architectural scale. From the larger study being developed, this paper focuses on the archaeological site and critically compares the technical and scientific different phases of the integrated digital survey applied to three case studies - the Amphitheater, the Villa of the Mysteries and the Tower of Mercury - which are emblematic for construction and excavation dating, for historical and artistic importance, for material composition, for architectural morphology.

Keywords: LIDAR, 3D Modelling, Amphitheater, Villa of the Mysteries, Tower of Mercury.

1. Introduction (Carmine Gambardella)
The "Campus" Project, in implementation of the 2.1 and 2.2 Operational Objectives of the "Programma Operativo FESR Campania 2007/2013", was to promote the concentration of scientific and technological skills in strategic fields through the synergistic interaction and integration between the Research and Industrial worlds. Within the Tourism and Cultural Heritage, this Project titled "Urban Ecotourism for the sustainable use of the Cultural Heritage in Campania" is aimed to the local systems' strengthening in own field and also in high-tech one, that could be a technological and cultural turning point to the innovative approach for the sustainable Development in high tourist vocation areas.
In particular, the Program's objectives are prosecuted through the multisectoral development of industrial and experimental research, although the scientific expertise involved in the Project appear to be interested only on the field of Cultural Heritage. The achievement of these objectives needs multidimensional expertise according to the complexity of the approach planned for this topic, while focusing on Cultural Heritage and Tourism. The knowledge and project activity in the territory of Pompeii was carried out in a metropolitan scale, through multicreteri@ analysis of type implementable and interchangeable. The technology platform that integrates data both for the aims of this study and to continue the research is a handy support to public decision-makers and private actors. The knowledge activities, in fact, require a humanistic, historical and managerial knowledge particular and specific, in addition to specific knowledge about processes/products with high technological content in this Project, in order to promote specific research programs.
To enhance virtuous practices in cultural heritage and tourism management in Campania Region, the program of activities proposed aims to develop three platforms integrated each other:
- Connected Urban Environment Heritage (CUEH): application of a handheld, as well as being an information tool for tourists, statistically analyzes the paths and calculations required by users becoming a tool for the improvement of infrastructure and information.
- Heritage-Link Environment Program (HELP): a model of recovery of traditions and environmental efficiency, we will collect and rationalize the information contained in the historical archives about the historical buildings of the city of Pompei. An innovative and technological system not only for maintenance, and

restoration of historic buildings but also for the definition of new criteria and procedures for the construction of "Heritage buildings", public buildings (museums, institutions, etc.), tourist reception and private ones (hotels, accommodation, parking areas etc.) with improved energy efficiency and reduced environmental impact.
- Multisensory Virtual Simulation (SiSMuV): a platform that will advance the project outline architectural structures and environments with less invasive in the area and greatest positive impact on the population.
The project involves the Research Center BENECON Scarl and industrial partners, enterprises in the cultural heritage and tourism fields, environmental monitoring, sensors and new materials. In particular, the study and experimentation area within the Project Campus affects the city of Pompeii, for significant interest from the point of view of tourism development and the impact of the same flow of tourists in the area. The Project has also extended the study area to the coastal strip between Vesuvius and Portici and Castellammare di Stabia, also providing for this test and the integrated use of different remote sensing technologies within the technology platform "Cloud Data and Monitoring Knowledge ".

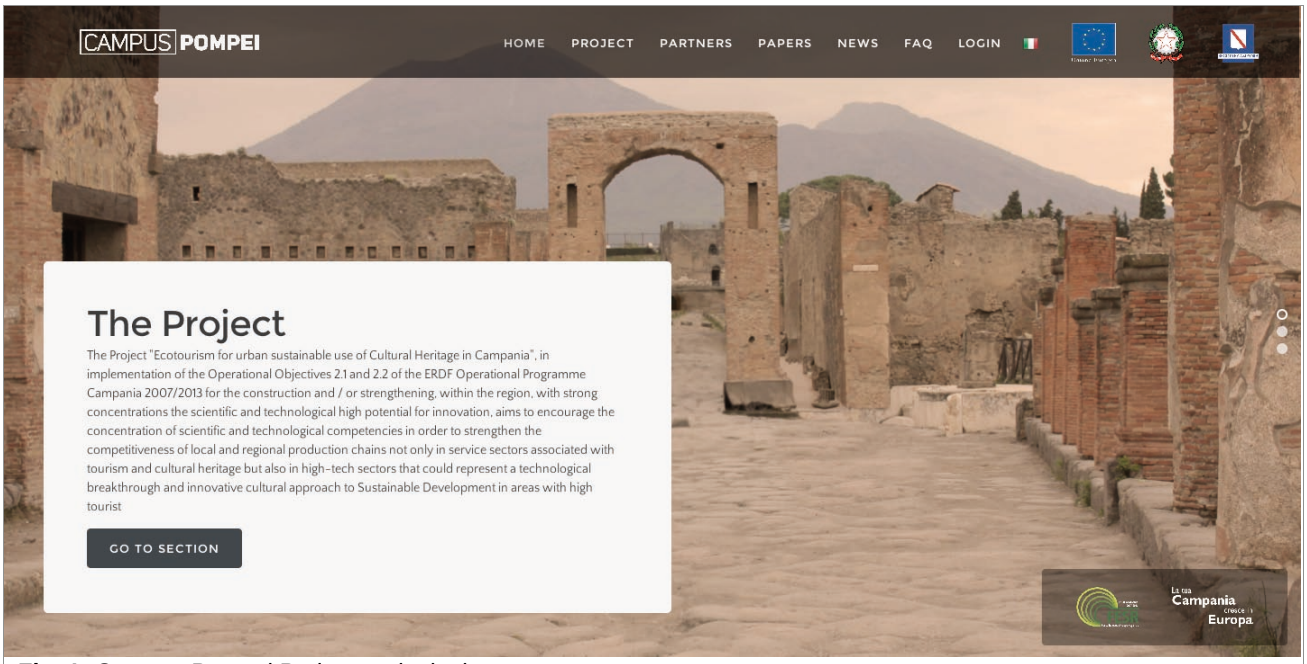

Fig. 1: Campus Pompei Project, web site homepage.

Within the wider “Campus” Project, this study focuses on the definition of the geometric multiscale layer, essential for the planning of the multidimensional research activities in the Pompeii area and in archaeological particularly.
Preliminary knowledge of the City and archaeological site is a fundamental premise in order to test the integrated use of the remote sensing survey techniques and tools and to develop a methodology that can be exported to other contexts. The method applied to the City of Pompeii aimed to the creation of the “Data Cloud and Monitoring Knowledge” technological platform that collects and integrates all the analysis and the data acquired and processed on the City, thanks to the use of airborne and terrestrial survey equipments.
In according to the scientific Protocol coordinating this research, the satellite acquisitions, the aerophotogrammetric scans, hyperspectral and thermal surveys, terrestrial and airborne LIDAR scans, as well as three-dimensional processing (meshing and rational) from the urban scale to the architectural detail were carried out on the territory of Pompeii. It is a multiscale methodological and technological approach, aimed at the processing of a discrete model with variable resolution, in close relation with the morphological complexity of the natural or anthropogenic objects. In particular, today the satellite survey return images with very high spatial resolution (one meter or less) in the ranges of the visible and near infrared; the LIDAR scanning by Leica ALS50II is necessary to develop the DEM (cm 25 ground resolution) for the ortho-projection of aerophotogrammetric, hyper-spectral and thermal images, subsequently acquirable. Given the importance of this data, in addition, the research team planned the LIDAR calibration flight on the same area, in order to manage a dual geometric check between the 3D laser scans - performed at different altitudes by standard procedures - and the Ground Control Point already put and measured. The LIDAR point cloud model was also used as geometric macro-mesh for the Mobile Mapping surveying; the aerophotogrammetric scanning by Leica ADS40 allowed the processing of the stereo-photogrammetric model of Pompei, particularly detailed thanks to the technological characteristics. The integration with DEM optimised the data ortho-rectification, and consequently the outcome 3D model allowed a precise and detailed characterisation

of the territory. Inside the archaeological area, especially, the LIDAR data texturing allowed to classify more carefully those parts where the ruins were covered with weeds and the geometrical data was automatically classified not well.

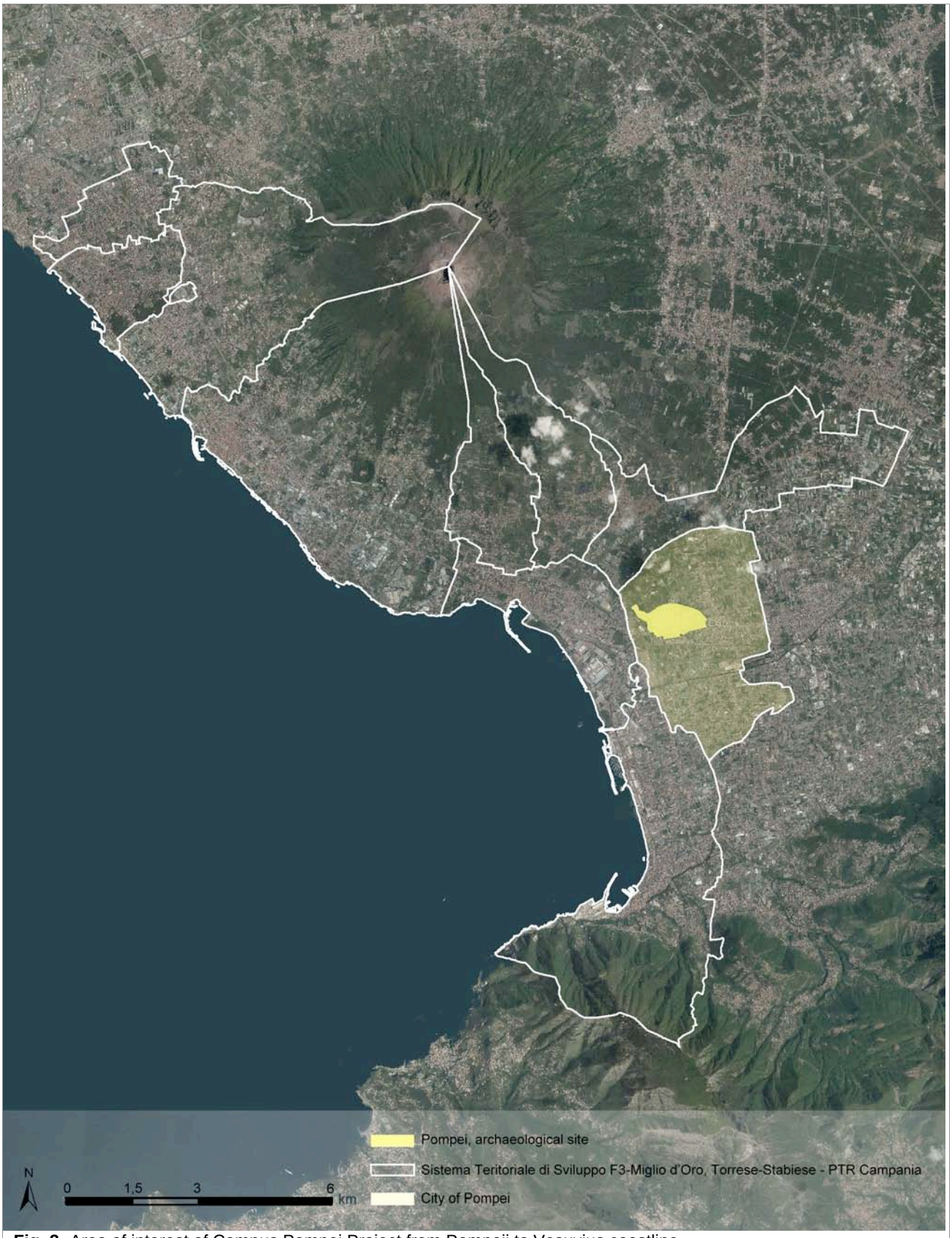

Fig. 2: Area of interest of Campus Pompei Project from Pompeii to Vesuvius coastline.

The theming in the visible and tangible characteristics of the city was completed with the invisible and intangible ones, possible thanks to the development of hyper-spectral and thermal imaging.



Fig. 3: Three case studies into Pompeii's boundary.

These scans were performed respectively by Itres CASI-1500 and TABI-320 sensors, installed on a military aircraft of the Italian Guardia di Finanza, under a collaboration agreement for remote sensing in Italian territory and abroad. In order to control the geometric quality of the data acquired by airborne and terrestrial platforms, the research team installed a permanent GNSS station (ETRF2000 φ:40°45'12.4156" λ:14°29'38.1878" h:79.206 m) connected to the regional geodetic network, in turn calculated by the national one of the Istituto Geografico Militare, at Florence. The multi-scale link between airborne and terrestrial surveys was carried out through the integrated processing of LIDAR and Mobile Mapping data. The point cloud model of the territory acquired from aerial platform with LIDAR sensor Leica ALS50II, texturised with infrared digital ortho-photos and RGB geo-referenced by Leica ADS40 digital aerial camera, has become the digital macrotexture for the point cloud model and digital images acquired by terrestrial 3D laser scanning static and dynamic.
Referring to the terrestrial investigation, the urban and architectural survey has interested the urban screens, situated along the streets that cross the square overlooked by the Sanctuary of Our Lady of the Holy Rosary, adjacent to the archaeological site. The buildings on both sides from 'Villa of the Mysteries' Street to 'Bartolo Longo' Square were also scanned by Mobile Mapping system that involved both the urban facades as well as the road.



Fig. 4: Pompeii data cloud and monitoring knowledge, conceptual framework and iconographic synthesis of the multiscale and multidimensional investigations.

The applications of 3D laser scanning survey, which integrated the acquired data by mobile mapping system, were carried out at the Hospice of the Daughters of the Sacred Heart, interesting building for rational architectural drawing and for the location in relation to the entrance to the excavations in the area of 'Amphitheatre. Inside the excavations, the Tower of Mercury, the Villa of the Mysteries and the amphitheater were the subject of integrated digital survey by applying 3D laser scanning sensors, GNSS topographic and close-range photogrammetric by drone.
The methodological variations developed by the authors for the integrated digital survey of the three case studies of the Amphitheatre, the Villa of the Mysteries and the Tower of Mercury highlight the importance of scientific Protocol.

2. A comparison among three digital surveying projects in the archaeological site of Pompeii (Pasquale Argenziano)

The integrated digital approach to the architectural remote sensing is becoming a standard practice as documented in the scientific literature, although it is usually confused with 3D laser scanning use. In fact in various fields, as customary or a trend, the 3D laser scanner is always used for the architectural surveying, or cultural heritage documentation, regardless of the reasons, the morphology, the scale, the materiality of the object. The morphological data capture through the 3D laser scanner is only one of the possible actions of the digital integrated approach: to realise a georeferenced topographical network, to which connect at least the position of the 2D target used for the scans orientation, is certainly an essential step of the surveying project's setting; to complete the scans' gaps (evaluable only at the end of the first processing) by the digital photogrammetric close-range technique, is an interesting and innovative integration, still being tested. In addition to the metrical and visible dimensions, the data capture that enrich the architectural diagnostic can range from spectrophotometric and thermal characterisation of surfaces to that sonic ones to check the structures and their materials.

The dimensional and morphological integration can instead continue changing the distance between sensor and object, according to a multi-scalar approach which is another paradigm featuring new technologies in architectural and terrestrial surveying. The practice of close-range photogrammetry by UAV adds to the LIDAR or aero-photogrammetric data capture - widely established and used: it is a promising technique in the lower middle economical segment which is still being developed and tested; and it is emerging in recent years, especially for the novelty of the aircraft rather than to the validity of the data acquirable. The comparison of three survey projects in the archaeological site of Pompeii is an opportunity for a fruitful discussion of critical approaches experienced - certainly no completeness presumption - trying to put the focus on the results and the progress on the issues addressed.

Established the expected outcome that is the realisation of a multi-scale digital model of each building from which deriving the geometric, structural, conservative and fruition characterisations, the planning the integrated digital survey was first characterised by three factors: the buildings' size, their plan-altitude articulation, the relevant environment.

The choice and knowledge of sensors, accessories, hardware and software integrated in the many activities on site and in the laboratory are added to the spatial aspects. The choice and knowledge of sensors, accessories, hardware and software integrated in the many activities on site and in the laboratory are added to the spatial aspects: the network topography is made with the Trimble VX S6 Total Station, which provides technologically high standards of precision; georeferencing of topographical landmarks is acquired by Trimble R5700 sensitive GPS constellation; the photogrammetric are made with Nikon D70 respectively calibrated to different software version tested in 'educational' as an opportunity for critical evaluation and comparison; the 3D laser scanner is the Faro CAM2 Focus 3D X330, which can be properly defined as a multi sensor platform multi-sensor integrating compass, inclinometer, a RGB photographic camera (70 Mpx) and laser sensor with a scan range variable between 0,6 and 330 meters, and a relative accuracy variable between 2 and 200 mm, depending on the scan settings.



Fig. 5: Pompeii, the Tower of Mercury seen from the town center.

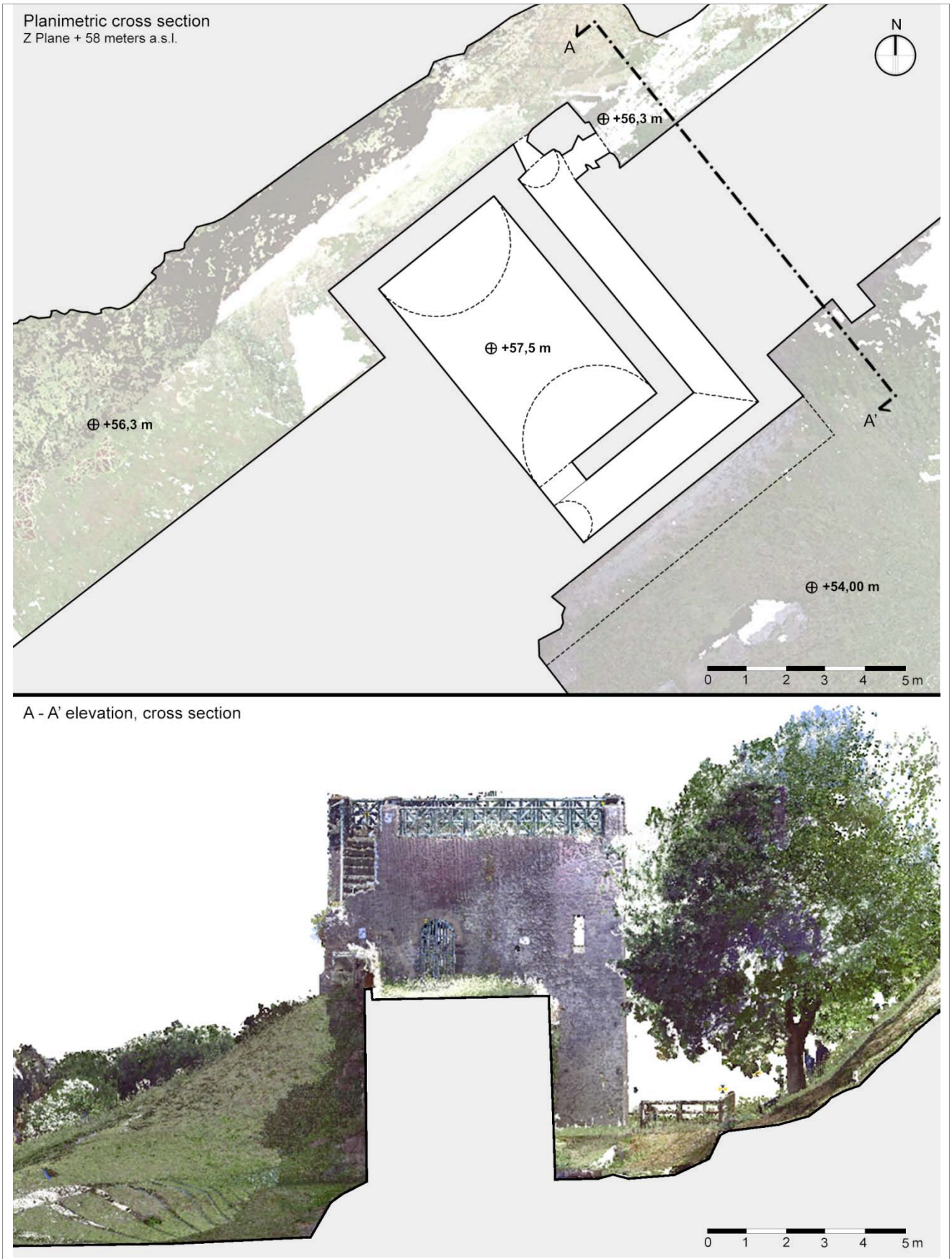

Fig. 6: Pompeii, Tower of Mercury. The 2d graphics of the tower were obtained through sections made on polygonal surface; redundant points were eliminated to check geometric inconsistencies that were in the mesh. The model has almost always gaps created by shadows. Four horizontal planes were drawn to realize plans at different altitude level. The sections had been useful to understands planimetric configuration of tower. The figure shows plan of 58 meter above sea level that is the ground floor. (Drawing by L. Abate, 2015).

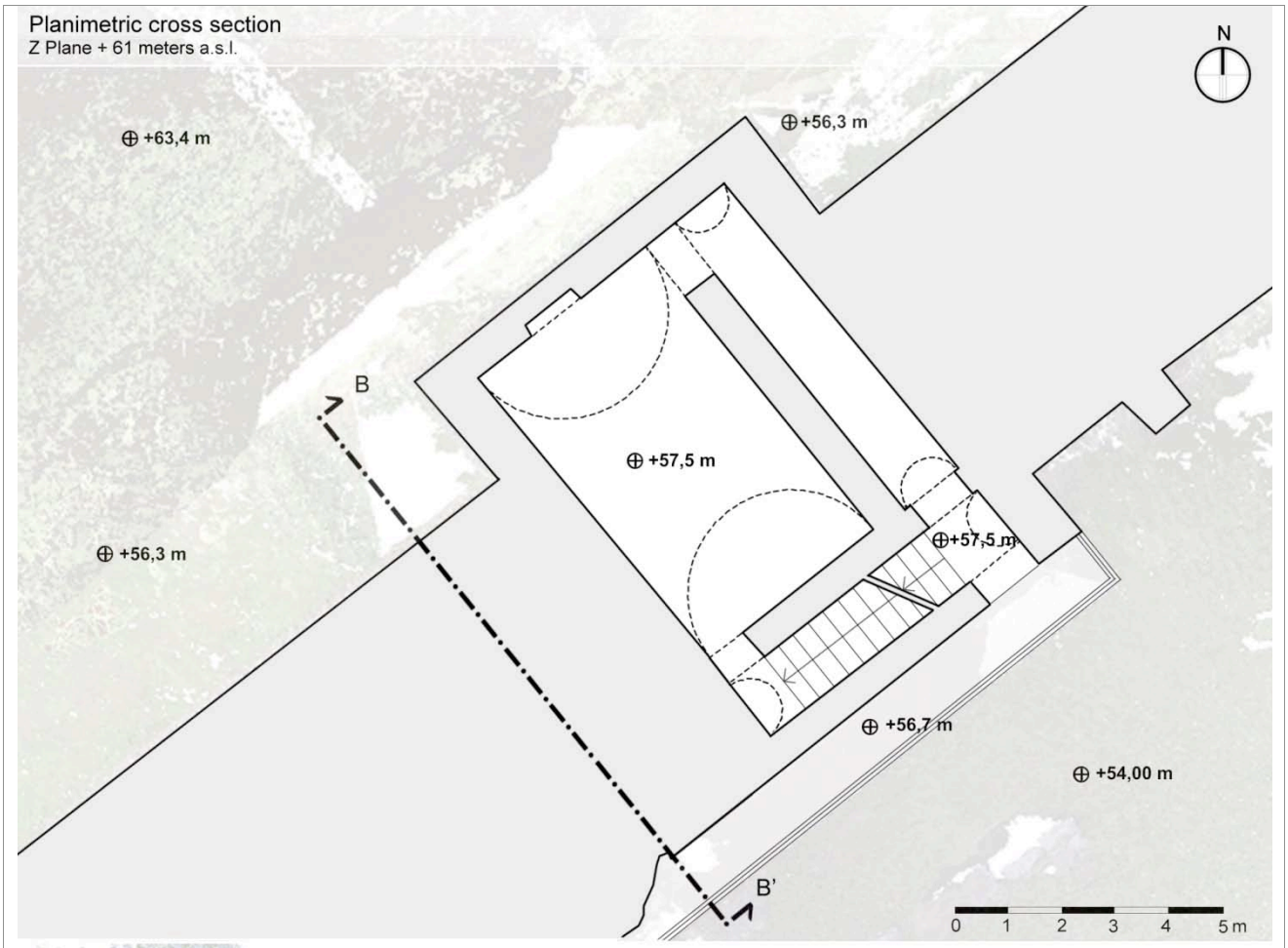



Fig. 7: Pompeii, Tower of Mercury. The figure shows plan of 61 meter above sea level. In this case drawing is accordant to UNI 936. (Drawing by V. Cirillo, 2016).

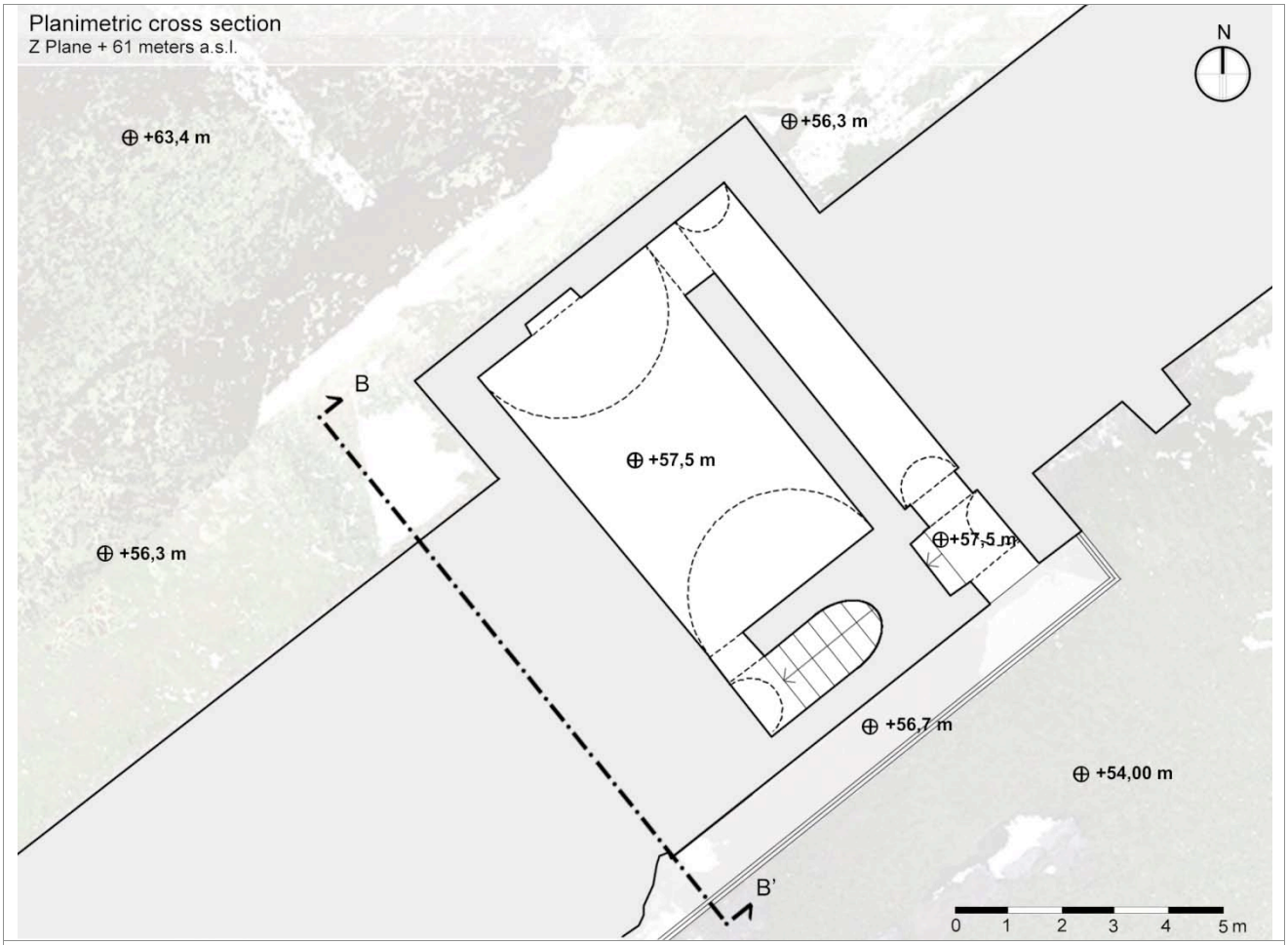

Fig. 8: Pompeii, Tower of Mercury. Some graphic signs are not visible in the orthogonal projection of the cloud like vault drawn with a dashed line. In all figures, we had to re-draw graphics according to UNI 936. In this case the work of re-drawn has concerned the representation of stairs. This is the result without the work of re-drawn. In 3D geometry the drawing is correct but it is understandable and don't respect the standards of the legislation. (Drawing by V. Cirillo, 2016).

The latter characteristics - reported by the manufacturer - have been tested and verified before the activities in the site, in order to optimise the acquisitions sequence in relation to the plan-altimetric buildings set up and consequently the spatial distribution of the 2D and 3D targets, chosen for the scan orientation.
The test results have shown that the accuracy of measurement decreases linearly with respect increasing distance between the sensor and the scanned surface, regardless of the resolution set to the sensor. This data concerning obviously affects the accuracy on semi-automatic recognition of the barycentre of the target (2D or 3D) into the dedicated software Faro Scene, with a quantitative difference between the same operation performed on point clouds processed with only the reflectance data or with the addition of RGB images taken with the built-in camera.
The choice of the resolution of each scanning will affect, also to the subsequent steps of alignment of the point cloud models or meshing ones. The enhancement of the hardware performance of the 3D laser scanner allows to capture millimetric point clouds (as in the cases under review) and generates, consequently, a 'bottleneck' in the performance of the hardware workstation processing and the intrinsic characteristics to proprietary software or third-party ones, which must be integrated throughout the processing chain.
So, a last factor to be considered during the survey planning is the relationship among the sensor resolution, the expected accuracy of the point clouds, the GB size of each raw files and model processing ones.
In contrast to the analogical or analytical approach (direct and instrumental), in which the drawing representation scale affected just the first measuring phase on site, the integrated digital approach shifts the choice of model representation scales to post-processing during the meshing or 'rational' models generation.
As described in the next paragraph, the density of the triangular mesh or the graphic detail of architectural vector profiles is directly related to the expected scaling of the 2D or 3D drawings, with further implications in the relationship among the graphic models' density, the hardware workstations' power and the algorithmic features of CAD modelling softwares.

The Tower of Mercury is a stocky parallelepiped (approximately 8 meters on each side by 13 meters high), placed in the city walls, from which exceeds in both sides, approximately 2 meters. Among the first urban elements brought to light, the building was restored in stages over the years, and today it looks altogether intact, with walls without plaster, and has no architectural elements or decorations.
Observed the morphological factors and evaluated the technological ones, the survey project was divided into two data capturing steps on site, performed by three researchers in two days.
The first step, focusing the building outside, provided a continuous sequence of scans, which starting from the outside area went around the building to the east leaping over the walls towards the the urban side, then coming into the tower through the gangway built on the facade in the last century. The second step, dedicated to the tower's interior, provided a continuous scans' sequence, which starting from the bottom room, followed the architectural path through the corridors and the stairways, up to the flat roof.
The relative alignment of the two scanning projects was assured by 31 2D target, also checked by 25 tie points, which were neatly arranged in the outer areas and inner spaces of the building, with a focus in the shared areas between the two projects' paths, identified the three significant portions of 'building (ground level, the wall pick and the floor covering).
The scan scheduling according to a sequential path is justified by the sensor's technological characteristics, and its operability in the alignment scans' software. Starting from the first scan, the sensor stores the data of the compass, the inclinometer, and the GPS receiver (outdoor) incorporated therein; these data are used synergistically with relative coordinates of the homologous targets, picked semi-automatically in several scans.
The point clouds' alignment is then calculated with respect to the sensor position when shooting 3D capturing, and the homologous targets' position. This processing feature therefore integrates the traditional topographic approach to the more recent 3D laser scanning technique, adding an upper check error level to the sensors feature.
The integration and mutual adjustments of the data from embedded sensors into the scanner, and the targets' coordinates, however, are able to control and mitigate the errors can be focused in the exclusive use of the first or second ones. The calculation of the model global position through the embedded GPS sensor, and the negligible error of the clouds alignment led to excluding the option to realise a georeferenced topographic network.
From the complete point cloud model, consisting of 515 million points, it was subsequently developed a mesh model from which were extracted the two-dimensional drawings, illustrating this paper.

The digital integrated surveying project of Villa of the Mysteries, as expected, was much more detailed and complex, and despite the detailed preliminary planning, it was in progress adapted to optimise the activities in relation to contingent problems.
The scanning resolutions and the expected accuracies were chosen in relation to the architectural peculiarities, and the historical and artistic decorations of every single room in the Villa, giving more importance to the realisation of the geometrical data-base rather than the optimisation of the 3D modelling process.
It was opted for the realisation of a discrete model with high accuracy, postponing the solution of the hardware/software management post-processing problems, to the filtering data stage. The organisation in 5 macro scanning projects was instead determined according to the wide planimetric extension and to the complex plan-setting of the 70 Villa's rooms. The global alignment of the projects was instead assured by the georeferenced topographic network, against which were calculated the xyz positions of several 2D targets for each macro-project.
The rooms' spatial setting and the decorations quality prevented the massive use of 2D targets, choosing instead spherical, although they can not be determined in relation to the topographic network, they ensure high speeding setting up in the scanning site, and then the optimisation during the scan alignment software process, in the laboratory.
In the complexity of the laser scanning activities, the use of 2D and 3D targets differs substantially: while 2D targets shall be bound to the scan scenario during the data capturing time, especially if several of them are to be determined respect to the topographic network, the spherical target can be gradually moved, when they go out from the optimum scanning radius, and may be so relocated in subsequent areas in the same scan scenario. According to this operating practice, it can scan buildings as complex as the Villa of the Mysteries with only six spherical target; a greater number of these, would only serve to further speed data capturing in site.
As tested in the previous case study, in each macro-scanning project it was followed an ordered scan sequence taking care to overlap the last scan on the first one, or to detect in the last scan position some targets saved in the first one. This in order to optimise the operations of scans compensation, integrating data of the embedded sensors with the global targets' coordinates.
The scans sequence from the generale floor of the Villa guaranteed the morphological data capturing of the intrados of the rooms. Therefore, the model would have been lacking the covers' extrados, although the

perimeter embankments to Villa had allowed scanning of emerging external positions. To complete the Villa's nadir morphology was finally planned the photogrammetric shooting from an UAV platform, whose data were bound to the complete point cloud model by the coordinates of some targets laid on horizontal surfaces, related to the topographical network.
The complete point cloud model of the Villa is composed of 7 billion points, 9 people are still working on its mesh model, after 12 days of activities on site (from July to September 2014). The two-dimensional drawings illustrating this paper are projected and optimised from the complete mesh model.

The Tower looks like a small and compact volume; the Villa is an ordered extension of rooms connected and distributed on one level; Amphitheatre, finally, is a large concave building, walkable along concentric paths, on three significant levels at least.
In years of experience by the team coordinated by prof. Carmine Gambardella, the Amphitheatre of Pompeii is the most complex challenge of digital integrated survey. The obvious issues relating to the size and the morphological characteristics of the building in addition to the restrictions imposed by the Soprintendenza of Pompeii: capturing instrumental data in six days and do not use adhesives targets to archaeological surfaces.
The solution was structured: to divide the building into homogeneous architectural sectors, corresponding to the same macro-scanning projects; to use two laser scanners Faro CAM2 and one total station, with a team of 12 surveyors, divided into homogeneous groups according to acquisition activities.
Following the capture mode already tried and tested, the team working with the Faro 330 sensor mostly worked in the open areas, leveraging the power of the laser beam propagation up at least 200 meters with good quality; the other team, working with the Faro CAM2 Focus 3D X130 sensor, worked in the lower underground level and the ima cavea sector. The open areas of the ima cavea were selected to overlap the point cloud models captured along six days, with two Faro sensors.
Not being able to use fixed targets in the Amphitheatre scenario, they were used 30 spherical targets, positioned on cylindrical or prismatic bases to better lay them to horizontal surfaces. Assessed the overall size of the Amphitheater, the technological characteristics of the two Faro sensors, the various accuracies reached by them, it was tested spherical targets of 3 different sizes (respectively 14, 25 and 50 cm in diameter) in order to optimise the semi-automatic targets detecting by the software even at great distances from the sensor.
Following the same principle of spatial dislocation, already experienced in the Villa of the Mysteries, the spheres were placed in about 300 positions to guide each other 275 scans. In order to solve the inability to measure the coordinates of the spherical targets' center, it was materialised a topographic network georeferenced with respect to which were measured the coordinates xyz of a large number of target areas in 2D placed underground, at the Bourbon substructures. The UAV photogrammetric sensor, just used in the Villa of the Mysteries, finally solved the shadow cones of the scans in the coverage areas of the Amphitheatre's apical ring.



Fig. 9: Pompeii, the Tower of Mercury seen from the upper side of the city wall.

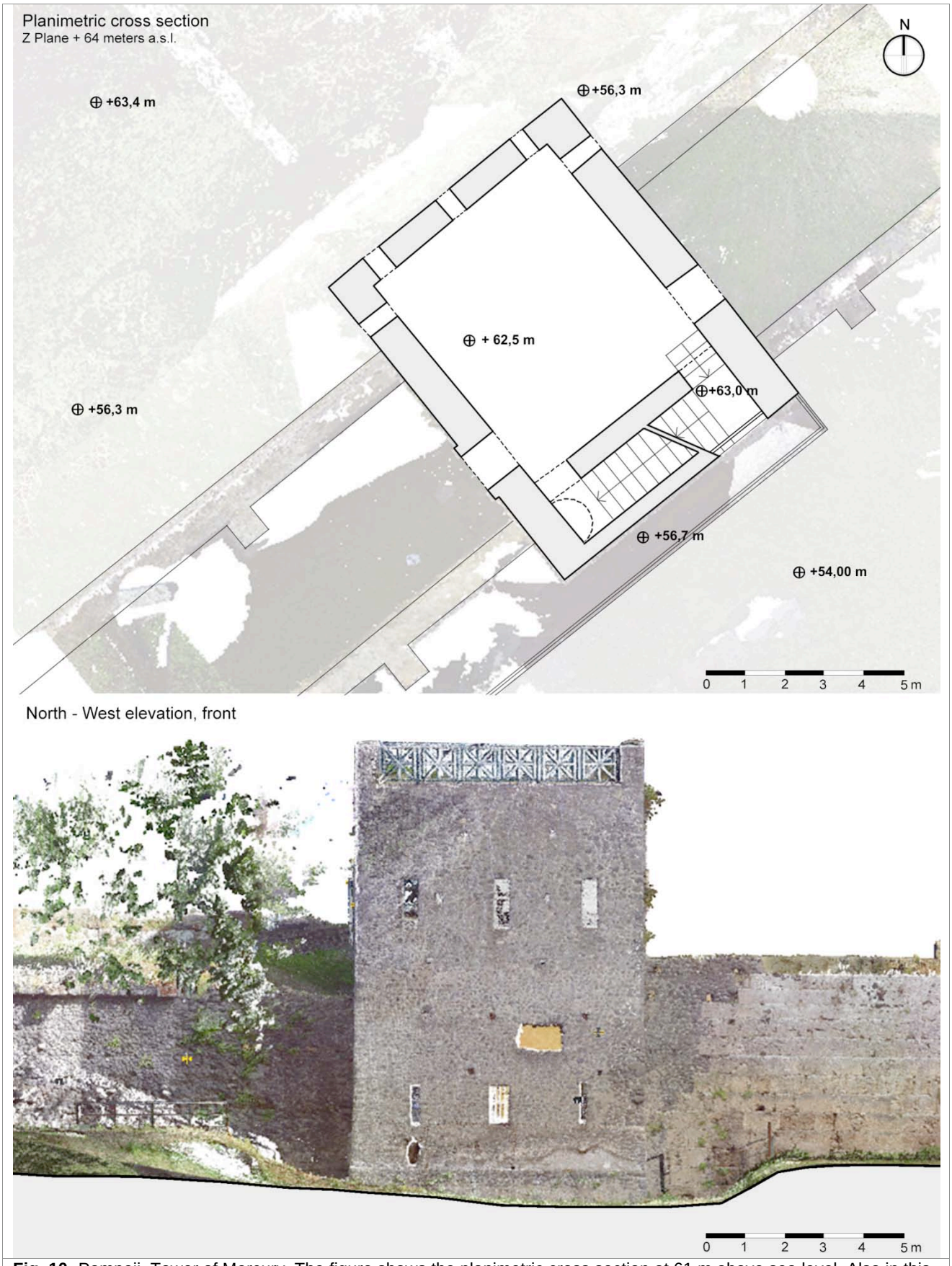

Fig. 10: Pompeii, Tower of Mercury. The figure shows the planimetric cross section at 61 m above sea level. Also in this case we had to draw the correct orthogonal projection of the architectural building. The most important element are the stairs. The result is accordant to UNI 936. (Drawing by L. Abate, 2015).



Fig. 11: Pompeii, Tower of Mercury. A detail of axonometric cross section. (Drawing by V. Cirillo, 2015).

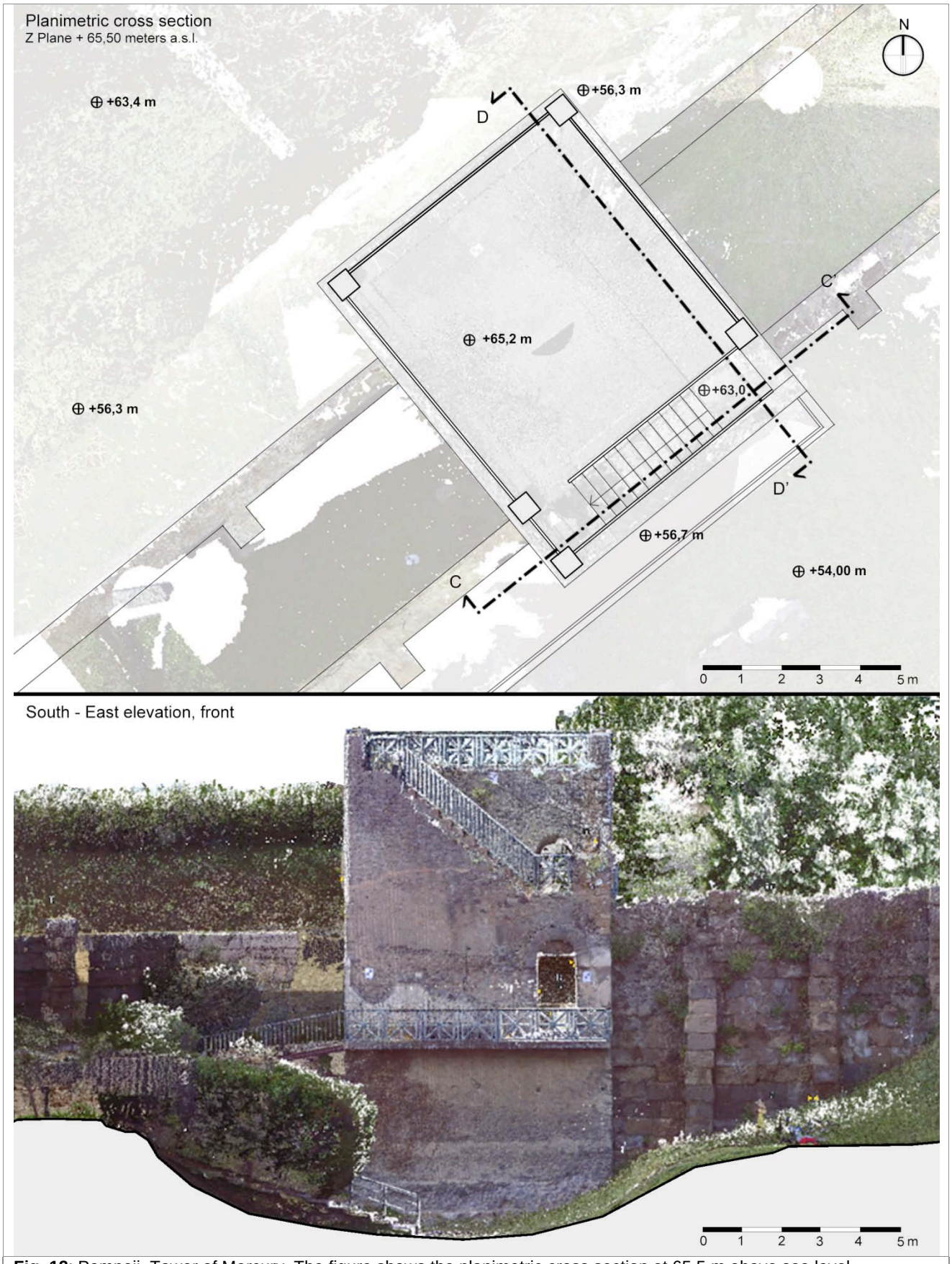

Fig. 12: Pompeii, Tower of Mercury. The figure shows the planimetric cross section at 65,5 m above sea level. Metal element reflect the laser beam so produce noise in the representation of tower. We had to clean the cloud points and re-draw the plan accordant to UNI 936. (Drawing by R. Parente, 2015).



Fig. 13: Pompeii, Tower of Mercury. The cross section of this figure are useful to understand the vertical structure of tower. The section planes were drawn along the scale in two different direction. Also in this case the drawing has been standardized in accordance to the UNI 936. (Drawing by R. Parente, 2015).



Fig. 14: Pompeii, Tower of Mercury. This figurers show two axonometries view that are unequivocal in the communication of the architecture. Through an isometric cross-section it is possible to understand the depth of the architecture. (Drawing by L. Abate, 2015).

At the time of this paper, the scans' alignment processing is still in progress. The problems highlighted concern the simultaneous management of an high amount of data, such as to distress the workstations specifically assembled for this point clouds processing. The mesh processing being planned is aimed at the best compromise between 'rational' modelling of the architectural elements, and the meshing of the green and dirt areas, inside and outside. These issues are discussed in the subsequent contributions.

3. The architectural mesh modelling. Critical insights about three case studies in the archaeological site of Pompeii (Alessandra Avella)

In application to Architecture and in particular to the architectures surveyed in the archaeological site of Pompeii, these notes focus on theoretical and practical implications of the process of interpretation of data acquired with laser scanning technology for three-dimensional modeling. The morphological discretization of the 'point cloud' model in mesh or 'rational' surfaces is critical operation specific to the Drawing of Architecture.

The integrated digital survey performed on the three case studies of the Amphitheater, the Villa of the Mysteries and the Tower of Mercury, is part of a wider research being developed on the Pompeii area, with a focus on the archaeological site. This research has involved synergistically different scientific and technological competencies within the “Campus” Project.

This study presents a double opportunity: in general, to validate the multiscale technological and methodological approach in according to the Scientific Protocol coordinating this research, already tested with positive results in technical and investigative activities carried out by these authors on comparable case studies; to think about the different methodological interpretations of the three-dimensional modeling of Architecture and Cultural Heritage between discrete and continuous, shifting the focus from the urban scale to the architectural detail.

The integrated approach to geometric measurement of the architectures, subject of these notes, is part of the research field of the Geomatics applied to the study of the Cultural Heritage. In this regard it should be noted that until a few years ago the survey was carried out with the systems used in the two previous centuries. From the debate of the 80s on the direct or indirect survey of the monuments, which welcomed with great suspicion the photogrammetric technique dedicated to this aim, we are witnessing today a real invasion of technological innovation in the field of the archeology and the Cultural Heritage in general.

New digital surveying technologies based on measurement for the three-dimensional modeling applied in the archaeological field allow the representation of complex objects and places, such as archaeological sites and the buildings that characterize them through a digital model; this combines the visual capabilities of the images, usually employed for the documentation, and the precision of the survey: the three-dimensional model of any architecture of historic and artistic interest so developed is both a support for the 3D visualization of architectural heritage, and for the its metric evaluation through the geometric data-base. Current geomatic technologies, therefore, provide interesting instruments of survey: when used appropriately they open new possibilities of knowledge and documentation of cultural heritage, and guide the fruition, cataloguing and valorisation of this preciousness heritage.

A confirmation of the documentary value of multiscale models, especially in relation to cultural heritage, this study describes the methods and techniques adopted to create 3D models for the representation of the architecture that were selected appropriately in the archaeological site of Pompeii. The archaeological site of Pompeii and the architecture within it are, at the same time, a witness of great historical and archaeological value and an ideal opportunity to explore the integration of advanced survey by indirect methods. The extension of the archaeological site, its long cultural sequence, together with the multitude and variety of architectural and archaeological objects make Pompeii an extraordinary and unique complex to be investigated with rigorous methods. The survey of an archaeological heritage, in fact, makes it necessary to intervene with an instrument and a methodology which do not affect the state of its conservation while allowing the documentation of the status quo before the execution of any restoration: frequently the digital survey guarantees the virtual preservation of all that remains of the past as the only evidence of the cultural heritage, sometimes 'crystallising' in the date of the acquisitions what no longer exists or has been transformed at the end of human intervention or natural calamities.

The Amphitheater, the Villa of the Mysteries and the Tower of Mercury - which are emblematic for construction and excavation dating, for historical and artistic importance, for material composition, for architectural morphology in the wide typological repertoire of Pompeii - have been subjected to the integrated digital survey aimed at the geometric and morphological characterization of each architecture. As fully described in the previous section, the digital survey integrates four different acquisitions: 3D laser scanning, GPS and traditional topographic survey, high-resolution photographic mapping, digital photogrammetry techniques. The laser technology digitally acquired three architectures as 3D point clouds; to complement the data acquired by the GNSS sensor integrated in the same laser scanner, a topographic network of each survey was planned and carried out with total station and GPS system and the relative/absolute orientation of different 3D scans and the georeferencing in the IGMGPS95 national geodetic system was performed; the shady areas were integrated with photogrammetric techniques where it was not possible to access them with the laser; the terrestrial surveys was integrated with close-range photogrammetry by drone in the high and inaccessible areas of the buildings, as the roofs. The product of the acquisitions is a point cloud model in real scale of the actual and continuous object coloured with RGB values of images taken by high-resolution digital camera integrated in 3D laser sensor. This digital geometric representation of the object is discrete and tending to continuous: the higher the resolution set to acquire the

more is dense the point cloud and then the detail of the representation. Having the morphology of an object through scanning laser, orientation and mapping of point clouds does not mean having finished its survey: the acquisition phase must necessarily follow the critical processing of numerous three-dimensional data acquired; this must be controlled according to the Drawing of Architecture practices.



Fig. 15: Pompeii, Villa of the Mysteries. The figure shows the merge of 265 scans made for the survey of Villa of the Mysteries. The 2d graphics were obtained through sections made on polygonal surface (mesh); redundant points were eliminated to check geometric inconsistencies that were in the mesh. The model has almost always gaps created by shadows. In particular you can notice shadow cones represented by white circles in the figure, they are the position of the laser scanner in different phase of scanning. The figure is useful only for a visualization of Villa of the Mysteries, it is not a drawing accordance to UNI 936. (Drawing by R. Parente, 2015).

As it is common knowledge to our scientific community, the problem of Representation of Architecture is no longer about acquisition phase, that is automatic through laser technology, but rather about processing and

then of 'rational' modeling through the selection of the set of software most appropriate among those made available by the most recent technologies. The orthogonal representations (plan, elevation, axonometric) of the surveyed object, obtained by central projection and parallel projection of the 3D point cloud model, can not be counted among the 'traditional' drawings in the Drawing of Architecture, but rather considered the visualizations characterized by an effective synthesis of dimensional and quality data, completely comparable to orthophoto regarding the metric reliability. In this regard, it should be noted that the orthophotos processed by the point cloud model and integrated with colorimetric dimension through photographic images were affected inevitably by the character of discontinuity that is specific to point cloud model. This discontinuity in orthorectification phase of the photographic images involves the loss of the colorimetric information in correspondence to the lack of points in the discrete model, specifically in the so-called shadow areas. Differently, the orthophotos processed by the corresponding mesh model do not have these limits thanks to the very nature of the continuity of this model; this continuity makes it more adapted to orthorectification of photographic images.

The representation of the conventional 2D and 3D models of the Drawing of Architecture requires, in the more advanced approach of the three-dimensional scanning as in the traditional survey, the critical processing of the considerable amount of three-dimensional data acquired indiscriminately while scanning laser through the geometric discretization (meshing and rational) of the point cloud model: the continuous geometric or mathematical model is processed from the three-dimensional discrete model to extract the 2D and 3D graphics of the real object specific to the Drawing of Architecture.

Digital modeling can be done through two different geometric operations: the meshing and geometric discretization that allow, with different modalities, to interpolate the points of the point cloud model directly into 3D space in order to convert them into geometric elements of higher level: mainly surfaces and solids. By the meshing of the raw point cloud, a digital model is constructed through the semi-automatic extraction of a surface model with triangular mesh, which is the result of the interpolation of the points of the point cloud model. The distribution of the triangles, conditioned by the step taken in the scanning process, is almost homogeneous. Therefore a plane surface is described with the same density of triangles of a complex surface; this generates a surface model that overly detailed surfaces that have simple geometry, and at the same inappropriate for description of complex surfaces.

By the geometrical discretization, the point cloud model is sectioned along parallel planes to the tern of Cartesian planes associated with the point cloud itself. The discretization of the points cloud through significant plans allows the identification and the determination of the generative geometries of the architecture. The 'rational' discretization obviously involves a slight loss of definition, because it could easily be argued that the surfaces of a manufactured does not correspond exactly to the corresponding geometric surface; this type of objection can of course extend to the physical reality, because we know that notions of plan or straight are abstractions and simplifications that we use to interpret and represent the built.

Based on the experiences published in the literature, it should be noted that in terrestrial laser scanning applications have not yet established rules that can uniquely lead the construction of a geometric model to extract the traditional representations of the object of the survey.

According to these considerations and in application to the three architectures subject of these notes, the author describes some critical reflections that emerged during construction of 3D geometric models emphasizing the need to consider from time to time the operation of geometric modeling to be applied with regard to the particular case studies and to the different complexities of each.

Based on the experience, consolidated in similar applications or being developed in the case of this study, the author sets some guidelines that may be useful to the identification of a protocol for the geometric modeling. The selection of most appropriate methods of modeling is addressed by the following parameters principally: the specificity of the architectural object subjected to the survey, the nominal scale of representation and the aim of the survey.

The specificity of the architectural object is a function of the morphological articulation, of the dating of construction and excavation, of the stratigraphical and material composition, as well as the presence of conservation and restoration, with special attention to their date and type.

The nominal scale of representation influences the simplifications to be carried out on the discrete model through the selection and the activation of the geometric information specific to different nominal scales in order to represent the architecture with different levels of detail.

The aim of the survey is an interesting parameter particularly urging us to reflect upon the selective extraction of data from three-dimensional discrete data-base in relation to the processing of a three-dimensional model aimed to geometric representation of the Architecture as the main instrument of analysis or aimed to its photorealistic visualization.

In the first case the mesh model, obtained by successive approximations of the geometric discrete model, is produced in relation to the different analysis that various experts and professionals can perform on the original architecture. The geometric approximation, therefore, is constantly monitored and evaluated according to: the specific requirements of each operator (architect, archaeologist, engineer, restorer, historical); the software parameters of exchanging data specific to each type of investigation, the observance

of the most common techniques of architectural representation and geometric modeling that are more fit for the specific sector of architectural diagnosis.

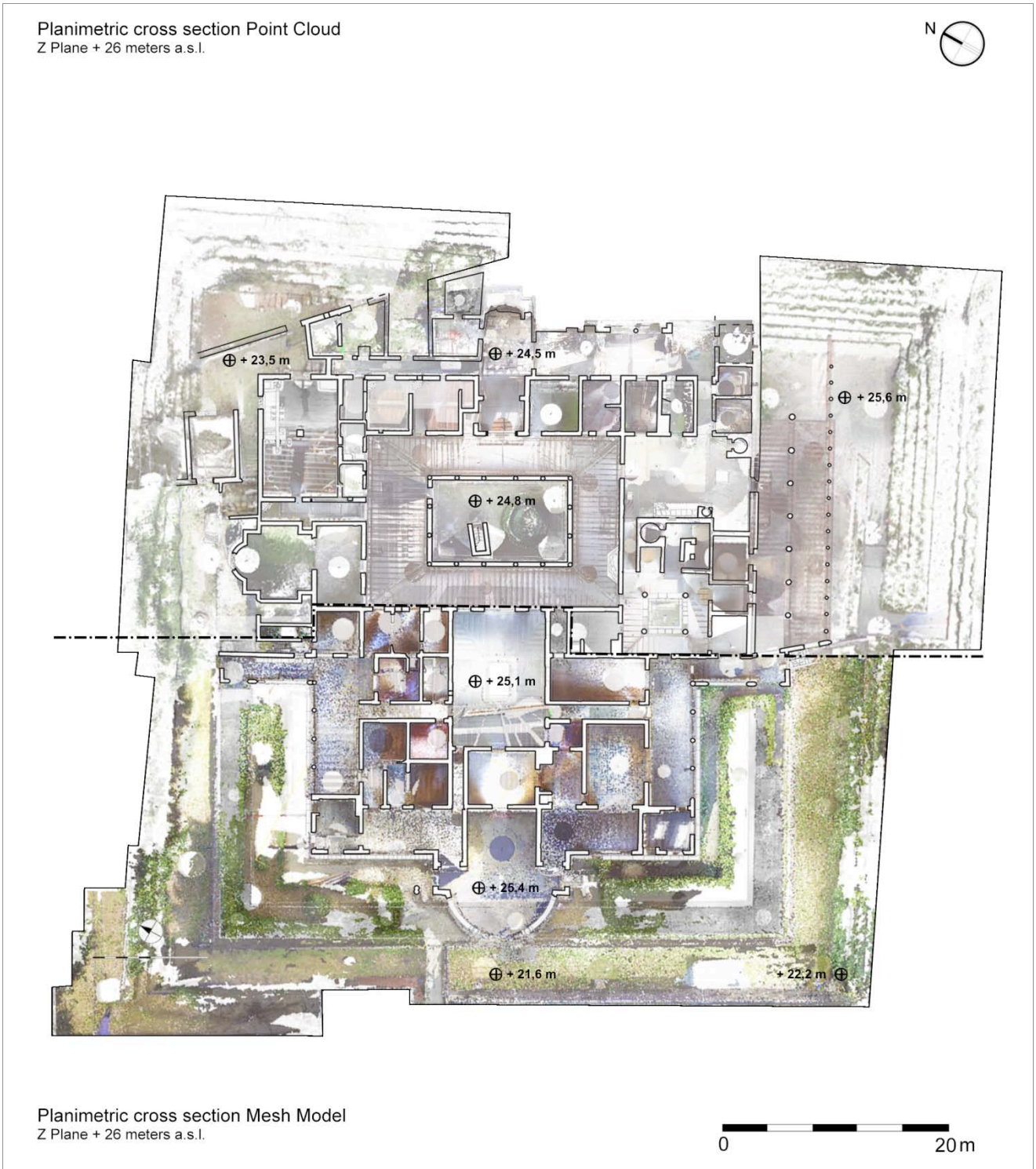

Fig. 16: Pompeii, Villa of the Mysteries. In the figure there is the planimetric cross section and Mesh Model. This plan has been obtained by the discretization of the polygon mesh of Villa of the Mysteries. Some graphic signs are not visible in the orthogonal projection of the cloud like thickness of wall. In all figure, we had to re-draw graphics according to UNI 936. In this case the work of re-drawn has concerned the representation of wall. It is necessary to make understandable the drawing. (Drawing by V. Cirillo, 2015).

It is known that the most widespread processing software used in fields of research different from that of the survey, are unable to organize large quantity of data produced in 3D modeling phase; frequently this limit is exceeded with the adaptation to the potential of the software recipient of the 3D model; in some cases limit the phase of geometric modeling of 3D data is deleted and replaced with the simplification of the point cloud

model to the detriment of geometric three-dimensional information acquired. Therefore, the discretization and the simplification of the data acquired must be carried out carefully, in a continuous return not only to the Manuals of the Treaties of Architecture but also to information that we intend to give to allow the different specialized studies, through the interpretation of the raw data.
In the second case, however, the three-dimensional models mapped with high-resolution photorealistic images, have an even stronger link with the computer graphics for the virtual visualization of architecture. This latter, aimed to facilitate the perception pseudo three-dimensional of a site or historical-archaeological resource through the two-dimensionality of a monitor, desktop or handheld, does not require the accurate metric correspondence between physical object and numerical model in the process of geometric modeling. This simplification process of the 3D model should be into crisis if the simplified model was enjoyed through augmented reality devices. By using of these devices the complexity of the real, in turn, putting into crisis also the not simplified mesh model.
According to these guidelines, the 3D model mapped with photorealistic textures and/or with those produced as a result of specific analysis is the result of the right balance all of these factors; it is to support specific analysis that can be performed; it is the result of the optimization of the whole process of survey (acquisition/modeling/representation/visualization) from input to output in relation to the aim of the survey.
Disregarding in this study the modeling topic aimed at photorealistic visualization of the Architecture, although this topic is interesting in the field of Cultural Heritage, we describe the first geometric-spatial analysis performed on the Amphitheater, the Villa of the Mysteries and the Tower of Mercury for the construction of three-dimensional geometric models. It is necessary to emphasize that these geometric-space analysis needed to a continuous return to classical texts to inspect the materials and manufacturing techniques that are specific of the Roman Architecture; these techniques are almost all detectable in buildings of Pompeii. This is true if considering that the unique system of historical and archaeological heritages make Pompeii a privileged observatory of the Roman Architecture. The tragic eruption of Vesuvius, in fact, suddenly interrupting the daily life of the city of Pompeii, has left houses, furniture, everyday objects almost unchanged. These materials, which are signs of inestimable value, show how they built and lived in a provincial town that is an extraordinary insight of truth, while not presenting specific characteristics. In general, in each architecture, the architectural surfaces by the clear geometric connotation were distinct by constructive and/or decorative elements for which prevails the plasticity of forms. The first one were processed with a geometric reduction of the surfaces through a process of 'rational' discretization of the point cloud: each flat surface, spherical or cylindrical has been assimilated to a single geometric element that best approximates the corresponding portion of the point cloud. The geometric modeling through ‘rational’ discretization was brought within the scheme 'object - geometrical model'; the second one, however, was modeled starting directly from the set of 3D acquired data through the meshing of the raw point cloud. The mesh 3D model, that is obtained by interpolation of the points of the point cloud model, is 'like' the scanned object and, like this, it has an irrational geometry. Where the density of triangles (conditioned by the step taken in the process of scanning) is inadequate to describe in detail the complex surfaces with a plastic development of the forms, a various processing of fragmentation and densification of the triangles was performed through the use of appropriate software tools. In particular, the operations of densification performed in proximity of the variations of inflection of architectural surfaces allow optimizing the density of the triangles. In this way the triangles are more developed and sparse on large surfaces, while considerably increase in number and density in proximity of the edges in order to accommodate the morphology. The result is the topological configuration that best approximates the real surface of the surveyed object.
From the general to the particular in the Villa of the Mysteries the results of critical evaluations that were conducted on the procedures of geometric modeling has highlighted the need to differentiate the original roman architecture and the contemporary restoration. For the restoration works, in fact, prevalently in reinforced concrete dating back to World War II, it was decided to perform the ‘rational’ discretization of the raw point cloud model, obtaining the 'geometrical model', then a 'scale model' and finally its 'representation'. Differently, the modeling of structural elements and/or decorative (wall and floor coverings) specific to Roman architecture was performed after recognizing the techniques and building materials. Some examples can better illustrate this point. The preliminary acknowledgment of modular architectural elements allowed to apply, during the processing step, the constructive rule of each element through the development of the profiles-section, reducing the complexity of the model in relation to the number of data required for its representation without substantial losses of 3D information. Just think: the columns made of campanian tuff; the roof with shingles (*tegulae*) made of terracotta and tiles (*embrices*) that have simple and recognizable structures because they are made according to the norms dictated by Vitruvius; the canals in stone in ‘peristyle’ to collect rain water; the arches and vaults. The Romans attained construction technique of arches and vaults with high level both in form and materials. As part of vast selection of Pompeii, this technique is still recognizable within the entrance arch of the northern *vomitorium* of the Amphitheatre. These examples do not want to be exhaustive, but only illustrative of the interesting and complex repertoire of architectural elements that can be modeled geometrically according to 'rational' discretization for the structural characteristics and/or materials.



Fig. 17: Villa of the Mysteries. The figure Pompeii, show front section and cross section. In this case the work of re-drawn has concerned the rapresentation of wall. It is necessary to make understandable the drawing. (Drawing by L. Abate, 2015).



Fig. 18: Pompeii, Villa of the Mysteries. The figure shows two different cross section. The section on the mesh show only the intrados of Villa of the Mysteries. We have to integrate this representation with data of APR survey.
This photogrammetric data will allow to drawn the configuration of Villa of the Mysteries. (Drawing by R. Parente, 2015).



Fig. 19: Pompeii, Villa of the Mysteries. This figure shows axonometries view that is unequivocal in the communication of the architecture. Through an isometric cros-sectiion it is possible to understand the depth of the architecture. (Drawing by R. Parente, 2015).

The systematic application of this approach has allowed the progress of the construction and management of the 3D model of each survey, still being worked out.
As a comment to the images accompanying this paper and as support for methodological decisions largely motivated describes the conditions that oriented the geometric modeling of the Room of the great Dionysian painting which, unearthed in 1910, it is named 'Villa of the Mysteries'. In this Room, the roof built in a recent restoration was modeled by 'rational' profiling; the vertical elements, namely the walls decorated with frescoes, open to two possible modeling mode according to the type of three-dimensional representation to be obtained: if the photorealistic 3D model must represent the stratigraphic composition of the wall that has been frescoed with techniques of Roman wall painting, highlighting the different levels of preparation of the wall surface in correspondence of the detachment, then you run the meshing of architectural surfaces through operations of parcellation and of densification of the triangles at the edges in order to observe the morphology. The mesh modeling can be integrated in 3D space with the data of the characterizations specific to the structural diagnostic of the architecture, which always belong to the field of instrumental actions of integrated digital survey conducted by our research team.
If, however, the construction of three-dimensional model is aimed prevalently at the 3D representation for the virtual visualization and documentation of the Dionysian Painting, then it is possible to represent a photorealistic model of the Room through the creation of mesh with rational discretization of the numerical model and the mapping of the flat surfaces with photographic images acquired during the scan.
It is known to the scientific community that the images taken by cameras integrated into laser sensors have a resolution far lower than of digital photos taken from the latest measurement instruments. Reference is made to the Trimble V10 sensor, for example, that have a panoramic camera that can acquire panoramic images quickly and with a high level of detail thanks to 12 cameras with 12 calibrated sensors from which the 3D metric information can be extract through the use of specific software. The option of integrating the Trimble V10 sensor with a GPS system allows georeferencing metric and chromatic data scanned. This acquisition process was tested in the Room of the Mysteries and the verification of the results is still in progress.
In the case of the Tower XI, more usually known as the Tower of the Street of Mercury, geometric modeling depends primarily on its material composition. The Tower, located between Herculaneum Gate and Vesuvius Gate at the end of the Street of Mercury in Regio VI, is in '*opus incertum*' with small stones of lava and tuff linked with mortar and covered with plaster. Its construction dates back to the last phase of construction of the fortifications of Pompeii in the first century BC. These fortifications were reinforced with strong towers placed into the thickness of the double curtain of the fortification wall. Tower XI, that protrudes slightly on the outside and inside fortification wall to be astride the parapet and to dominate with the third floor the parts of the wall between the towers, has a quadrangular structure (9,50 m x 7,60 m), as required by military technique, with two vaulted superimposed, connected by an interior staircase and surmounted by a terrace equipped with battlements, now destroyed. The meshing of the Tower produced a mesh model with irrational although continuous geometry that best approximates the irrational morphology of the inner and outer surfaces made entirely of stone. If the three-dimensional representation of the Tower should be supportive to specialized analysis, it will prefer the geometric operations that are more appropriate in relation to the type of investigation.
The processing still in progress of the 3D geometric model of the Roman Amphitheatre is more complex, although it is one of the best-preserved amphitheatres. The large dimensions of the Architecture, the vast selection of materials and construction techniques of Roman Architecture present therein, a particularly complex and interesting plant morphologically, spatially and typologically, make it an emblematic case study to explore and testing the measurement techniques through laser scanning technology.
The laser scanner data were the starting point to deal the complex problem of identifying the geometrical drawing underlying of the architectural form of the Amphitheater; difficulties that required a careful geometric study, for which reference is made to the next paragraph. From the laser scanner data we have processed the mesh model, elaborated in part by rational profiling and in part by the meshing of the point cloud. The integration of the terrestrial surveys with airborne surveys by LIDAR sensor (Leica ALS) and photogrammetric camera (ADS40 sensor) and with close-range photogrammetry by drone, was useful for modeling and the representation of the ground (arena), of the roofs and of the extended horizontal surfaces.
In according to the operational procedures described herein, the construction in comparison of geometric models of the Roman Amphitheatre, the Villa of the Mysteries and the Tower of Mercury allowed: to examine the construction techniques specific to the Roman architecture; to tackle some of the most common problems related to its representation; in the end, to collect a records of mesh or rational modeling of the architecture enough exhaustive through the analysis of three case studies emblematic.
The geometric models, still being processed, represent every single architecture with a level of detail consistent with the aims of the survey, guaranteeing in each case the geometric, constructive and formal congruence of each 3D model with the information acquired through integrated digital survey.

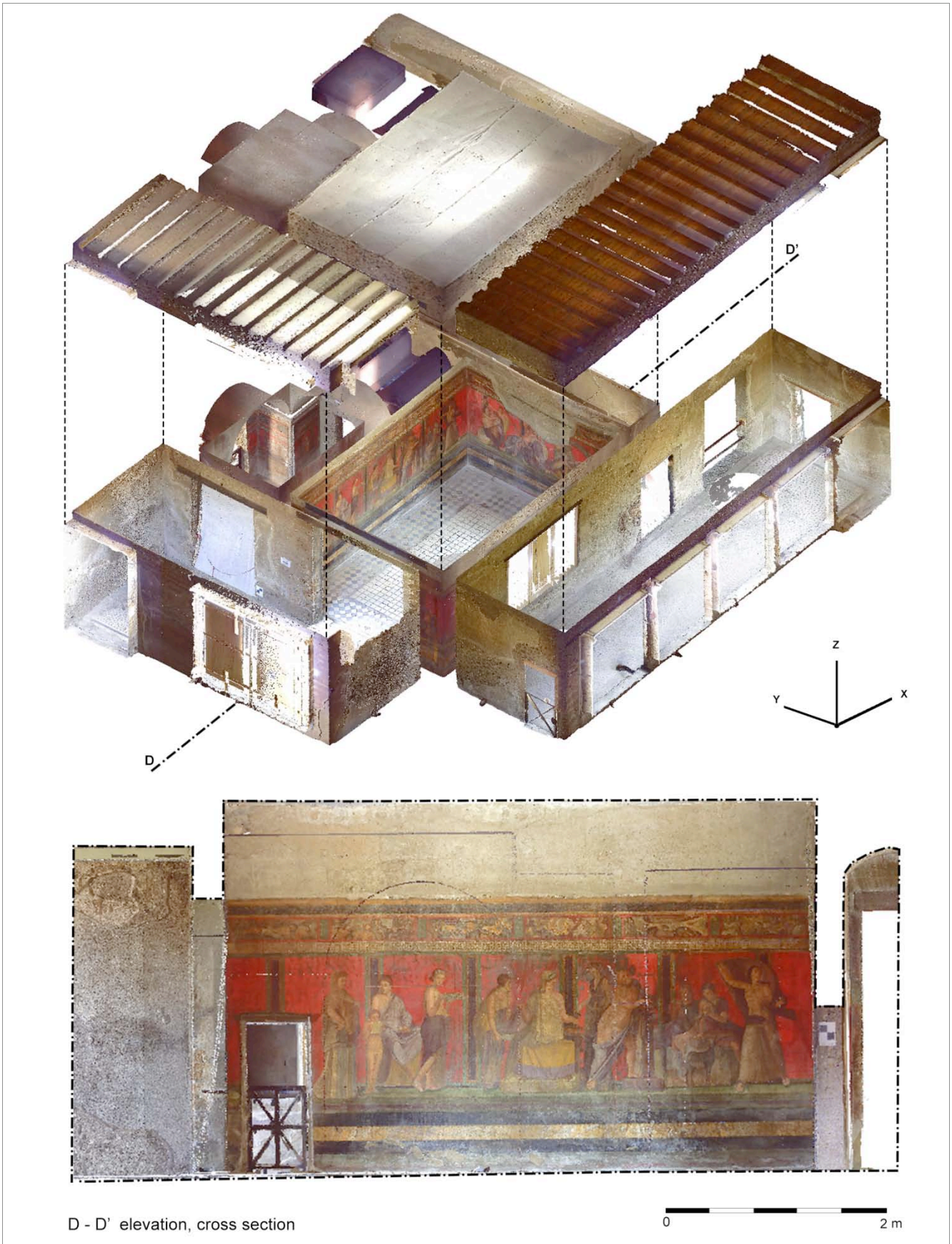

Fig. 20: Pompeii, Villa of the Mysteries. The cross section of this figure shows the “Room of the Mysteries“ before the restoration. You can notice the different roofing in comparison with the section after the restoration. (Drawing by V. Cirillo, 2015).

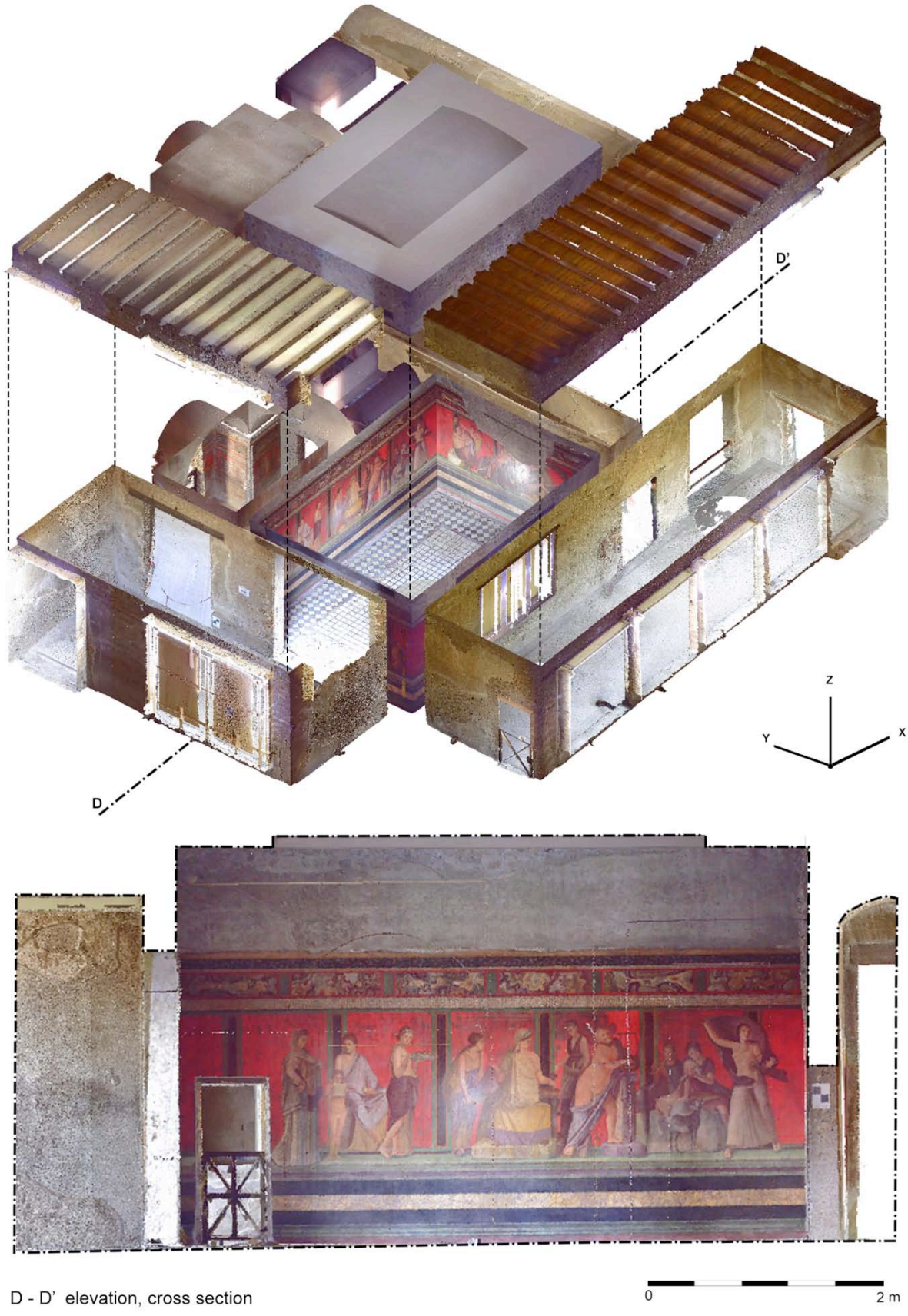

Fig. 21: Pompeii, Villa of the Mysteries. In this figure there is the “Room of the Mysteries” after restoration. The colour of fresco is brighter than before the restoration. (Drawing by V. Cirillo, 2015).

4. Using 3D point cloud model for geometric consideration about complex archaeological buildings (Nicola Pisacane)

These paper want to offer considerations regarding the restitution of digital models acquired by 3D laser scanner. In particular, on it will outline some possible considerations to be made in the modeling from point cloud for the transformation of a discrete model into a continuous one. The survey activities carried out on some buildings from the archaeological site of Pompeii offer, for their different spatial configuration, material consistency, transformations during the time, a panorama sufficiently wide to be able to trace a method implementable and extensible to other contexts, archaeological or not. The approach to buildings with different shapes -the 'Mercurio' tower, the 'Villa of the Mysteries' and the Amphitheatre - led to the start of considerations and methodological experimentation for the redrawing of three-dimensional point cloud through acquisitions. In particular, this contribution will emphasize the difference between the methodological approach if the case studies modeling through flat geometries or equivalent, compared to those with complex spatial articulations for which the analysis of the shape represents the first step in the establishment of the redrawing method. In the specific case study in question, it is interesting to clarify the approach that we are having in finding a better modeling of the Amphitheatre of Pompeii. This approach is not limited to mere geometric restitution but also a comparison with the construction techniques, the events and restorations have occurred over the centuries. Well we know that especially in the case of archaeological buildings is necessary to investigate and study changes and additions occurred in order to understand the difference in shape and structure. The approach and method that is being conducted aims to deviate from experiences in other contexts and described in the scientific literature on the subject. Specifically, the approach is trying not to limit the study of internal and external shape of the building to the simple form derived from planar projections but deepening their knowledge through a study of the formal complexity of the cultural heritage.

The literature concerning the surveys of Roman amphitheatres alternates some hypotheses about elliptical or oval plan shape. Scholars and experiences, also chronologically different, have led to different results on the actual trend in plant amphitheatres. An issue that has always been analyzed in relation to the possibility to realize at that time of the plan tracking –of the ellipse or of the oval- and then the skills and equipment available to Roman 'gromatici' for execution of these works. There is no doubt that the study and the survey, in particular, of this type of architecture is performed in reference to the construction techniques as well as the implementation phases of the works themselves and the spatial relationship between the work and its context. Amphitheatres in the specific case were realized through the construction of the outer wall from which then came the construction of the internal parts of the auditorium. Plan tracking of the external shape was dependent by the tracing of the geometry of successive internal parts. In fact, the tracking of the ellipse is much more laborious although operationally, especially for large curves, presents problems similar to those of the oval. The oval has however the advantage of being able to simply describe concentric curves (substantial problem for the bleachers amphitheater) as well as a simplification in the preparation of ashlars stone that constitute the structure.

But the consideration of the plan shape greatly limits the possible considerations useful for redrawing the discrete model: it is equally important to understand, learn and investigate the complex geometry of the auditorium, the direction of the stairs crossing and reaching the different parts of the theater space, such as the shape of the corridor below the auditorium itself: an integrated study of the different parts of the same amphitheater in function of the same use it had. Then we can not separate from the study of the slope of the auditorium in relation to the visibility inside the different parts of the theater, as you can not study the trend of the tiers according to the problems of cutting of stones and other materials used for the construction.

The approach used has first verified the plan shape and then extend the considerations to the spatial geometry of the auditorium. The first verification was the application of Pascal's theorem to the inner perimeter of the upper wall and that of separation between the auditorium and arena. Recall that the Pascal's theorem verifies the curves obtained from the flat section of the cones through the relationship between six points of the same curve through the alignment of three points inside and outside the same curve. Pascal's theorem is a fundamental result that is part of the theory of conics. Blaise Pascal (1623-1662) published it under the name of 'mystical hexagram' theorem in "Saggio sulle coniche" he wrote at the age of sixteen. The theorem can now enunciate thus: "If a plane hexagon ABCDEF is inscribed in a conical, then the three pairs of opposite sides AB-DE, BC-EF, CD-FA meet in three aligned points ". The theorem also occurred to the sides of the triangle between them intertwined. Verification and application of the theorem is performed on plan sections of the horizontal mesh generated from point clouds. Therefore, the audit was conducted on points and then actually detected with considerable accuracy, due to the high precision required when scanning. The test, performed on two pairs of six points for the two sections made -share perimeter wall, and the inside portion of the wall of separation between 'arena' and 'cavea'- verified with a minimum margin of error of the elliptical amphitheater. The above test should be checked but with the identification of major and minor axes of the ellipse and the gap size between the theoretical curve and the real one.

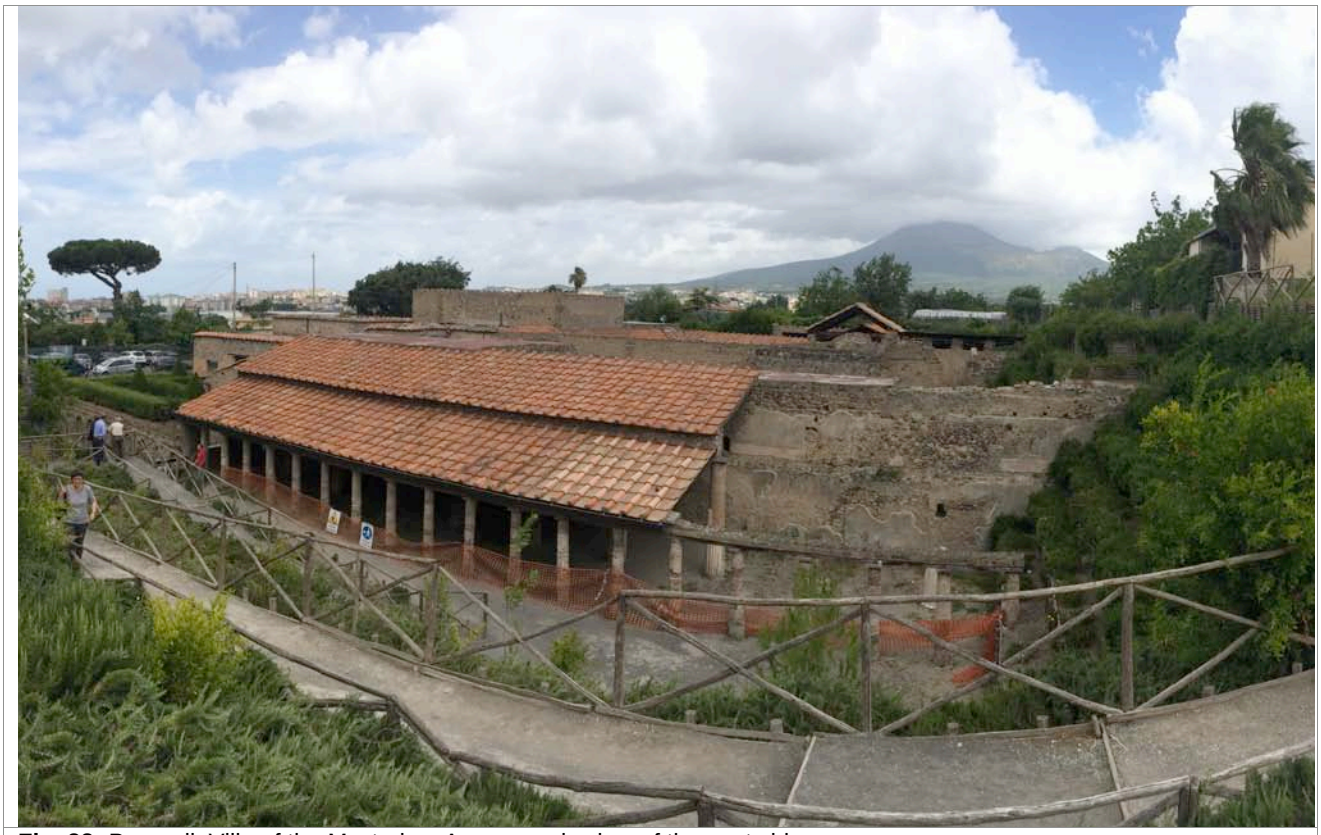

Fig. 22: Pompeii, Villa of the Mysteries. A panoramic view of the east side.



Fig. 23: Pompeii, Villa of the Mysteries. A instant view during the capturing laser data.



Fig. 24: Pompeii, Villa of the Mysteries. A detail of axonometric cross section. On the right, the room of the Mysteries. (Drawing by L. Abate, 2015).

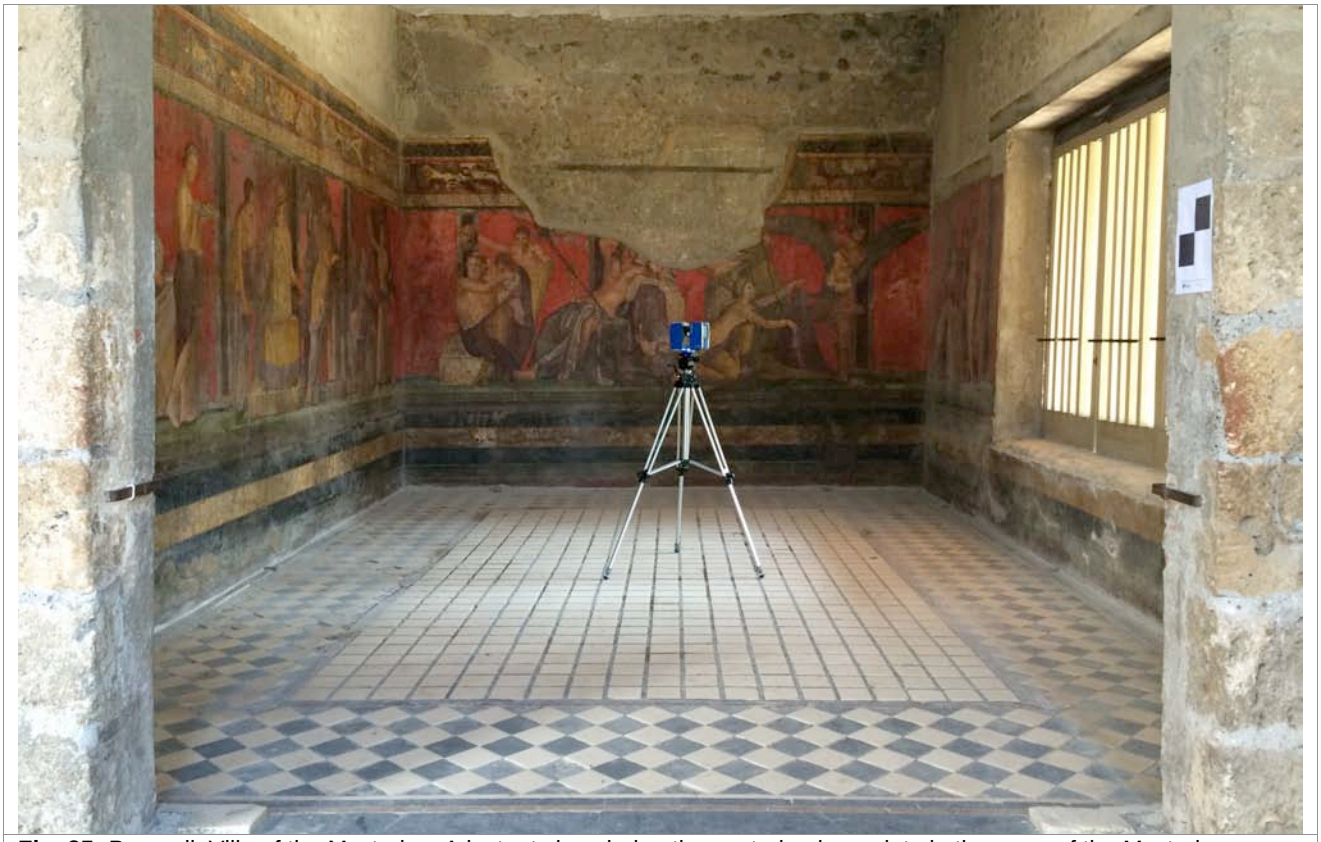

Fig. 25: Pompeii, Villa of the Mysteries. A instant view during the capturing laser data in the room of the Mysteries.



Fig. 26: Pompeii, Amphitheatre. A instant view of the *cavea* during the capturing laser data. In the scenario there are many white spherical targets.

The correct identification of the axes would be possible through pairs of conjugate diameters always identified through the Pascal's theorem itself.
But the attention to the geometry of the amphitheater of Pompeii, as already mentioned, must not be limited to the study of its plan, but the spatial configuration of the surfaces that describe the spaces. Indeed checks plan will mainly determine the curve that describes the real performance with less error and how this same curve turns into model space through the creation of surfaces of different complexity. Just in case, think the influence that this information determines the trend of bleachers and on their radially and their disposal than the performance of the perimeter of the amphitheater. Different, in fact, it is the tracking mode of a perpendicular line to an elliptical wall, than to an oval one. In the first case the curvature varies at each point, in the second is constant for the individual arcs of circumference that determine the final shape.
This trend involves variations of the surface detected by the steps of the auditorium, as occurs on digital model must verify the direction in which the slope of the auditorium is constant. Direction of the slope constitute the generating of theoretical inner surface that define a good chance a cone, from which sections define direction connecting the various parts of the theater as well as the ways in which various stone elements were designed, cut and built. The operation of surface definition of the auditorium will be the analysis of the innovation development of the mesh from point cloud guaranteeing an even more thorough than those available through only plane sections with vertical or horizontal position.
The above considerations want to be a first approach to the analysis of complex geometries directly on the 3D model that can be in the case of some buildings the opportunity to develop and elaborate in the best way the discrete point cloud model from which generate the continuous model. A modality that can optimize the use of laser scanner systems for survey of buildings and a critical use of software for processing and modeling, also for the construction of structural models, assumptions of restoration and design. These outcomes, subject to the continuation of the Project 'Campus' research, will be announced in the future.



Fig. 27: Pompeii, Amphitheatre. A instant view of the upper walkway during the capturing laser data. In the scenario there are many white spherical targets.



Fig. 28: Pompeii, Amphitheatre. A instant view of the perimetrical arches during the capturing laser data. In the scenario there are many white spherical targets.

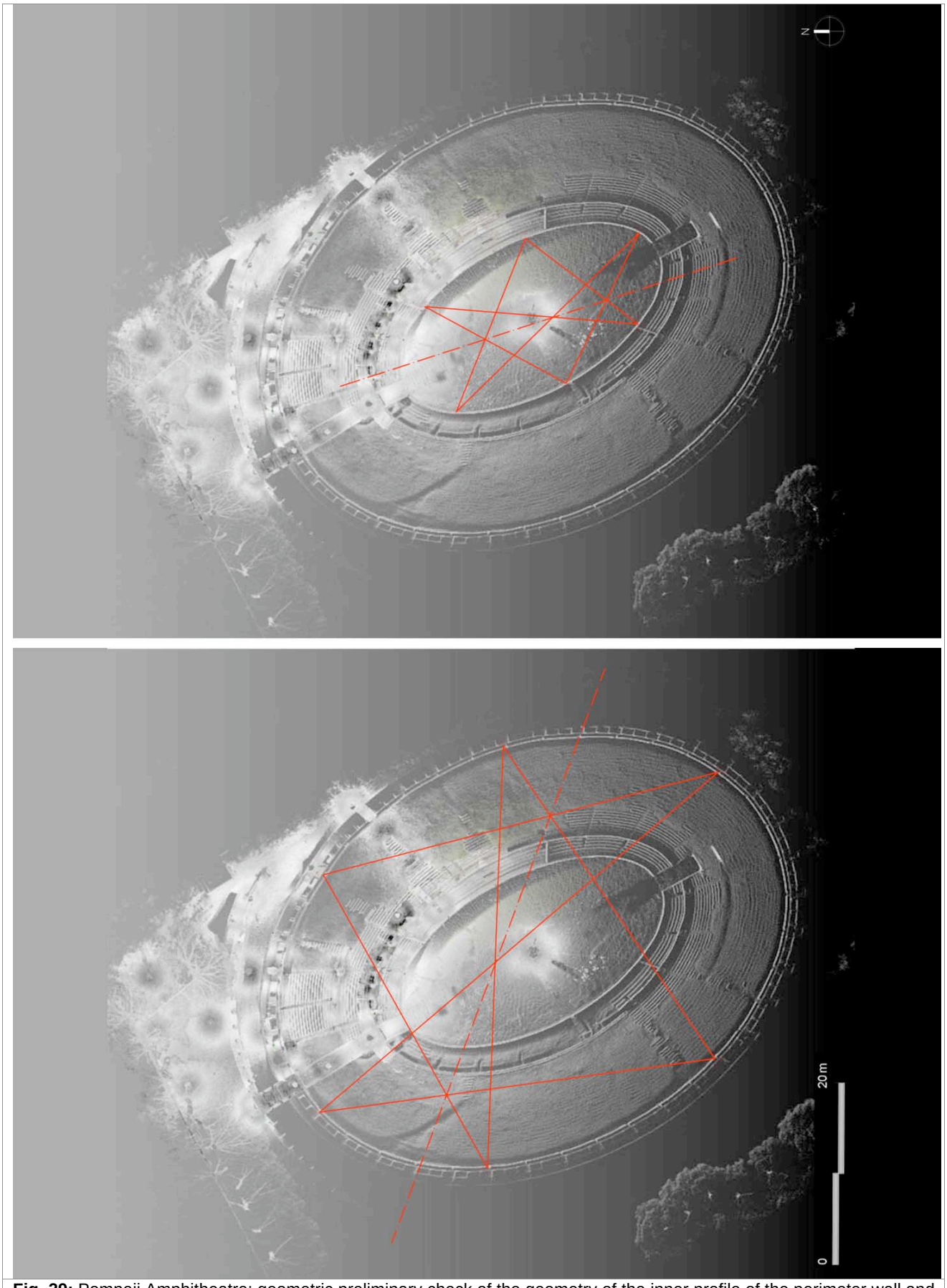

Fig. 29: Pompeii Amphitheatre: geometric preliminary check of the geometry of the inner profile of the perimeter wall and the profile of the wall of the arena through the application of Pascal's theorem in plan sections of the mesh model generated from 3D laser scanner acquisitions. (Drawing by N. Pisacane, 2015).

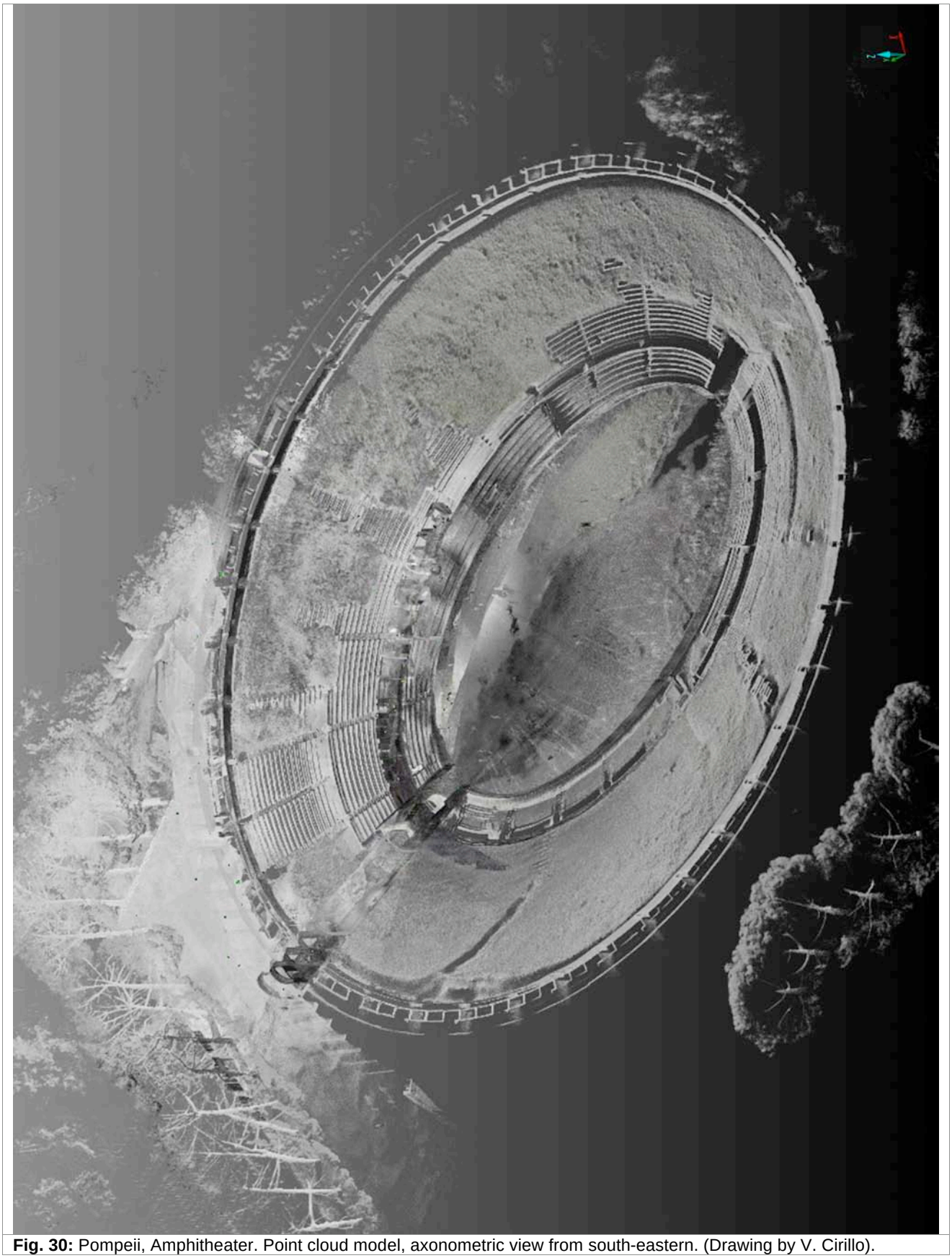

Fig. 30: Pompeii, Amphitheater. Point cloud model, axonometric view from south-eastern. (Drawing by V. Cirillo).

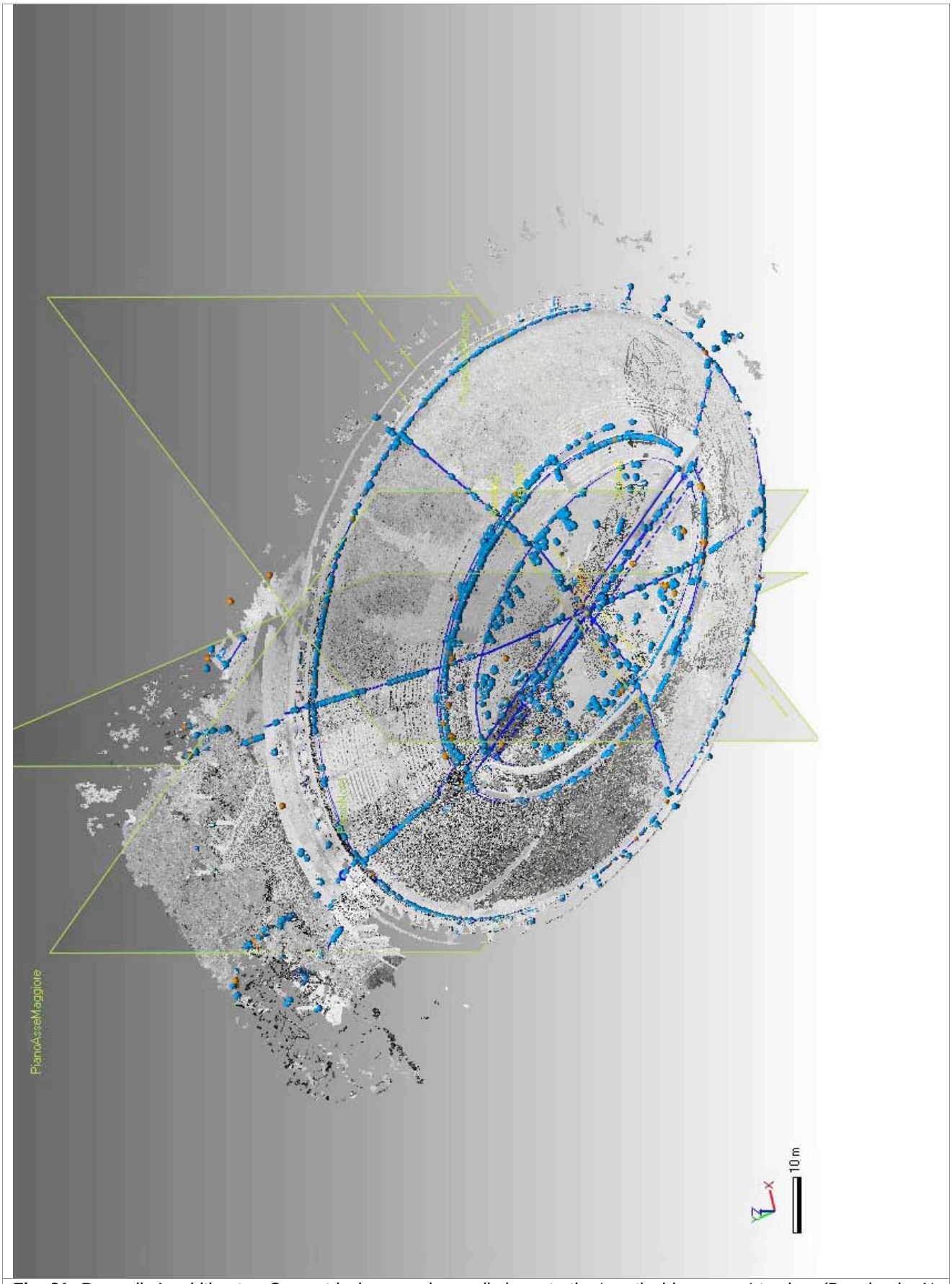

Fig. 31: Pompeii, Amphitheatre. Geometrical processing preliminary to the 'mystical hexagram' tracing. (Drawing by N. Pisacane, 2015).

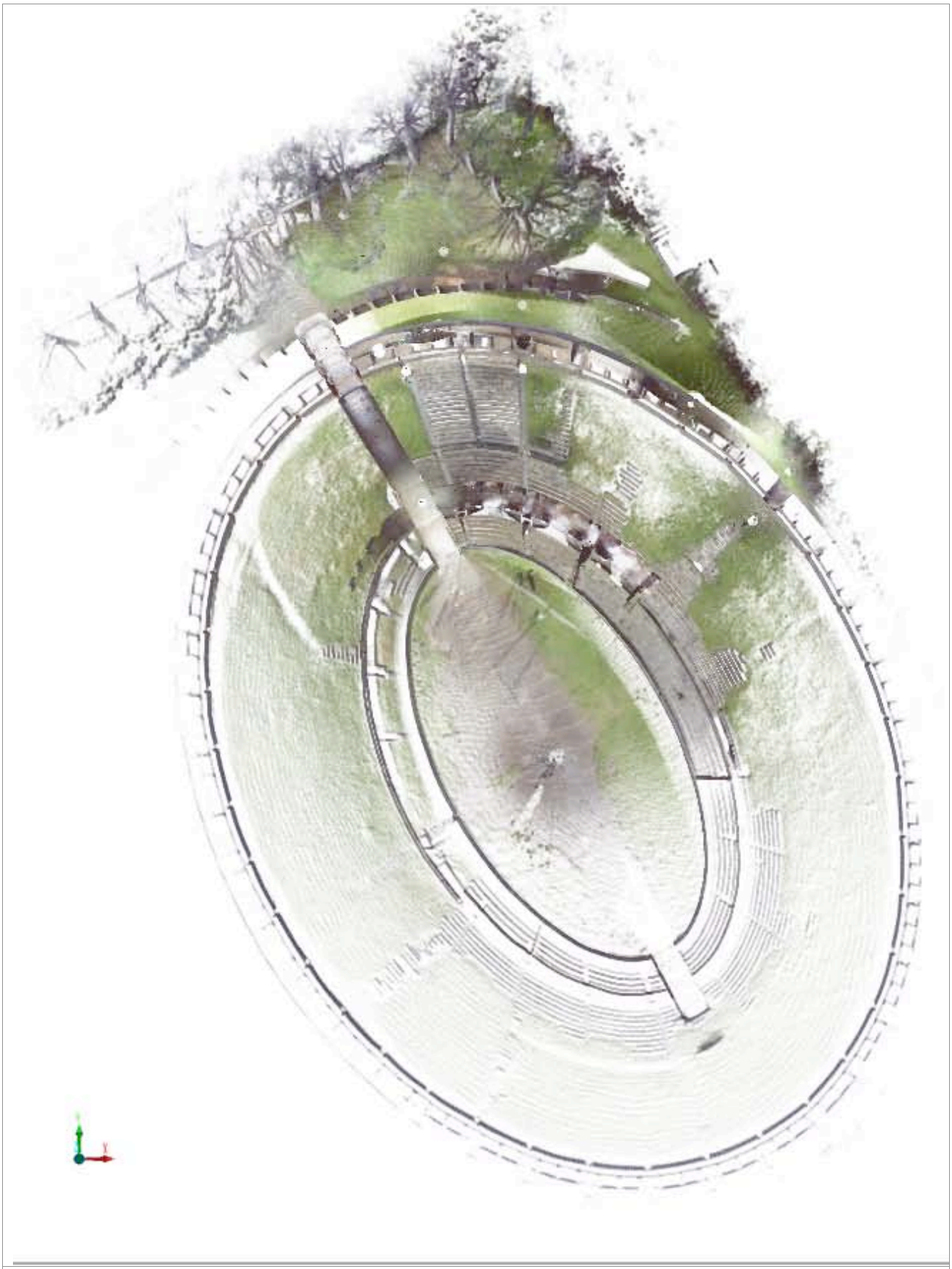

Fig. 32: Pompeii, Amphitheater. Nadir projection of the Point cloud model textured with true color pictures. (Drawing by V. Cirillo, 2015).



Fig. 33: Pompeii, Amphitheater. Point cloud model, axonometric view of the north-western side. (Drawing by R. Parente, 2015).



Fig. 34: Pompeii, Amphitheater. Point cloud model, perspective view of the *cavea* from the bottom *arena* to the upper ring. (Drawing by L. Abate, 2015).

5. Conclusions

Photographic and 3D laser scanner remote sensing activities described, with particular reference to the archaeological area of Pompeii, fully in line with the relationship between heritage and technology main topic of this forum, are totally recorded in a technology platform that collects and processes georeferenced data carried out by the activities on the study area of this research.
The GIS platform, which at the conclusion of the research will be accessible from the web, is structured in thematic layers from which integration can envisage scenarios for development and protection for environment and for cultural heritage. The system still allows, in continuous and dynamic updating of data collected in the different layers representing a tool for the management of a wide and complex site.
The chance to view and explore existing buildings, covered by the survey and modeling activities described, and hypothesis of urban land modification, will provide users with a powerful tool both for decision-making than for the sustainable use of the cultural heritage.

Bibliographical References

[1] GUIDI, Gabriele. BERALDIN J.A.. A*cquisizione 3D e modellazione poligonale. Dall'oggetto fisico al suo calco digitale.* Milano: Edizioni Poli.Design, 2004.

[2] GUERRA, Francesco. BALLETTI, Caterina. ADAMI Aandrea. *3D multiresolution representations in archaeological sites*, in Proceedings of CIPA 2005 - XX International Symposium "International cooperation to save the word's cultural heritage". Torino, 2005.

[3] ADAM, Jean Pierre. *L'arte di costruire presso i Romani*. Milano: Ed. Longanesi, 2008.

[4] GAMBARDELLA, Carmine. *Atlante di Pompei*. Napoli: La Scuola di Pitagora Editrice, 2012.

[5] AGNELLO, Fabrizio. *Un metodo per il rilievo e la modellazione digitale di superfici non razionali in manufatti antichi*, in E-ARCOM, maggio 2004, pp. 6-11.

[6] AVELLA, Alessandra. *La modellazione tridimensionale attraverso la discretizzazione geometrica 'razionale' delle forme nel disegno di architettura. Il caso studio dell'architettura cimiteriale a Napoli*, in GAMBARDELLA, Carmine. GIORDANO, Paolo. *CAMPANIA WORLD HERITAGE PROPERTIES Anckno*l*edged lands [material and immaterial] and Unknown fragments [built and natural]*. Napoli: La Scuola di Pitagora Editrice, 2015.

[7] ARGENZIANO, Pasquale. *Il Laser Scanning dell'architettura: database geometrico e "fonte documentaria" di discretizzazione critica. Il caso studio dell'architettura cimiteriale a Napoli*, in GAMBARDELLA, Carmine. GIORDANO, Paolo. *CAMPANIA WORLD HERITAGE PROPERTIES Anckno*l*edged lands [material and immaterial] and Unknown fragments [built and natural].* Napoli: La Scuola di Pitagora Editrice, 2015.

[8] *Il Colosseo. Studi e Ricerche*, in "Disegnare. Idee Immagini", nn.18-19/1999.

[9] WILSON JONES, Mark. *Designing Amphitheatres*, in "Mitteilungen des Deutschen Archäologischen Instituts", Römische Abteilung, n.100/1993.

[10] MIGLIARI, Riccardo. *Ellissi e ovali. Epilogo di un conflitto*, in "Palladio" n.16/1995.

[11] SALATI, Rosanna. *La geometria degli anfiteatri romani. Verifica delle ipotesi di tracciamento applicate ai più antichi esempi presenti in area campana*. Edizioni Accademiche Italiane, 2014.

[12] ZERLENGA, Ornella. *La «forma ovata» in architettura. Rappresentazione geometrica*. Napoli: Cuen, 1997.

Credits

The surveying activities described in this paper were coordinated by Professor Carmine Gambardella.
The laser scanning capturing on the Tower of Mercury were carried out by Pasquale Argenziano, Alessandra Avella, Paola D'Auria, Dario Martimucci; its point clouds and meshing models were carried out by Luciana Abate, Vincenzo Cirillo, Rosaria Parente. The digital integrated surveying on the Villa of the Mysteries were

carried out by Pasquale Argenziano, Alessandra Avella, Carlo Alberto Bozzi, Vincenzo Cirillo, Eduardo Fiorillo, Piero Lusuardi, Donato Marcantonio, Dario Martimucci, Rosaria Parente; its point clouds and meshing models were carried out by Pasquale Argenziano, Alessandra Avella, Luciana Abate, Vincenzo Cirillo, Rosaria Parente, Nicola Pisacane.
The digital integrated surveying on the Amphitheatre were carried out by Luciana Abate, Pasquale Argenziano, Alessandra Avella, Carlo Alberto Bozzi, Vincenzo Cirillo, Ciro Ferrandes, Eduardo Fiorillo, Piero Lusuardi, Carmine Maffei, Dario Martimucci, Rosaria Parente, Nicola Pisacane, Pasquale Pizzini; its point clouds and meshing models are still carrying out by Pasquale Argenziano, Alessandra Avella, Luciana Abate, Vincenzo Cirillo, Rosaria Parente, Nicola Pisacane.

The research team thanks to the Special Superintendency for the Archaeological Heritage of Naples and Pompeii, particularly Grete Stefani, Stefano Vanacore, Marialaura Iadanza.



Fig. 35: Pompeii, Amphitheater. A instant view of the elliptical tunnel during the capturing laser data.

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Metropolitan Strategies. Urban planning scenarios for the territorial system of Pompeii

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Abstract
The Development's Territorial System "F3 – Miglio D'Oro-Torrese-Stabiese" of the Regional Territorial Plan, over Pompei, incorporates the municipalities of Boscoreale, Boscotrecase, Castellamare di Stabia, Ercolano, Portici, San Giorgio a Cremano, Torre Annunziata, Torre del Greco, Trecase. This area includes some of most relevant italian archeological site, such as the Unesco sites of Pompei and Ercolano.
To define spatial planning strategies for this fragment of Metropolitan City of Naples, has been extracted strategic points and provisions relevant to the following territorial and urban plans: Regional and Territorial Plan (PTR – approved), Territorial Plan for provincial coordination (PTCP – adopted), all of Town Plans (PRG, PUC), Basin of Central Campania Plan (PSAI). These data were supplemented by ISTAT data regarding population, built heritage, employment, industry, agriculture, tourism. All data are georeferenced and comparable on GIS. Particular attention was dedicated to the identification of the infrastructural network and accessibility, understood as essential to proposed development and implementation of the region's potential.
The territorial analysis conducted within the research project named "Urban Ecotourism for Sustainable Exploitation of Cultural Heritage" besides defining a heritage of knowledge that makes consistent and overlapping data from different sources, have led to the definition of a preliminary strategic diagram, called "The gates of Pompeii" that traces a path along which will politics and territorial planning strategies as a base for development and to encourage this region's potential in order to strengthen the competitiveness of local "production chains" in service sectors associated with tourism and cultural heritage.

Keywords: Urban planning, Strategies, Landscapes, Heritage, WebGis.

1. Introduction
This paper is a summary of the territorial analysis aims to determine the characteristics of the territory , in terms of potential and degrade, the infrastructures, the dynamics of mobility, risk levels and the status of urban plans within the research project named "Urban Ecotourism for Sustainable Exploitation of Cultural Heritage" co-financed by Campania Region and European Union.
This territorial area has been identified as the Development's Territorial System "F3 – Miglio d'Oro – Torrese-Stabiese" of the Regional Territorial Plan (a territorial plan drawn up by the Campania Region) that, over Pompei, incorporates the municipalities of Boscoreale, Boscotrecase, Castellamare di Stabia, Ercolano, Portici, San Giorgio a Cremano, Torre Annunziata, Torre del Greco, Trecase [1].
This area is characterized by high urbanization and population density, with relevant sprawl and illegal housing phenomena and it is innervated by infrastructure and marked by situations of degradation that alternate with beautiful landscape contexts.
In this paper I'll expose the complex phase of territorial and urbanistic analysis, but is in course of processing the second phase which includes some projects of landscape urbanism [2] related to:

- environmental recovery and regeneration of degraded landscapes and drosscapes, primarily through the reuse of brownfield sites;
- redevelopment and urban regeneration while respecting the principle of the lesser use of the land and the priority of recovery.

This approach is shared by the strategies identified by the Ministry of Culture [3].
The preliminary part of the research has extracted Plans' strategic points and provisions relevant to the following territorial and urban plans: Regional and Territorial Plan (Ptr - approved -), Territorial Plan for provincial coordination (Ptcp - adopted -), all of Town Plans (Prg, Puc), Basin of Central Campania Plan (Psai).
These data were supplemented by Istat data regarding population, built heritage, employment, industry, agriculture, tourism. All data are georeferenced and comparable on GIS, in particular using Google Map technologies and software to share informations and scientific results and representing them on an interactive map. Geographic Information Systems (GIS) has powerful information processing capabilities, spatial analysis capabilities and visual display capabilities.
Particular attention was dedicated to the identification of the infrastructural network and accessibility, understood as essential to proposed development and implementation of the region's potential.
Was also created a three-dimensional TIN model of the area (Triangulated Irregular Network) (fig. 2).
A TIN is a digital data structure used in a geographic information system (GIS) for the representation of a surface. A TIN is a vector-based representation of the physical land surface or sea bottom, made up of irregularly distributed nodes and lines with three-dimensional coordinates (x, y, and z) that are arranged in a network of nonoverlapping triangles.
The territorial analysis conducted, besides defining a heritage of knowledge that makes consistent and overlapping data from different sources, have led to the definition of a preliminary strategic diagram, called "The gates of Pompeii" that traces a path along which will move the subsequent phases of the project development.

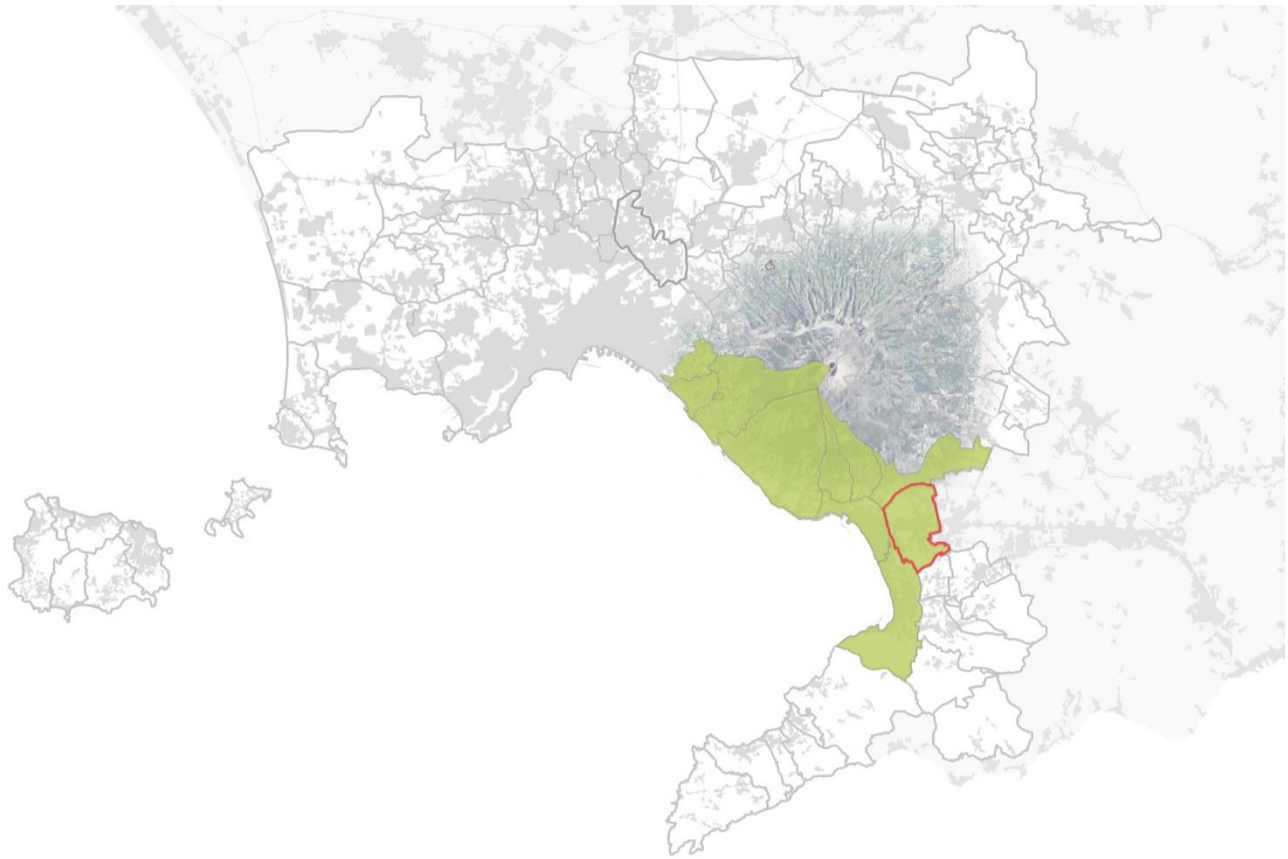

Fig. 1: The “F3 Development's Territorial System” in the Metropolitan City of Naples. In red the boundary of the city of Pompeii (graphic interface: Giovanni Bello, Enrico De Cenzo, Giuseppe Guida).

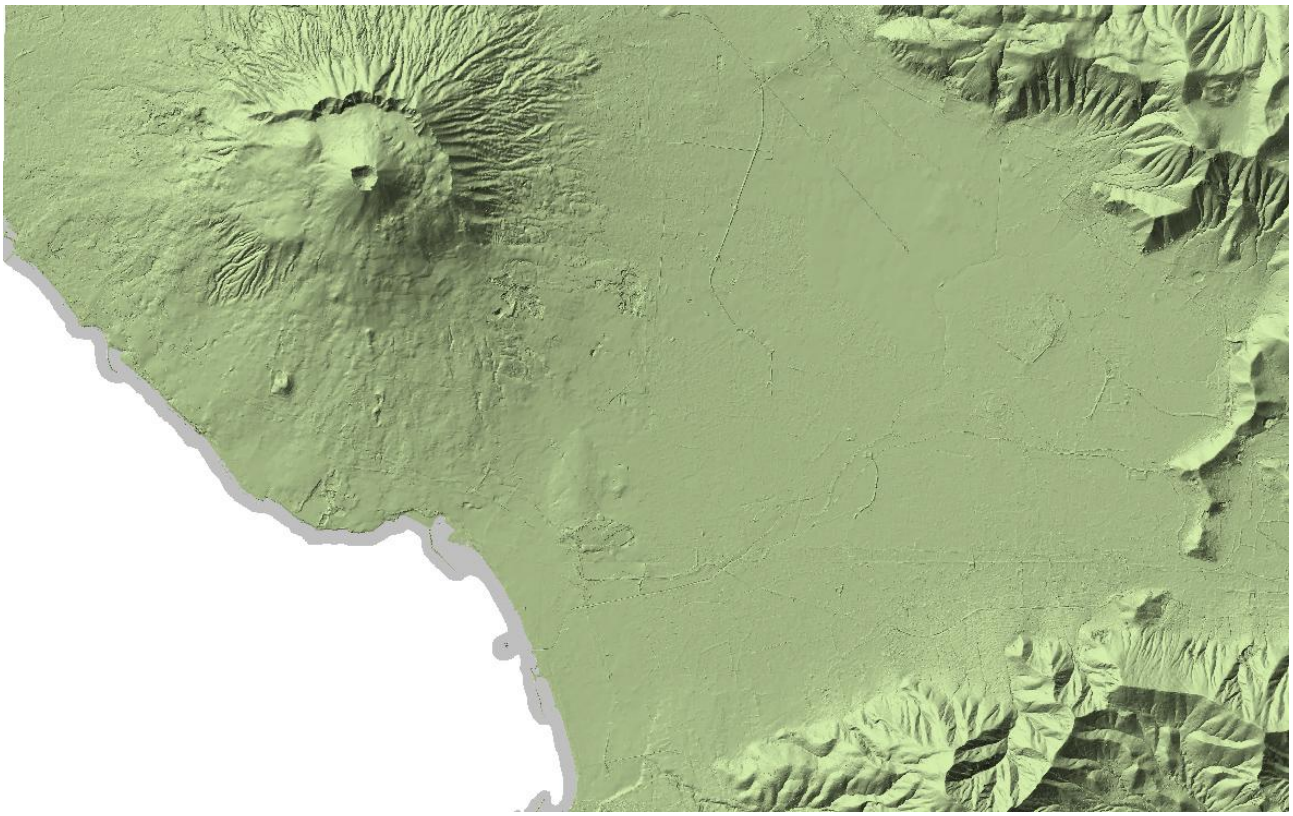

Fig. 2: The TIN (Triangulated Irregular Network) (output: Giovanni Bello, Enrico De Cenzo, Giuseppe Guida).

2. Urban and territorial plans as a reference

As part of a study on the implementation of eco-tourism for the area of Pompeii, urban planning can play the role of background and reference to the necessary territorial changes, but also (and especially) for the protection of beautiful landscapes of this territory, but also as imaginary futuristic tank and programming tools [3].

The larger scale plan that provides standards and rules for the territory of the whole Campania region is the Piano Territoriale Regionale (Ptr), a plan that contains, above all, scenarios, frames and a strategic approach. To reduce conditions of uncertainty, about territorial knowledge and interpretation of the actions of different institutional operators or of other operators, Regional and Territorial Plan (Ptr) defines territorial and urban planning conditions by Development's Territorial Systems. These are 49 sectors of regional territory each one with a specific identity in term of economics, cultural, heritage and possible development strategies. The Development's Territorial System which refers to Pompeii, as well as to other archaeological areas of the site (Ercolano, Oplontis, Stabia), is so called “F3 - Miglio d'oro - Torrese stabiese” this Sts belongs to the type F: “Coastal systems of environmental, cultural and landscaping dominant”.

At a provincial scale the referring plan is Piano Territoriale di Coordinamento (Ptc) that only adopted (but not yet approved) by the Provincia di Napoli (now, after the Law 56/14, called Città Metropolitana di Napoli, i.e. Metropolitan City).

At the municipal level (fig. 3) urban planning needs to be adapted and updated. Nearly all urban plans of the ten municipalities content in the F3 DTS are dated and contain strategies no longer in line with the most recent economic, cultural and social mutations. Especially evident is the lack of coordination between the different zoning rules of the plans of each municipality. The final strategies proposed by this research also suggest and give urban and territorial indications to the municipalities in the definition of new strategies and scenarios for their territory.

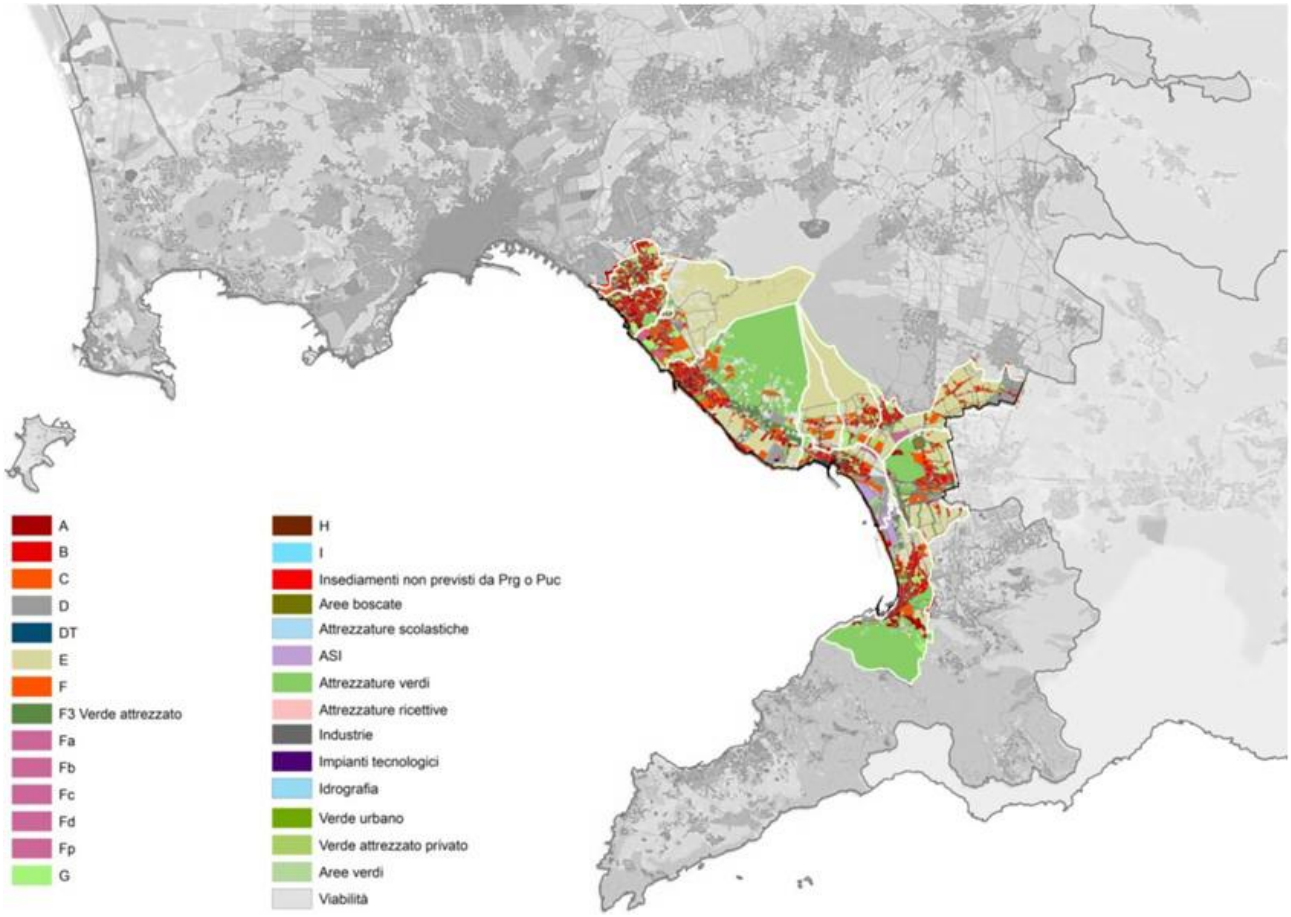

Fig. 3: The mosaic of municipality urban plan in the “F3 Development's Territorial System” (graphic interface: Giovanni Bello, Enrico De Cenzo, Giuseppe Guida).

3. A landscape that coexists with risk

The F3 territory contains, besides an alternation of fine landscapes and large areas of unplanned urban sprawl, different natural risk elements, object of planning tools that affecting substantially in the urban policies and urban plans.

The perception and reactions to risk are often of type " context " and, in this sense, typical elements of the Company Which contemporary "society of risk" [4] In this framework, the risk factors "described from science" are relativized from the cultural background of the society, exposing to oblivion some clear risks or, conversely, considering whatever potentially dangerous, depending on the perspective from which you observe events [5].

Regarding the instruments of land government about risks the most important is the Basin Plan of the Hidrogeological Risk design by The Basin Authority of Central Campania. This plan defines different levels of risk to be followed also by urban plans and public policies for the territory and landscapes (fig. 4).

The whole area is also included in the so-called "red zone" and "yellow zone" of the volcanic risk tied to the Vesuvius (fig. 5), established by the National Department of Civil Protection.

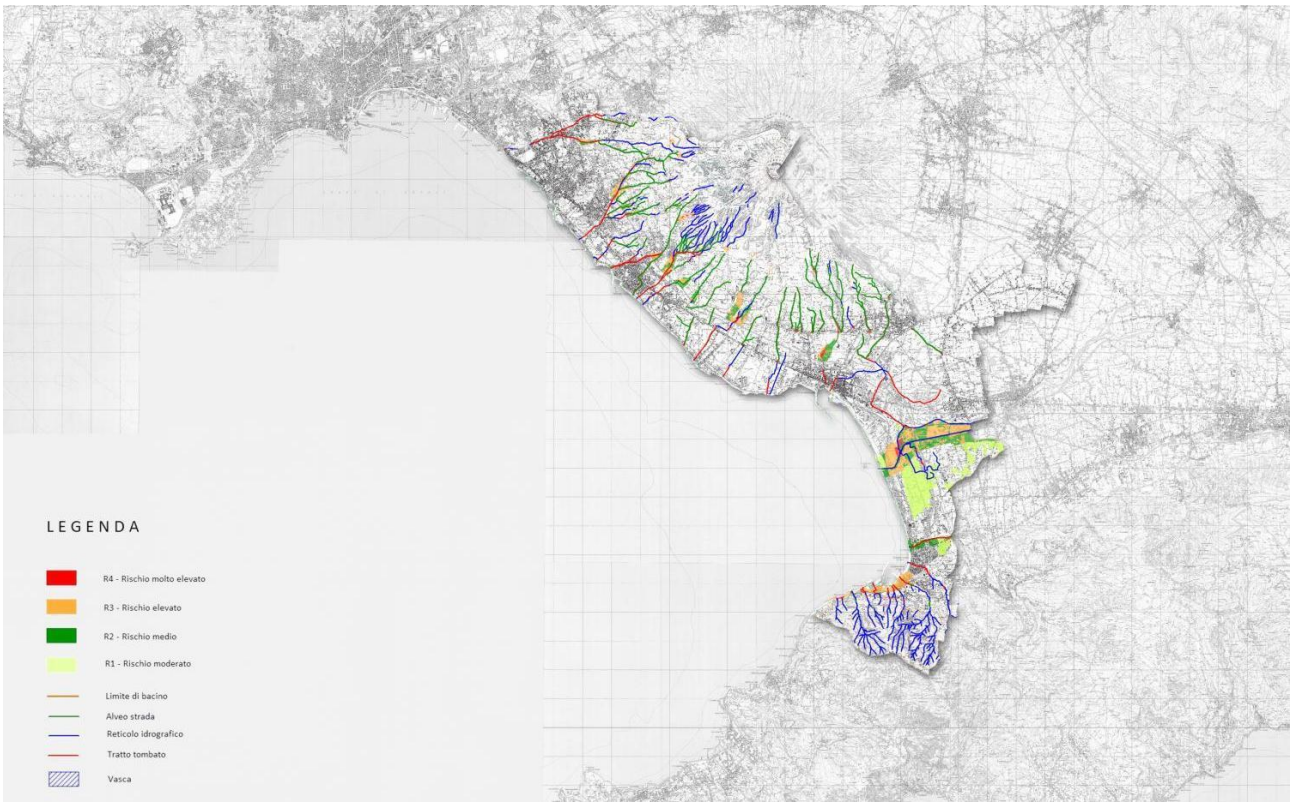

Fig. 4: An excerpt of the Basin Plan of the Hidrogeological Risk (source: Basin Authority of Central Campania)

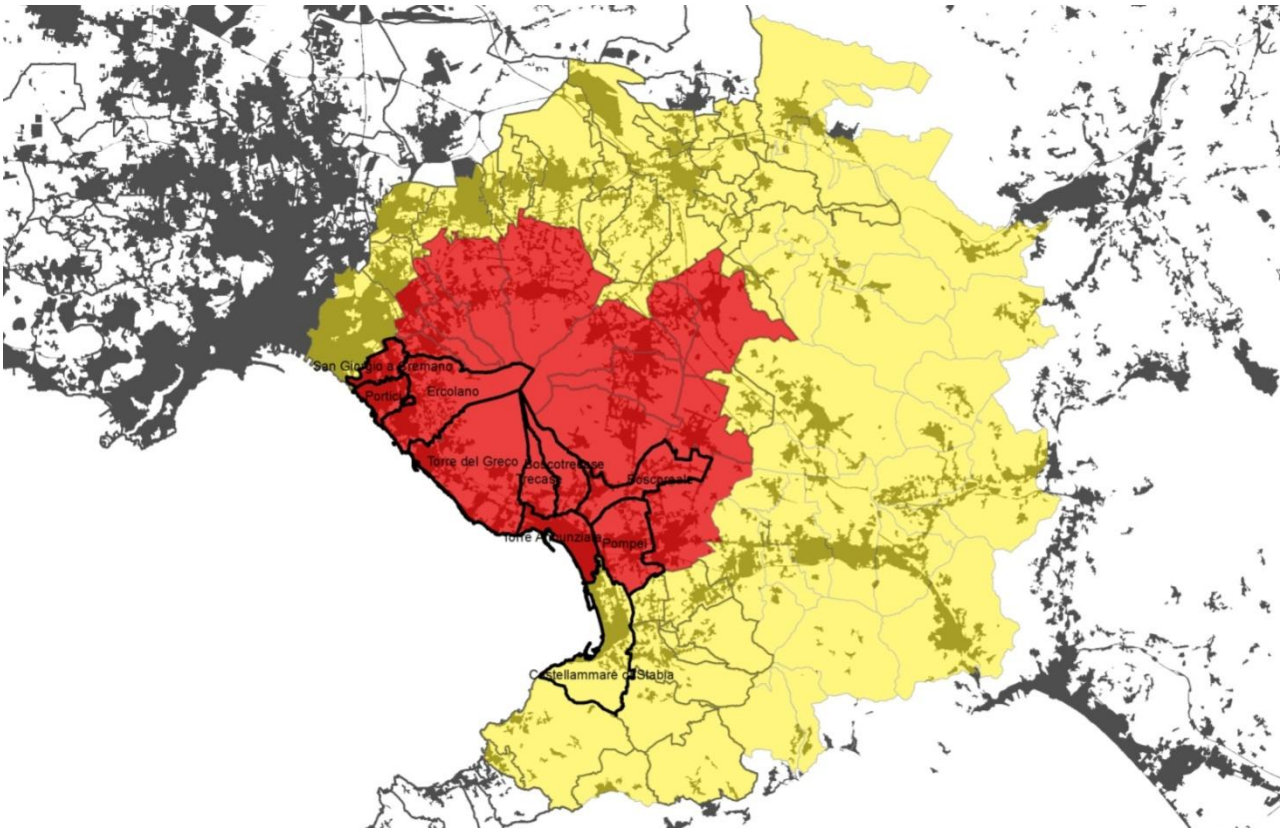

Fig. 5: The red and yellow zones of Vesuvius volcanic risk (source: re-elaborated from National Department of Civil Protection).

4. Mobility and infrastructures

The infrastructural network of mobility (car, railway, by the sea), is strictly connected with all the development strategies, particularly those related to sustainable and eco-tourism. As can be seen from the fig. 6, the Development's Territorial System F3 is connected to the rest of the Campanian region and Italy through a lot of important transport routes.

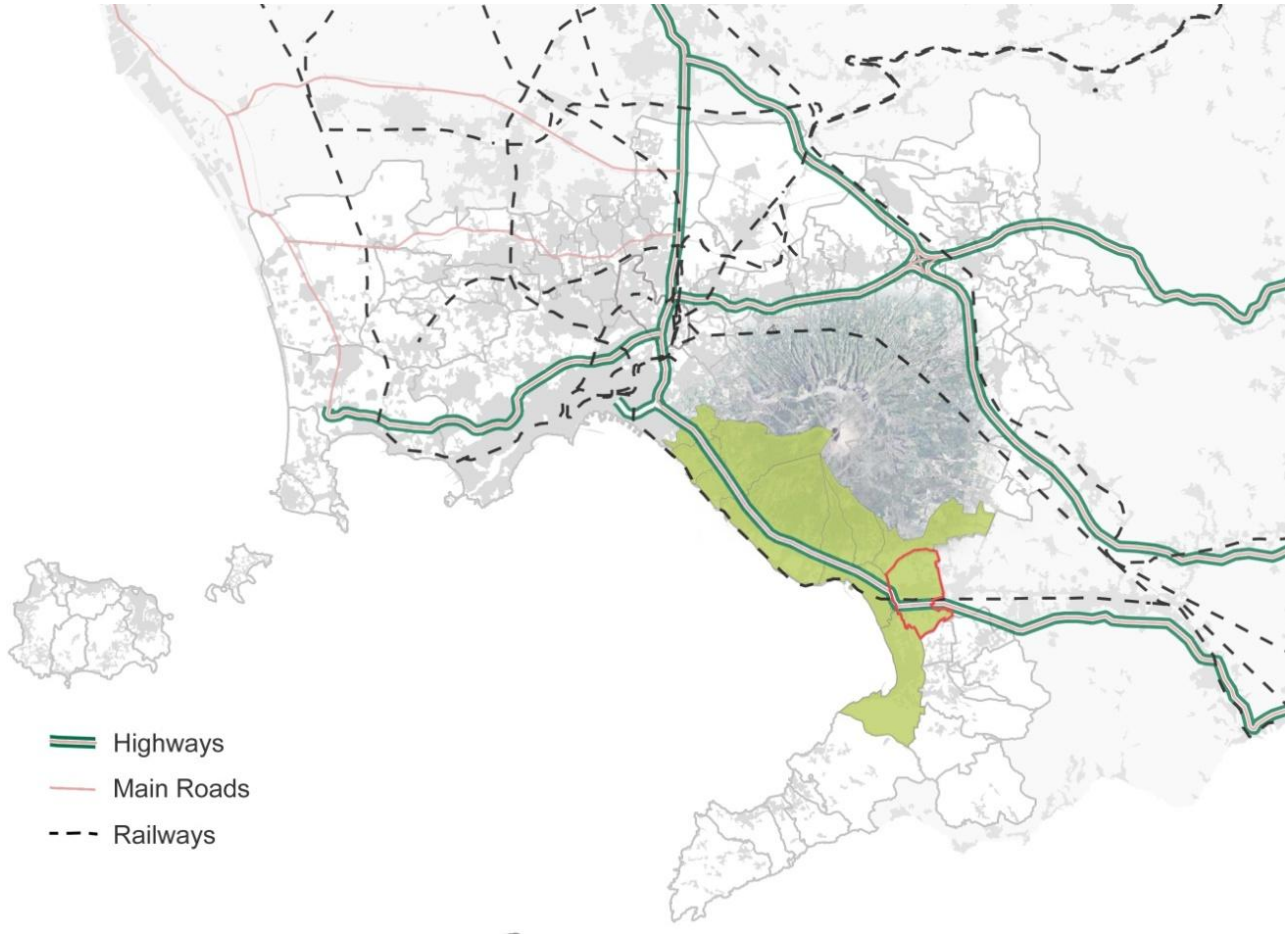

Fig. 6: The mobility network in and around "F3 Development's Territorial System" (graphic interface: Giovanni Bello, Enrico De Cenzo, Giuseppe Guida).

In detail, regarding the infrastructure, STS F3 is crossed by SS 18 Tirrenia inferiore route, on which connects SS 268 route after passing Boscotrecase, and by A3 Napoli-Pompei-Salerno highway. Interchanges serving the territory are S. Giorgio, Portici, Ercolano, Torre del Greco, Torre del Greco Nord, Torre Annunziata Sud, Torre Annunziata Nord and Pompei.

The railway lines that cross the territorial system are:

- Naples-Salerno railway line - Stations: Torre del Greco, S. Maria la Bruna, Torre Annunziata Città, Torre Annunziata Centrale and Pompei;
- Cancello-Torre Annunziata railway line - Stations: Boscoreale e Torre Annunziata;
- Napoli-Torre Annunziata-Sorrento of the Circumvesuviana line - Stations: S. Giorgio, S. Giorgio Cavalli di Bronzo, Bellavista, Via Libertà, Ercolano, Miglio d'Oro, Torre del Greco, Via S. Antonio,Via del Monte, Via dei Monaci, Villa delle Ginestre, Leopardi, via Viuli, Trecase, Torre Annunziata Oplonti, Villa dei Misteri, Ponte Persica, Pioppino, Via Nocera, Castellammare di Stabia, Terme and Scrajo.
- Torre Annunziata-Poggiomarino Circumvesuviana line – Stations: Boscotrecase, Boscoreale, Pompei Valle and Pompei Santuario;

The nearest airport is Naples-Capodichino that can be reached by car, via A3 highway or via A1-A3 highway, along about 17 km from Torre del Greco to Capodichino.

About infrastructural planning there are several priority actions, but the most important are: strengthening and upgranding of A3 Napoli-Pompei-Salerno highway (now almost completed, and from which there are

about 800.000 transit input at the exit of “Pompei”), and doubling of the Circumvesuviana railway from Pompeii to Castellammare di Stabia.
In brief, it is a territory well infrastructured in terms of mobility, but who need some coordinated actions, the improvement of intermodal hub and strengthening the railways, in terms of frequency of service and trip quality, especially on the Naples – Pompeii – Sorrento of Circumvesuviana railway. This contribution to research “Ecotourism for urban sustainable use of Cultural Heritage in Campania” is, therefore, to promote technologies for the promotion and protection of cultural heritage and to add value within the tourism, using appropriate techniques of representation of the territory, able to encourage the participation and implication of stakeholders, also through open-source platforms for real-time sharing of information [6].

5. The Web Gis Exploration

In the definition of scenarios to define decisions on city’s and territory’s transformation is necessary the comprehension of the interactions between multiple aspects that influence the territorial and urban dynamics. WebGis is one of the key technologies in the process of Digital City informational, networking, intelligent and visualization.
In Italian urban analysis and planning process the radical change in planning theories move from the rationalistic approach led by planners towards the communicative approach [7]. In this sense, planning has evolved to a mutual learning and knowledge creation process between planners and citizens.
The spatial data knowledge and the development of new ICT solutions (in particular open-source solutions) which can guide the planners and stakeholders towards strategic and shared decisions are essential[8].
As noted by Saskia Sassen: «As the practice of technological innovation open source so far has not been an urbanism issue, but a question of technology. However it is in consonance with the real essence of the city at the basic level, where are the users» [9] . You now need to tighten the definition of a kind of Linux for the city, from homes to public spaces that induces a change that make tangible and physical technologies for the digital collaboration [6].
Along this path is here proposed a methodology that have at his center online interoperability of Geographic Information System technology on Google platform. In this system is possible to have a spatial and synthetic representation of a great of part of the researches of the Pompei Campus project. In particular, is possible to implement the control of the effects of changes in land use, the environmental quality, the risks, mobility, and all the data will become operational in the network, in a very interactive way.
In this way the territory is “measured”, not only from a euclidean-metric point of view, but mainly through a lot of indicators, such as demography, mobility flows, the production system, employment, use and protection of soil and of the landscape.

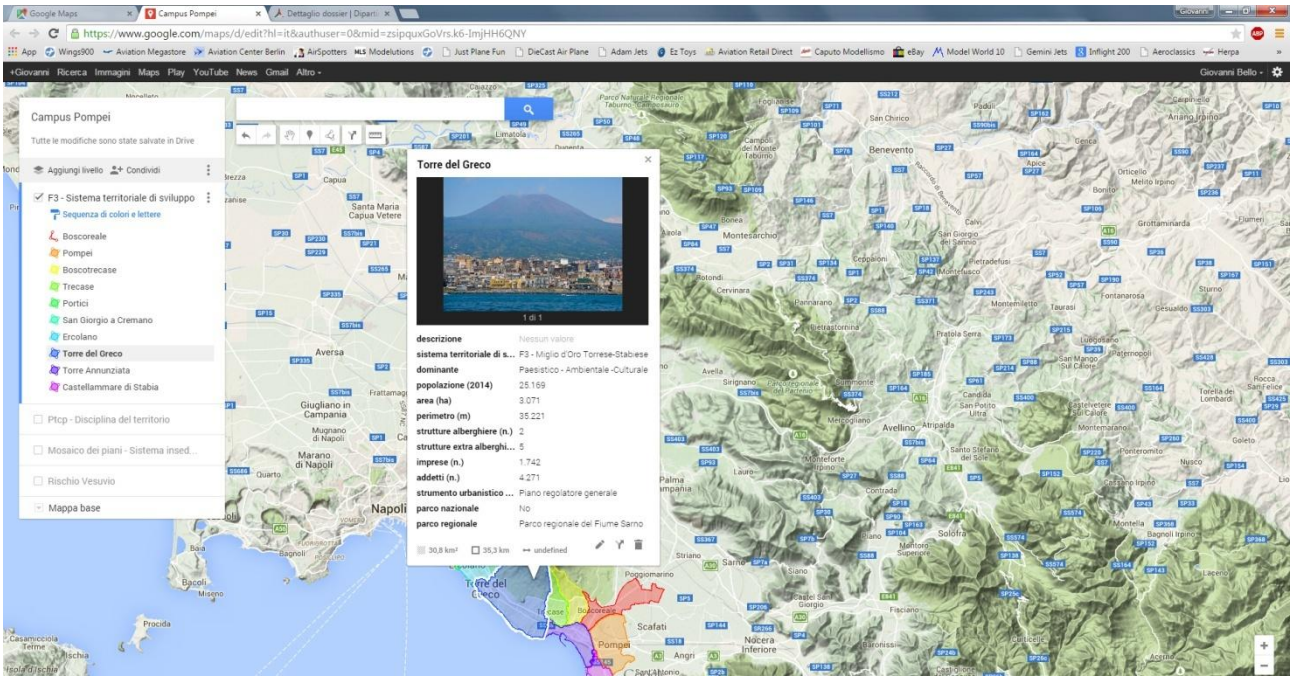

Fig. 7: A screenshot of the WebGis on Google platform

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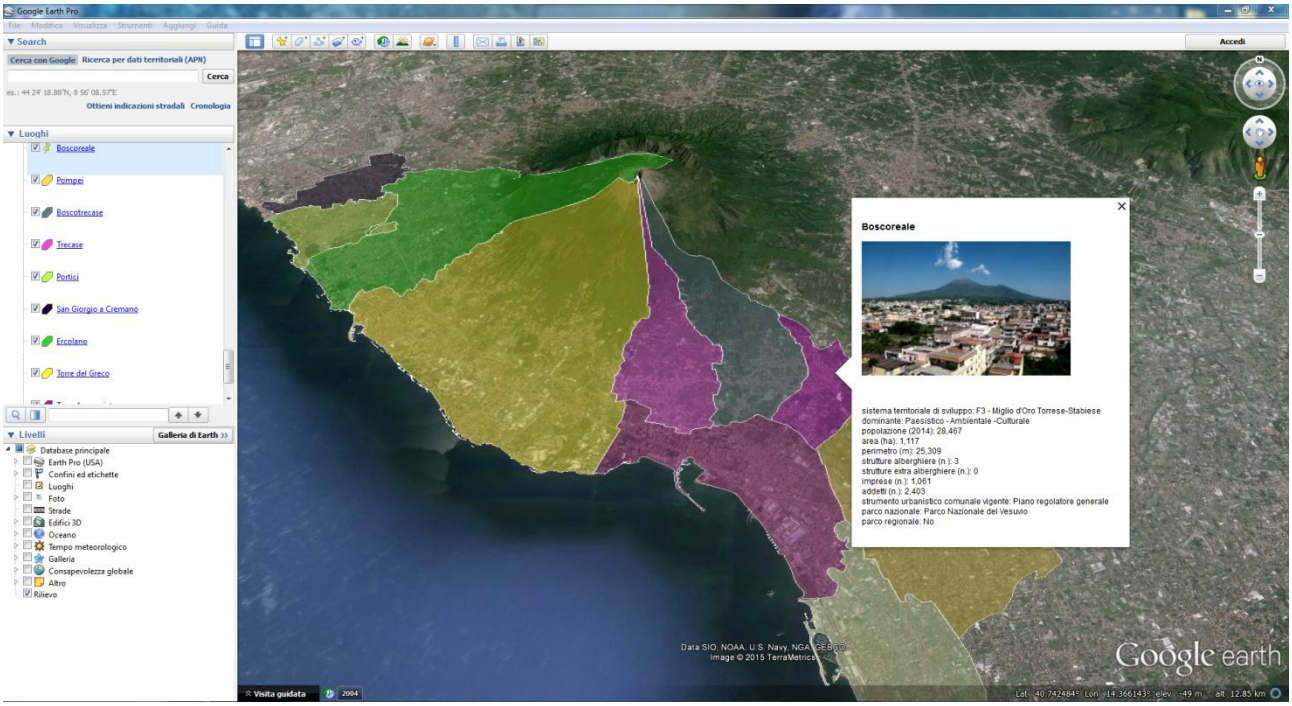

Fig. 8: Another screenshot of the WebGis on Google platform.

6. Conclusion

The section presented of the research “Urban Ecotourism for Sustainable Exploitation of Cultural Heritage”, is in progress and will be complete with some scenario and strategies for the analyzed territory.
In summary here it is possible to identify some points .
First, the goal of sustainable accessibility to the entire area of Pompeii is central to this research project.
In this sense, preliminary research provides a knowledge on mobility flows, taking as reference points ("doors") accessible via “iron” (FS stations and AV), via “rubber” (Highways A3 and A30) and by sea (ports of Naples and Salerno).
Then it seems necessary to impress programming in the area to the concept of "land consumption zero" and eco-sustainability.
It is clear, finally, that the potential of the area are not fully utilized and the flow of tourists appear fragmented and they fail to intercept the many resources in the surrounding area (and that other parts of the research "Urban Ecotourism for Sustainable Exploitation of Cultural Heritage" have developed simultaneously with that described here).
The strategic framework " The gates of Pompeii " (fig. 9) summarizes the main elements of the places.
From the point of view of urban planning, moving from the analysis presented here, is possible to draw up a masterplan and scenarios [10] for specific areas that can define innovative and coordinates intervention strategies for this territory.

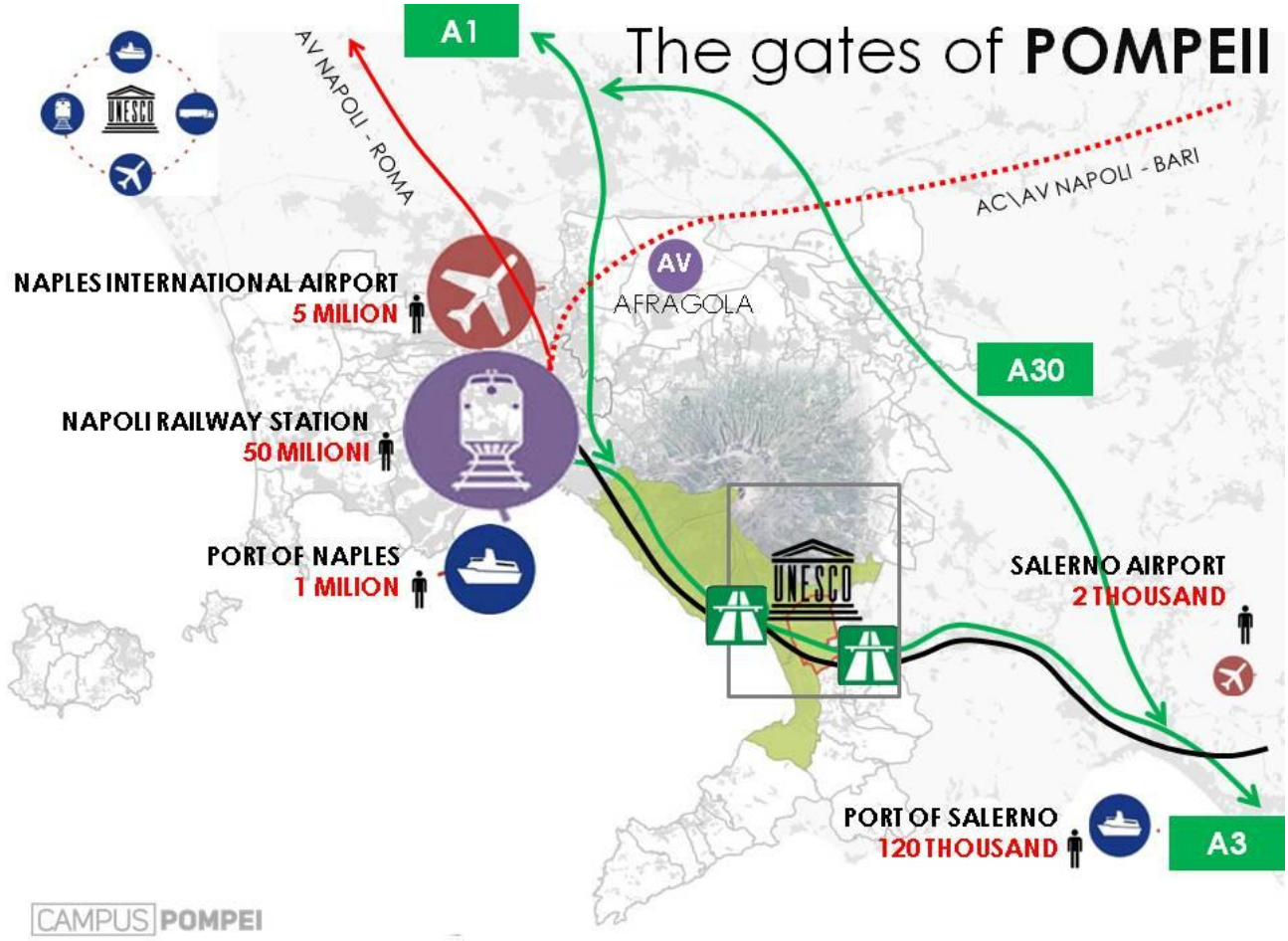

Fig. 9: An analytic masterplan of the study area.

Bibliographical References

[1] CAMPANIA REGION. *Piano Territoriale Regionale*. Napoli, 2008.

[2] CORNER, James. Terra Fluxus. In *Landscape Urbanism Reader*: 2006.

[3] MIBAC. UGP. *Piano Strategico per lo sviluppo delle aree comprese nel Piano di gestione del sito UNESCO "Aree archeologiche di Pompei, Ercolano e Torre Annunziata".* Rome-Pompeii.

[4] BECK, Ulrick, *Risikogesellschaft. Auf dem Weg in eine andere Moderne, Suhrkamp*. Frankfurt a.M., 1986.

[5] LUPTON, Deborah. *Il rischio. Percezione, simboli, culture*. Bologna: il Mulino, 2003 (orig.:, *Risk*, Taylor & Francis Books Ltd.- Routledge, 1999).

[6] RATTI, Carlo. *Architettura Open Source. Verso una progettazione aperta*. Torino: Einaudi, 2014.

[7] NAROOIE, Mahnaz. Boosting Public Participation in Urban Planning Through the Use of Web GIS Technology: A Case Study of Stockholm County. KTH, *Degree Project in Regional Planning*. *Proceedings of.* Stockholm: 2010.

[8] DI GIACOMO, Tullia Valeria. (2015). Interactivity of webgis for the simulation of land development. In *Tema. Journal of Land Use,* Mobility and Environment, 8 (1).

[9] Referring Web Pages Web https://opensourceurbanism.wordpress.com.

[10] GUIDA, Giuseppe. Urban imagery. Metaphors, rhetoric and images in the urban projects. In AA.VV. *Proceedings of Eurau 10*. *Venustas. Architecture, market, democracy*. Napoli: Clean, 2011, p. 40-48.

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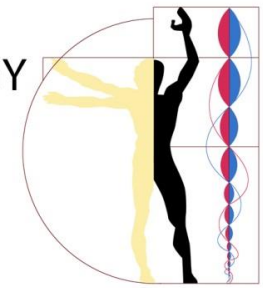

Smart Planning

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Abstract
Increasingly more often Smarter Cities are now being included in the broader concept of Smarter Planet, a more intelligent, technological and interconnected planet. In this sense, IBM claimed that (artificial) intelligence could be introduced into the systems and processes that are already running the world, in devices that are not considered to be computers: cars, household appliances, motorways, power grids, clothes, even integrated with nature, such as agricultural or water networks. The Smarter Cities of IBM are characterized by a form of intelligence applied to different themes such as mobility, sustainability, territory, education and urban security. These are clearly key issues in urban and territorial planning and need to be rethought, not only through the technological upgrading of urban knowledge but also through a total change of paradigm. As Klaus Kunzmann (2014) noted “The development of new paradigms has become a passion for planners, architects, urban planners and environmentalists”, a passion through which he desired for better cities. In this sense, the concept of smart applied to cities is the last of numerous urban paradigms: the city sustainable, eco-city, the compact city, the diffused city, the resilient city. The new paradigm of the smart city can only be supported by a new type of urban planner who adds to his traditional tools, those of global communication technologies, new digital network infrastructures, so as to transfer at least a part of the managing of the urban space into a flow of information that has a final aim of the residents and a smart tool (phone, tablet, etc.) with which to interact with and experience the new public space.

Keywords: Smart city, Smart Planning, Urban Planning

1. Smart city and Smart planning
In addition to the references in current literature, the different concepts of smart cities, along with innovative interpretations and representations of the city, attempt to import the Internet of Things concept into urban knowledge: a neologism referring to the extension of the Internet to the world of concrete objects and places. This term was used for the first time as the title of a presentation by the Executive Director of the Auto-ID Center, Kevin Ashton, held in 1999 at the headquarters of Procter & Gamble (P&G). The fundamental concept is that objects can independently create web content, without the creation of content (such as web pages) being mediated by human intervention. They are configured so that objects communicate and exchange data or information with other objects using the web. Over the years, the term has assumed different degrees of meaning, while also becoming integrated into other areas of research such as, among the most important, “The Disappearing Computer” and the M2M world (Machine to Machine). In particular, the latter, namely the world of M2M, refers to telemetry and telematic technologies and applications that use wireless networks. They were initially created to identify the connection between objects, without having to switch Internet connections, but also through ad hoc local networks. Even though M2M technology is constantly evolving and changing, it may already have useful applications in the governance and control processes of territorial transformations. In fact, automatic technological networks in a smart city dimension, where terminals communicate with each other and then transmit the information to users and decision-makers, are central and become complementary to physical networks, relating to mobility, energy, greenery and public spaces. At a metropolitan level, where the size of a large area makes any form of decision-making and control complex and complicated, the use of Internet of Things applications facilitates and integrates urban and territorial planning. In this sense, the Internet of Things approach and its direct application to urban and territorial planning expands its potential in a logic of integrated digital urbanism and a real “Internet of Everything” (Mitchell et al. 2013), in which a GIS software,

Location Based Services, models of Augmented Reality (visualization in streaming of the overlap between real and virtual elements), Sensor Web Enablement (real-time integration of heterogeneous sensor web in an IT infrastructure) and, in general, the extension of the Internet platform to the world of concrete objects and places, converge to define a computerized planning that goes beyond the mere use of ICT, but rather defines a true paradigm shift and an "informatical turn" for the discipline. In this sense, this confirms the term "augmented city" which, as discussed in the following section, is a challenge and possible answer of urban planning to the complexity of contemporary urban organisms.
The evolution of the Internet of Everything, and, consequently, systems that are smartly connected, creates a system with new features and abilities grouped into four areas: monitoring, control, optimization and autonomy.
Monitoring; smart and connected systems allow for a comprehensive monitoring of the conditions of products, operations and environments through sensors and external databases. With the data collected, users can be alerted by intelligent systems relating to any changes in conditions or performance.
Control; thanks to software embedded into objects and the cloud, it is possible to remotely control the functionality of an intelligent system as well as customize the user experience depending on the applications.
Optimization; the ability to monitor and control activates algorithms that optimize the operations of the objects and their use so as to improve the performance of the system, while also allowing for preventive diagnostics. For example, in wind turbines, a local microprocessor can adjust each blade on each rotation to capture as much as possible the maximum wind energy. Each turbine can also be adjusted not only to improve its own performance but also to minimize the impact on the efficiency of its neighbours.

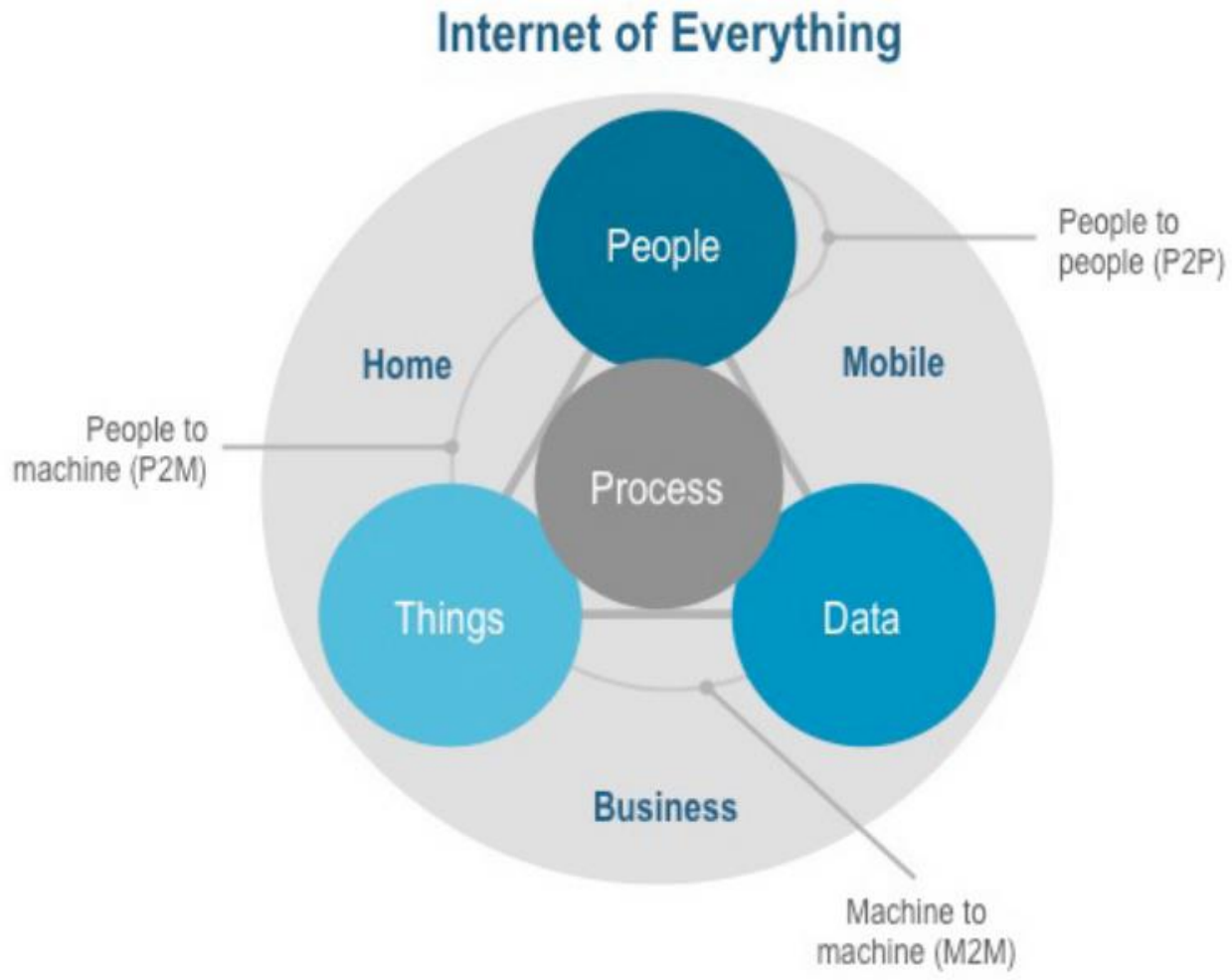

Fig. 1: Internet of thing (Mitchell et al., 2013)

Autonomy; the ability of monitoring, control, and optimization combined together allows smart and connected systems to achieve previously unattainable levels of autonomy. The intelligent devices of the system can independently carry out self-diagnostic capabilities, coordinate with other devices and improve their own performance. Sophisticated systems are now able to recognize the environment in which they find themselves, self-diagnose the needs of their service, and adapt to the users' preferences.
This new technological paradigm has made it possible, in some cases, to replace certain products. For example, intelligent systems for bike-sharing, which use the information available on smartphone applications

will replace not only bicycles being purchased but potentially also cars as well as other forms of urban transport. Smart and connected functionality have made this type of replacement possible. (2014, HBR).
Furthermore, in smart strategies, there are integrated systems that connect the various components to give the true value and not that of the components.
A city can only be smart if it can quickly integrate and synthesize the data produced by each type of sensor so as to improve the efficiency, equity, sustainability and quality of life of the city itself (Batty et al., 2012). It is therefore the major impact of technology on new forms of policy-making and planning. In analysing smart cities, Batty et al. (2012) identify seven points upon which to focus when analysing the key problems of cities, using information and communication technologies:
1. A new approach to the understanding of urban phenomena;
2. More effective and feasible methods to coordinate the various technologies adopted on an urban scale;
3. Models and methods for the use of urban data on different spatial and temporal scales;
4. The development of new communication and dissemination technologies;
5. New forms of urban organization and governance;
6. Define the critical issues related to City, Transport and Energy;
7. Risks, uncertainties and dangers in the smart city.

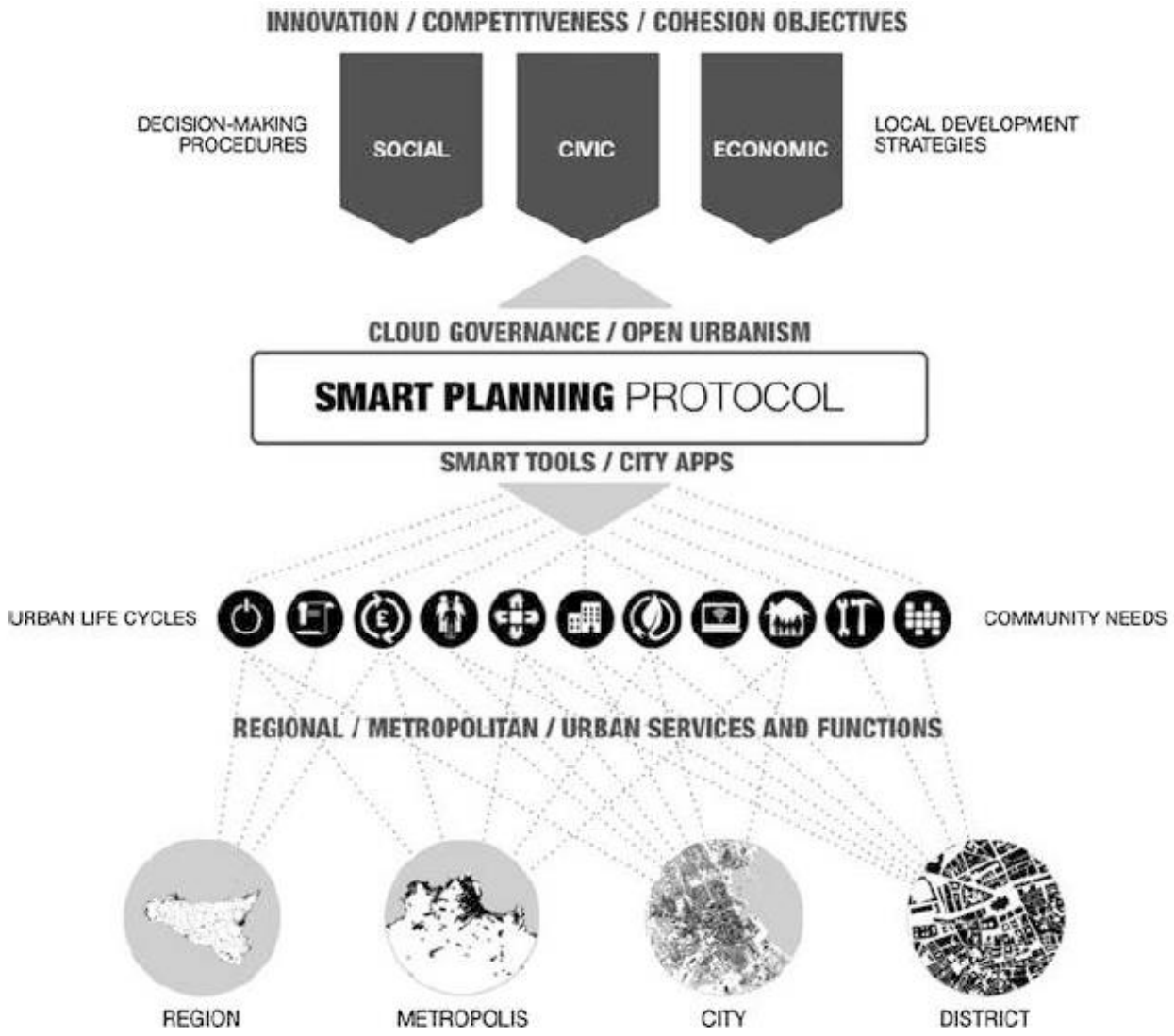

Fig. 2: (Carta, 2014)

Finally, it is worth noting how the diffusion to “everything” of connectivity, continuous monitoring and constantly increasing resulting data stream require in parallel a continuous updating of transmission protocols and data management. For example, the new system of assigning addresses, IPv6 is the successor to the IPv4 Internet Protocol, which has almost exhausted the number of unique addresses available. The new protocol introduces a number of new services, while also simplifying the configuration and management of IP networks. However, it has also created several problems during the switch from one system to another.

The most important feature of the new IPv6 protocol is the larger address space: IPv6 reserves 128 bits for IP addresses and manages 2128 (about 3.4 × 1038) addresses; IPv4 reserves 32 bits for addressing and manages 232 (about 4.3 × 109) addresses (Wikipedia).
Is it possible to think in smart terms for a city in the planning and policy development for the territory stages? How can spatial planning make use of smartness logic to change in essence the design approach to urban and metropolitan contexts?
From an urban planning and design perspective, smart programming can be interpreted as a set of strategies aimed at optimizing urban planning and innovating public services so as to relate the physical infrastructure of the cities with the human, intellectual and social capital of those who live it through the widespread use of new communication technologies, mobility, environment and energy efficiency, in order to improve the quality of services and public spaces, understanding better the needs of the citizens, businesses and institutions.
The potential of ICT (understood in the complexity of the previously described M2M, IoT, IOE, GIS, etc.) in the planning and designing processes of the territory are especially clear in the maps, data and models, that are increasingly becoming common heritage. The integration of web, wiki and geo-referenced technologies (like Google Earth) with GIS applications, for example, improves the interaction between citizens, policy-makers as well as the technical and scientific skills involved in the urban planning processes. Shared multi-utilities databases can encourage public-private partnerships and solely private or project financing urban transformation projects (Carta, 2014).

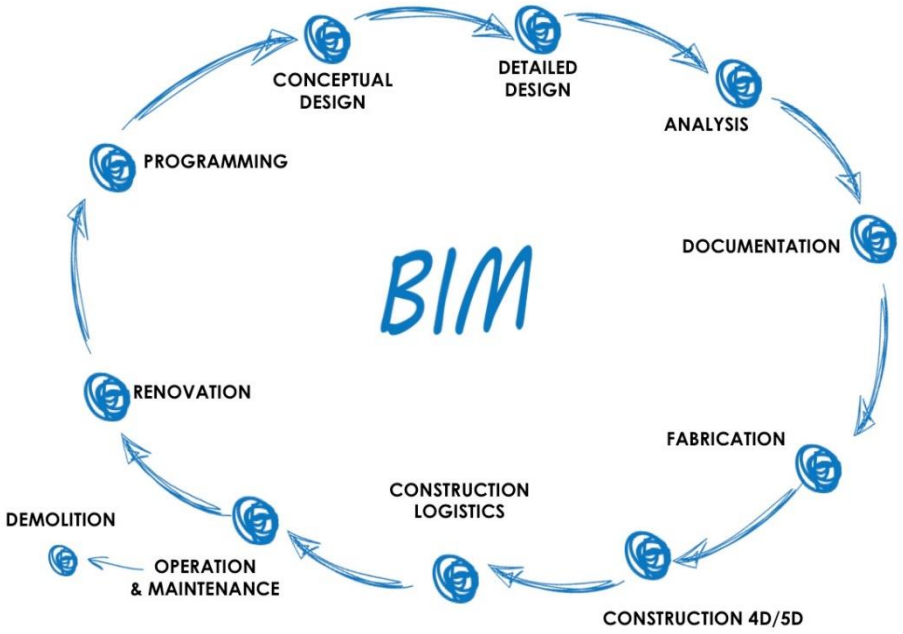

Fig. 3: BIM Process

The availability of information and databases in real time improves the level of “confidence" in the institutions and processes of governance, from both the citizens as well as investors and the so-called third sector. The following diagram presents these interactions and the implicit potential in this new planning model.
One of the most useful and effective methods in this perspective, but not yet applied convincingly to an urban project, is that of the BIM, Building Information Modelling. The British Standard Institution provides a definition: Building Information Modelling (BIM) is the process of designing, constructing or operating a building or infrastructure asset using electronic object-oriented information (British Standard Institution, 2013). It is a procedural approach to the various components of architectural design, but which may in future be usefully applied to the design of parts of the city, in order to control the various stages of its implementation (design, construction, management during the life cycle), that are generally highly complex and difficult to coordinate.

In general, BIM systems are able to manage the various pieces of information about a building: geometry, spatial relationships, energy performance of the lighting and acoustics, geographic information, quantities, qualities and properties of the different components, as well as post-construction project management and facility management. BIM data can be used to illustrate the entire lifecycle of the building, from its concept and design through to its demolition and the reuse of the materials; The properties of the materials and the destined use, including the management of the project objectives and facility management for the entire life cycle, can be easily extracted from the model. This possibility of information management is integrated with the possibility to visualize all the systems and components in different scales relating to either the entire project or individual elements. From a general point of view, changing to a BIM type of design goes simply beyond switching to a new software. The BIM approach requires a change in the definition of traditional architectural phases and a greater sharing of data by the professionals involved. The whole process involves collecting information in a database that, consequently, becomes the heart of the BIM. Compared to simple 3D modelling, this archive provides a rich source of geometric, visual, dimensional, environmental, technical and process information (Dalla Mora et al., 2014).
Evidently, it is still a technology orientated towards a single architectural process, but it is equally clear that the move to design and urban planning could be a further paradigm shift that can manage better the complexity of the urban processes (in particular those related to the reuse and redevelopment of degraded areas, where, in addition to the planning, remediation, safety and infrastructure measure are also necessary) which is often due to variations, design changes and constant interruptions in the design, construction and management phases.

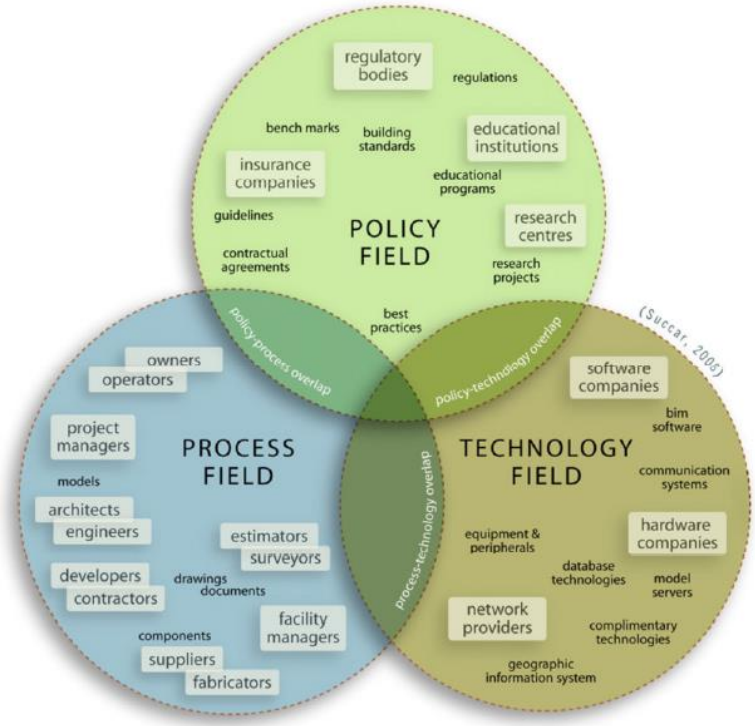

Fig. 4: BIM (Della Mora)

The fundamental aspects of integrated design, of the collaboration between different professionals, of defining common objectives, of the fast and efficient presentation of complex concepts allow for a better dialogue between the stakeholders, while also supporting the decision-making of the project at the basis of a smart design process. This process supports a common understanding among various stakeholders for a move from an isolated and static vision of design towards an expansive and dynamic dialogue that encourages understanding and efficiency.
The methods for measuring the success of the implementation of the process often predominantly focus on financial indicators. These studies examine the benefits primarily from a financial point of view but do not determine the best practices or give details on any improvement of the processes.
The McGraw Hill Report is based on a survey of 2,228 responses from Architects, Engineers, Building Contractors, company owners, etc. 77% of the respondents perceived a positive ROI (Return on Investment) of their investments through the use of the BIM process and technologies for their projects.

However, in most studies on the subject, only improvement indicators are proposed and there is no actual description of the improvement. BIM methodologies and tools, through the standardization of processes and practices, could lead to being liberated from the traditional bureaucracy of the construction process, eliminating the restrictive conditions associated with the construction process due to the ability to improve collaboration and dialogue, as well as promote a meaningful involvement of the various stakeholders.
Practical applications of the BIM model on an urban planning scale are still experimental, but the proposed case studies of smart cities could include the use of what has already been prepared to define project areas of BIM -type environments, that could be called TIM (Town Information Modelling).
Among the first experiments of urban planning using a TIM model, it is worth mentioning the one developed by Torti Gallas and Partners, Inc. It is a patented modelling and data collection system that works in 2D and 3D with multiple databases that converge in a single user-friendly platform. Using a Building Information Modelling (BIM) technology and NavisWorks programme, a software that allows for the easy navigation of three-dimensional models, the TIM process provides users with a visual representation of both the current and design conditions of the project. The visualisations of the model are connected to several databases that reflect the “before and after” impacts associated with the planned physical changes, and can include anything from the calculation of areas to that of the population density, the traffic forecasts, etc. With one click, it is possible to visualize all the information related to the transformation of an existing vacant lot in its complete “build-out” future with all the associated data. This will provide images and information, in a dynamic and user-friendly format, in order to resolve any complex planning and urban design: problems: “Real time information to solve real problems”.

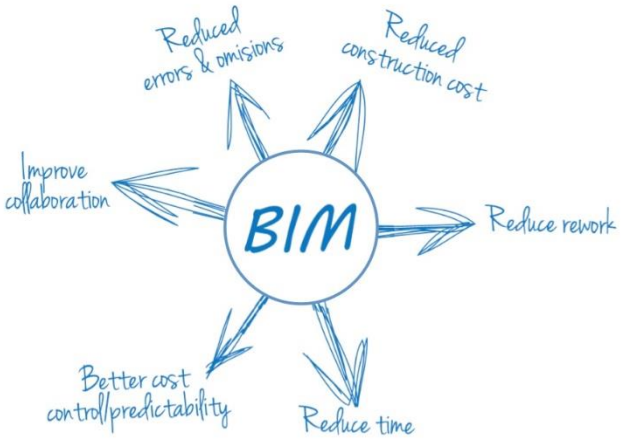

Fig. 5: BIM (McGraw Hill Construction)

In general, a TIM process begins with the construction of a three-dimensional model of the actual state of a neighbourhood or part of a city. It must exactly present the topography, trend of the roads, the plans of existing buildings and 3D volumes, blocks, subdivisions of lots, etc. Once the model of the current state has been created, the database connections must be made. Each model and database is generally realised according to the specific needs of the client and the specific project.
The complexity of urban phenomena, as previously described, far from generating crisis in the programming processes, can be turned into an opportunity to determine new types of projects as well as new planning methods and technologies of neighbourhoods or cities. The TIM model, as described above, can have a particularly relevant application in the control of social and environmental sustainability, urban projects, while ensuring the participation and sharing of choices and, fundamentally, the spatial quality of the interventions. Subsequently, the city project can integrate the various aspects of sustainability, especially with respect to the “context” of the intervention. The various profiles and the way they are combined will have to be defined in the design process, which must integrate and finalise the different variables involved in order to adapt the working of the urban fabric with the multiple levels of environmental and landscape sustainability. The management of

the infrastructures and collective services, dimensioned and concerted by the stakeholders, can control and enable economies of scale, capable of effectively solving environmental issues that are shared between multiple subjects.
Rethinking urban planning in a smart way, therefore, also implies rethinking and improving the effectiveness of the role of advocacy planning, in defence of the community and, in general, avoiding excessive compression of public spaces and property. In this sense, ecological urbanism (Mostafavi and Doherty, 2010) seems to be the best field of application of a design and management methodology like TIM, and it is on this basis that urban planning, with far from convincing experiments in this area, can find new fields of research and development. The diffusion of eco-neighbourhoods is also essential to disseminate the know-how in specialized areas, interest and convince citizens, orient the housing market and investments, as well as determine national and local public policies (Moccia, 2011).
It is not the case of agreeing with the ideas expressed by the “Transition Town” movement, relating to the ecological issue and the whole control and design paradigm, with it being necessary to change methodologies and technologies in order to carry it out.
Nevertheless, there are various examples in Europe of neighbourhoods built on an “ecological” model, even if essentially linked to the architectural dimension of sustainability and poorly integrated individual energy saving technologies: Solar city in Linz, BedZED in London with zero emissions, Hammarby in Stockholm, Bo01 in Malmö, Vauban in Freiburg, Torshavn in Copenhagen, as well as several Italian examples such as Casanova in Bolzano and San Rocco in Faenza (Pavia, 2012).
In this sense, the concept of smart city, can be associated with that of decoupling: improve efficiency through the use of the resources. Regarding urban planning, it could be translated into being aware of the limits of the resources, in order to introduce new sustainable and quality urban interventions (especially for the renewal, regeneration and innovation of the city) (Russo, 2014).

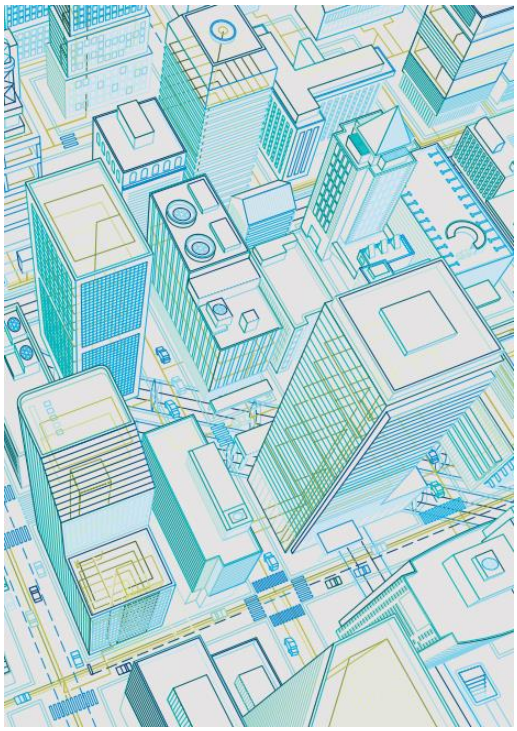

Fig. 6: Smart city (ABB-Ambrosetti, 2012)

The concept of decoupling, was first presented at an institutional level in the UNEP Report (United Nations Environment Program) (2011) with the clear title: “Decoupling natural resource use and environmental impacts from economic growth”. This is an evolution of the idea of ”doing more with less”, increasing the level of “productivity” of resources, decoupling the intensity of energy and raw materials per unit of the GDP, resulting in a reduction of the input of raw materials and energy for the production of goods and services. This objective obviously requires reconsidering the links between resource use and economic and human prosperity, triggering a major process of investment in technological innovation that is connected to a rethinking of financial flows and cultural patterns to sustainably balance the consumption levels per capita in industrialized countries, while supporting sustainable paths in developing countries.

As highlighted by the British economist Tim Jackson (2009), the decoupling model, of which Jackson is one of the first theorists, is now considered by analysts as the central solution to resolving the serious current problems present among our social and natural metabolisms.
Despite some pessimism on the underlying possibility to actually apply in a general and global way, the "decoupling" between GDP and the amount of energy needed to generate it (a "myth", in fact), Jackson remembers that relative and absolute decoupling should be distinguished. The first refers to the reduction of ecological intensity per economic output unit, in other words, as described above, it reduces the impact on resources compared to the GDP, but not necessarily its absolute value (in fact, the impact on resources may also increase, but at a lower rate of the GDP). The second, however, aims to reduce the use of resources (or emissions) per economic output unit at the same level, i.e., the efficiency of resource use should increase as much as the output.
Obviously, applying smartness to crucial sectors of the economies of the most developed societies means going in this direction difficult, controlling the energy flows, but also those of people and things, mobility, infrastructures, balancing consumption and thus making it more sustainable as well as urban development and renewal. Thus, the term decoupling, and everything that it means, is a central element to making sense of a smart planning, that is not limited to the using and re-using of ICT to probably obtain the same results.
Decoupling, applied on an urban level, is one of the pillars upon which the paradigm shift of the discipline can be based but that still, however, is not convincing and well underway. Whereas, the current trends related to the growth of urbanization could help in this direction, in as such that the urban structures may encourage, if properly managed and governed, significant economies of scale and efficiencies in service management. The densely populated areas can consume fewer resources per capita than in areas of urban sprawl and low density, due to targeted policies on the availability of water, energy use and transport, waste treatment and recycling, as well as the way to design houses (www.greenreport.it).
In these areas, urban planning still has ample room for manoeuvre if it adapts its tools and methodological approach to planning. Energy use is, in fact, undoubtedly the most "intelligent" issue that the city can seriously attempt to solve. Something is therefore moving, albeit within sectorial contexts. For example, the PAES (Action Plans for Sustainable Energy), of the containers drawn up by the union of Municipalities which defines (and often only stated) how the council intends to achieve the reduction targets of carbon dioxide emissions by 2020, as indicated by the EU. It is an interesting instrument whose impact on regional policies has yet to be verified.



Fig. 7: Vauban in Friburgo

Bibliographical References

[1] ABB-Ambrosetti (2012), *Smart Cities in Italia: un'opportunità nello spirito del Rinascimento per una nuova qualità della vita*

[2] AIM-Amsterdam Innovator Motor, ASC-Amsterdam Smart City Platform (2011), *Smart stories*, Amsterdam.

[3] Allwinkle, S., Cruickshank, P., 2011. Creating Smart-er Cities: An Overview. *Journal of Urban Technology.*

[4] Bakici T., Almirall E., Wareham J. (2013), *A Smart City Initiative: the Case of Barcelona*. In *Journal of the Knowledge Economy*. June 2013, Volume 4, Issue 2, pp 135-148.

[5] Baker N., Steemers K. (2000), "Energy and Environment in Architecture", E&FN Spon, London.

[6] Batlle, J. (n.d.). Barcelona Smart City: paving the way.

[7] Batty M., Axhausen K. W., Giannotti F., Pozdnoukhov A., Bazzani A., Wachowicz M., Ouzounis G., Portugali Y. (2012), "Smart cities of the future", in *The European Physical Journal*, Special Topics Volume 214, Issue 1.

[8] Borga, G. (2014), *City Sensing. Approcci, metodi e tecnologie innovative per la città intelligente*, Franco Angeli, Milano.

[9] Campbell T. (2012), *Beyond Smart Cities. How Cities Network, Learn, and Innovate*, Earthscan Publications, London.

[10] Canton, J., (2011), "The extreme future of megacities", *Significance* n. 8.

[11] Caragliu A., Del Bo C., Nijkamp P. (2009), *Smart Cities in Europe*, Serie Research Memoranda 0048, VU University Amsterdam, Faculty of Economics, Business Administration and Econometrics.

[12] Carta M. (2014), "Smart Planning and Intelligent Cities: A New Cambrian Explosion", in Riva Sanseverino *et al.* (eds.), *Smart Rules for Smart Cities*, Springer, 2014.

[13] Carta M. (2013) , *Reimagining Urbanism. Città Creative, intelligenti ed ecologiche per i tempi che cambiano*, Trento-Barcelona, ListLab, 2013.

[14] Cook D. (2005), *Smart environments. Technology, protocols and applications*, Hoboken, N.J, Wiley.

[15] CRS – Vienna University of Technology (2013), *European smart cities*.

[16] Dalla Mora T., Peron F., Cappelletti F., Romagnoni P., Ruggieri P. (2014), "Una panoramica sul Building Information Modelling (BIM)", AiCARR.

[17] Dall'Ò G. (2014), *Smart city. La rivoluzione intelligente delle città*, il Mulino, Bologna.

[18] Dirks S., Gurdgiev C, Keeling M., Smarter cities for smarter growth, New York, 2010

[19] Ercoskun Y. O. (ed.) (2012), *Green and Ecological Technologies for Urban Planning. Creating Smart Cities*, Information Science Reference, Hershey.

[20] Fini G. (2010), "Polarità periferiche e nuove forme di urbanità. Due progetti nella regione urbana di Amsterdam", in *Territorio*, n.54, pp.97-109.

[21] Fini G., S. Caschetto S. (2014), "Politiche 'Smart' e Visione Metropolitana: la Dimensione Territoriale nell'Esperienza Progettuale della Amsterdam Smart City Platform" in T*EMA Journal of Land Use, Mobility and Environment,* Vol. 7 n. 3 December 2014.

[22] Fulton W. B. (1999), *Guide to California Planning*. Solano Press.

[23] Fusero P., Massimiano L. (2012), "Smart Cities", in Angrilli M., *L'urbanistica che cambia. Rischi e valori*, FrancoAngeli, Milano.

[24] Gasparrini C. (2015), *In the City. On the Cities*, List Lab, Trento.

[25] Goughl M.Z. (2015), *Reconciling Livability and Sustainability. Conceptual and Practical Implications for Planning*. In *Journal of Planning Education and Research* March 9.

[26] Hatzelhoffer L., Humboldt K., Lobeck M., Wiegandt CC. (a cura di) (2012), *Smart City in Practice. Converting Innovative Ideas into Reality*, JOVIS Verlag, Berlin.

[27] Homsy G. C., Warner M. E. (2015), "Cities and Sustainability: Polycentric Action and Multilevel Governance", *Urban Affairs Review*, January 1.

[28] Iandelli N., Giannotti V., Di Prinzio L., "Il monitoraggio e la gestione, attraverso servizi LBS, di eventi diffusi sul territorio". In: *La smart city al servizio del cittadino* - Disponibile online in http://goo.gl/BuX95E.

[29] ISFOL (2013), *La riqualificazione sostenibile dei contesti urbani metropolitani*, Roma.

[30] Jackson T. (2009), *Prosperity Without Growth. Economics for a Finite Planet*, Earthscan/Routledge, London/New York.

[31] Jung Hoon L., Phaalb R., Sang-Ho L. (2013), *An integrated service-device-technology roadmap for smart city development*, in *Technological Forecasting and Social Change*. Volume 80, Issue 2, February 2013, Pages 286–306.

[32] Hall R. E. (2000), "The vision of a smart city", presented at the Second International Life Extention Technology Workshop, Paris, France.

[33] Komninos N., Schaffers, H., Pallot M., (2011), "Developing a Policy road map for Smart Cities and the future internet", *eChallenges e-2011 Conference Proceedings*, Florence.

[34] Kunzmann R. K. (2014), "Smart Cities: a New Paradigm of Urban Development", in *Crios* 7/2014.

[35] Kuhn T. S. (1999), *La struttura delle rivoluzioni scientifiche*, Einaudi, Torino.

[36] Krause R. M., Feiock R. C., Hawkins C. V. (2014), "The Administrative Organization of Sustainability within Local Government", in *Journal of Public Administration Research and Theory,* August 18.

[37] Kriken J. L. (2010), *City Building. Nine Planning Principles for the Twenty-First Century*. Princeton Architectural Press.

[38] Lee J., Gong Hancock M. (2012), *Toward a framework for Smart Cities: A Comparison of Seoul, San Francisco & Amsterdam*. Stanford University, program on Region of Innovation and Entrepreunership in partnership with the Yonsei University, Seoul, Korea, Graduate School of Information.

[39] Lund Kriken J. (2010), *City Building. Nine Planning Principles for the Twenty-First Century*, Princeton Architectural Press, New York.

[40] Mitchell S., Villa N., Stewart-Weeks M., Lange A. (2013), "The Internet of Everything for Cities. Connecting People, Process, Data, and Things To Improve the 'Livability' of Cities and Communities", *www.cisco.com*.

[41] Moccia F. D. (2011), "Indirizzi operativi per un'urbanistica ecologica", in *id.* (a cura di), *Abitare la città ecologica. Housing ecocity*, Clean, Napoli.

[42] Moldavanova A. (2014), *Two Narratives of Intergenerational Sustainability. A Framework for Sustainable Thinking*. The American Review of Public Administration December 25.

[43] Mosannenzadeh F., Vettorato D. (2014), "Defining Smart City. A Conceptual Framework Based on Keyword Analysis", *Input2014 Conference Proceedings*, Naples.

[44] Mostafavi M., Dohery G. (a cura di) (2010), *Ecological Urbanism*, Lars Muller Publisher, Zurigo.

[45] Mumford L. (1938), *The Culture of Cities*, Harcourt, Brace & Co., New York.

[46] Murgante B., Borruso G. (2013), “Smart cities: un’analisi critica delle opportunità e dei rischi”, in *GEOmedia* n° 3.

[47] Odendaal N. (2003) “Information and communication technology and local governance: understanding the difference between cities in developed and emerging economies”, in *Computers, Environment and Urban Systems* n. 27.

[48] Onwuegbuzie A.J., Leech N.L., Collins K.M. (2012), “Qualitative Analysis Techniques for the Review of the Literature”, *Qualitative Report* 17, 56.

[49] Osservatorio Nazionale Smart City – Anci (2013), *Vademecum per la città intelligente*, Edizioni Forum PA.

[50] Pavia R. (2012), “Eco-logiche”, in *PPC* n. 25-26.

[51] Ratti C. (2014), *Architettura Open Source. Verso una progettazione aperta*, Einaudi, Torino.

[52] Reis M. (2014), “5 U.S. Cities Using Technology To Become Smart And Connected”, in *Forbes*.

[53] Ricci M. (2012), *Nuovi paradigmi*, List, Trento.

[54] Riva Sanseverino E., Riva Sanseverino R., Vaccaro V. (a cura di) (2014), *Atlante delle smart city. Modelli di sviluppo sostenibili per città e territori*, FrancoAngeli, Milano.

[55] Russo M. (2014), “Un’urbanistica senza crescita?”, in *id.* (a cura di), *Urbanistica senza crescita. Progettare il territorio contemporaneo*, Donzelli, Roma.

[56] Sassen S. (2013), intervista in https://opensourceurbanism.wordpress.com

[57] San Francisco County Transportation Authority (2010), *Strategic analysis report: The role of shuttle service in San Franciso’s transportation system*.

[58] Siegemund J, Koring D., Schulz J., Hanses K. (2013), *Smart City Concepts*, avedition, Ludwigsburg.

[59] UNEP United Nations Environment Programme (2011), *Cities Investing in energy and resource efficiency*, UNEP, London | disponibile on line su: www.unep.org.

[60] UN-Habitat (2011), Cities *and Climate Change: Policy Direction. Global Report on Human Settlements 2011*, Abridged Edition | disponibile on line su: www.unhabitat.org.

[61] UNEP (2011), *Decoupling natural resource use and environmental impacts from economic growth, A Report of the Working Group on Decoupling to the International Resource Panel*. Fischer-Kowalski M., Swilling M., von Weizsäcker E.U., Ren Y., Moriguchi Y., Crane W., Krausmann F., Eisenmenger N., Giljum S., Hennicke P., Romero Lankao P., Siriban Manalang A., Sewerin, S.

[62] Van Timmeren A., Henriquez L., Reynolds A. (2015), *Ubikquity & the Illuminated City*, TUDelft, DEI, DIMI, AMS, Delft.

[63] Vienna University of Technology, University of Ljubljana, Delft University of Technology (2007), *Smart Cities: ranking of European medium-sized cities*.

[64] Walker L. A. (2015), “Community-Level Engagement in Public Housing Redevelopment”, in *Urban Affairs Review*, January 5.

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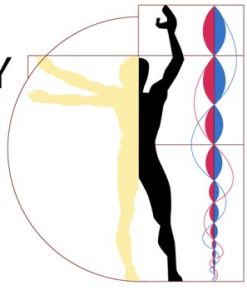

THE MUTABLE VISION: The study case of Montesanto Metro Station

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Abstract
The described "artifact", starts from the assumption that the weaknesses are turned into strengths, the "residual" becomes "resource". The vision of a space or a place coincides with the aspirations of a given generation and will depend on the economic, technological, cultural and political development in a given time. The actions of transformation of a place coincide with the realization of a vision.
The dynamic process of transformation of the natural and built environment, presupposes that the signs that are printed in the present establish continuous and variable relationship with all the signs that preceded them, thus giving rise to a complex system of relationships. The realization of real actions of transformation of the territory, will depend on the living conditions of the relative community.
It implies the contribution of those who live in the community and the determination of consequences never expected: in which the construction process of a vision of a place is determined by actions and by signs associated with human activities and associated with processes of spontaneous transformation.
The construction process is a process of dynamic transformation in which time is part of the project or artifact.
The time generates residues, which can be transformed into RESOURCE[1] through the modification and the mutation that the designer must already imagine and include in his VISION, because motivates, unites, coordinates, challenges, stimulates change, starts from the heart and you It combines with the mind.
By detecting the weaknesses, the project born and outlines.

Keywords: vision, time, residues, resource.

1. A journey inside the city structure and its elements
Montesanto Metro Station is placed in the historic city of Naples, in the Montecalvario neighborhood, belonging to that expansion segment of the seventeenth century intended by the viceroy Pedro de Toledo.
This is also evident from its regular system, set on a mesh checkerboard. The connections between neighborhoods, obstructed by the impervious shape of the ground, are divided into steep paths, often terraced, which thus become characteristic elements and from a certain point of view also fascinating if you consider that they can arouse the curiosity to the observer- visitor to follow them and find out where they lead or what views are able to reveal.
"No Theseus and Ariadne, if you should miss that it is really" [2]
From Corso Vittorio Emanuele, we climb down the first step and more we climb down more the view is filled with this mess of XVII century palaces of warm colors. These frame the edges of roads and streets that cross the neighborhoods, and depending on where or how you get there, salita Pontecorvo, via Montesanto, via Tarsia or via Pasquale scura lead us to the other large artery that is Via Toledo. Walking along it, you live the charm of the buildings and their historical entries, and then you find yourself in Piazza Dante, at whose right appears the entrance to Port'Alba. A such small street that already upon the entry you will see the end, and yet you may also lose hours to cross it only if you stop to scrutinize those stalls of used books,

where you can find newspapers and historical prints, which make me get goose bumps just to see and smell them, not to mention the titles printed on those almost yellowed pages that seem to carry you back in time.
But basically there is no need to read, because all these neighborhoods narrate a story by itself, and you can not stop the curiosity and the desire to walk again because you do not know what will show you the next corner ... the excavations in the Piazza Bellini or the Monastery of Santa Chiara with its beautiful courtyard garden, not to mention the charm of the craft and musical instruments shops that characterize via S.Sebastiano or the buildings that surround Piazza del Gesù Nuovo. Suddenly you feel the need to go back and go through all the paths, even those who appear to be more narrow and cramped, because you get the feeling that you will discover new things.
Here, by following calata Trinità Maggiore, you are in Piazza Salvo d'Acquisto, ready to sneak in the narrow alleys parallel to via Pignasecca.
Along these flagstone roads , ours is a walk looking upwards, under balconies of little more than half a meter, on which million flags (washing hanging in reality) seem to flutter. Yet there is no need to look up to peek into the private lives of the inhabitants, because along these alleys are located the so-called "BASSI", small houses on the street level: a large room with a kitchenette, a bedroom and a bathroom built in a corner, furniture a bit showy but always a vase full of flowers resting on a doily on the table. Someone has enclosed the small space in front the house, in order to spend afternoons chatting with neighbors or passers-by. Because will you believe to meddle into their affairs without being questioned in turn? It is not really difficult to approach these people, are almost always them to approach you, especially if they see you take pictures and consult a map. These meetings, we call them accidental, because they make us discover simple and kind souls which can provide more information of any guide book written on the historic center of Naples.

1.2 Historical and social analysis

Further along these historic roads, and through the homonymous road long less than a kilometer, we reach the Pignasecca.
Among the most popular and populous area of the city, the Pignasecca is the location of the most famous food open-air market of the city. Upon it they show pizzerias, bakeries and other activities, while the sidewalks are prey for peddlers. You walk with difficulty among those loaded with the daily shopping and users looking for bargains that run towards the tram, the metro or Cumana (a step away from Pignasecca). An eternal market, especially on a Sunday morning with the fish and fruit stands ... and in its season, the smell of oranges and tangerines.
Here is why, in this street, you need to walk making acute the sense olfaction, to fully experience the transmitted sensations and then leave to the sight the enjoyment of the colors and pulsating life.
Here really you can find the heart of the city, its people, men and women of all classes and all tempers. This place is a good starting point to undertake the study of the social reality of the area.
From a socio-cultural point of view the illiteracy rate remains significant although it affects mostly the elderly and adult classes.
The holders of higher qualifications, university and high school degrees reach almost the 36% and the incidence of people with no educational qualifications is the 11.18% (11.31% Napoli).
However you measure it, the level of education highlights the economic and social disparities among the population.
So in this area the employment rate amounts to 28.89% while the unemployment rate to 30.4%. The 97.97% of buildings for residential use, while only 2.85% are buildings used for hotels, offices, business ...
Montesanto Metro Station of the line 2 is surrounded by via Olivella and Vico Montesanto.
It plays a role of interchange with the Cumana Circumflegrea railways and the Montesanto funicular, as well as being a few steps from the Corso Vittorio Emanuele, Via Toledo and Largo Pignasecca.
In the representation in Figure 1, it has been outlined the study carried out on a smaller area, of which has been analyzed present activities and flow of citizens and commuters.
This kind of analysis has allowed us to know the different categories of users of the metropolitan service, such as:

- Tourists visiting the historical center
- students of the middle and higher classes
- Citizens seeking deals at the open- air market of Pignasecca
- Workers from different sectors
- Commuters to and from the Cumana
- Citizens visiting the Pellegrini hospital



Fig. 1: Scheme of the path to reach Montesanto Metro Station

The metropolitan building is placed in an area of about 1700 square meters, divided by the architecture itself, in two regions: one behind the metro, uncultivated and fenced, the other on the front, open to the public. (Fig. 2) The square is surrounded by buildings of before the nineteenth century, visibly defaced by time and by the actions of private individuals, especially in that strip of the road along which are placed three small business activities (a bookshop, a body shop and a rotisserie - bakery) .
The main entrance is located along the walking line that comes from the south-east of Via Olivella, where the flow of commuters is greater.
The space of the square is divided by eight curved flower beds, fenced and uncultivated. The presence of tall trees within them increases the dispersion of the resulting paths, creating dark spaces, empty and isolated, used by few people who prefer to retire.
These among other things also become points of support for street vendors positioning themselves along the direction of access to the subway and try to take advantage of the flow of commuters to sell products as diverse as plants, books, cd ...
The result is the block of the flow of people, especially those in a hurry to catch the train. If we add the lack of maintenance and the lack of benches, we come to the conclusion that this area gives up to the aggregative and symbolic potential that the presence of a metro can provide.

The building, dates back to 1925, appears in its regular plan, a cross-shaped base of 300 square meters, completely uprooted from the context side from the use of yellow and red colours in the facade that reflects the tone of the surrounding buildings.
Inside the metro it was expected the presence of commercial premises that, however, to this day are closed with the exception of a tobacco. The rest of the area is attributed to the control and technological equipment rooms, so all that remains to citizens is a space corridor that connects entry and exit and from which to access to the escalators leading to the trains; no attention is paid to the desabale.



Fig. 2: The sourronding study area

2. The vision: Montesanto Metro Station

The Project starts from the assumption that the weaknesses are turned into strengths, the "residual" becomes "resource".
The vision of a space or a place coincides with the aspirations of a given generation and will depend on the economic, technological, cultural and political development in a given time. The actions of transformation of a place coincide with the realization of a vision.
The dynamic process of transformation of the natural and built environment, presupposes that the signs that are printed in the present establish continuous and variable relationship with all the signs that preceded them, thus giving rise to a complex sistem of relationships. The realization of real actions of transformation of the territory, will depend on the living conditions of the relative community.
It implies the contribution of those who live in the community and the determination of consequences never expected: in which the construction process of a vision of a place is determined by actions and by signs associated with human activities and associated with processes of spontaneous transformation.
The construction process is a process of dynamic transformation in which time is part of the project or artifact.
The time generates residues, which can be transformed into RESOURCE through the modification and the mutation that the designer must already imagine and include in his VISION, because motivates, unites, coordinates, challenges, stimulates change, starts from the heart and you It combines with the mind.
By detecting the weaknesses, the project born and outlines.

RESIDUES	RESOURCE
1. presence of dead space **2. poor organization of flows** **3. presence of street vendors**	To design an open space, where the paths are defined lightly, without creating visual obstructions and without providing any kind of support useful for vendors.
4. inadeguate lighting **5. shortage of seats**	Though this must be a place mostly lived during the day, this does not imply that at the sunset must be created spaces of shadow due to poor lighting. The objective is to design equipment to illuminate both the street and the square and then to use the spot light to emphasize the formal choices. The problem is solved by creating long sittings around the edges of the square.
6. problem of vandalism **7. poor maintenance**	the polished concrete is a material that responds very well to the needs of poor maintenance and to wear of the time, as it is very difficult to scratch. To prevent the problem of graffiti it can be used a finishing system, manufactured by Sikkens, called Alpha Anti-graffiti that allows the removal of graffiti with the simple use of pressurized hot water and the treated surface becomes hydrophobic and smog deposits are removed by rainwater.
8. narrow metropolitan area **9.absence of comfortable break spaces** **10. lack of services for disabled**	The metropolitan area is so conceived not as a mere place of passage, but also to stop, where you can enjoy a large outdoor space, a bar-tobacco and the warmth and brightness of the light that comes from natuarale large windows.The path for the disabled has been designed and enabled through the placement of elevators and the expansion of the platforms.
11. savings and energy gain **12. absence of meaning**	What we believe is necessary in a structure, especially public, it is the recognition, the presence of an identity, something that expresses a meaning that tease the mind of the observer. Through the study of the positioning of transparent parts and the use of coatings with integrated photovoltaic system, it will also ensure the saving of electricity, making the most of the sunlight that certainly is not lacking in this city of sun and sea.

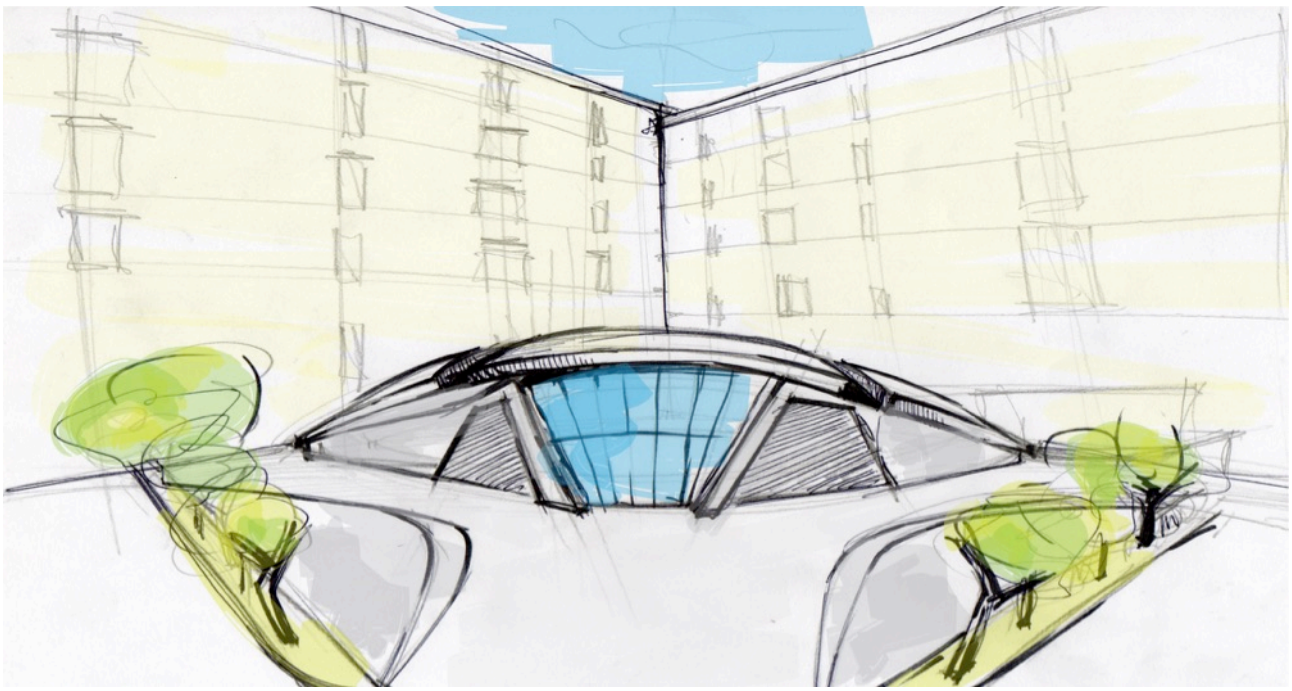

Fig. 3: Sketch of the vision

The square has been freed from any decorative element; the roles have been inverted and so the polished concrete it is the master, while the vegetation marks its boundaries. In the southwest, the level of the square

is linked to that of Vico Montesanto by a staircase, whose sinuous lines beckon the visitor to go along to be able to observe the square from the top, both by day and by night. The landscape, free from any visual barrier, reveals the architecture. The structure takes shape from a half-open seashell that invites passers to discover it and to live not only the interior but also the outside space on which it lies. In a sea bed, corals and shells are treasure while references for those who explore. In the city of Naples, the historic fabric is certainly valuable ... a backdrop, why the poles of connection, such as railway, belong to the class of distinctive items, useful to locals and visitors ...., they should be "corals and shells". The triangular building, about 700 square meters, is directed towards the east. The predominant materials in it are essentially three: concrete, glass and aluminum. The concrete constitutes the perimeter walls and the curved facade. The center is dominated by a huge window also trapezoidal, made up of 16 glass panels fixed to a steel structure with metallic spiders that catch the light from the sun when it is facing east. The choice of glass was driven by the goal of making visible the inside and not to conceal, as is usually the case, the stairs and elevators that lead to the trains. The cover is the main reminder of the conchoids shape, thanks to its curved silhouette consists of aluminum panels (with integrated photovoltaic system), it settles on the walls and tilts upward. On the surface there are a series of cuts glazed. The largest, drop shaped (long 20m and larger diameter 3m), illuminates the interior space by capturing the afternoon light, thanks to its inclined position towards the west. Two more cuts, thin (1 m wide), follow the shape of the cover, recalling the veining of the shell, capturing the light from the north-west and south-west, increasing the interior lighting and projecting on the ground two rays of light which outline the two paths from the inside to access



Fig. 4: *Ante and post operam*



Fig. 5: *Ante and post operam*

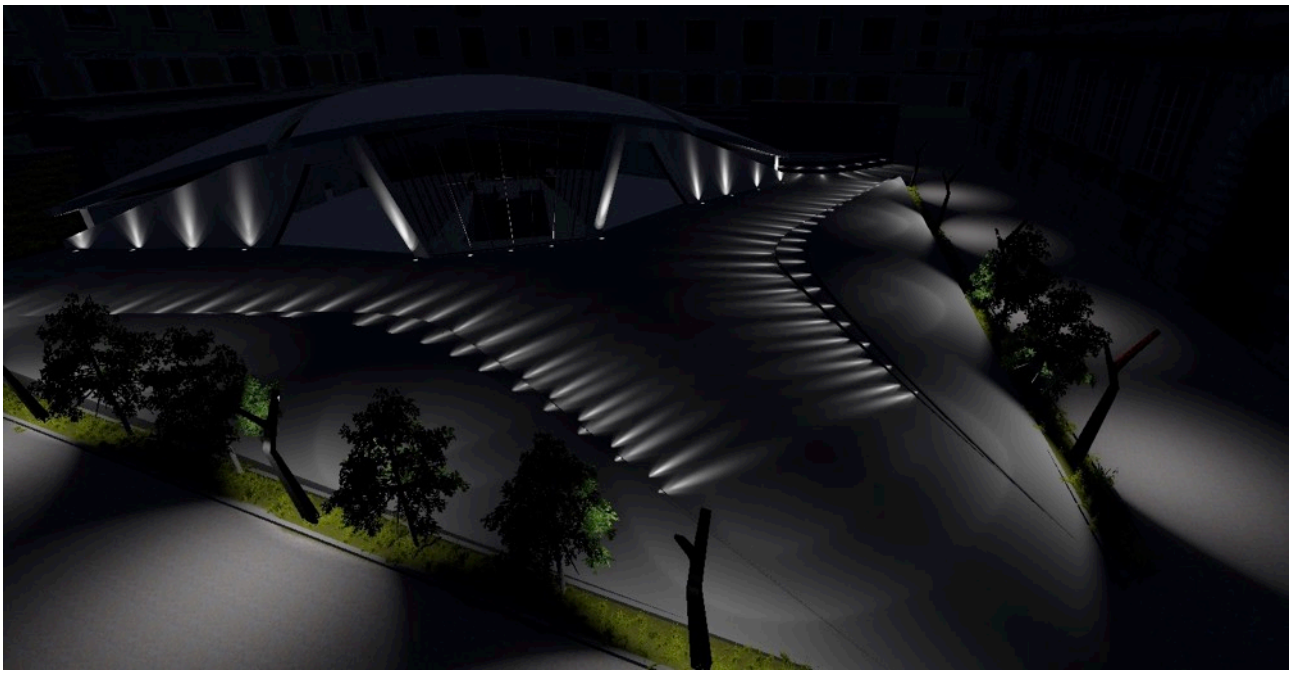

Fig. 6: Night view



Fig. 7: *Ante and post operam*

Bibliographical References

[1] CLEMÈNT,Gilles. *Manifesto del Terzo paesaggio.* (Translated by QUODLIBET). 8ª ed. Macerata, 2004. ISBN 88-7462-048-9

[2] PALUMBO, Agnese. *101 cose da fare a Napoli almeno una volta nella vita*. Newton & Compton. Roma, 2008. ISBN13: 9788854112254

NUNEZ Joao. *Landscape Architecture*. Area. (N.127).Tecniche Nuove .Bologna, 2013. ISSN 0394-0055

ARCHITECTURE-STUDIO. *La città ecologica, contributi per un'architettura sostenibile.* (Translated by Nick Hargreaves)). SilvanaEditoriale. Roma, 2009. ISBN 978-8-83661-377-9

LYNCH Kevin, *The Image of the city.* (Transleted by Guarda G.C.). MarsilioEditore. 2006. ISBN 978-88-317-7267-9

NORBERG-SCHULZ Christian. "*The Phenomenon of Place" from The Urban Design Reader.* 3ª ed. Michael Larice and Elizabeth Macdonald. Great Britain. 2011. ISBN 978-0-415-33387-0

NORBERG-SCHULZ Christian. "*The Phenomenon of Place"* in *The Urban Design Reader.* 3ª ed. Michael Larice and Elizabeth Macdonald. Great Britain. 2011. ISBN 978-0-415-33387-0

H. WHYTE William. *"Introduction", "The Life of Plazas", "Sitting Space", "Sun, Wind, Trees, and Water"* in *The Urban Design Reader.* 3ª ed. Michael Larice and Elizabeth Macdonald. Great Britain. 2011. ISBN 978-0-415-33387-0

HESTER Randolph, *"Neighborhood Space"* in *The Urban Design Reader.* 3ª ed. Michael Larice and Elizabeth Macdonald. Great Britain. 2011. ISBN 978-0-415-33387-0

METRO (The Greater Portland Regional), "Green Streets" in *The Urban Design Reader.* 3ª ed. Michael Larice and Elizabeth Macdonald. Great Britain. 2011. ISBN 978-0-415-33387-0

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"Environmental networks" as complex management tool of the urbanized territory

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Abstract
In recent years, ecological networks are taking on an increasingly strategic role in regeneration policies of the territory and the landscape for their prerogative to be a tool aimed to biodiversity conservation through the identification, protection and connection of habitats and more generally of natural areas. In heavily anthropised areas such aspects have to be included in the transformation strategies both in order to recover the compromised areas, but also to connect with each other elements of naturalistic diffused quality present on the territory and necessary to promote the spatial diffusion of plant and animal species. Currently a large part of human activities take place in technological complexes supported by systems of infrastructural networks and integrated with the environment in which are placed through relationships increasingly complex. In order to tackle the problems associated with sustainability of urbanization, deepening the dynamics of interference between natural and anthropic aspects, it is proposed the integration of infrastructural and ecological networks that generates a new type of network, defined environmental, which takes account not only the supply and flow of matter and energy, but also the quality of ecosystemic processes and the preservation of biodiversity. Taking a cue from these issues this paper aims to provide method indications concerning the urban regeneration interventions of sensitive areas with particular reference to a specific context as the territory of Pompei in Campania within of the CAMPUS project *"Ecoturismo urbano per la fruizione sostenibile dei Beni culturali in Campania"* (Scientific director: prof. arch. Carmine Gambardella) - Benecon SC.aR.L.

Keywords: urban eco-system, ecological network, infrastructural networks, environmental rehabilitation

1. An environmental-ecological approach to sustainable management of the urbanized territory (Rossella Franchino)
One of the problems related to increasing urbanization is that of protecting the local environmental conditions from the impact of development and anthropisation.
To take action on the development of the urban territory in order to find an alternative to the model that has emerged over the last century, the transformation and rebalancing interventions have to give particular attention to environmental compatibility.
In this perspective, the territory must be conceived as an organism with a dynamic equilibrium achieved through the technological control of complex functions. A compatible and sustainable territory must therefore be configured as a usable environment with quality and safety, along with high ecological-environmental standards, in which each process is controlled so that its impact and consequent induced irreversible degradation is minimized as much as possible in relation to the constraints of the process itself.
The territory, which is an "urban ecosystem", with its complex of interrelated structures and relationships generates its own path in the surrounding environment. In order to improve the ability to absorb and control the phenomena of urbanization, with a sustainable impact on the ecosystem, it is very important to structure the rebalancing interventions so that they are compatible with the sustainable changes of the environment in which they are located and then orientate the processes so that the uneliminable imprint is contained as much as possible [1].

An approach to the management of the urbanized territory necessarily requires carefully identifying the possible interference between the natural and anthropised aspects with the issues related to sustainability of urbanization, conservation of the biodiversity, control of land use and territorial fragmentation.
The protection of the biodiversity passes through the connection to the network of the habitats, and more generally, of the natural areas, since it is the fragmentation of the natural environment, i.e. in the gradual division of a basin of naturalness into ever smaller and isolated fragment due to the direct action of man, that is one of the most serious threats to ecological diversity [2].
Fragmentation has the immediate consequence of isolating the natural environment, with eventual repercussions on the ecological conditions, causing the reduction and, in some cases, the destruction of any biological populations present. The main causes of the fragmentation process are mainly due to urban growth, the exploitation of the soil through intensive agriculture, as well as the distribution in the area of infrastructure networks responsible for material and energy flows, data transfer, etc.
The redevelopment interventions of the area must be carried out with particular interest, among other aspects, to the ecological conservation of the biodiversity in order to safeguard the natural processes that form the basis of the survival of ecosystems. Particular attention should be given to ecological networks, which are one of the tool that allow to carry out redevelopment interventions of the countryside within the context transformed by man.
It is therefore obvious that an organic restructuring of the network system that takes into account not only the ecological aspects but also other environmental issues related to the water, air and soil subsystems can be important for a sustainable land management, with the need to safeguard the interests of the species present as well as conserve the biodiversity [3].

2. The environmental network as an extension of the infrastructure network model (Rossella Franchino)

Facing the problems of the territorial rehabilitation, we must consider that currently the human activities are developed in technological complexes integrated with the environment, where they are placed, and through more and more complex relationships, many of which based on exchanges of energy or energy products and on waste disposals.
These exchanges or distributions are supported by either networks in continuous service or non-continuous vectors that determine two ways of relationship; between them the networks play a prevailing role for their characteristics of continuity, availability, flexibility, measurability of the service.
In the urbanized areas the traditional "network distribution" happens through infrastructures that may include:

- communication networks;
- relationship networks;
- energy supply networks;
- networks for the integrated cycle of the waters;
- networks for the waste management.

A network is a programmable and repeatable system of supplies of performances, information exchange, conferring of products, energy transmission, transport of things and people, arranged and built so that, unless an accidental failure, it is always available on users' request. As the infrastructural networks on the territory constitute a mesh made up of knots and connections, which aim at establishing relationships with all the fluxes of material and energy, it is important that, in the interventions of urban environmental rehabilitation, they are connected with the ecological and landscape networks; these networks play an essential role in this kind of interventions.
Therefore, we propose in the ambit of the interventions of rehabilitation of the territory to reserve an important role to the reconfiguration of the network system, so that, from the integration among the infrastructural, ecological and landscape networks, a new kind of network can be created, that can be defined as "environmental", considering not only supplies and fluxes of material and energy, but also the needs of water, air and ground environmental subsystems.
The concept of environmental network doesn't define a different network, both physically and for performance from a tout court infrastructural network, but an infrastructural network that is managed, from planning to construction, operation, disposal, with a special viewpoint of insertion in the environment and qualification of the environment, with compatible and sustainable ways.
This is with the purpose of conservation and rehabilitation of the natural resources present on the territory and connection between the environmental and landscape values of the areas for an overall valorisation of the territory. Therefore, it is essential to individualize the ties of the energy and mass networks with the environmental base, where they make the service, so that they optimize some configurations for which the networks assume the qualification of environmental networks in relationship with the various typologies of urban and territorial contexts.

In the intervention of urban rehabilitation, studying the control of the transformations of the environmental condition with the aim of conservation and preservation, through the close examination of the environmental networks, means to face it with an integrated approach, without reducing it to a sectoralisation of problems involving complex, interrelated, diversified and specialist aspects [3] [4].

3. Application to the case study of Pompei in Campania (Rossella Franchino)

These considerations, developed by the author in previous studies, have inspired the research that is reported methodologically in the paragraphs below and that relates to the identification of technological strategies for the eco-oriented redevelopment of the natural spaces in anthropised contexts with particular reference to improving the ecological and environmental quality.
In particular, the study, which is part of the CAMPUS project "*Ecoturismo urbano per la fruizione sostenibile dei Beni culturali in Campania*"" (Scientific director: prof. Arch. Carmine Gambardella) - Benecon SC.aR.L. was applied to the sensitive context of the territory of Pompei in Campania, which is an area with a high archaeological-cultural-historical value.
In addition, the context of Pompei is particularly significant for the purposes of this research due to the mass urbanization, which is characterized by natural spaces that have been damaged by anthropisation (e.g. the Sarno river which has a poor water quality and whose banks are cemented in many places and often without vegetation) and intersected by a complex network of infrastructures (e.g.: roads, motorways, railways, bridges, water treatment plants, distribution systems for electricity) that have contributed to altering the natural landscape, fragmenting the territory as well as changing the eco-systemic quality of the context as a whole. Subsequently, the research has focused on identifying eco-oriented redevelopment strategies, with particular attention being given to the eco-systemic analysis and environmental improvement interventions for the restoration of the connection elements, along with the physical and functional continuity for the construction of the ecological network for the territory under study, which is characterized by a dense urban matrix.
The construction of the ecological network, particularly important since it defines the ecological connection, is necessary for the future definition of the "environmental network" that comes from the integration of the infrastructure, ecological and landscape networks and will incorporate the needs of the water, air and soil sub-systems in which it is customary to divide the environment with those of ecosystems and those of the users of its territory. By combining both the ecological and environmental aspects with the social and economic ones of the territory, the environmental network can become an important tool for the sustainable management of the anthropised territory. Proposing the study of the networks with the environmental viewpoint means to approach a complex model, which can be traced back to a synthesis, that can be easily assimilated and make us realize a matter of great importance: in the planning, construction and operation phases of networks connected to either infrastructures, or single buildings or generally urban complexes, quality, safety and reliability can be added, which valorise the environment without damaging it. Valorising the environment means getting back levels of quality, which it had before human-made interventions happened in the time, that is, in some cases, bringing its quality even at higher levels, if possible.

4. The ecological network in the territory of Sarno River Basin (Raffaela De Martino)

In anthropised landscapes urbanization and infrastructuring of the territory have determined, along with the practices of agricultural mechanization and water drainage of water courses, a trend towards simplification and standardization of the landscape, and the separation of "natural" and "renaturalized" areas who lost with the passage of the time elements of contiguity. For this reason it is said that the territory is fragmented [5].
In recent decades, advanced studies in the field of ecology have made it possible to understand the ecological consequences of the phenomena of territorial fragmentation, while also highlighting the need to counter them through the creation of an ecological network capable of existing with the network systems of the city. The ecological network, defined as a system of interconnected habitats that maintain biodiversity, basically consists of areal elements and linear elements. The areal elements represent the "biodiversity tanks" for many species, while the linear elements allow the functional habitats to be connected and are available for the wildlife, combating fragmentation and its adverse effects on biodiversity.
From these questions, the paper aims to give methodological indications for the construction of an ecological network for the territory of Pompei in Campania as part of the Campus Project "*Ecoturismo urbano per la fruizione sostenibile dei Beni culturali in Campania".*

4.1 The territory under study

The definition of the limits and size of the area to be analysed is a delicate phase since it is from this that the effectiveness of the subsequent ecological assessment depends.

The area under study is the territory of the city of Pompei, with the research aiming to carry out an eco-systemic analysis as well as identify the main elements of the "local" ecological network, capable of connecting to the next level. It is, however, clear that a comprehensive environmental assessment cannot be limited to the municipal area of Pompei but has to consider the broader environmental system of which it is part, along with the main corridors of territorial connection. The river Sarno is of particular importance, with its tributaries being an important element of the regional network, since they are connection corridors between the Vesuvius National Park and the Regional Parks of Lattari and Picentini mountains.



Fig. 1: The Sarno River between the major regional natural basins (Source: elaborated by R. De Martino)

Hence, the need to extend the scope of the study to a wider area and specifically to the territory of the Regional Park of the Sarno River which is part of the city of Pompei.
The territory of the river basin of the Sarno has been severely damaged by continuous anthropic aggressions over the last fifty years: water supply at the source, intake of agricultural, civil and industrial pollutants, illegal dumping, overbuilding and the cementing of long stretches of the river banks have led to a drastic eco-systemic and ecological depletion. Numerous studies have highlighted how the quality and river dynamics are influenced by the conditions of the surrounding area. The river is, in fact, a living ecosystem, not only inside but also in the relationships that it physically and ecologically establishes with the local landscapes. It is therefore clear that an environmental requalification of the area, aimed at the creation of a local ecological network, should aim to rebuild the long-term balance between the territory and the river network.

4.2 Methodology

The methodological scheme for the construction of the ecological network includes several phases:

- eco-systemic/ecological analysis;
- identification of the ecological territorial network;
- comparison of the ecological territorial network with the initial analysis;
- identification (if any) of the environmental improvement interventions on the previously identified network elements.

The construction of an ecological network implies respecting two conditions: the first is that the environmental units constituting the landscape are characterized by an adequate level of quality; the second is that an ecological connection between these units is ensured. To test these conditions, it is necessary to preliminarily analyse the territory in question through an eco-systemic/ecological approach.
The ecosystemic analysis is based on ecological indicators and analytical-descriptive methods, already present in current literature and aimed at highlighting the level of ecosystemic equilibrium of a specified territory and the level of territorial fragmentation.
One of the most used tools to analyze the state of the environmental health in a specific area and able to return a graphical model that schematically represents the level of ecological connection of a given territory, is the Ecological Graph. It is based on the definition of the environmental system as a *combination of different landscape units in structure and function, characterized by different degrees of connectivity and related by exchanges of energy, with more or less rapid evolutionary processes* [6].

This model can be represented by a graph consisting of nodes (landscape units), links (energy and matter exchanges) and a set of rules that govern the relationship between the nodes and links. Landscape units are defined as portions of landscape, made up of different biotopes (unit of the physical environment in which the life of a single population of organisms or biological association takes place) identified and delimited by elements of anthropic network (roads, railway lines, settlements) that, overlapping the natural network, divides it into units.

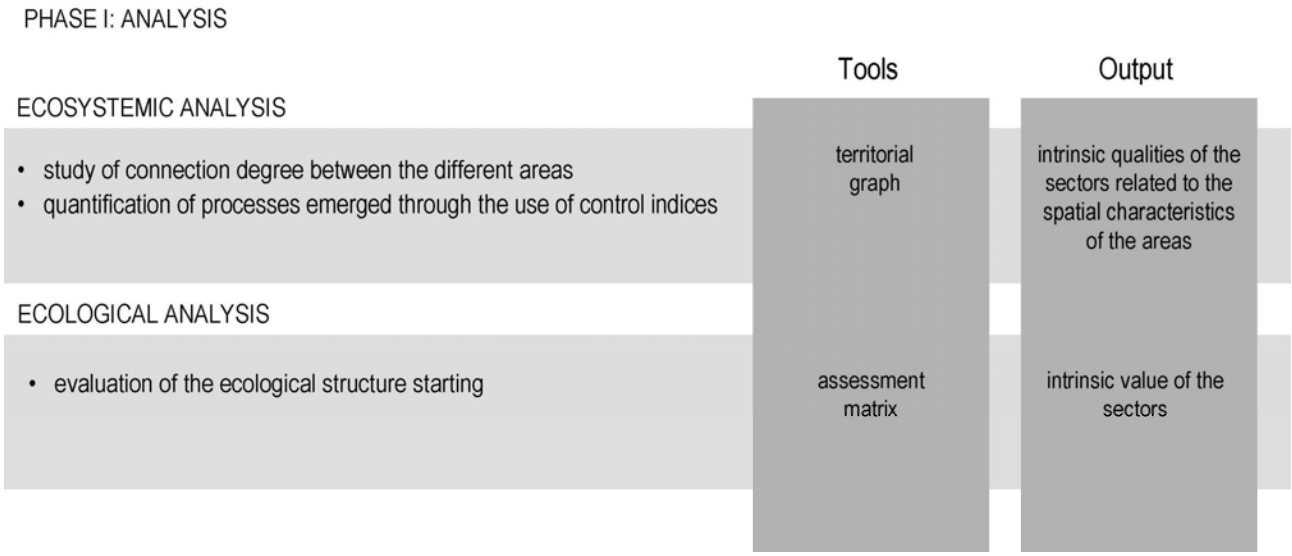

Fig. 2: Ecosystemic/ecological analysis (Source: elaborated by R. De Martino)

While within each unit the circulation of matter and energy is not hindered by the presence of significant barriers, the circulation between the various units is heavily conditioned by the anthropic network elements that produce a barrier effect whose greater or lesser permeability depends on the type and characteristics of the ecotonal elements. The evaluation and quantification of spatial dynamics is possible using some control indexes. The main control indices used are the level of bioenergy and the level of flows between units [6].
The first represents the static component of the system, i.e. the resources allocated within the sectors; the value of the flows between units represents the dynamic part of the system and it estimates the amount of possible functional exchanges between the sectors, taking into account the type of sector boundary.
The results of this evaluation, conducted on each sector, allow constructing an ecological graph for the environmental system examined. The Ecological Graph allows to know the trend of the interactions that occur in the analyzed territory, provides very accurate and operational directions to guide ecologically sustainable interventions and allows to objectively describe territorial fragmentation.
Identified and quantified the territorial fragmentation through spatial indexes, it is necessary in order to complete the analysis phase, to collect various informations related to the environmental analysed system to define and assess the starting ecological structure. To do this it's used to an ecological analysis which assesses the territory in question, according to some parameters: predominant land use, functional coherence of the elements, naturalistic interest according to the prevalent use, health status of the area, status of the surrounding sectors, position in the ecological fabric, water quality of the scope, quality of the banks of the scope, presence of large artificial barriers, bird species diversity, fish species diversity, role in the ecological network, presence of rare elements.
Each area is then evaluated according to the above parameters, each through a score between 0 and 1. Each area is judged for each attribute not absolutely but in relation to other areas, so that the maximum score is assigned to the that, with respect to the other, has the best conditions for that parameter. The partial scores, for each sector and for each parameter of evaluation, are placed in a matrix. Summing the partial scores is obtained a final score for each sector. Total scores are divided into classes of values that classify the territories under conditions of increasing environmental quality.
After the analytical phase (ecosystemic and ecological) we proceed to the construction of ecological network for the territory in question. This means identifying the territorial elements that can take on the role of network core areas and the most important ecological connections.
The identification of network elements on the territory is possible through the application of criteria landscape/structural and biological/functional. The landscape/structural approach involves identifying of environmental entities that, due to their spatial and structural shape, may belong to the potential ecological

network. However, the connectivity of a system is determined, as well as structural parameters, also by biological/functional parameters that take into account the behavioral differences of the different species on a territory.
The method involves the following operating steps:

- selection of a subset of representative species of the ecosystem studied (focal species);
- development of a behavioral model of focal species specimens motion compared to various land uses (impedance model);
- identification of potential networks for focal species and their composition in a single network potential [7].

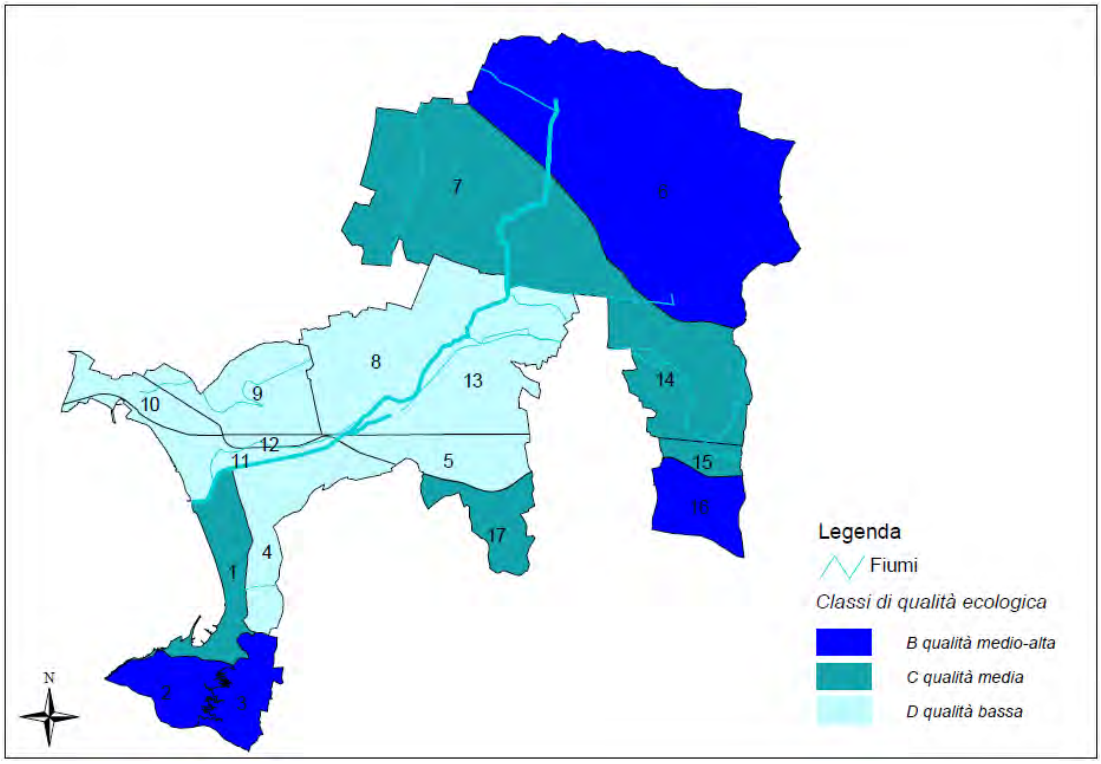

Fig. 3: Sarno River Basin: ecological analysis (Source: elaborated by R. De Martino)

Finally, the method requires the comparison of the ecological network identified with the results of the ecological analysis carried out in the initial phase of the work.
It's obvious that for the network to function properly, it is necessary that the structural elements (areal or linear) that compose it are characterized by an appropriate ecological-environmental quality. If this condition is not met then it will be necessary to prepare a series of environmental improvement interventions, in order to implement the overall level of local ecosystems quality [8].

Bibliographical References

[1] FRANCHINO, Rossella. *Green and blue infrastructures to naturalize built urban contexts*. In: HoPUE - *Housing Policies and Urban Economics*, 2014 - Vol.1 - No 1, p. 91-101, Print ISSN 2385-1031 - Online ISSN 2385-0671

[2] DE MARTINO, Raffaela, FRANCHINO, Rossella. *Le reti ambientali nella gestione della complessità del paesaggio urbano.* In: *TOPSCAPE PAYSAGE* - Overview, Allegato al n. 9/2012 - ISSN 2279-7610

[3] FRANCHINO, Rossella, AMORIM, Miriam, NIGRO, Matteo. *Le reti ambientali come incontro tra due complessità - Environmental network as a match between two complexities*. Napoli: La scuola di Pitagora editrice, 2011. ISBN 978-88-89579-41-1

[4] FRANCHINO, Rossella. *Le reti ambientali nel progetto di riqualificazione urbana*. Napoli: Arte Tipografica Editrice, 2006. ISBN 88-89776-29-3

[5] FIDUCCIA, Andrea. *Rapporto finale relativo allo studio per la realizzazione di una metodologia idonea all'individuazione degli elementi di connessione ecologica territoriale attraverso l'ausilio delle tecniche di analisi spaziale supportate da tecnologie GIS*. MondoGIS, 2003

[6] FABBRI, Pompeo. *Principi ecologici per la progettazione del paesaggio*. Milano: FrancoAngeli, 2007.

[7] FIDUCCIA, Andrea, FONTI, Luciano, FUNARO, Marina, GREGARI, Lucilia, RAPICETTA, Silvia. RENIERO, Stefano. *Strutture di informazione geospaziale e processi di conoscenza per l'identificazione della connettività ecosistemica potenziale.* In SITZIA, Tommaso & RENIERO, Stefano (a cura di) *Reti ecologiche: una chiave per la conservazione e la gestione dei paesaggi frammentati*. Atti del XL Corso di Cultura in Ecologia, 2004

[8] DE MARTINO, Raffaela. *La rete ecologica per la riqualificazione di ambienti fluviali*. Monfalcone (Gorizia): EdicomEdizioni, 2014.

HERITAGE and TECHNOLOGY
MIND KNOWLEDGE EXPERIENCE
XIII International Forum Le Vie dei Mercanti
Aversa, Capri 11-12-13 June 2015

Urban Regeneration - Largo Ex-Gesuitico - Piazza A. Moro - Ortanova (FG)

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Abstract
The redevelopment of the square stands as the necessary work in order to make decent urban area overlooking the Palace Jesuit, that, in fact, is the emblem of the municipality of Orta Nova, as well as headquarters of the Union of Municipalities of the Five royal Sites. it Is a historic building that embodies both the history of the City of "Orta", is the story of the Five royal Sites.
The objectives aim to meet the demands and needs of citizens by providing a road system that allows staff mobility vehicular, bicycle and pedestrian safety and functional, giving new spaces can also be used for outdoor events.
The project aims to change the perception of space through the use of a new paving a new system of street furniture and a new lighting system.

Keywords: urban regeneration

1. Identification of action was in fact
The redevelopment of the square stands as the necessary work in order to make decent urban area overlooking the Palace Jesuit, that, in fact, is the emblem of the municipality of Orta Nova, as well as headquarters of the Union of Municipalities of the Five Royal Sites. It Is a historic building that embodies both the history of the City of "Orta", is the story of the five real sites, organized in Union City in December of 2008.
In fact, the existence of the site "Orta" seems attributable to the twelfth century: the place name is in fact mentioned for the first time in a document of 1101, and then in a contract of 1157. But it is in the Swabian period that the settlement enjoyed his moment of glory. The Emperor Frederick II, the Puer Apuliae notoriously enamored of Apulia, and the captains in, actually chose this place for residential and productive purposes: built his palacium, identifying a defensa (the wooded area where only he could hunt), creating a farm and a marescallia (horse breeding) for the agricultural use of the land. And always at Orta Manfredi, in 1263, he issued his Datum Orte with which founded the city of Manfredonia. In 1611 the Jesuits of the Roman College acquired for 57,000 ducats the feud Orta - which also included those of Stornara and Ordona - giving rise to the "Casa d'Orta": also called Residentia Asturnariensis named Stornara, who was the first possession purchased. After 150 years, in 1767, the Jesuits were expelled from the Kingdom of Naples; and in 1774 was implemented "a census of Tavoliere", ie the allocation of plots of land to farmers destitute. This led to five colonies, which the following year was named the five Royal Sites: Orta and, with 105 settler families target of 10 versure of land, it was one of those. The census, however, were held for a short time this land, who returned to the Royal Treasury before being sold to nobles as Matthew Scherini and Duke Nicola di Sangro. In 1806 Orta became independent, in 1862, changing its name to the current one of Orta Nova. The monuments disappeared, unfortunately, the ancient church of Santa Maria delle Grazie, built by the Jesuits in 1620, as well as the Palazzo Arcieri, which surrounded the ancient Jesuit grange and had a stone inscription on the building of Palacium of Federico II, Orta Nova does still have the former Jesuit building, with its small belfry and the bell tower, a building erected on the ruins of the imperial residence, which later became the seat of the Royal Customs prosegretario Sheep, home of the City, police station,

School and District Court, and today the town library and cultural associations and the Union of Municipalities of five Royal sites.
Building's historical importance is the need to restore dignity "urban" at Palazzo former Jesuit, through improvements in the square outside, eliminating the driveway and equipping this space in urban square. The elimination of the path driveway will allow the use of the square from the people, including the organization of outdoor events. The square will then be provided with street lighting, trees and benches, necessary for its full fruition.
Full reconstruction surgery the space in front of the church of Our Lady of Sorrows (Piazza A. Moro), the project involves, as Largo ex-Jesuit, new flooring, replacement of the public lighting and the new furniture system, setting up a perfect plan churchyard for special religious occasions.
The share of new flooring is the current share of the sidewalk, the choice is suggested by the desire to revive the historic paving flagstones white, originally made of stone like "toed" of Trani, as evidenced by the few identifiable remains intersection with Corso Giacomo Matteotti.
Upon the recommendation of the City Administration, technically assessed the needs and priorities expressed by it, have been identified interventions, which will then be covered by this project, covering the following stretches of road:
1. Largo Ex-Jesuit;
2. stretch of Via Veneto;
3. Piazza A. Moro;
The areas to be redeveloped are currently paved with basalt (lava stone), bitumen and concrete tiles. The blocks are set in place on a bed of sand on the background in mixed stabilized (natural). In these areas there are sidewalks in relief bordering the roadway. The cross section of the road is shaped with double slope and watershed line positioned so that the rain water flow towards the axis road (via Trento and Via Matteotti). The sidewalks are raised and are paved with concrete tiles.

1.1 Goals
The objectives aim to meet the demands and needs of citizens by providing a road system that allows staff mobility vehicular, bicycle and pedestrian safety and functional, giving new spaces can also be used for outdoor events.
In fact the "Largo" or "square" in front of the Palazzo former Jesuit is currently occupied by a driveway that connects the Corso Giacomo Matteotti the Via Vittorio Veneto. Besides this path driveway, a wide sidewalk, unused and free from any street furniture, is located adjacent to the Palace, while a sidewalk, much narrower and shabby around the seat of the municipality of Orta Nova, overlooking the Jesuit. The paving materials currently used are dark lava stone blocks and blocks of limestone from Trani (these apparent intersection with the Corso Matteotti), then the space behind the Jesuit and the building of the Municipality industrial flooring tiles of concrete.

1.2 Work To Be Done
Flooring
Interventions for the renovation and repositioning of the road surface, regardless of the existing floor, involving the removal of both the top layer (blocks, stones or asphalt layers) and the substrate (where it is not reusable). Such an intervention is necessary in order to create a foundation layer of appropriate characteristics of resistance and rigidity, such as to ensure the stability and the duration of the new pavement.
In particular, it must provide the maneggiatura, masonry and materials for moving share of manhole covers and drains.
The new floor will consist of a band of basalt lava stone reused (area north of the fountain), and hammered tiles stone Trani separated by strips in Trani white tiles placed in line on the left side of the Church is expected repositioning of paving stone of Trani existing. Piazza A. Moro there is a homogeneous floor in Trani stone hammered. These elements have high resistance, durability, friction and slip. The road section will have the same configuration of the existing one (in the stretch of Via Matteotti). The substrate of the flooring will be constituted, starting from the ground portion, stabilized by mixed and overlying concrete screed with interposed metal net.
Basically it involves the repaving of Largo ex-Jesuit and Piazza A. Moro.

Electrical and lighting
The public lighting system required by the project is completely new for materials and positioning, being provided at strategic points in the form of various types of illumination.
1. the technological inspired by the energy savings and consumption, there is the installation of lighting with LEDs that enable significant cost savings while maintaining a quality of remarkable lighting intensity and uniformity;

2. providing the aesthetic types of lighting-distance marks, recessed floodlights and spotlights on pole for a diffuse atmospheric lighting at night.

Street furniture
To remedy the state of abandonment of the square and the lack of street furniture was provided to insert benches and wastepaper baskets to ensure better accessibility for citizens. the benches are designed in wood and cor-ten steel, according to a plan that takes due account of the existing structures.
Fountain water jets
The plant is part of a fountain in the project as an innovative element given its feature water spray that integrates with the square adding dynamism to the environment, as well as determining a comfort and visual comfort to the users of the widening. The plant produces the jets of water that can be controlled by a computer.

Public green
There are limited works to green for the integration in the trees that will have the dual function to decorate and shade the area in the summer months. The system of trees will also be used to shield the building of the municipality, not interesting from the architectural point of view and in poor condition, and also the buildings located in the north, since these buildings are not in good condition .



Fig. 1: current state



Fig. 2: current state



Fig. 3: project



Fig. 4: project



Fig. 5: project



Fig. 6: project



Fig. 7: project

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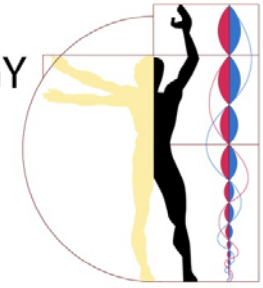

Evolution of design and application of a method

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Abstract
Design and project are two absolutely interrelated actions in the creative act.
The advent of computer graphics and the consequent possibility of being able to work in open areas, has led to investigate new types of surfaces and test new models.
The evolutionary process of projects is strongly influenced by the degree of freedom granted by the computer. The creator can handle any geometric complexity and transforming the gestural quality of his drawings in his models.
In the last thirty years there has been a real revolution, which changed the way of approaching the design.
Late last century have been developed systems, able to automate certain tasks, previously entrusted to the descriptive geometry.
Visualization and measurement are two tasks previously entrusted exclusively to descriptive geometry, are very well today acquitted by computer systems.

Keywords: design, project, evolution

The interaction between design and project continues and is strengthened over time. They are two totally interconnected actions in the creative act. The idea took shape and body to this inextricable link and comes to its materialization.
This ratio tends to an ultimate goal which is to be able to study, explain, understand through representation.
The design is also projection, then, is project.
Project seen as pro-iectum, that toss back, then aim for a purpose.
The project can be considered as a projection, so not a thing in itself, but an image of the thing. An idea takes shape and body when its contents are projected on a monitor or on a maquette.
The figure of the maquette, both material and digital, is an increasingly important element both in the concept phase, both in terms of delivery.
The contemporary significance but we give to the "model" differs definitely from what was given in the past.
The model is no longer understood as the construction of a prototype material, a miniature, but as a necessary means for the development of a series of cognitive systems. You can: go back to the construction of exact geometry, both three-dimensional is two-dimensional; establish parametric relationships bijective continuous, controllable with changes in real time; in addition to being able to reproduce the model developed with CNC machines.
The advent of computer graphics and the consequent possibility of being able to work in open areas, has led to investigate new types of surfaces and test new models.
The evolutionary process of projects is strongly influenced by the degree of freedom granted by the computer. The creator can handle any geometric complexity and transforming the gestural quality of his drawings in his models.
In the last thirty years there has been a real revolution, which changed the way of approaching the design.
Late last century have been developed systems, able to automate certain tasks, previously entrusted to the descriptive geometry.

Visualization and measurement are two tasks previously entrusted exclusively to descriptive geometry, they are admirably acquitted by computer systems.
This change is primarily concerned with the production of technical drawings and those intended for the first communication. After generating the three-dimensional model a series of operations can be produced and processed by machines in a semiautomatic way.
Simultaneously, the profound change that we have mentioned for the instruments that provide control of the metric form, and thus serve to its construction.
For centuries, architects have used forms that can be easily described in space by imposing restrictions on the movement of a point or a line: the so-called loci. These places are in line simple shapes such as sphere, cylinder, the ruled surfaces, figures that arise from the movement of the circle or straight. Today, thanks to new digital geometry, you can control various and complex surfaces and sculptural forms, that move and are articulated in space without following a clear law, as is the case in certain known works of contemporary architecture [1].
The computer is used not only to develop an idea already born in the mind but also to generate new ideas.
The architects of this "digital generation" is used with ease of new communication networks interacting remote, infinitely multiplying the modes of interaction between individuals, managing to overcome the physical limits of space. Today we are accustomed to mingling of languages having lived in a cultural climate more open, facilitated by the Internet, the cheaper flights, by the spread of international journals of architecture [2]
The continuing use of this new technology has accustomed to the speed of change in real time of each individual element.
The advent of new technologies has accelerated data processing and made it increasingly easy use of the information technology with the introduction of increasingly powerful hardware combined with user-friendly software.
This rapid evolution of technology and computer science, which was recorded in the last twenty / thirty years, has had strong repercussions in the world of architectural representation.
In recent years, architects have quickly seized on the potential and resources offered by digital. Resources are often not born specifically for use in architecture, adapting them to their own needs and purposes. It has started to investigate geometries and surfaces completely new, experimenting methodologies that deviate and go beyond the principles of classical geometry.
The drawing is no longer tied to a method of representation, one can operate regardless of the final outcome. Do you work more on projections obtained in various ways, but it acts directly on the object.
This important change allows operating, then, through the use of solid modeling programs, the resolution of the typical problems of descriptive geometry by means of spatial operations that are often more immediate as it does not require any graphical construction.
The development of the solid modeling software has led, therefore, the possibility of investigating, in a smooth and correct, very complex shapes and also their mutual relations.
The great opportunity of the use of computer geometry is to allow simultaneous observation of the represented object from several points of view.
The important aspect of this opportunity to represent the images lies not in the mere use of overtime by computer, but mainly consists in the possibility of having a cognitive approach and a control equivalent to that which it has in reality. It follows an acquisition and an immediate knowledge of all space operations whose understanding was entrusted, in the classic graphic methods, the ability of the individual to imagine space.
"The virtual space", however, as stated by Carmine Gambardella, "is in particular to overcome the dualism perspective / isometric, immanent / transcendent, historical / dynamic inside / outside" [3].
"The virtual space", as well clarifies Carmine Gambardella, "is not a challenge to the theory of representation, but it is a moment that synthetic supplements, treats, and more than amplifies the perspective and isometric. The contribution of software, in this direction, is used to represent human thought, the project in its complexity, as never been possible until now, moving the viewpoint above, below, on all sides but also in the ' object. The new tool box is richer and more flexible because they can investigate to perfection the thing, grasp the matrix numerical and geometrical, but also transmit alternative possibilities to the construction of the form of thought, that same idea and test the form in a particular material or assembly materials " [4].
In the book The Virtual Pierre Lévy, philosopher and university professor, faces the long road of virtualization phenomenon that is always present in human history. When asked "What is the virtual", Pierre Lévy responds "Transformation from one mode of being to another, that is nothing to do with the fake, the illusion, imagination, rather one of the possible ways of being, opposable not the "reality", but the current ". "The virtual word comes from the medieval Latin virtualis, derived, in turn, from virtus, strength, power. In scholastic philosophy is that which exists in the virtual power and not in act. The virtual tends to actualize, without being passed to a formal or actual realization. The tree is virtually present in the seed. Wanting to

follow strictly philosophical reasoning, the virtual is not opposed to reality but current: virtuality and actuality are just two different ways of being "[5].
Levy wants to dispel the prejudice that sees the virtual as opposed to something real. The virtual should be understood instead as a possibility, a potential.
Another important component of the virtualization is the use of new parameters such as the time and space, which become an integral part of more and more present and used within the new software.
The "virtual reality" becomes increasingly virtual, when virtual spaces are integrated with modules that allow you to use animation, and simulate "walks" in the virtual model. A continuous route, and continually changed, replacing the static images and partial.
From a long interview of Peter Zullino Bruno Zevi appeared on a page number 15 of the magazine online Telema 1998/99: "[...] The computer has brought freedom, the revolution in our house. He knocked down the old constraints induced by the tools of traditional work; it wiped out the grammar and syntax of classical architecture based on right angle and nausea repetitive elements [...] The computer allows the architect to do everything and does not impose nothing: this is the extraordinary thing. It frees us from all slavery of architectural representation that are born from the beginning of the fifteenth century [...] Awareness became general in 1988, with the exhibition of the Museum of modern art of deconstruction New York. Having accepted the idea of deconstruction was clear that this could be achieved only with the computer "[6].
The computer has totally changed the way we approach the design.
The design has evolved over hundreds of years by encoding the bases of representation for all partners involved in the process of defining the architectural body. Since ancient times, the architecture was entrusted to the design for the representation of the data needed for the project and for the realization of all its elements, in particular, however, in the last 50 years has evolved due to technological developments in the field of digital science, with the introduction of CAD, which has changed the way in which the drawing is realized.
Some buildings designed in recent years, built or not, have seen the light almost exclusively thanks to the new tools of this is called digital age. Just think of the many projects of the last twenty years of architects such as Frank Gehry, Peter Eisenman, Zaha Hadid, Coop Himmelblau, to name a few.
Highly complex forms of their projects could see the light only thanks to new software design and modeling, which allowed the development of landforms otherwise drawable and therefore not achievable. Evidently this has also brought new ways of representation of architectural design itself. Today make it clear to a layman as the design of a building is seen in the context environment is much more simple and accessible to all thanks to animation programs that allow, through procedures of contextualization, placing the building project in the it will have to accept.
Zaha Hadid says, "From the beginning I thought the architecture in a different form. I knew what I wanted to do and I had to draw, but I could not do it the conventional way, because traditional methods could not represent him. The traditional instruments of representation they had help. So I began researching a new way to design, to try to see things from a different point of view. Then, with time, those drawings, those prospects and those pictures have turned into my true instruments of representation, something more than the mere processing of sketches ... I think the best efforts for an architect to be the organization of the plant , knowing how to get inside, handle and move it. The fluidity of the plant, its fragmentation, the gambling perfectly calculated, are ideas taken from Malevich and supremacists, leading to new forms of exploitation and the creation of space. There are many other indications derived from the teachings of the supremacists, like the idea of lightness, the tension to break away from the soil that produced the development of engineering and has made possible the curtains Crystal Mies van der Rohe in Chicago and New York [...] There are other aspects of architecture that people forget. Architecture must instill pleasure, the pleasure you feel when you are in a good or in a pleasant house, regardless of size. What usually people do not understand the concept of luxury is that it has nothing to do with the price. Copacabana beach, for example, has a beautiful sand and not have to pay anything to go there! This should make the architecture: to offer the idea of luxury on a grand scale "[7].
"Looking at the drawings of Hadid depicting the Vitra station, we can see the close relationship that binds them to their architecture. And not only for the reason that the computer aided design allows an accurate representation of the complexity of the forms in motion. But also because the plants, to the financial perspectives and the traditional, static and formally defined, replacing elaborate designs made of shapes darting and overlay planes taken from unusual views and antinaturalistic, works almost autonomous, that resemble the paintings of the early avant-garde ‘900 "[8].
"The computer gives you the opportunity to achieve things that you could not do directly from mind to hand," says Peter Eisenman, who adds: "you still need to think, to see in three dimensions, because the architecture of the era of the media, of 'image, must respond effectively to spatiality, corporeality to space. We produce consistently models after they are conceptualized at the computer. And' then a process of continuous refinement "[9].
Frank Gehry says "My sketches are like gestures: how to build them? I succeeded thanks to the computer, otherwise I would not even try "[10].

After completing the Vitra Design Museum, Gehry realizes that his sculptural architecture can no longer be developed with traditional drawing methods, without a processor forms and images. "In these years," recalls Gehry, "I began to have technical problems: we could not make drawings for large projects, they had to commission other studies. When Jim Glymph came to work with us in 1989, I pointed out that in the study stood out curves as those of the Vitra Museum using descriptive geometry and said, 'Now I want to deal with more complex shapes. He said, 'No problem, we will use the computers'. "
Glymph, expert programs and vector processing computer, can give Gehry exactly what he needed; In fact, after analyzing many computer graphics software, Glymph identifies Catia, a software that Dessault Systèmes had devised for the French aerospace industry, and decided to develop it, by funding Massimo Colomban company CEO Permasteelisa, changing its code, making it a suitable tool to the architectural project. From that moment Gehry to design changes so, free to imagine for their architectures any form, confident that the power of the computer it would calculate every aspect of creation. Catia, in fact, allows to manage with relative ease surfaces extremely complex and to develop near real-time analysis of structural feasibility and costs.
The first application example of the new software is the Vila Olimpica of Barcelona. This work represents the final transition from an architecture designed and planned in two dimensions on an architecture designed in 3D, designed to be completely managed through the use of computers.
Mildred Friedman, in his essay "Gehry. Architecture + development ", he got to see that the brake on the implementation of some important architectures of previous years was linked to the need to entrust the structural calculations to qualified personnel outside the studio. One obstacle that often generated misunderstandings between the designer and structural engineer and that was up costs required for building [11].
Ben Van Berkel in an interview with Emiliano Gandolfi, clarifies, in reference to the project for the Mercedes-Benz Museum, as the innovative technology in terms of automation of the design process has been fundamental, "we had the need to develop new tools to manage the design process. In some respects the final design and construction proceeded in parallel. The client had the foresight to put in one place in Stuttgart all the different companies involved in the design, but often change a detail was going to change the entire structure. And this need was imperative to have appropriate tools to synchronize the work of all in a single model. In total there were more than fifty teams, from the lighting design in all aspects of engineering. The solution was to adopt a new technology of dynamic correction Daily entire 3D model. Through the use of three software coordinated, we were able to update the entire system to the slightest change and interactively".
The Mercedes museum is not only the expression of the design of a protagonist of contemporary architecture, but turns out to be a manifesto for a new course in digital design. Ben van Berkel proceeds from a diagram, able to express the needs of the project, and adopt it as a vector of the entire design process: from the organization of space, the design of the structure up to the creation of details and finishes. It is a path that from the representation of the architecture builds a real model, self-sustaining and to generate services, volumes and openings. In clear opposition to those who use digital architecture as aesthetic, for UN Studio the computer continues to be a means to manage, through imagination, a mathematical model, not from formal solutions preconceived [12].
The diagrammatic models frequently used to depict issues functional location and to express graphically connections vertical and horizontal, are used as real models of control of the project idea.



Fig. 1: Regeneration of via Appia _ Santa Maria Capua Vetere - Capua
Graduate thesis _ Degree Course in Architectural Science and Engineering | Architecture and Industrial Design Department Luigi Vanvitelli SUN Second University Naples, Italy
Supervisor: Prof. Arch. Carmine Gambardella,
Co- Supervisor: Prof. Arch. Gianluca Cioffi,
Candidate: F. Marucci

Centro Internazionale Smart Territories
BOOK SHOP





Rendering

Centro Internazionale Smart Territories
LABORATORI DI BIOTECNOLOGIE ALIMENTARI





Rendering



Fig. 2-3-4: Regeneration of Carditello
Project carried out under the course architectural design 2
Prof. Arch. Gianluca Cioffi
and thesis _ Course Degree in Architecture – Design Interior and autonomy | Department Architecture and Industrial Design "L. Vanvitelli "SUN.
Supervisor: Prof.Arch. Carmine Gambardella,
Co-Supervisor: Prof. Arch. Gianluca Cioffi

Bibliographical References

[1] MIGLIARI R. I fondamenti geometrici della progettazione in “Gli spazi e le arti, quarto volume dell'appendice XXI Secolo della Enciclopedia”, Istituto della Enciclopedia Italiana Fondata da Giovanni Treccani, 2010, vol. 4, pp.299-306.

[2] BUONINCONTRI F. Giovani architetti italiani: Silvio D’Ascia e la stazione di Montesanto a Napoli in Bloom - Trimestrale di architettura, p. 13.

[3] GAMBARDELLA, Carmine. Ecogeometria in Venafro. ESI, Napoli 2001

[4] Ibidem, p. 34

[5] LÉVY, Paul. Il virtuale, Ed. Cortina Raffaello, 1997, p.12.

[6] B. ZEVI, interviewed by Pietro Zullino, *Il nemico era la prospettiva. Con il computer l’abbiamo vinto*. In Telèma, n.°15, inverno 1998-99

[7] Interview of Richard Levene e Fernando Màrquez Cecilia to Zaha Hadid, El Croquis, n. 52. p.24

[8] PRESTINENZA PUGLISI, Luigi, Hyperarchitettura. Spazi nell'età dell'elettronica. Testo & Immagine, Torino 1998, p. 26

[9] BRADASCHIA, Maurizio La partita di scacchi. Maurizio Bradaschia intervista Peter Eisenman. Il progetto, n.1, luglio 1997, pag.7.

[10] FRIEDMAN, Mildred, SORKIN, Michael, Gehry. Architettura + sviluppo, Rizzoli, Milano 2002, p.140.

[11] BRUZZONE, Monica, Frank Gehry architetture, testimonianze, Feltrinelli 2007 pp.34,35,100,101 and compare DAL CO, Francesco, FORSTER, Kurt W., SOUTTER, Arnold H., Frank O. Gehry, Electa, Milano 2000, terza edizione.

[12] GANDOLFI, Emiliano, Museo Mercedes-Benz. Stoccarda - Germania/Mercedes-Benz Museum. Stuttgart - Germany. Ben van Berkel, UN Studio, The Plan 14, maggio-giugno 2006, pp. 46-61


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